Donald Bruce Corner
Professor of Architecture
University of Oregon.

These pages provide examples of Professor Corner's teaching and research initiatives. During his tenure at Oregon, he has taught design and building technology to over 3000 students graduating with the B.Arch and M.Arch degrees. He has lead 143 students on design studio terms in Italy, including seven years in a continuing program developed with Professor Jenny Young. Drawn from those in recent contact, the lists below represent a sample of the many and varied professional distinctions earned by his former students.

Graduates who are principals in their firms:

Allied Works, Portland OR
- Kyle Lommen

Anderson Shirley Architects, Salem, OR
- Karl Anderson
- John Shirley

Architecture Brian Cavanaugh, Portland, OR
- Brian Cavanaugh

Atelier Markgraph, Frankfurt, Germany
- Lars Uwe Bleher

Atelier Waechter, Portland, OR
- Ben Waechter

Bergsund Delaney Architects, Eugene, OR
- Sarah Bergsund
- Anne Delaney

Blue Sky Studio, Anchorage, AK
- Catherine Call

The Façade Group, Portland, OR
- Robert Kistler

Fore Solutions, Portland, ME
- Gunnar Hubbard

Goody Clancy, Boston, MA
- Jean Carroon, FAIA

GTrue Studio, Oakland, CA
- Greg True

L64 Design – Northern Architecture, Fairbanks, AK
- David Hayden

James Carey, Architect, Seattle, WA
- James Carey

Jones Payne Group, Boston, MA
- Michael Payne

Kaplan Thompson Architects, Portland, ME
- Jesse Thompson

KH Designs, Inc., Kelowna, BC, Canada
- Kevin Halchuk

Lead Pencil Studio, Seattle, WA
- Daniel Mihalyo
- Annie Han

McCoppin Studios, San Francisco, CA
- Ned White

MOSI Architects, Portland, OR
- Laurie Simpson

Northwind Architects, Juneau, AK
- Sean M. Boily

Patano+Hafermann Architects, Seattle, WA
- Laura Hafermann

Pivot Architecture, Eugene, OR
- Curt Wilson

remshardt architecktur, Vienna, Austria
- Marc Remshardt

Rowell Brokaw Architects, Eugene, OR
- John Rowell
- Greg Brokaw

S.T.S. Architects, Wellesley, MA
- Shannon Taylor Scarlett

Strening Architects, Santa Rosa, CA
- Daniel Strening

TLCD Architecture, Santa Rosa, CA
- Alan Butler

Wagner/Galloway, Palisade, CO
- John Galloway

Walker Warner Architects, San Francisco, CA
- Brooks Walker
- Greg Warner

Graduates who are engaged in teaching:

Boston Architectural College
- Kevin Settlemyre

Cal Poly San Luis Obispo
- Margot McDonald
- Troy Peters

Middlebury College
- Ashar Nelson

Philadelphia University
- Christopher Harnish

University of Cincinnati
- Michael Zaretsky

University of Idaho
- Bruce Haglund
- Diane Armpriest

University of Louisiana Lafayette
- Corey Saft

University of New Mexico
- Mark Childs

University of Oregon
- James Givens
- Brook Muller
- John Rowell

University of Wisconsin Milwaukee
- Greg Thomson
- James Wasley

Urban Green Council, New York, NY
- Yetsuh Frank, Director of Programs

Architecture 4/571: Building Enclosure
Professor Donald Corner
Associate Professor John Rowell

The subject focus of this course is the weather envelope that surrounds primary structure. Major material groups will be examined in sequence: wood, metals, glass, roofing, masonry veneers and concrete panels. The emphasis will be on the selection of appropriate materials and their application to design problems that require the integration of architectural concepts with good standards of technical practice. This course requires substantial reading from sources that describe the history and practice of building construction. There are extensive lectures presenting detailing practices appropriate to major materials. In addition to the lectures, students must attend one laboratory session per week in which they will explore construction concepts, and develop and present integrative detailing projects. Understanding of these concepts and processes is further measured through two-hour examinations, at the middle and end of the term.

