PATRICK RAND
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Notes regarding teaching philosophy

My mission as an educator is to impart not only knowledge, but also the values and reasoning skills that will prepare students to apply the knowledge to unforeseen situations in the future.

The making of excellent architecture, perhaps like many human endeavors, depends upon insightful conceptualization and skillful implementation. The architectural concept is made possible through the construction materials and assemblies. Elements of construction are not merely of technical concern. They have compositional and symbolic content that make them potent catalysts for form and meaning.

It is rare in design or architecture that there is only one correct answer to a question, an assignment, or a project that students undertake. Rather, the emphasis is placed on instilling in students a capacity to be broadly inclusive in their thinking, rational in their path toward a solution, and capable of presenting their reasoned conclusions.

To do this, students must be able to adeptly fuse knowledge-based technical professional realms with creative aesthetic realms. For students to become skillful at this, we as educators must provide them with many examples, and must ourselves be models. This integration of technology and design is embodied in variety of lecture courses, labs, seminars and design studios that I teach.

Project-based instruction dominates in my courses and studio offerings, as this most closely simulates the abilities needed for architects to succeed in their licensing exams and professional careers. Outcomes-based learning places emphasis on how students/professionals use the information, imbedding the kernels of information into a relevant context. The instruction becomes “ready to use”. Outcomes-based education focuses everything in an educational system around an essential and evolving intellectual core, for all students to be able to successfully synthesize and apply at the end of their learning experiences, and hopefully long thereafter.

My task involves constantly making the information visible and memorable, while engaging the senses, instilling an intuitive sense of proportion and relationships between parts. These awarenesses are needed early in the design process, well before calculations are made. Architects (perhaps many others as well) are visual learners; they tend also be active experimenters in terms of their learning preferences. Our courses must empower the student to see and engage the information in a variety of modalities.

Teaching Technology through Design

The following thoughts were first put forth in a paper I presented at an ACSA Technology conference approximately 20 years ago. In reflection, this paper was pivotal in that it brought clarity to the first half of my career as an educator, and laid the foundation for the second half.

The making of buildings forms the intersection between architectural concept and implementation. Concept is dependent upon detail. Detail is dependent upon concept. In architecture, the general concept and the specific detail are simply two aspects of the same thing. Elements of construction are not only of technical concern, but have potential compositional and symbolic content that make them integral to, and inspiration for, the making of form. Construction materials and details give voice to the architectural concept.

Optimal learning in building technology courses takes place when technology and design are engaged together. To integrate technology with design, and to integrate knowledge with imagination, faculty may have to overcome a tendency unintentionally taught by our years in the discipline. We sometimes erroneously tend to think of technical knowledge and imagination as two separate and even antagonistic domains, perhaps the result of misappropriating tools for analyzing architecture as tools for generating architecture. Traditional frames of reference, such as the scientific method with its emphasis on measurable data, or the aesthetic mode, with its emphasis on qualitative features, are quite useful as tools for understanding and analyzing architecture. However when used as tools for generating architecture, the result is often a univalent design, lacking in sophistication. Great works of architecture typically are significant in terms of many frames of reference. One aspect is not pursued at the expense of others. These are simply lenses for viewing the same comprehensive whole.

Architecture curricula should integrate technology instruction with design instruction

Architecture curricula have historically included discrete courses regarding construction materials, usually coexisting with the design studio, but not connected to it. Is that curricular model ideal? For several reasons, the answer is no. Construction materials and other technology subjects should be reconsidered in an effort to present their fact-based content in a manner that fosters quick integration into the design process. There are three important reasons for doing so.

1. Understanding comes from critically engaging information
2. Knowledge triggers new design ideas
3. Integrating technology and design enhances teaching effectiveness
1 Understanding comes from critically engaging information

To understand a subject, one must acquire the information, then must internalize the information by transforming it to fit new tasks. Psychologist Jerome Bruner, in his classic *The Process of Education*, outlines the learning process as initially qualitative in nature, and chiefly oriented toward fundamental principles. For example, the child asks: Why does the rain fall? Only much later is the scientific description needed as the scientist explains: masses attract; gravity causes object to fall at the rate of 16 feet per second squared, etc. “Statistical manipulation and computation are only tools to be used after intuitive understanding has been established. If the array of computational paraphernalia is introduced first, then more likely than not it will *inhibit* or *kill* the development of probabilistic reasoning.” (Bruner, *The Process of Education*, p 65) The more you know, the less you fear.

A common pitfall in building technology courses is that a vast array of information is presented without a clear hierarchy, in never-ending episodes, with no climax in understanding.

If learning indeed involves the ability to manipulate knowledge and apply it to relevant situations in an appropriate way, then our courses must constantly provoke the student to engage the subject matter as designers. The student needs to rehearse the initially perplexing trek through this new information-rich terrain, trying out various paths toward the solution. Our courses should serve as atlas and roadmap, or even as visitor’s centers along the path.

2 Knowledge triggers new design ideas

As the student gains new knowledge, confidence increases and intellectual risk-taking begins. “Yet it seems likely that effective intuitive thinking is fostered by the development of self-confidence and courage in the student.” (Bruner, *The Process of Education*, p 65) The more you know, the less you fear.

It is not enough to merely teach technology through technology courses; we must try to teach Architecture through them. If construction materials courses only address technical considerations, then we implicitly teach our students that there need be no connection between general concept (*WHAT the building is*) and specific implementation (*HOW the building is made*).

3 Integrating technology and design enhances teaching effectiveness

In 1986 Rand received an ACSA / wood industry grant to survey faculty who teach structures and construction materials courses in the US and Canada. The purpose of the survey was to find out how structures and construction materials courses were taught, and to assess faculty satisfaction with those courses. Of the 112 schools surveyed, 71 responded, including data regarding 69 structures courses, 46 materials courses, and 51 construction systems courses.

