AC 2011-1900: GENERALIZING THE PARTICULAR: RETHINKING THE ROLE OF THE CASE STUDY IN BUILDING TECHNOLOGY COURSES

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In many ways my argument is best made as a tale of two textbooks (and for this audience I will assume well-known textbooks) in the development of two different building systems courses that were started in a nine lecture-hours per week trial by fire in the summer of 2003. The first text is Norbert Lechner's *Heating, Cooling, Lighting* (HCL), at last now more confidently subtitled in its third edition, *Sustainable Design Methods for Architects*.[1] Second we have the quintessential all-systems tome, *Mechanical and Electrical Equipment for Buildings* (MEEB) having recently passed in care from Benjamin Stein and John Reynolds to Walter Grondzik and Alison Kwok, with sustainable additions expanding its girth from 1724 to 1766 pages.[2] Ever a reliable favorite among architecture students for its literal as much as its referential density, the MEEB can still be spotted in many a studio holding down models while their glue dries. The two courses, taught for third year B.Arch.'s and second year M.Arch.'s at NJIT over four years, and more recently translated into first and third year B.Arch. "tech-track" courses at Syracuse University, can be generalized as, respectively, Building Envelope Performance and Building Interior Environment & Service Systems, aimed principally in both programs at satisfying NAAB requirements: 15. Sustainable Design (in part), 21. Building Envelope Systems, 19. Environmental Systems, and 22. Building Service Systems.[3]

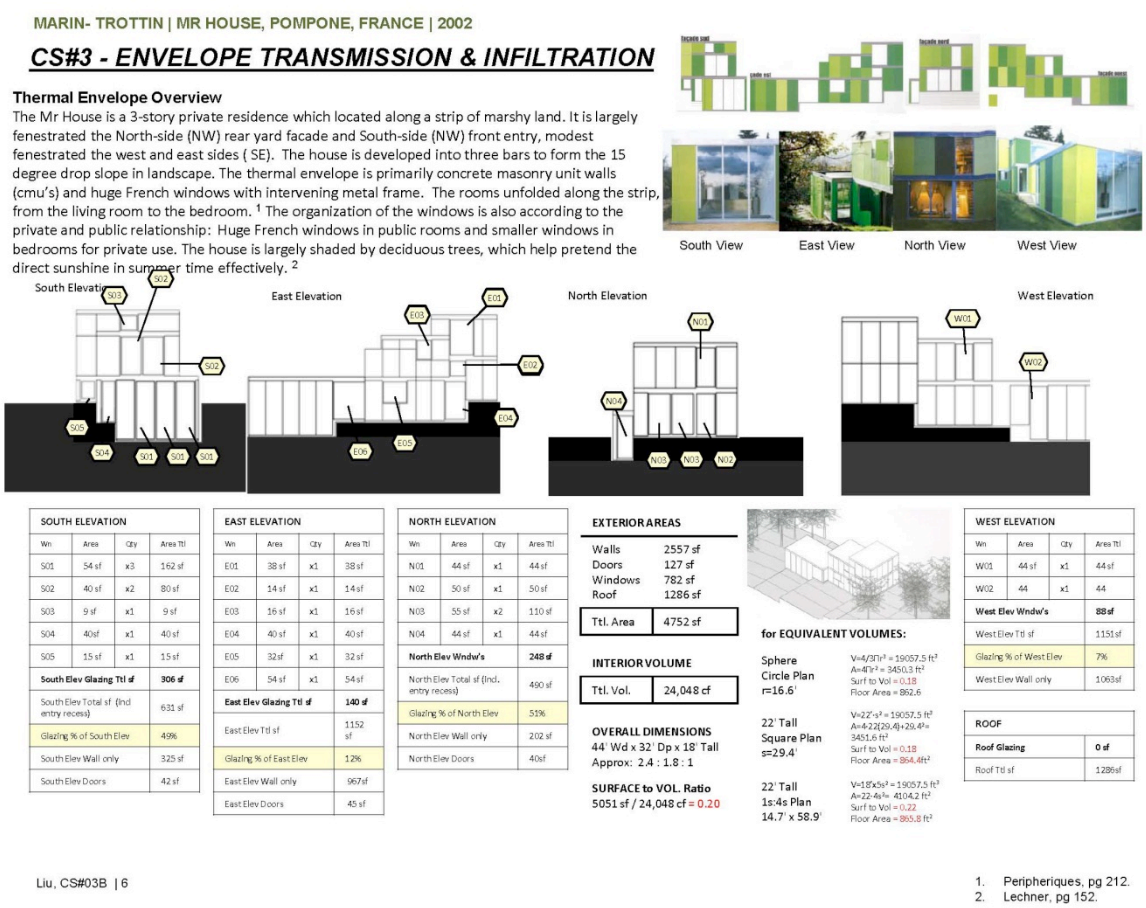
Having studied this same NAAB-compliant material for my own B.Arch. degree under the aegis of Stein and Reynolds then 10th edition for both courses (and, I must add, with the building envelope course taught by a joint-appointed engineering faculty), the discovery of Lechner's less dense and more schematically design-oriented text in the lecture preparation crunch of that first five-week summer version of my envelope course couldn't have been a more welcome surprise. Some seven years later, I am still assigning Lechner's text for my now first-year "performalist" envelope course, supported with various other sources, including Bobenhausen's *Simplified Design of HVAC Systems*, the Fine Homebuilding anthology *Energy Efficient Buildings*, the most recent edition of the *IECC*, and what is still the pure gem of Heschong's *Thermal Delight*. Yet for the interior environment and service systems material I have moved eventually fully away from the MEEB toward a more hybrid course reader that strives to balance MEEB-style authoritative reference chapters (albeit more concise ones) with more design-inspired texts containing greater numbers of aesthetically accomplished case study examples. This split and shift has been largely inspired by the relationships of those very different type of texts to both my own slide-intensive lecture format, and, more importantly for the purposes of this paper, the still evolving "case study" assignments (and their software integration requirements) which have proven to be such a successful component of these courses from both my own and some now few hundreds of my students' point of view.[4]