Course objectives:
1. Build on the student's developing understanding of the role and impact that construction materials and processes have in determining the form of the built environment.
2. Introduce building science concepts relevant to the building enclosure.
2. Emphasize those areas of building technology in which the architect must be competent to act alone, the enclosure envelope and the interior finish systems.
3. Study the physical properties, manufacture, appropriate use and behavior in place of traditional, contemporary and experimental materials.
4. Provide experience in construction detailing and documentation.

Required Texts:
Allen, Fundamentals of Building Construction Materials and Methods, 5th Edition.
Allen and Rand, Architectural Detailing, 2nd Edition.
Herzog, Façade Construction Manual.
Brock, Designing the Exterior Wall
Brookes, Cladding of Buildings
Posted readings drawn from building science research and manufacturing literature.

Example of Project One: Wood and Metal Detailing
The firm you work for has been hired to design a classroom and teaching lab for the West Eugene Wetlands Education Center. The building looks south and east over the wetlands, and you will focus on that corner. Of special interest is a fully glazed south wall that turns the corner for a view and provides a strong connection to the site. The clients want a building that responds to the climate with a contemporary "northwest" character. Specific requests include expression of natural wood, but protected from the weather for durability. They want a pitched metal roof, with some of the slope available for the future installation of PV panels. Beyond that the form is negotiable. To relate to the industrial context, metal wall cladding should be used where appropriate. They like the idea of mixing steel connectors and/or steel structural elements with the wood frame. They want big view windows that are fixed, but also need some that operate with screens for ventilation. There is great concern about mold and indoor air quality. The building should weather well and be low maintenance. Detailing is to be of high quality, elegant and durable. You must apply best detailing practices, including rainscreen cladding and well developed flashing, to make sure there are no moisture problems in the building.

Example of Project Two: Glass and Masonry Detailing
The UO Integrated Science Complex needs a front door that is visible to the campus and that reflects the image of cutting-edge science. This detailing project proposes a new entry on the southeast corner of Huestis Hall, replacing the existing "non-entry" that was common in the 1960s. The concept calls for an oriel window to mark the entry, bracketed between two brick towers. The donor wants a ventilated glass double façade, with operable shading and high thermal performance. An addition to the existing stair tower will provide a ventilation shaft for mechanical systems in the basement. At the east corner, a stair exiting from lab space under the quad define a shorter brick tower. These new brick masses will frame the glass oriel, and should demonstrate a contemporary approach to brick texture and pattern. The solid walls will be primarily an anchored brick veneer, detailed in accordance with best practices. The top of the addition takes cues from the new ISC2 Lab building by HDR/Thomas Hacker Architects. A deep roof overhang creates a shadow line and strong horizontal cap to the addition. A clerestory glass band wraps around the east tower over the top of the masonry to accentuate the floating quality of the roof plane.

ARCH 471/571: Building Enclosure: Course Schedule

1 Lecture: The cladding of buildings, designing the detail.
Read Allen: *Architectural Detailing*: Chapter 15.
Read Allen: *Fundamentals...*: Chapter 19.
Read Brock: *...Exterior Wall*: Chapters 1-3.
Read Lstiburek, Building Science Digest 104, 105 and 106.

Lecture: Roofs, windows and contemporary sidewalls.
Read Allen: *Fundamentals*...: Chapter 7.
Read CMHC: Woodframe Envelopes in the Coastal Climate of British Columbia: Pages 3-1, 3-2, 3-25 to 3-27. Review the overall document as a reference.

Labs: Introduction to projects. Wood detailing workshop.

2 Lecture: Exterior detailing and weather protection in wood.
Review Allen: *Fundamentals*...: Chapters 3-5.
Read Allen: *Fundamentals*...: Chapter 6, Chapter 16 (Steep roofs).