The survey showed that

- In a surprising 34% of technology courses there was no linkage in course content with a studio, nor did the faculty who taught the course teach a design studio.
- On the other end of the spectrum, 8% of the courses surveyed actually were design studios, with an emphasis on structures or construction materials.
- Most courses (58%) fell in the middle range, having some relation between studio and technology courses (such as: instructor teaches both, co-requisite with studio, or sharing project with a studio), but they were not studios themselves.
- When instructors were asked about their *satisfaction* with the relation between courses and studios, there was a direct correspondence between satisfaction and relation to design studio. Satisfaction was highest (100%) when the course was a design studio, and lowest (21%) when there was no relation at all to a design studio.
- Ironically, the most common teaching format was the least satisfactory, and the most satisfactory format was the least common.

This data demonstrates that for the teaching of technical courses to be effective, the technical subject matter should exist in the context of the design process. This may be achieved through thematic studios, and by integrating the design process with technical subject matter.

Two viable curricular models

Curricula should carefully avoid the segregation of technology issues from the act of design. There are two obvious ways to integrate design with masonry technology:

- **Incorporate Technology content into the Design studio.**
- **Incorporate the act of Design into the Technology courses.**

The following diagram describes a traditional architecture curriculum. The design process on the vertical axis, and the design product (the architectural solution) on the horizontal axis.

A traditional studio is in the upper left of this diagram. In a traditional design studio the work is often undirected, that is the students work through a process that is broad and inclusive of as many ideas and issues as possible. They work independently or in parallel, but not as a team. Their thinking is divergent.

A traditional technology course is in the lower right of this diagram. In a traditional technology lecture lab course, the work is directed. That is, the focus of the project is typically narrow, rather than broad and inclusive, and convergent thinking, focusing on a particular issue in the technology course would be a priority.

The arrows illustrate the expansion of scope of a traditional design studio toward the right, engaging new content regarding *How* the building is made.

The technology course is expanded to the left, engaging additional content regarding *What* the building form is.

**ACSA Distinguished Professor Award / Rand / 2**

**Teaching Philosophy**

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Manifestations of Teaching Efforts
Earnest L. Boyer’s landmark 1997 book Scholarship Reconsidered, described four overlapping forms of scholarship relevant to the discipline of architecture.

- Rand’s greatest contribution is in scholarship of teaching, manifest through ongoing pedagogical experimentation in the classroom and studio, followed by papers and conference presentations to colleagues involved with architectural education. Rand has co-authored four books published since 2006 that have enhanced the teaching effectiveness of educators at other institutions in the US. One of these was described by a prominent book reviewer in Architectural Record: “In short, this textbook that many of us wish we had in architecture school.” Rand’s pedagogical research regarding architecture curricula has been presented at more than 50 educator’s conferences, serving as a catalyst for enhanced technical course instruction in architecture curricula at many institutions.
- Next is scholarship of discovery, manifest through research regarding how exterior building walls perform, and how to improve their performance. Findings regarding masonry wall design and construction have received national recognition and have influenced how this ancient method of construction has adapted to contemporary practice. Investigations comparing various exterior materials in terms of sustainable design objectives (embodied energy and CO2) are also examples of this form of scholarship.
- Scholarship of integration has been engaged through involvement with other disciplines in various formats, including research collaborations, multi-disciplinary courses, invited lectures, and multi-disciplinary graduate student committees.
- Scholarship of application has been pursued through Rand’s own professional architectural practice and consulting as a registered architect. Practice and consulting aid in keeping content of courses and studios current and relevant.

The Curricular Context in the College of Design
Selected course descriptions will follow, but it is important to place those courses in the relevant academic context. As shown in the curriculum vitae, Patrick Rand has been an active teacher in the Architecture program continuously since 1977. Initially his teaching was chiefly at the undergraduate level, but for the past 20 years has chiefly been at the advanced level. From 1988 to 2005 Patrick Rand held several administrative positions. Only two of those positions, Assistant Dean and Associate Dean for Research, had partial (50%) release time for administration. No other form of leave has ever been used.

In the College of Design a full/normal teaching load for faculty is 18 credits per year. Final Projects, Independent Studies, etc. are in addition to this 18 credit/year load. In the past five years Rand has taught an average of 344 student credit hours per year (# students x credit hours). Education in this discipline places great emphasis on active learning through the design studios and labs associated with technical lecture courses. Both of these are labor intensive, but are the most effective means to provide advanced education at high quality.

Courses and Curricular Contributions
Rand’s contact with Undergraduate, Graduate and Professional degree students occurs in three forms.

One is the lecture or seminar format, in which the faculty substantially controls the format and content of the learning experience. The student is expected to come to understand and be able to use the subject matter. The relevant courses are Architectural Construction Systems (ARC 432), Design of Architectural Details seminar (ARC 534), and Project Preparation Seminar (ARC 581). Rand initiated Design of Architectural Details (ARC 534) in 2006. Materials for Design (ARC 590), was initiated in Fall 2010, and is now being taught for the second time.

The second form is the design studio, usually with approximately 12 to 14 students working in parallel under the close supervision of the faculty member on one or more hypothetical architectural design projects. The primary course of this type is Professional Architecture Studio II (ARC 502), in which candidates for the post-baccalaureate professional B Arch degree complete their capstone Final Project.

The third form is the independently structured Final Project for Architecture students, in which the individual student and faculty committee collaborate typically for one term in Final Project Research (ARC 697) and one additional term in the execution of the Final Project Studio (ARC 598). At this point the student is expected to be able to take initiative to define and research an architectural issue, articulate a position relative to it, and define a methodology through which they test their position via a vehicle project.

Courses and Studios Taught in the Past Four Years
- ARC 405; Arch. Design: Technology Studio (6 cr)
- ARC 432 and ARC 432 Lab; Arch. Construction Systems (3 cr) each Fall semester
- ARC 581; Final Project Preparation Seminar (3 cr) each Fall semester
- ARC 502; Professional Architecture Studio II (6 cr) each Spring semester
- ARC 534; Design of Architectural Details Seminar (3 cr) each Fall semester
- ARC 590; Special Topics: Materials for Design Seminar (3 cr) each Fall semester
- ARC 697; Final Project Research (3 cr) as required by student plan of work
- ARC 598; Final Project Studio (6 cr) as required by student plan of work

Final Project (thesis)
Professional degree curricula in the School of Architecture contain a Final Project, which is required in the Bachelor of Architecture curriculum, and is an option in the Master of Architecture curriculum. Rand helped create the Bachelor of Architecture Final Project curricular model many years ago, and has been responsible for its implementation ever since. Examples of this 2-semester Final Project are presented later in this submission.

