Drawn from Practice: A Hands-on Method of Teaching the Building Technology Lecture Course

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Fig. 1. Case study, poured-in-place concrete house (design by the author)

Introduction

This paper presents an alternate method of teaching building technology within the undergraduate architectural curriculum.

In a large-format lecture course with over one hundred students, the method minimizes the time in class devoted to dictation. Instead, the professor briefly presents broad themes of assembly, describes an existing building which creatively addresses the topic at hand, and then proceeds to sketch select detail(s) from the project. Students follow along on blank sheets of 8-1/2x11 paper.

As far as practicable, I select case studies from my own body of built work, enriching and enlivening the technical data with illustrative anecdotes which attempt to make palpable to students the realities of putting a building together.

The method has certain advantages:

•It eschews the technocracy of most building construction systems courses, emphasizing instead practical, useful knowledge.

•It avoids the static recitation of facts and their corresponding rote repetition on exams, in favor of a dynamic teaching method in which students cannot passively accept information, but must craft their own mode of learning.

•It explores how any assembly can serve to realize the broad intentions of the architect, emphasizing that design thinking persists throughout all phases of project conceptualization, detailing, and execution.

•It demonstrates the links between practice and pedagogy, since I so often deploy details from my own body of work; and

•It favors hand-on learning, requiring that students in a lecture hall actively craft drawings. The method stems from my abiding belief that, for architects, the hand remembers what the mind too easily forgets.

An Overview of the Course and Its Place in the Curriculum

Since 2004, in each of the last three fall semesters, I have taught the second course in a three-course series of building technology courses.

In the first term of their third year, undergraduates in Architecture and Interior Architecture are required to enroll in the course, “Building Construction Systems in Architecture.” Enrollment varies but has ranged from a low of 103 students to a high of 120.

The first course in the series, Building Science, has a rather clear emphasis on building materials. The University catalog describes the course as follows:

ARCH 248. Building Science. (3) I. Instruction in the materials of building design; sources, characteristics and uses in design and construction; emphasis on evaluation and selection.

Here, the traditional emphasis on materials and their technical properties seems entirely appropriate. That course, which students take in the fall semester of their second year, uses two commendable textbooks, Edward Allen’s *Fundamentals of Building Construction* and Francis D.K. Ching’s *Building Construction Illustrated*.[1]

The second course in the series is the subject of this paper: **Building Construction Systems in Architecture.** Nominally, my course focuses on assemblies, or systems of building construction.

The aspirations of the course are clearly stated in the catalog description. In short, tectonic understanding can “reinforce and extend the intentions of the designer”:

ARCH 433. Building Construction Systems in Architecture. (3) I. A lecture course that develops an understanding of how materials and systems assembly reinforce and extend the intentions of the designer as well as an understanding of the strategies and techniques for integration and coordination of the building components.

The third course in the series, taken by architecture majors only, is an integrative studio in which fourth-year undergraduates in their fall terms prepare a mock “working drawings” set detailing their design. In their sets, which typically consist of twenty to thirty 24x36 sheets, students attempt to integrate tectonics, environmental systems, structures, and other support courses in the curriculum into the their own personal design process.

That course, which is a recent addition to the curriculum (fall 2004) has been a remarkable success.

The Flaws in the Course Require Action

When I began teaching my building technology course, some obstacles to my success were understood both by me and my colleagues: how, for instance, should a professor handle the teaching of assemblies to a lecture class of over one hundred students, when there is neither room in the curriculum nor resources (multiple teaching assistants, for example) for laboratory or recitation sections?

How should a professor teach assemblies when the College lacks a workable wood- or metals-shop, in which students might first craft conventional details and then learn to fabricate ones of their own devices?

How should a professor teach assemblies when the requirements and parameters of the course tend to convince students that the material is “uncool” and a distraction (or worse, an impediment) to the “creativity” of their studio work?

Given the inherent difficulties in teaching the material, my predecessors tended to repeat the course content of **Building Science**, relying on the same two textbooks but attempting to give a greater depth and focus to the topics under review.