Lecture: Metals. Exterior systems and details.
Read Allen: *Fundamentals*...: "Metals in Architecture," sidebar in Chapter 12, pages 458-460.
Read Brookes: *Cladding of Buildings:* Chapter 4.

Labs: Design development of project 1.
Project 1: First round drawings due to GTF: 5:00PM Friday

3 Lecture: Large scale cladding systems.
Review Allen: *Fundamentals*...: Chapter 11.
Read Allen: *Fundamentals*...: Chapter 21.
Read Brookes: *Cladding of Buildings*: Chapter 5.

Lecture: Curtain walls.
Read Brock: *...Exterior Wall*: Chapters 4-5.
Read Herzog: *Facade Construction...:* B 2.1 The glass double facade.

Labs: Review and refinement session for project 1.

4 Lecture: Glass and glazing systems.
Read Allen: *Fundamentals*...: Chapters 17 and 18.
Read Brookes: *Cladding of Buildings:* Chapter 6
Read Herzog: *Facade Construction...:* B 1.6 Glass.
Read Straube: *Can Highly Glazed Building Facades be Green?,*
Project 1 Due: Hand in complete set of drawings at the beginning of class.

Lecture: Roofing. Brick materials and manufacture.
Read Allen: *Fundamentals*...: Chapter 16 (remainder - low slope roofs), Chapter 8**.**

Labs: Project 1 final presentations.

5 **MIDTERM EXAM**
Covers all lectures and readings on wood, metals and glass. Includes workshop sessions and Project 1 detailing exercise.

Lecture: Masonry wall systems and details.
Read Allen: *Fundamentals*...: Chapters 9 and 10.
Read Brock: *...Exterior Wall*: Chapter 6.

Labs: Project 2 introduction and detailing workshop.

6 Lecture: Masonry weathering. Stone: origins.
Read Herzog: *Facade Construction...:* B 1.2 Clay and B 1.1 Natural Stone.

Lecture: Stone, preparation and installation.
Read Allen: *Fundamentals*...: Chapter 20.
Consult Blackboard for additional readings on stone for this date.

Labs: Design development of project 2.
Project 2: First round drawings due to GTF: 5:00PM Friday

7 **FIELD TRIP**: Masonry and concrete detailing.
Follow instructions announced in previous class.

Lecture: Terra Cotta, stucco, EIFS, plaster and gypsum
Read Allen: *Fundamentals*...: Chapters 22 and 23.
Read Brock: *...Exterior Wall*: Chapters 8-9..

Review and refinement of project 2.

8 Lecture: Interior systems; partitions, drywall, ceilings.
Read Allen: *Fundamentals*...: Chapters 12 and 24.
Project 2 Due: Hand in complete drawings set at beginning of class.

Lecture: Architectural concrete.
Read Brookes: *Cladding of Buildings:* Chapter 1, on Blackboard.
Read Herzog: *Facade Construction...:* B 1.3 Concrete.

Project 2 final presentations.

9 Lecture: Concrete finishes, weathering and preservation.
Review Allen: *Fundamentals*...: Review portions of Chapters 13-15 pertaining to the form, finish and durability of exposed "architectural concrete."

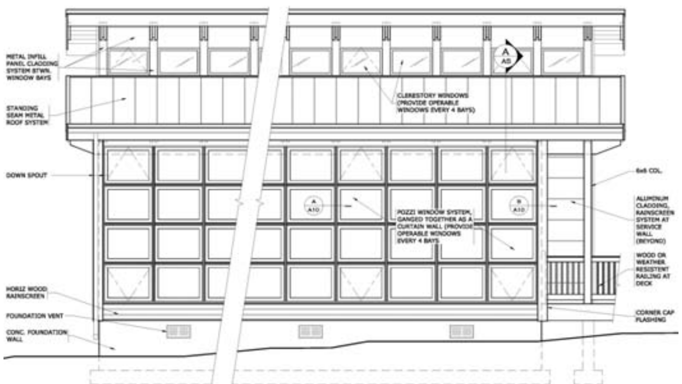
Thanksgiving Holiday
Classes canceled.