Rand has also been active in the Master of Architecture Final Project process, having served on more than 100 individual student thesis committees, more than half as chair.

In the independently structured Final Project for Master of Architecture students, the individual student and faculty committee collaborate typically for one term in preparation and one additional term in the execution of the Final Project. The student is expected to be able to define an architectural issue, articulate a position relative to it, and define a methodology through which they test their position via a vehicle architectural design project. The topics are highly variable due to the natural variety of student interests. Through these student-initiated projects, Rand’s intellectual horizons have been greatly expanded. Most of the students also chose a concentration outside of their major, requiring that they include a faculty member from the other discipline on their graduate final project committee.
Architectural Construction Systems (ARC 432 and the co-requisite ARC 432 Lab) 3 cr
Catalog description: Building construction systems related to architectural design. Historical and current building practices. Implications for design and systems selection. Case study analyses. Field trips are required.

Approximately one-third of the 50 – 60 students are graduate Architecture students; the remaining are undergraduate Architecture students. For both groups of students, this course is part of a series of tightly coordinated courses and studios that quickly lay a foundation for advanced studies. Patrick Rand teaches Architectural Construction Systems, which is part of this foundation. He created this course in 1989, and substantially revised it in 1996 to conform to changes in the architecture curriculum. The course format involves two lectures per week, plus a weekly laboratory, which is used for group mini-design projects, field trips to construction sites, and tutorial instruction related to ongoing projects.

This course was cited by the two most recent visiting teams from the National Architectural Accrediting Board for its innovation and strength in the curriculum. This course has also received an Honorable Mention from the American Institute of Architects Education Honor Awards program.

Excerpt from Syllabus:
ARC 432 ARCHITECTURAL CONSTRUCTION SYSTEMS
Patrick Rand, Professor of Architecture (Brooks 310A, tel: 515.8319, email: patrick_rand@ncsu.edu)

Construction is the medium through which architecture is made. Architects are expected to be thoughtful and skillful with this medium, including material selection and the detailing of construction assemblies. Excellent architecture results from the convergence of insightful design and mastery of the medium of construction.

An academic foundation in construction methods is important for several reasons. An architect is responsible for the design of a building and all of its constituent parts, including its physical fabric. Construction technology is becoming increasingly sophisticated, resulting in a greater challenge for designers to be proficient with principles and methods of construction. Without knowledge about construction materials, well-intended design ideas are doomed to inept implementation.

For the designer, a grasp of construction methods can also be a catalyst for generating new and unforeseen design possibilities, thereby broadening rather than limiting the range of possible design solutions.

The lecture / laboratory format is important in order to link academic learning with application to real design situations. The laboratory projects, field trips and case study investigations are intended to stimulate the student to synthesize the abstract information from assigned reading and lectures. Tests and exercises are intended to simulate actual decision processes regarding the design of a building’s construction systems.

COURSE OBJECTIVES:
• To develop a basic conceptual framework and vocabulary for dealing with building construction issues
• To examine various construction systems so that students are better able to design with construction principles in mind
• To outline processes for comparing and selecting appropriate construction systems for a given application
• To show the relationships between various subsystems of a building, and to examine their influence on design
• To present the complexities of current construction practices in a clear way, and to develop abilities to discriminate good from bad practices

Two of the weekly laboratory sessions provide opportunities for field trips to observe construction processes directly, and engage in dialogue with key architects and construction superintendents. At right, a site visit to the new university library, designed by Snøhetta.

In addition to scheduled field trips, students also form small teams to carry out a term-long observation of a building under construction. In this Case Study project they study the project drawings and compare them to the work in the field. They also examine one construction trade in detail. Anxieties about contact with construction processes and personnel are dispelled. At the end of the term students present their findings to the class.

This longitudinal contact with a project for 3 months provides valuable perspective for the students. Principles taught in the class can be affirmed, or may challenged based on the particular project circumstances.

Students prepare detailed technical drawings of wall sections and exploded views of the building assemblies, such as the one illustrated to the right of the NCSU 1911 Building, when it was renovated a few years ago. Analytical drawings such as this enhance student skill and comprehension of technical assemblies. They also often reveal features of the building that are not evident through direct observation.
Students are challenged to apply the information from lectures and readings to small scale design projects in each of four major construction materials: concrete, wood, masonry and steel.

Solutions strive to be innovative and competently executed. Structural performance, building code conformance and weathering resistance are among the criteria used to assess the projects.

Scholarship support from industry and publication in national trade journals sometimes provide added incentive to students.

Three tests also assess student grasp of subject matter, often using questions that simulate project-based critical reasoning challenges.
Architectural Detailing: Function Constructibility Aesthetics

Published: John Wiley & Sons, c 2007

At the request of Edward Allen, FAIA, Rand prepared the second edition of Allen’s 1993 book. All changes were initiated by Rand, and reviewed by Allen. Every pattern from the preceding edition was revised, and new patterns and drawings were added to reflect changes regarding building codes, sustainability and other factors that affect current building design and construction.

Educators have found the book useful in building technology courses and studies that have a technology focus. It contains hypothetical case studies that apply the principles to projects, and suggested class projects. Others have called it “the thinking person’s Graphic Standards”, because it teaches you how to create countless viable details.

Detailing is the language of the architect, the means by which architectural ideas are transformed into built reality. It is the one technical area in which the architect must be expert.

Rather than being an inventory of stock details, this book describes and illustrates the most important principles that affect the design of architectural details. These are the “patterns” that affect the function, constructibility, and aesthetic qualities of a building. These detailing patterns can be used to produce countless effective detail solutions, enabling students and practicing professionals to detail a building competently. The case study projects that reveal the thought process involved in detailing buildings.

Since its initial publication this book has been accepted as a text in many architecture courses and studios. It has been used by architects and educators around the world, and has been translated into French and Korean. Two of the chapters were further developed for Wiley’s online Continuing Education tutorials for architects.


Expected Life, Simulated Assemblies and Composing the Detail (next page) are new patterns that Rand wrote and illustrated for the second edition of Architectural Detailing: Function Constructibility Aesthetics.