During my first term teaching BCSA, in the fall of 2004, I relied on the course outlines and syllabi of my predecessors. However, I departed from precedent and began lecturing directly from and about my own experience in practice. For while I was new to university instruction, I had spent twelve years in professional practice, the last six of which I spent running my own firm in the SoHo neighborhood of Lower Manhattan. My firm prepared dozens of schemes, many of which I saw realized, for sites in metropolitan New York City as well as in Europe and South America.

In the BCSA lecture format, the class reviewed the material from Allen chapter by chapter, pausing occasionally to produce in-class sketch exercises. I varied slightly from the course and Wiley’s companion materials by following the Construction Specifications Institute’s numbering system as a template for my lectures. Even in my first iteration of the course, I tended to use details from my own work. However, I used in-class sketching primarily as a means of taking attendance.

My assigned studio courses that year began to inform my awareness of the building technology course’s weaknesses. In the fall of 2004 I had been assigned to teach the third course in the building technology sequence, the fourth-year working-drawings studio. I assumed the students’ difficulties in crafting details which advance their design intentions stemmed from shortcomings in their own BCSA course, which had been taught by a visitor prior to my arrival on campus. I assumed that my own version of the course, which highlighted my international experience on high-end, well-crafted constructions, would make the material more accessible to the students.

The next semester (spring 2005), when I taught a studio of fifteen students who had taken my lecture course the previous semester, I discovered a weakness in my course format.

As I am wont to do, I assigned my studio a wall section of their building. They faltered and fumbled with the assignment.

Topics which I thought had been quite clearly addressed in lecture—the distinctions between structure and cladding, for instance, or the need to trace through the building envelope to identify thermal bridges—had not been incorporated into the students’ own design vocabulary.

Worse, they did not have a keen understanding that buildings happen systematically and sequentially, that they happen by *procedure* over *time*. Their details were the stuff of jobsite nightmares: assemblies might require that steel be erected to a given height, then stopped, followed by a new crew who would form and pour concrete, followed by the assumed return of the steel crew . . . Alternately, details included impossible conditions: fixed backlit translucent glazing with fixtures that could never be relamped or lights that could never be cleaned.

I realized that while they they might have grasped the course material in my BCSA lecture, may even have been able to respond correctly to exam questions assessing whether they mastered the concepts, they did not have knowledge they could directly apply to their creative work. My students were simply not thinking tectonically and they were not seeing detailing as an opportunity for the poetical or even aesthetic realization of their design intentions.

I set out to address the problem.

The Prevailing Texts (and Their Limitations)

I began my course preparation for the fall of 2005 by assessing whether I needed to swap textbooks.

For many professors in building technology, Allen’s *Fundamentals of Building Construction* is preeminent. My college uses the book, and we justify its hefty expense by making it the required text for two courses. The Ching book supplements Allen nicely.

But my students were not sensing the aesthetic possibilities of constructional means and methods, and I suspected that *Fundamentals* was part of the problem. In particular, I myself had been somewhat dismayed at the quotidian nature of buildings illustrated in the text. I was particularly aghast at Wiley's companion website, in which the examples used to illustrate building systems were the stuff of suburban sprawl and "value engineering." In sum, the textbooks and support materials placed little premium on design excellence, exquisite detailing, and fine craft.

I contemplated using a text which more directly addresses the poetics of tectonic thinking: Frampton's *Studies in Tectonic Culture* or Edward R. Ford's *The Details of Modern Architecture*.[2]

Here, however, I encountered the opposite problem: neither author fully addresses the technical specificities of American construction practices. I did not want my students to become numbed by the particulars of M, S, N and O types of mortars, but neither could I endorse eliminating the technical data from the course entirely.

A particularly valuable series proved to be the gorgeous set of "Detail Construction Manuals" published by Birkhäuser, whose several titles include *Glass Construction Manua*l, *Masonry Construction Manual*, and *Timber Construction Manual*.[3]

The books offer insightful and edifying technical data, and supplement the specifics with lavish photographs of finely considered and realized buildings. Most satisfyingly, unlike many American publications which feature prominent designers or noteworthy designs, the Birkhäuser series includes detailed drawings. The details are clearly delineated and well-labeled. Texts are in English.