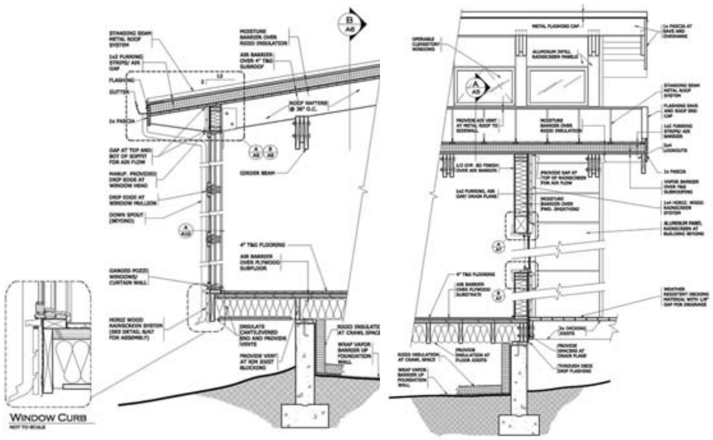
Optional review sessions for final exam

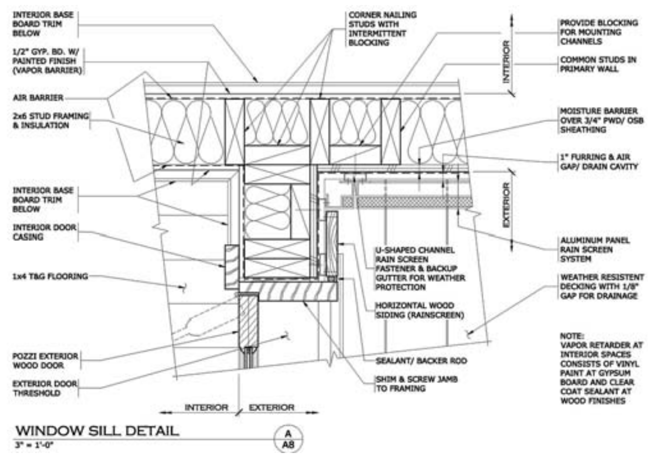
10 **FINAL REVIEW WEEK**: No lectures**.**

11 **FINAL EXAM**: Consult the University exam schedule.
Covers all lectures, readings and course activities since the mid-term.