Expected Life

1. Primary structure and primary enclosure systems
2. Major building service systems
3. Interior enclosure systems
4. Functional, exterior, and interior finishes

Simulated Assemblies

6. Anticipating Service Life—Two Versions

Architectural Detailing: Function Constructibility Aesthetics

Published: John Wiley & Sons, c 2007
Aesthetic goals are often catalysts for exploration of a detail's technical possibilities. The detailer fuses aesthetic composition and technical exploration to find the best solution.

1. In the best architecture, the details go beyond the technical realm to convey important compositional qualities and meaning. A well-composed detail can capture the essence of the building design in a vivid way and can explain the relationships between the parts of the building they are joining. The wood siding that is scribed to meet the irregular face of the ashlar stone wall tells us that the stone hearth is the dominant element, anchoring the composition. The detail demonstrates the basic architectural concept.

2. Many buildings have one little feature that people can fall in love with. The potency of the detail as a memorable building feature is sometimes underestimated. Details that are seen up close or touched have the greatest potential to positively influence the observer. Grasping the door pull that was designed by the building's architect is as close as one can come to shaking that architect's hand.

3. Compositional questions such as whether a shadowline is desired, whether the window should be flush or recessed, and whether or not a joint should have a piece of trim all provoke technical exploration. The detailer probes what must be done to produce a shadowline, for glass to be in the same plane as the exterior cladding, or for a joint to be seamless. What the detail looks like and how the detail is made are inseparable aspects.

4. A detail can join elements in countless ways, from an almost seamless weld as in a Mies steel frame, to the boldly expressed joints and fasteners of a Greene and Greene connection. Is the connection to be celebrated and objectified or to be quietly competent, not calling attention to itself? If fasteners or splices are used to make the connection, should they be prominent in the composition or should they be downplayed?

5. Details must be visualized in three dimensions. It is wise to develop details in three-dimensional sketches or models to visualize completely their forms and implications. Three-dimensional development also helps to explore how each detail turns the corner or intersects another element.

Detailing for Landscape Architects: Aesthetics Function Constructibility
Published: John Wiley & Sons, c 2011

At the request of the publisher, Rand collaborated with Tom Ryan and Edward Allen to prepare a new book following the successful concept and format of Architectural Detailing.

Approximately 50% of the content was entirely new in this publication, and all of the remaining content was revised. Since its publication this book has been accepted as a text in many landscape architecture courses and studios.

The new industry standard on Landscape Architectural Detailing

Detailing for Landscape Architects takes the reader on an educational journey across three major areas of landscape architectural detailing—function, aesthetics, and constructibility—to demonstrate how powerful design patterns can transform thematic ideas into awe-inspiring built realities. Richly illustrated examples accompany concise discussions of a varied blend of landscape design detailing issues such as water movement, soil environments, articulating structures and construction assemblies, life cycle costing, sustainability, health and safety, and more. This book approaches the subject of detailing in a systematic manner and provides a balanced framework for design and workmanship that conveys the essence of the built landscape.

Detailing for Landscape Architects shows how details can:
• Reinforce the design ideas through the continuity and discontinuity of patterns
• Actively contribute to the overall form or geometry of the design
• Be designed to be durable and flexible while enhancing the entire design
• Gracefully accommodate the natural growth and change of plant materials
• Anticipate maintenance needs to minimize future disruptions
• Maximize their cost effectiveness through understanding their function while designing to meet those functions
After publishing the *Architectural Detailing* second edition, Rand began to offer a graduate seminar on this subject.

**Design of Architectural Details (ARC 534) 3 cr**

Catalog description: Using detail patterns based on function, constructibility, and aesthetics, students analyze existing successful building details, diagnose problems in existing buildings, and design details for their own projects.

Rand initiated this graduate seminar in Spring 2007, based on the book *Architectural Detailing: Function Constructibility Aesthetics*. Students gain a working knowledge of principles that are elemental to all building details. They represent an accumulation of wisdom about what works in building construction and what doesn’t. Many detail patterns are firmly grounded in scientific fact. Others are based just as solidly on common sense and the realities of human behavior and performance. Fear of detailing is replaced with curiosity and competence.

This is a graduate seminar, typically with 12 – 16 students enrolled. It is taught in a tutorial format, with class discussions centered around projects in which students design a series of building details, following principles the instructor presents in the textbook and in class.

**Excerpt from Course Description:**

**ARC 534 Design of Architectural Details**

Intended for: M Arch and B Arch students  
Prerequisite: Architectural Construction Systems (ARC 432) or equivalent

**Course Outline**

Details have been referred to as the DNA of the building. In the best architecture, the details contain the genetic code that transcends the pragmatic and technical to engage the intellectual and spiritual domains. It follows that details explain the intended relationship between the parts of the building they are joining, whatever that might be. Just as idea, site and program are the designer’s basis for the building’s overall features, so too are they the basis of the details.

Details have always been important, but they have never been more important than now. Whereas previously, the architect relied heavily on the craftsperon in the field or shop to competently design the detail, now that responsibility largely falls to the architect. The opportunity to extend the core principles of the building’s design to the details has never been greater than now. As architects we should not squander this opportunity.

Rather than being a review of stock details, this course focuses on the fundamental principles that affect the design of architectural details. These are the “patterns” that affect the function, constructibility and aesthetic qualities of a building. These detailing patterns can be used to produce countless effective detail solutions.

Students will gain a working knowledge of a set of detail patterns that are elemental fragments of natural phenomena relevant to all building details. They will exercise critical reasoning skills necessary to make appropriate choices. The patterns fall into the following three groups:

**Function:** Designing details that are airtight, watertight, allow for expansion and contraction, take a sustainable life-cycle perspective, and weather gracefully.

**Constructibility:** Designing details that are easy to build, forgiving of small lapses in workmanship, and use resources efficiently.

**Aesthetics:** Designing details that are pleasing to the eye, contribute to the building’s architectural expression, and create beauty out of necessity.

The structure of the course anticipates the day to day workings of the practicing architect whose activities frequently involve data collection, analysis, and interpretation of architectural issues prior to their resolution in tangible building proposals. Legal (e.g.: building code) parameters and generalized cost implications will be included in the scope of the analyses. High quality architecture can only be made when these factors are creatively addressed.