Before describing these two different course's particular case study assignments, the general claim I want to make is that a shift towards thinking about the "case" as a particular instance that "retroactively" creates the very general rule it derives or even deviates from - what I'll call *generalizing the particular* - is a more productively "design oriented" approach among studio audiences[5] than seeing the case as merely a purified example which doesn't so much prove as often merely graphically restate its general rule, tautologically *particularizing the general*. Notably, of course, both HCL and MEEB feature photos and drawings of well known "designer" buildings that therefore tend to be recognizable from studio, history/theory, graphics and other courses in the architecture curriculum. Yet, when the hard numbers come out, something interesting happens.

In MEEB, the numerical case, the "scientific" proof, is nearly always anonymous, settled by a diagram showing the spacing of luminaires in some "generic" office ceiling plan or the plumbing riser diagram for a "medium rise building" that is at once everywhere and thus nowhere. In HCL, to both its credit and its detriment, the same numbers almost all but disappear into side-bars or simple rule-of-thumb tables[6] yet with a purpose that I believe has greater promise and purpose. For the bulk of HCL's arguments are qualitative, relational and geometric - *more or less* southern exposure, *greater or lesser* degrees of cross ventilation paths, etc. - in a manner that literally relies on a student's "obvious" reading of its very *not* slick photographs and simple illustrations to pass along *ownership* of their "proof" *to the reader* - "Here, see for yourself!"

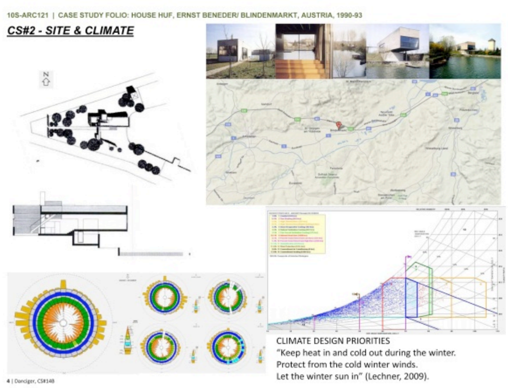
Reflecting now on my two systems courses, there were two key measures I took in tandem with substituting HCL and similar texts for MEEB that I think drives home this larger point about a vectored reversal in priority between the particular and the general. First, I realized that my own slide (ok, power point) lectures were filled some two-thirds with photos of buildings I had visited myself, affording me the luxury of a more testimonial narrative, rather than demonstration by calculation, about their thermal, acoustic, luminous and other experiences. Second, as I had the good fortune to have Bill Bobenhausen for a senior colleague at NJIT, I learned of and thereafter came to rely on his text's two generic vehicles - "the House" and "the Office" - for rendering some of the critical calculation complexities that Lechner's text explicitly avoided. In this heightened division between my own lecture's photographs and qualitative descriptions of particular high-end "designer" buildings and the simplified objectivity of Bobenhuasen's utterly generalizable house and office examples, I found myself empowered to, in a sense, follow Lechner's lead and "produce" general principles as more or less derivable from specific building examples rather than the reverse. More importantly, my sense of how students responded to connecting lecture images and personal testimonials back to more generic diagrams and calculations lead me to develop case study assignments that could likewise students themselves to "own" their discovery of the technical material as much as they were used to owning their studio and graphics projects.

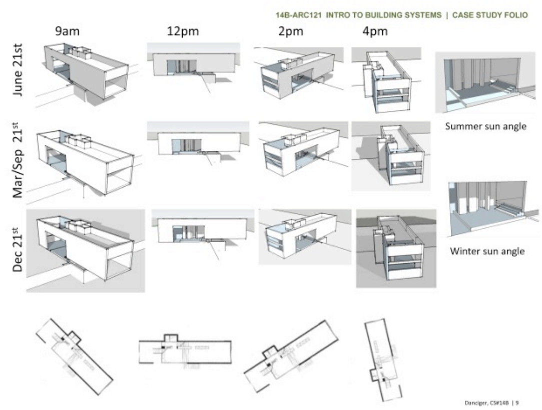
In the first of my two tech courses, which focuses on building envelope performance, every student is assigned a recent and rather "formally persuasive" house for the semester. Originally, my selections were of classic/late/post-modern vintage - i.e., houses which offered good documentation for redrawing or critical essays for expanding the scope of the study - but in short time I realized that not only did a “lure of the new” hold greater attraction to the students’ and my own interests, but that “less” documentation could offer “more” return for the type of assignments I had in mind. Fortunately, with the ushering in of the *Phaidon World Atlas*[7] I was able to shift my house selections into a more globally dispersive agenda, especially fitting for the comparative climate assessment aspect of our skin-dominated heating/cooling loaded residential scale.