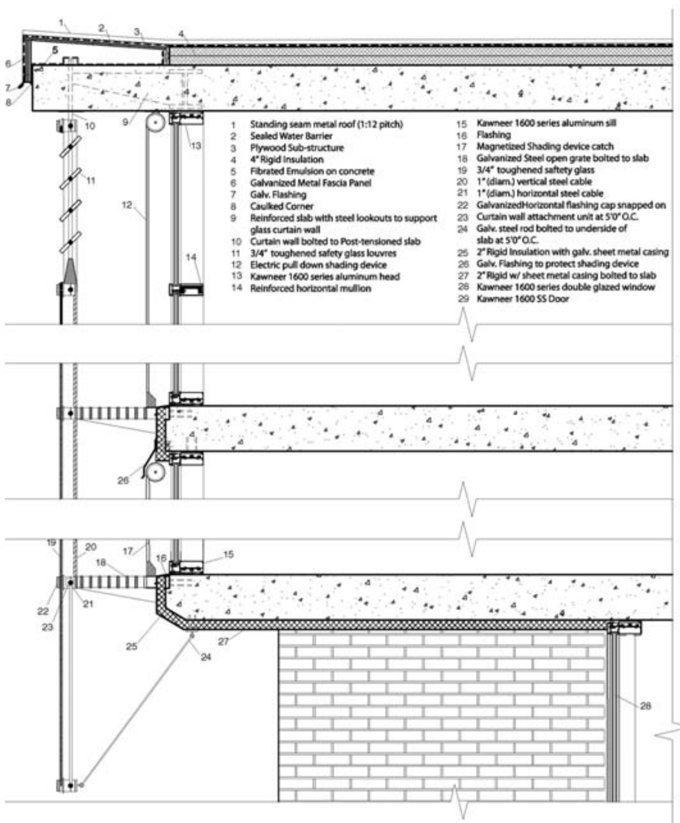
Arch 4/571: Project One: Wood and Metal

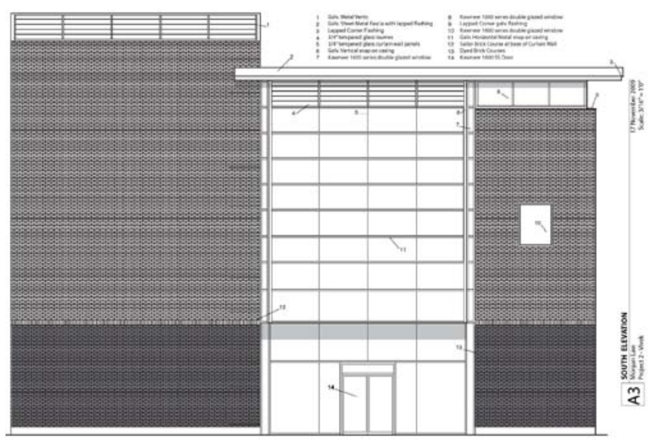


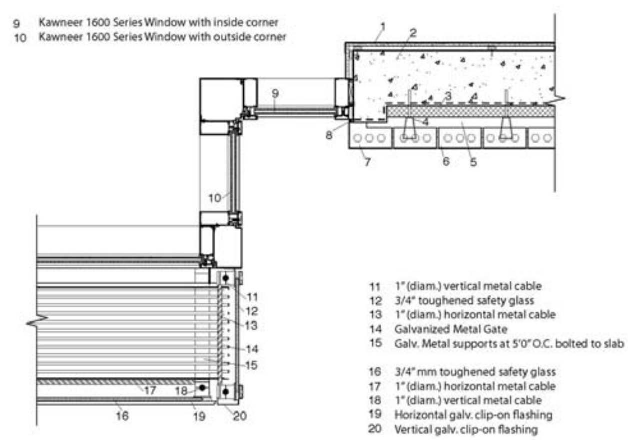




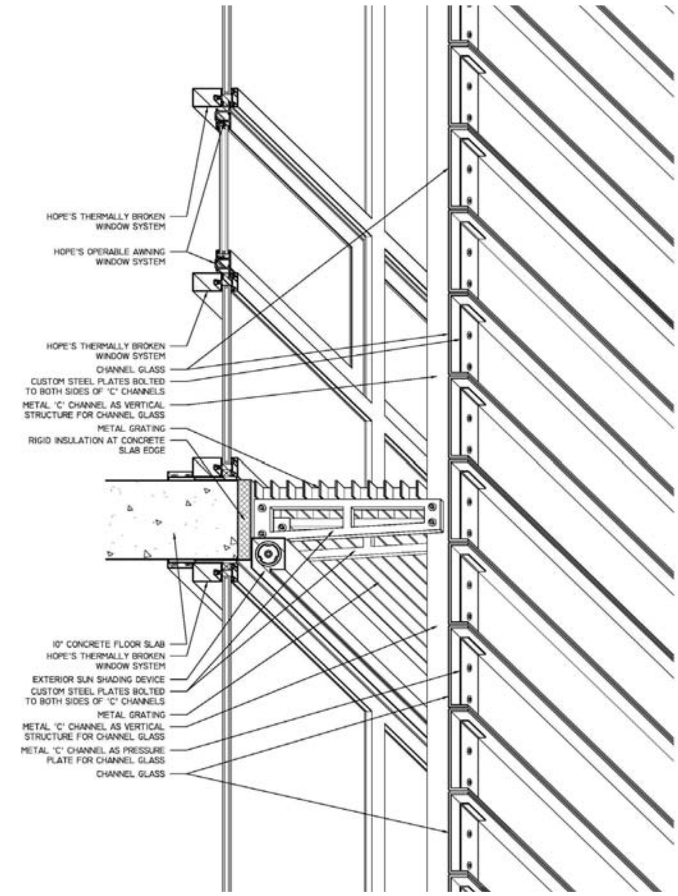
Arch 4/571: Project Two: Glass and Masonry