**Course Objectives / Learning Outcomes:**

The primary objective is to gain the ability to use a comprehensive set of principles for the design of architectural details. In accomplishing this goal, students will need to address the following secondary objectives:

- Become able to define the performance objectives of architectural details.
- Develop a working knowledge of basic methods and resources relevant to the design of details.
- Identify and analyze precedents regarding their architectural details.
- Develop ability to design architectural details for particular applications.
- Represent the conclusions of the investigations in oral, written and graphic form.

Students learn to detail a building by carrying out a series of four projects in which they apply the principles contained in the book. In the above project, a student analyzed the details of an existing building, Holl’s Nelson Atkins Museum, then proposed improvements (in blue) that would enhance performance while adhering to the architect’s aesthetic objectives.
The three student projects on this sheet are typical of the types of projects carried out in the Design of Architectural Details seminar. For instance, to the right, Emmie Tyson revisited a project she had designed in a previous studio, drawing the steps of construction to visualize those processes, and adding new thought to the wall and roof details.

Below left, Benjamin Chappel detailed and illustrated features of the exterior wall of a building he was designing in a concurrent studio. Below right, Matt Shelton wrote and illustrated a new pattern that might be added to the book.

### Structural Glazing

Designers often wish to incorporate large window walls or glazing into their buildings. Traditionally this could be done with curtain wall or storefront glazing systems. Using structural glazing systems as an alternative to curtain wall can help the detailer maximize the size and maintain the desired transparency of single or multi-story glass walls. Consideration must be given to local code and wind load requirements.

Glass fins act as stabilizers for large glass walls. They may be used on walls up to 20 feet tall without a secondary horizontal structural system. They serve a similar purpose to storefront or curtainwall systems but without the mullions. Often, glass fins are used at the joints of butt glazed wall systems.

Spider fittings are a way of adjoining several sheets of glass in a structural glazing system. At the point where the sheets meet, one leg of the spider fitting is connected to each sheet and the fitting is connected back to the structural system (glass fins, cables, other structures). They can be used with single or double pane glass.
Materials for Design bridges the gap between construction materials and design. Architectural uses of glass, wood, metals, plastics and concrete are thoroughly discussed. Each is followed by a series of 10-12 case studies showing the material put to imaginative uses by today’s brightest architects from around the world. Rand prepared the case study analyses of the 60 projects in this book.

Each project is described and illustrated to reveal its design qualities and the technical means used to achieve them. Students, interns and practicing architects have found the projects to be a catalyst for the advancement of their own investigations of design and technology.

Materials for Design has been accepted as a text in many architecture courses and studios. It has been used by architects and educators around the world, and has been published in Europe. At one time it was the best-selling book on architectural materials on Amazon.

Architectural Record:
“The authors impart a thorough knowledge of glass, wood, concrete, metal, and plastic. A weighty tome, the book is a reference tool, complete with histories, production techniques, and each material’s properties, along with case studies of new work. In short, this is the textbook that many of us wish we had in architecture school.”

Architect Magazine:
“Required reading.”

Azure:
“Offers a well-illustrated compendium of the experimental leading edge. . . . Students will make good use of the book’s technical side, and it should provide inspiration for anyone interested in contemporary building.”
The analyses of New 42 Studios and Think Tank were two of the sixty that Rand wrote for *Materials for Design*.

### New 42 Studios

**Design Intentions**

This teaching building, located in downtown Brooklyn in New York City, houses the Rose Theater, a 500-seat performance space for dance and theater productions. It is named after New York City Mayor Bill de Blasio, in honor of his leadership in the arts. The building is designed to provide a unique and flexible space for students and performers alike. The building's design integrates state-of-the-art technology and sustainability features, ensuring a seamless and enjoyable experience for all users.

**Materiality**

The building is constructed primarily of steel and glass, with a focus on sustainable and recyclable materials. The use of recycled glass and steel contributes to the building's LEED Platinum certification. The building's design also includes green roofs and solar panels, further reducing its environmental impact.

### Think Tank

**Design Intentions**

Think Tank is a sustainable and adaptive design for a 100,000 sq ft waterfront office building in New York City. The design is intended to be flexible and responsive to the needs of future users, allowing for changes in function and use over time.

**Technical**

The building incorporates a combination of natural and artificial light, with a focus on energy efficiency. The use of daylighting and the integration of solar panels and photovoltaic systems contribute to the building's energy sustainability. The overall design and materials selection are intended to create a healthy and productive work environment.

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31 Parametric glass
32 South orientation
33 Expanded glass fins
34 Anticipatory thinking
35 White curtain walls

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10 Softened edges
11 Translucent section
Materials for Design 2 is a survey that bridges the gap between construction materials and design sensibility. Volume 2 revisits the format of their award-winning first volume and present 60 new case studies by today's brightest architects. Each material type—glass, concrete, wood, metal, plastic, and masonry. Materials for Design 2 exists because of the favorable assessments made by readers and reviewers of the first volume of this title.

As in the first volume, Rand prepared the case study analyses of the 60 projects in this book. Unlike the first volume, Rand also identified candidate projects for the book and corresponded directly with the architects to secure detailed project documentation.

This book recognizes that materiality is an important and quickly expanding influence in the construction process. Industries that once serviced a small segment of products are now engaged in much more in-depth research and development of new materials that are more effective, more efficient, and more environmentally sensitive. Once merely a tool for architects and largely confined to the realm of engineering, materiality has now become an instrumental methodology for a clear and bold design statement. The wealth of innovations in this realm has made materials a compelling field of study.

Architects are challenged to keep pace with rapid advances in materials science, manufacturing methods, and installation practices. This book helps students, interns and practitioners engage construction materials with renewed enthusiasm and competence.

Materials for Design 2 is in press at the time of this submission, and is expected to be available to the public in November of 2013. Like the first volume of Materials for Design, it will be distributed internationally.
The analyses of the Apple Flagship Store and SAHRDC were two of the sixty that Rand wrote for Materials for Design 2.
After publishing the first volume of *Materials for Design*, Rand began to offer a graduate seminar on this subject.

**Special Topics: Materials for Design** (ARC 590) 3 cr

Catalog description: This seminar is being offered for only the third time Fall 2013. It has not yet been submitted as a permanent course and thus does not yet have an official catalog description.