Alas, the series was unsuitable as textbooks in a large lecture course: they were too expensive and too expansive, too many in number for my purposes. Moreover, they depicted European rather than American standards. Graphics techniques differ, and many of the case studies in the series evince the European tendencies to elide distinctions between the profile of structure and the contour of cladding.

I preferred educating my students in the more pliant American attitude towards structure and weather enclosure, in which the frame clearly supports load and cladding (often on alternate or opposing geometries) defines space and provides protection from the elements. I teach at a land-grant university in the Midwest and I wanted my students educated in a building culture that more closely approximated their own.

A Practical Alternative

The Birkhäuser series inspired me to craft the entire course around the detailing of objects in which I could clearly explain the architects' aesthetic intentions, trace the design process, examine the details, and repeat those details in class. For many reasons, my own projects fulfilled my objectives more than any other architects' could.

I revamped the course to emphasize in-class sketches. Drawing on my readings into alternate textbooks, I introduced to my BCSA course Howard Davis's notion of the Culture of Building.[4] I had already directed learning toward the materialization of ideas through the specifics of constructional detailing; with Davis, I could introduce to students the argument that building systems contain values, and within quotidian norms of our industry lurk deeply embedded ways of thinking and being in the world.

We continue to use Allen and Ching as texts. I recapitulate salient points and facts from the literature, but depart from it in my discussion of the evidence.

Fig. 2. Case study lecture.

The Method Illustrated

Typically, over the course of the semester I show a dozen or so of my own projects. For this paper, I will illustrate my teaching method with a poured-in-place concrete house completed in 2002 (Figure 1).

The project is a house and staff apartment for a twenty-something actor with other homes in New York and Los Angeles. The design radically reconstructed and added to an existing house in the foothills of the Swiss Alps, which rise steeply to the south. Lake Zurich is to the north. From the elevated site, a broad panorama of the city and its suburbs stretches from east to west on both sides of the water. The program has been distributed so that interiors capture the dramatic views.

The three-level concrete house has an intense relationship to the ground: rooms are cut into the earth, at grade, cantilevered out over the hill or set beneath a planted roof. On each floor, the layered topography is present and felt. Below grade, retaining walls of board-formed concrete and “calanca” gneiss frame skylights. At grade, rooms open directly onto gardens. Here, the concrete is panel-formed. The panels impart a smooth, almost glassy finish to the material, a sharp contrast to the striations of the board-formed retaining walls.

On the roof, which is visible from the street and the neighborhood upslope, a clerestory rises over the thyme garden so that in the evenings horizontal bands of light glow against the terraced escarpment. The roof here is a carbon-fiber reinforced slab, replacing an existing conventional pour.

The project includes a range of sophisticated climatic controls, including a geothermal heating and cooling system that runs through coils in a concrete topping slab, triple-glazed windows along the expansive north facade, operable clerestory windows along the south facade, and a planted roof. The systems satisfy a range of imperatives: the local Swiss canton extensively limits the allowable energy consumption of single-family private homes; the dwelling’s passive systems suited the owner’s needs for a building that could be left unoccupied for several months at a time; and the architects sought environmental systems which would reinforce the scheme’s design *parti*, a dwelling embedded in the depths of the earth but emerging, luminous and crystalline, into the light. The blue glazed sitting room, cantilevered out over the rough hewn rock, emphasizes that dual reading.

The building illustrates my first of two lectures on concrete. Following a discussion of the constituent elements of concrete, derived largely from Allen’s *Fundamentals*, I introduce a series of construction photos of the Swiss house, from excavation through final occupation. I complete the talk by presenting and discussing details from the project.

At the beginning of the next class meeting, we spend about forty minutes drawing details from the project. I use an overhead projector, and begin by showing students a photocopy of the detail they will be sketching. We then block out the sketch.