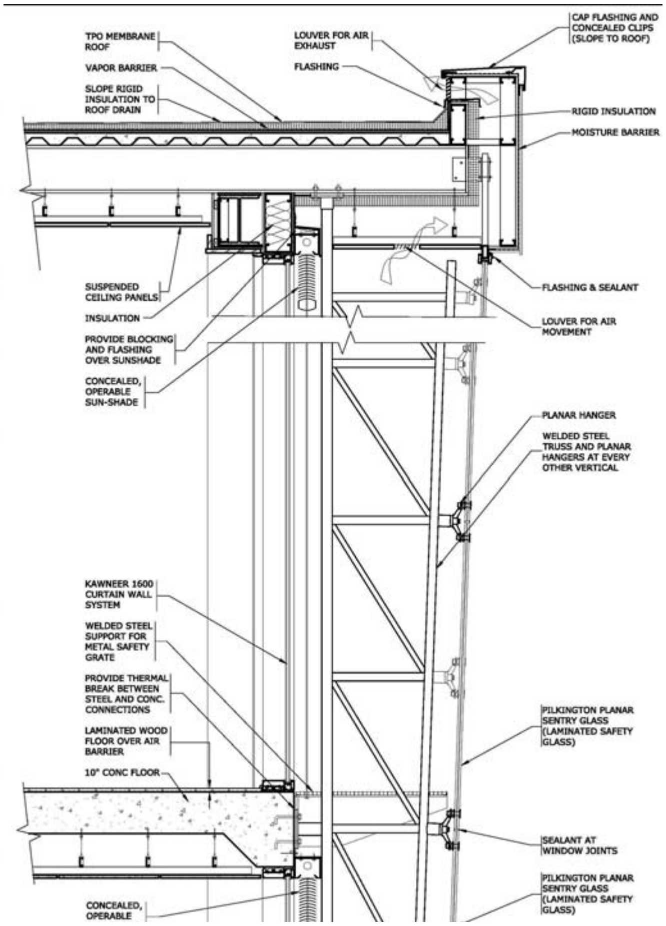


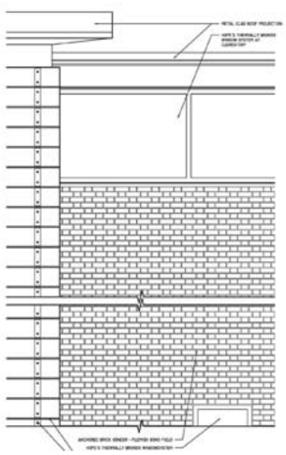


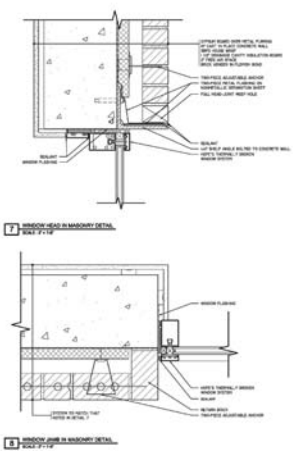


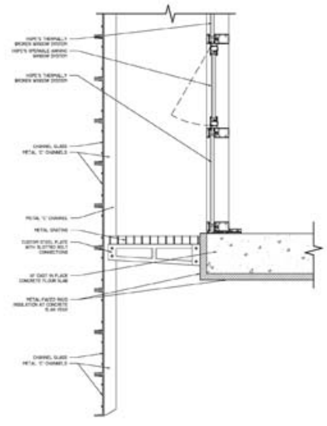
Arch 4/571: Project Two: Glass and Masonry