Rand initiated this graduate seminar in Fall 2010, based on student interest in the book *Materials for Design*, which he co-authored in 2006. The book had been used at other universities for several years, but not at NCSU until this offering. Some projects that students have identified in this seminar were later analyzed by Rand for inclusion in *Materials for Design / Volume 2*.

This is a graduate seminar, typically with 12 – 20 students enrolled. It is taught in a tutorial format, with class discussions centered around case study analyses that students carry out individually or in 2-person teams, as dictated by enrollment. Students select built works from around the world that display keen insight into its architectural materials. They examine detailed drawings and photographs of the project, and often engage in direct dialogue with the architects to secure unpublished information, or to verify their hypotheses regarding how the material was applied in the project. Emphasis is placed on finding buildings of exemplary design, but which also display technical refinements that are responsive to contemporary cultural and environmental criteria. For many students, engaging in direct dialogue with architects from different cultures regarding their common passion for architectural materials is a profound learning experience.

**Excerpt from Course Description:**
**ARC 590  Materials for Design**

Intended for: M Arch and B Arch students

Prerequisite: Architectural Construction Systems (ARC 432) or equivalent

To a great extent, an architect’s palette of materials has been unchanged for thousands of years. The number of materials has grown somewhat in the past century as polymers and composites have been introduced. New industrial processes have also expanded the range of applications of all materials, including the most ancient.

Contemporary practice calls for new insights into the use of materials, and industries have made many new materials and processes available for designers to explore to address emergent objectives. Material selections are among the most significant decisions an architect makes. With the advent of integrated design and production, the relationship between a project’s aesthetics and its materiality has never been more immediate or important.

Materials for Design aims to inspire the designer to discover how an idea or a concept can be made tangible with the use of a material. This course engages the physical and technical properties of materials, but also their impact on design choices. It searches for resonance between the facts of a material with the construction details, and with the overall building design.

A case study method will be employed to see how contemporary practitioners have insightfully joined design intention and materials. First, students will review the 60 examples in the text that show insightful use concrete, metals, glass, plastics, and wood. Students will then identify new recent works, which they will analyze and critique in search of lessons about the materials used. Published drawings and images will be the initial references for these analyses, but it is likely the students will also need to contact the designers for additional documentation. Students will analyze and present drawings that show construction details, because it is often at this scale that the subtle qualities of a material are most evident. They will also write careful technical analyses about each case studied.

Small to medium-scale projects will be chosen to allow a focus upon understanding the building in its entirety; projects of these scales are best suited as didactic prototypes. In some cases, new materials may be used; in others, properties of traditional materials may be discovered and exploited in new ways.

Emphasis in this class will be placed on students developing a grasp of the relevant material properties, and finding exemplary projects that demonstrate those properties. Students’ repertoire as designers will be broadened by this emphasis on technical knowledge and its vivid embodiment.

**Course Objectives / Learning Outcomes:**

- Become able to define the performance qualities of architectural materials.
- Develop a working knowledge of resources relevant to various architectural materials.
- Identify and analyze case study projects regarding architectural materials.
- Represent the conclusions of the analyses in oral, written, and graphic form.

Students learn rapidly and durably when they examine the work of an architect they admire. Beginning with published drawings and photos, they interrogate the material’s use in the project to search for any extra-ordinary features.

Each student uses a cyclic process to analyze each of the four projects that they analyze. The first pinup simply uses published information. The intermediate pinup adds to that student investigations of the state of the art, dialogue with the architect, and perhaps the fabricator or manufacturer. The final pinup presents the findings by each student.

To the right, the student examined the curved double envelope of channel glass that was used at Hartwig Schneider’s Art Gallery and Arts Education Center in Germany.
At the top of this page, the student project focussed on the innovative means used to place common brick by robots, fol-
lowing parametric designs of Gramazio & Kohler, who collaborated with Bearth & Deplazes to produce the Gatenbien Winery in Switzerland.

Below on this page is the student's analysis of the cold-formed insulated glass skin on Frank Gehry's IAC Headquarters in NYC.

For this analysis the student contacted the architect for technical information and made a personal on-site assessment of the completed project.

**MATERIALITY**

The 20,000 limestone colored clay bricks used on this facade were laid in the simple stretcher bond; 240mm x 115mm x 61mm. While this may not be unique, the use of robotically placed bricks is. The architects took advantage of the modular nature of masonry to create a subtle building scale pattern of grapes only achievable through this high tech method. The angling of the bricks in addition to vertical voids between each brick create a rain screen which filters light and temperature to help create the ideal atmosphere for the fermentation room. Similarly, the supporting layer of polycarbonate panels is protected from direct sunlight long enough for their lifetime. Each wall was designed and constructed to maximize the advantages of controlling light and air permeability per orientation. Taking advantage of the robots precision, the designers were also able to create a facade with a "dynamic play between plasticity, depth, and colour, dependent on the viewer's position and the angle of the sun" (Gramazio and Kohler) The pattern of grapes dissolve as the user moves closer and becomes instead a soft yet "solidified dynamic form" (Gramazio and Kohler) which relates to and translates into the adjoining stone work.

**TECHNICAL**

The first stage in creating this "informed architecture" was to computer generate grapes falling into a basket simulating gravity. The resulting digital image was then transformed into a rotation plan for the brick which in turn guided the one of a kind robot in laying the brick. Once begun, the robot took only 2 weeks to complete this 400 sq meter façade. The individual panel size was dictated by the ability of this robot more so than limitations inherent with the increased transportation needs of a prefabricated system. The cost of using such a high tech system could have been offset somewhat by the use of the typically low-cost material of brick. Similarly, the increased energy use involved with this fabrication system might also be offset by the inherent sustainability of brick as a local, abun-
dant, and durable material requiring little maintenance.

In addition to precisely placing each brick, the robot also applied the two part impregnated resin adhesive. This was intended to accelerate the process considering the unique bonding place-
ment needs of each brick, but appears somewhat inefficient. This bonding agent did prove to be very successful however in lab testing disqualifying the need for the typical additional rein-
forcements. The use of adhesive rather than mortar as a
Final Project Model / Bachelor of Architecture Professional degree program

Excerpt from paper presented at ACSA Southeast Region Conference:
A Final Project Model; Optimal Independence to Address Three Basic Elements

Any design project can be described as having three basic elements:
• an idea or theoretical position,
• a program or statement of practical objectives, and
• a site or physical context.