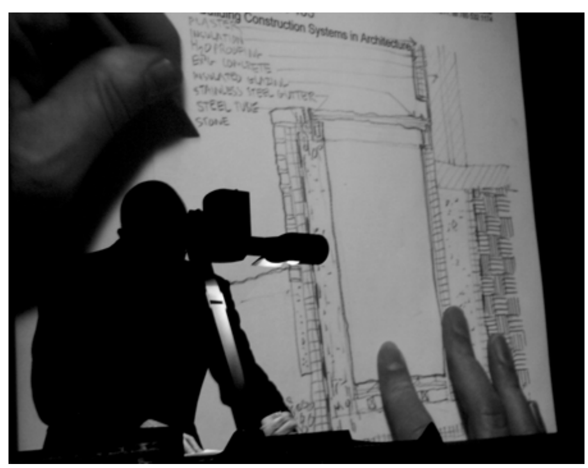

Fig. 3. In-class sketch on overhead projector

We first draw those elements which are fabricated or installed first, and insofar as is practicable I render the building component in the order in which it is installed.

I pause where necessary to show the original detail, sometimes toggling back to the slide lecture to show students photographs of the finished work they happen to be sketching.

As I draw, students follow along. Last year, my second time teaching the course, I included in the course handout a copy of the detail, so that students could trace from an original. While aiding the weaker draftspersons, this practice undermined the larger goals. Another flaw: I too often rushed the sketch, hastily completing it or leaving little or no time for annotations or exegesis. When we returned marked-up copies to students, they had a hard time recalling the individual components.

This year, I have significantly reduced the number of slides we review during each class period. Students now sketch directly on a blank, unlined sheet(s) of paper, which we provide. We proceed deliberately, with ample time to discuss specific items and principles. Students regularly ask questions, which they tended not to do previously.

At the completion of the drawing, we annotate the detail. Typically, we then highlight the insulation in the assembly (students are required to come to class with pink markers). Together, we identify potential areas where heat transfer might occur. We discuss strategies for introducing thermal breaks. And we review sequences of assembly and potential situations which might complicate project sequencing.

Students hand the work into the course's teaching assistant, who reviews the work for coherence and aesthetic effect. We return the marked-up original to the students.

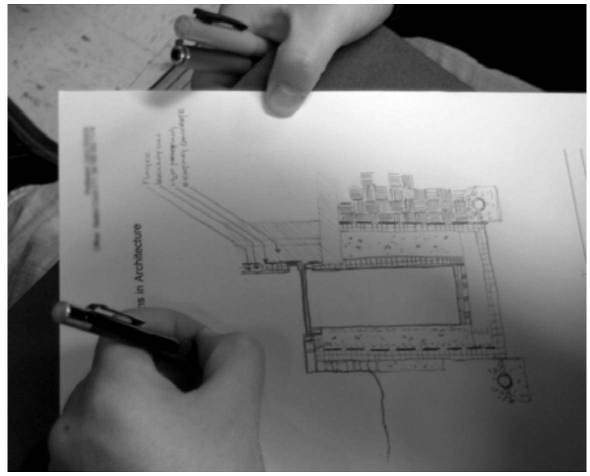

Fig. 4. Students sketch along with the professor.

Conclusion: Practice Makes Perfect?

One consequence of this in-class sketch method: I make mistakes. I pause on discovering an error, as when I have omitted an essential element of the assembly or drawn a component before I have shown its substrate. At times, I need to stop and reconsider how I have laid out notes or sequenced leader lines.

These halts in the process caused me some embarrassment at first; it is difficult, after all, to prepare freehand drawings in front of one hundred pairs of judgmental designer eyes. But my fitful starts are likely to be useful, as they indicate that detailing is itself an iterative process—we think through the detail, and detailing is a form of architectural thinking.

It pleases me to know that my lecture course emphasizes hand drawing. Architects learn by making, first by making drawings and models, and then later by making buildings. The procedures discussed here reinforce the essential component of craft. They give priority to the making of things, rather than primacy to technical mastery.

As an academic in a professional degree program, I have the opportunity to reconcile my professional practice with the more speculative nature of university research. I see now the inquisitive nature of details I have pursued (and continue to pursue) in my own private practice, and I see how those details, and the manner in which I develop them, are themselves suitable matters for pedagological investigation.