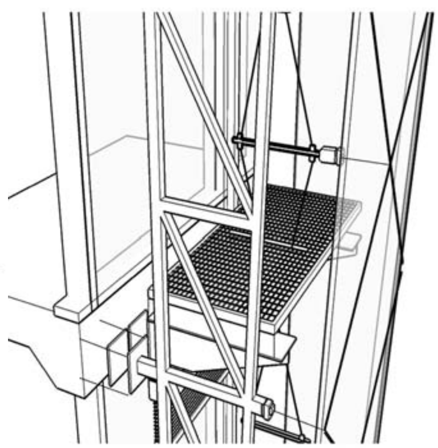


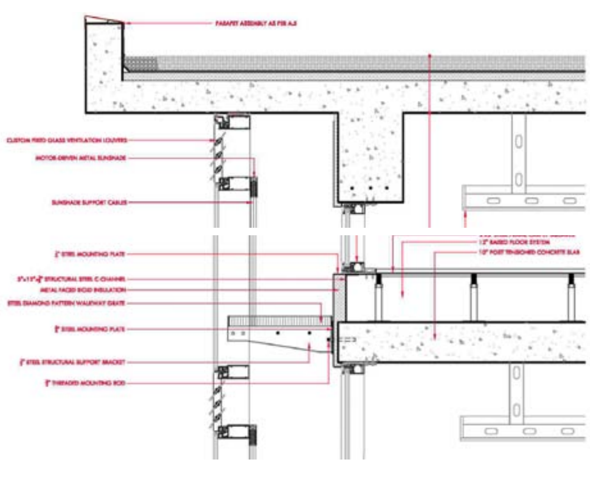


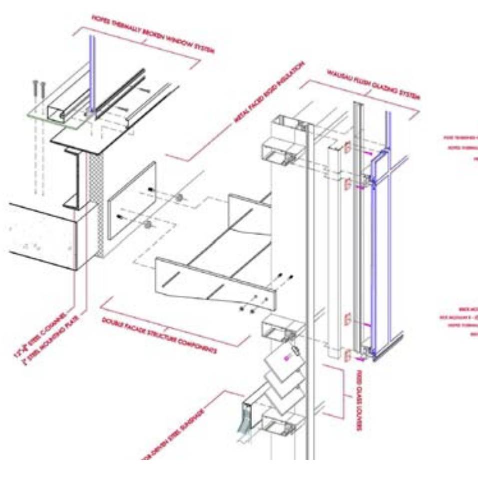


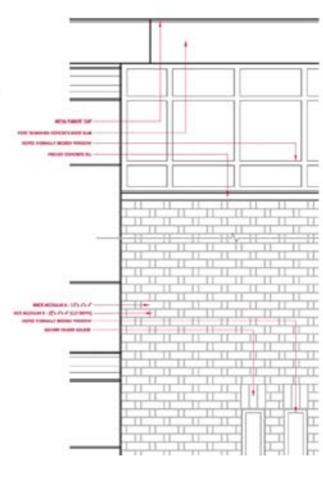












Architecture 4/561: Structural Behavior Professor Donald Corner
Architecture 4/562: Structural Design Associate Professor Stephen Duff

A Design Based Model of Structures Education

In order to make good buildings, as a designer you need to have control of construction, and to have control of construction, you need to have control of structure. The fundamental objective is to give you this control of structure and construction, first as student designers and then, more importantly, as professionals. Specifically, we must enable you to meaningfully use an understanding of structural systems and structural behavior early in the design process.

Specific Objectives
1.) Understand the relationship between structure, material, space, and building form.
Through study of the nature and inherent order materials and systems, you will learn what is possible and what is appropriate. You will seek buildings of character in which architectural form and structural behavior evolve together.