Since 1995 Patrick Rand has been the coordinator of the Bachelor of Architecture program, and has set forth the pedagogy for the Final Project process that is at the core of this 5th-year professional degree program. The Final Project process includes the capstone studio project, which takes place in the final semester. The studio is based on Project Preparation that the student completes in the previous semester.

In a conventionally taught studio in architectural curricula, faculty typically define these three elements. The terminal academic design experience should be different than undergraduate studios. Specifically, the student should have latitude to articulate the theoretical position, frame the programmatic task, and identify the physical context, but within general parameters that are shared among all students.

In this model, each student actively collaborates with the faculty to define the idea, program and site. Faculty present a general outline for each of these three components, upon which each student develops a specific project brief. Each student produces their own 60 - 80 page project brief, upon which the final studio is based.

This model provides the group of students with sufficient commonality to make discussions and design explorations synergistic. It also gives students important experience in defining a design challenge worthy of their attention, and in managing a complex design task, all of which are valuable preludes to fruitful professional careers.

The Project Preparation seminar is the first opportunity for the student has had to define their own project, in which they articulate all of the parameters of the architectural task. The capstone project is highly individualized, with no 2 students from among the 22 – 28 total having the same theoretical position, program or site parameters. The vehicle project is typically a substantial public building. This studio is challenging to teach because the expectations are very high and the projects are each unique.

Though not required, the vehicle projects for the capstone studio have been different each year under Rand’s instruction. Projects are chosen by the instructor to address specific architectural themes, while also being of sufficient functional complexity and technical challenge to advance student skills. The projects are also chosen to address real-world needs of the city, such as the downtown transit center, and an urban farming demonstration facility.

Project Preparation Seminar (ARC 581) 3 cr
Catalog description: Quantitative and qualitative conditions, considerations and determinants as preparation for architectural design. Emphasis on research methods, data collection and interpretation, theoretical discourse, site analysis, programming and architectural precedent.

In this seminar, students are given a general framework regarding the guiding architectural theory, the building program and the general site parameters. They then overlay their own objectives upon this general framework to develop a set of specific project objectives. They prepare a complete project brief, very similar to what practicing professionals might prepare leading in to a major commission. The results of this seminar then become the basis for the capstone studio project that they carry out in the following semester.

The Final Project curriculum is unique nationally. This pedagogical approach has been praised in NAAB Accreditation team reports, and has been presented by Rand at an ACSA Southeast Region scholarly conference.

Professional Architecture Studio II (ARC 502) 6 cr
Catalog description: Design investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design.

The design studio is the heart of the architecture curriculum. In it, students receive 6 credit hours and generally work at least 40 hours per week; contact time with the faculty is at least 12 hours per week. This particular studio is expected to be ambitious relative to design, but also to meet rigorous technical criteria, much as might be expected of an architect in practice.

Teaching Efforts / Final Project Model
ACSA Distinguished Professor Award / Rand / 16
Reflections Regarding this Final Project Model:

- This studio paradigm is in fact substantially different than that of undergraduate studios.
- The model is readily adaptable to varying faculty who teach the Final Project Studio, and by students who have varied academic and professional backgrounds.
- The two-semester experience functions as a coherent unit with minimal logistical effort by the faculty. Faculty teaching the seminar may also teach the subsequent studio, but this is not required.
- Student projects produced in this model have generally met or exceeded the goals outlined above. They are meritorious with regard to design, represent substantial critical reasoning skills, demonstrate skills in integration of technical issues, and often represent viable and professional development strategies.
- Self-assessment and accreditation analyses that the institution regularly undergoes have cited the Final Project Model as meritorious. In fact, the Chair of a recent NAAB Visiting Team stated in his concluding remarks to the School that he had seen no other program in the country that better prepared students for a leadership role in the profession. Whether that statement is true or not, the point here is that this Final Project model seems effective at demonstrating the student’s ability to meet many educational objectives that are part of a professional degree program in architecture.

Example of one student’s ARC 581 Project Preparation document: Laura Reed’s project was based on a quote she selected from Peter Zumthor. Her building program was for a NC Urban Horticulture Center, on a site that she selected at the seam between the university campus and a parkway.
Assessment of student work is a teaching opportunity. The seminar and studio syllabi explicitly state what is to be expected at each stage of the process. It contains easily measured elements, such as whether a drawing is submitted at the prescribed scale, but it also contains qualitative elements, such as the clarity of the information and whether the proposed design has responded appropriately to relevant spatial and even conceptual objectives, such as those of the selected quotation.

Individual assessments of the 22 - 28 students are carried out several times during both the preparation seminar and the final studio. Because the projects are individualized and rather complex, assessments place a significant demand on faculty time, but assures optimum student achievement.

At the left are evaluation sheets that Rand has used to indicate to the student how each element of their prep document was evaluated technically and qualitatively. Students in this seminar submit each element to the instructor in draft form, a second time in intermediate form to classmates for peer evaluations, then in final form to the instructor. This iterative multi-reader process enhances product quality, engenders mutual respect between student and instructor, and between students.

In the final studio, students are rigorously evaluated in each of 3 major reviews leading up to the final review. We also ask the students to assess themselves on each of the required deliverables, provoking them to gain skills at self-assessment that they will need after leaving academia.
Education efforts outside of the normal academic settings:
Please refer to curriculum vitae for complete listings.

TEACHING EDUCATORS
Rand is a frequent invited speaker at education conferences nationally. He was a founding member of the Building Technology Educators Society. He has co-authored 4 books since 2006, all of which are used in colleges and universities throughout this country. Rand has twice been the principal investigator for nationwide surveys of faculty in architecture and engineering programs, researching their teaching methods and identifying needs that academia would like to bring to the attention of industry. He chaired the ACSA Southeast Regional Conference in 1993 “Architecture: the Act/Art of Building”. He has also assisted as moderator and paper reviewer for many ACSA conferences.