And finally, the most significant reason for pursuing this method of in-class sketches at all: it restores design excellence as the motivation for studying tectonic assembly in the first place. We can seal against termites or guard against dry rot in any number of ways, and the ways in which we do so are themselves bound by the culture of building in which we find ourselves. But in whatever era we work, and whatever systems prevail, some things are eternal: beauty remains truth, and truth beauty.

And it remains all we know, and all we need to know. The study of that fact is worthy of a life's work. I stand with William Carlos Williams in asserting, "No ideas but in things."

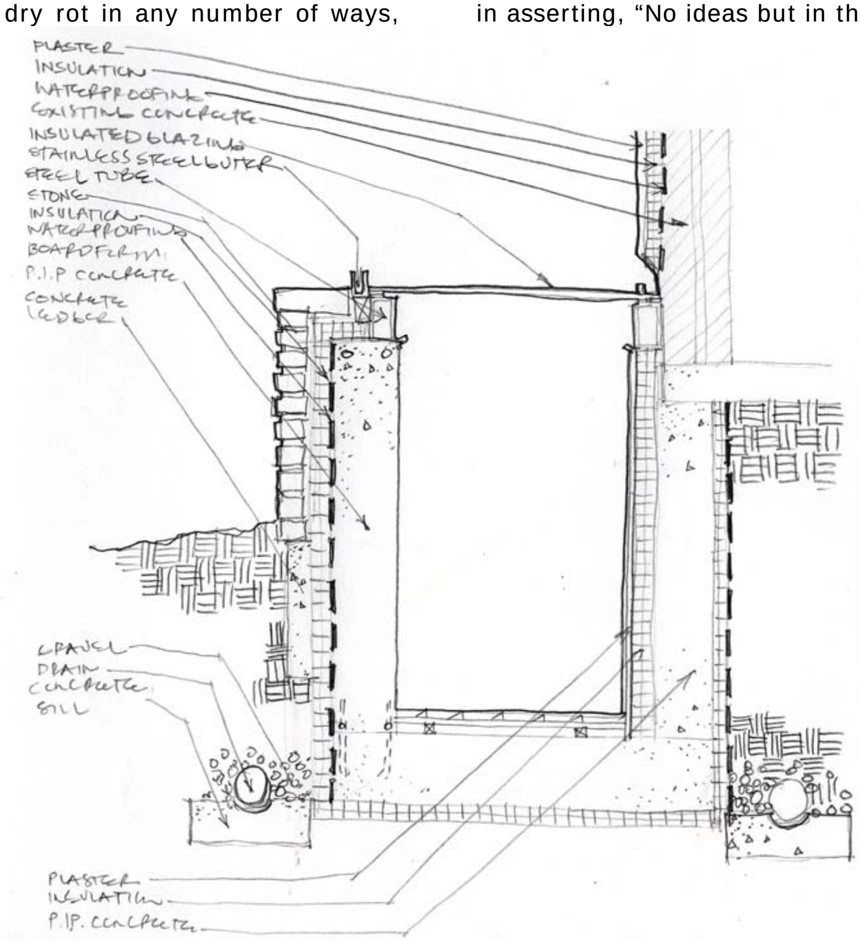

Fig. 5. Student's in-class sketch of a poured-in-place concrete passage at the lower level of the concrete case study, a house outside Zurich, Switzerland

Endnotes

1 Allen, Edward and Iano, Joseph, *Fundamentals of Building Construction: Materials and Methods*, 4th Edition, John Wiley & Sons, Inc., 2004.
Ching, D.K. Francis and Adams, Cassandra, *Building Construction Illustrated*, 3rd Edition, John Wiley & Sons, Inc., 2001.

2 Ford, Edward R. *The Details of Modern Architecture*, The MIT Press, 1990.
Frampton, Kenneth (John Cava, ed.), *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, The MIT Press, 1995.

3 Birkhäuser series, "The Construction Manual by Edition Detail," various volumes, from 1999.

4 Davis, Howard, *The Culture of Building*, Oxford University Press, 1999.