Four to five assignments prevail across the semester: 1) Form, 2) Site and Climate, 3) Heat Loss, 4) Solar Geometry and Shading, and 5) Heat Gain and Day-lighting (the last achievable in more accelerated third year versions of the course). Houses are carefully selected to insure at least two published reference sources that include a sufficient number of 2d drawings to allow some accuracy in redrawing the house, as well as photographs that show topography and vegetation. The first assignment is purely formal - relating the house to both its architect's timeline of work and speculating on the formal influences of their contemporaries. The second, coinciding with Lechner's early chapters, and now with Google-Earth, SketchUp, Rhino topography and Climate Consultant 5 modeling exercises, asks for an assessment of the site and climate as an opening into the discussion of which houses look great AND might perform great. A look at fenestration percentages and a simple heat loss calculation in the third assignment parallels Bobenhausen's similar calculations on "the House" with the distinction that the numbers are suddenly corresponding (given assumptions about R and U values, with relative accuracy if not precision) to a work of architecture that the students is already quite engaged with looking at. Finally, a solar geometry exercise rounds off the work, leveraging SkethcUp and to a lesser degree Ecotect's more intelligent solar-relational interfaces to produce legible graphic conclusions (as well as caution them about the liabilities of becoming lost in Autodesk's less than "stellar" not site-and-climate sensitive interface and coincidentally poor visual intelligence output to labor time input ratio).

In the second tech class, a Building Environment and Service Systems course, and which by good fortune at Syracuse coincides with the students' Comprehensive Design studio term, the case study vehicle is a bit more complex but equally successful in putting the building particulars in the students' hands as a means to drive home the lecture content. Paralleling the schematic and design development tracks of their studios, case study entries follow one of two types - either they are surveys of particular building systems in buildings on campus, or they are propositional representations of systems for the projects they are developing (often in pairs of two) in their comprehensive design studios. The semester is kicked off with two case studies that ask students to survey and evaluate both an egress/access/fire-safety and the plumbing/mechanical/electrical-closet "poché" cores in our own recently and quite beautifully renovated Slocum Hall.[8] Later in the semester, two case study assignments in acoustics and lighting send students into gallery, library and dining spaces on campus with metering instruments to make similarly systems-driven observations.





Regarding the second type of assignment, each student in the design studio team is asked to develop over the course of the semester one of two quantitative/qualitative annotated systems drawings that look at, first, the relationship of structure/day-lighting/hvac, and second, the relationships of circulation/transport/cores. These drawings' due dates are scheduled to be used for studio midterm and final pinups as well as being submitted in a final folio compiled from the four empirical case studies. In a similar vein, lecture materials for the second course rely on my own research into aesthetically systems-ambitious architects from Kahn to Koolhaas - a pairing that has remained largely underexplored in the literature that I hope soon to exploit - with connections constantly being made between the case study requirements and the lecture and reading content.

What I think has most importantly continued to evolve in this shift from primarily general-principle-driven textbooks as the source of all particular understanding toward leveraging the learning potentials of case study particulars themselves as primary "producers" of general principles is a student-ownership of the revelations that come with either seeing or drawing the systems in question first hand. Further, this approach lends greater support to the idea that only by working through the design studio practices of drawing and model making can any discoveries about building systems and technology come about, and that drawing systems "wrong" is as important as drawing them "right" since without drawing the particular nothing general can be argued.

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[1] Lechner, Norbert, *Heating, cooling, lighting : sustainable design methods for architects*, 3rd edn (Hoboken N.J.: John Wiley & Sons, Inc., 2009).
[2] Grondzik, Walter T., Alison G. Kwok, Benjamin Stein, and John S. Reynolds, *Mechanical and Electrical Equipment for Buildings*, 11th edn (John Wiley & Sons, Inc., 2009).
[3] The National Architectural Accrediting Board, *NAAB Conditions for Accreditation: For Professional Degree Programs in Architecture, 2004 Edition* (Washington, DC: NAAB, 2004), p14.
[4] Survey Monkey data for the conference presentation will look to combine Spring 2010 & 2011 feedback.
[5] Certainly architecture students, but my claim looks to advance the trend toward studio formats within engineering curricula as well.
[6] Perhaps buying in to architecture students' often proclaimed fear of "math" - certainly an American education problem that the architecture/engineering degree choice split only further serves to demonstrate.
[7] Editors of Phaidon Press, *The Phaidon Atlas of Contemporary World Architecture* (Phaidon Press, 2004).
[8] See Garrison Architects, 2008.