TEACHING PRACTITIONERS
Rand’s teaching outside the classroom includes seminars for interns preparing for the registration exam and continuing education programs for licensed professionals. He has shared his technical expertise in dozens of presentations to practitioners from Florida to Washington. He serves on juries for national design awards.

TEACHING INDUSTRY
Rand has carried out funded research regarding exterior wall assemblies, and has presented his findings at many industry and professional conferences. Rand is the only architect elected to lead The Masonry Society, and to receive its President’s Medal and Fellowship. His tenure as President in 2003-2005 included the creation of the Society’s first Sustainability Committee, which he subsequently chaired for four years. He also realized an alliance between the industries in the United States, Canada and Britain, which facilitated the sharing of masonry standards and peer reviews. His 1999 paper “The Contemporary Masonry Wall,” was a finalist for ASTM’s Yorkdale prize as one of the top ten research papers of the 3-year period worldwide.

Activities related to Interdisciplinary and Interinstitutional Advancement
- Rand has made more than 50 invited presentations about his innovative teaching methods regional and national educator conferences. These began when ACSA had an annual Technology Conference, but since those ceased have been provided through other vehicles. Several have been cited by others in published articles. Many Architecture faculty members who attended have applied these models to courses at their own colleges and universities. Comments from architecture faculty who were University Professors Masonry Workshop participants:
  - Thank you for the University Professor’s Masonry Workshop. The workshop was excellent, and filled with great information. Presentations by Professor J. Patrick Rand were especially relevant for my class at my University. He gave great examples of student projects that I hope to be able to incorporate into my class.
  - I very much appreciate the opportunity to attend the University Professor’s Masonry Workshop at Clemson University. The Workshop had an excellent agenda, was well managed, had good speakers, and provided useful information. Coverage of material was at an appropriate level for professors such as myself. The speakers in general were excellent. Pat Rand’s presentations were especially helpful to me in offering me ideas for my architectural studios.

- Initiated an interdisciplinary Concrete Masonry Design Competition at NCSU; starting in 1996. Students in Architecture and Landscape Architecture work in small teams to either design a new concrete masonry unit for mass production, or to design and build a wall using stock units. The project is one of the few to engage students from more than one Design department; approximately 60 students took part annually. Initially, the competition was sponsored by the Carolinas Concrete Masonry Association. This competition has continued at our school, and has also been adopted by the National Concrete Masonry Association; schools nationwide now compete, with the top 3 entries receiving generous industry awards.

- Initiated a Student Research Grant Program through which 3-5% of the College’s returned overhead each year was awarded to students from various disciplines based on the merits of their proposals. This program helped support student initiatives and developed research skills in students.

Recognitions from outside of the candidate’s College and University:
In addition to 12 teaching awards received at the College or University level, Rand has received several national recognitions.
- Institute Scholar, American Institute of Architects, National Award 1990
- Education Commendation Award; CSI National 1991
- ACSA Service Award; for service as Regional Meeting Chair 1994
- Fellow, National Concrete Masonry Association 2001
- Fellow, The Masonry Society 2006
- College of Fellows, American Institute of Architects 2007
- AIA Education Honor Award, Honorable Mention 2002
- DesignIntelligence 30 Most Admired Educators for 2013

Each year, DesignIntelligence honors excellence in education and education administration by naming 30 exemplary professionals in these fields. The 2013 class of education role models was selected by DesignIntelligence staff with extensive input from thousands of design professionals, academic department heads, and students. Educators and administrators from the disciplines of architecture, industrial design, interior design, and landscape architecture are considered for recognition.

PATRICK RAND
North Carolina State University
Rand has a special ability to teach both traditional and modern applications of building materials and assemblies in a manner that allows students to develop a well-rounded store of knowledge to draw from when deciding ways to articulate or inform design concepts. His own personal brand reputation is to “welcome new ideas,” and students resonate to him.

(excerpt from DesignIntelligence publication)
Patrick Rand has been actively seeking to identify causes of extensive moisture damage in many contemporary masonry veneer exterior walls. In this project, sample assemblies were subjected to harsh weathering simulations, and their performance is evaluated. Innovative materials and assemblies have also been developed, tested, and their performance documented.

This project received an AIA Institute Scholars Program Award; awarded in competitive review process. A paper by this title was peer-reviewed and presented at the 8th North American Masonry Conference, and was a finalist for the Yorkdale Award.

Findings from this project have attracted international attention, and have assisted designers, researchers and industry professionals to improve the design and construction of exterior masonry walls. The technical courses and studios taught by the nominee have also been greatly enhanced from this investigation. Graduate students have been involved as research assistants in these experiments.

The research proved that accepted strategies for water to drain out of cavities were not as effective as previously thought. A second set of experiments explored the viability of other strategies to remove moisture from inside the wall. Passive convection of outside air through the cavity was found to be an effective and economical means to remove moisture. A paper “The Masonry Wall as an Enclosure System; Findings and Recommendations”, was peer-reviewed and presented at the 9th North American Masonry Conference.

Rand has been invited annually to present these findings and his pedagogical research to faculty from the US and Canada at the annual University Professors Masonry Workshop. He has also presented the technical findings to mason contractors throughout North Carolina, which is an important audience, because the research showed that many of the problems are due to errors of workmanship by contractors. Rand has also written several articles in national industry publications, to better inform these vital collaborators.

Environmental Impact of Cladding Materials; Embodied Energy and Carbon Dioxide ‘Costs’

Academic buildings on the NCSU campus employing a full range of architectural cladding materials were analyzed in terms of the investment of energy and CO2 in their initial construction, as well as maintenance and repair over their lives. Long-term records from the University Physical Plant were the basis for the analysis.

The analysis compared masonry, concrete, wood, glass and metal exterior cladding installations. This research confirms that considerable differences exist between exterior wall materials with regard to their environmental impact. Durability of exterior materials also were shown to vary considerably.

Painted exteriors have a much greater environmental impact than most unpainted exteriors, due to the high embodied energy and embodied carbon content of paint and stain.

Unpainted, durable exterior wall treatments are the most environmentally sound option that an owner or architect could choose.

This was the first study that has quantified accurately the life cycle implications of maintenance and repairs. A paper summarizing this research was presented at the 11th North American Masonry Conference in 2010.