2.) Develop structural intuition and engineering judgment.
Structural intuition is a qualitative understanding of structural behavior, backed by sound quantitative theory and based on experience and experimentation. Exercise of developed intuition gives a designer the ability to make qualitative assessments of a problem prior to rigorous analysis or calculation and to find subtle solutions to complex problems through creative, conceptual leaps. For architects to raise structure to the level of other major design considerations and include it in the early, fast-thinking and fluid stages of design, structural intuition is indispensable.

3.) Understand global behavior of real, indeterminate structures.
Traditional structures courses are restricted to analytical investigations of determinate structures--simple structures or pieces of structures that can be analyzed using the three available equations of equilibrium. Real buildings, however, are always indeterminate structures, requiring advanced analysis techniques far outside the scope of architectural education. Moreover, the relationship between force distribution and stiffness is present only in indeterminate structures. Understanding global behavior is the crucial link between a qualitative understanding of structural systems and a quantitative understanding of structural details that makes engineering come alive and that gives an architect the ability to wield structure creatively.

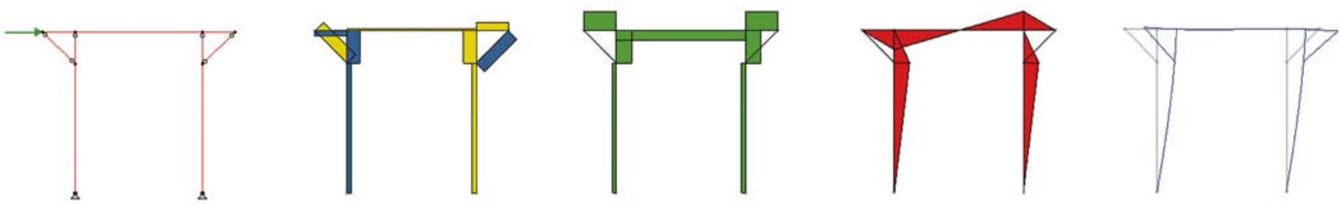
4.) Learn the mechanics of an integrated design process and implement it.
The tendency to solve formal and functional issues first, and then consider engineering is bad practice. An integrated process engages the simultaneous and continuous design of architecture and structure together. This means that at every level of architectural design there is a corresponding level of engineering design and that as design progresses, the two inform each other through repeated iterations. Students with a nascent understanding of structures can begin to integrate it into the design process only with explicit instruction and exercise of methods.

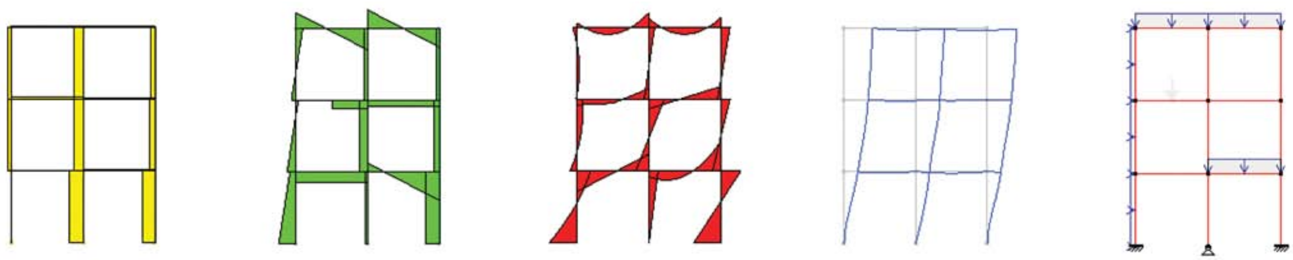
Streams of Material:
1.) Materials, structural systems, force distribution, spatial organization (case studies)
The nature of materials and the inherent order materials bring to architecture.
The palette of structural systems and their spatial implications: history and precedents.
2.) Global behavior (computer analysis, lab problems)
Kinematics: structure deformations and displacements
Force Distribution and Load Paths
Relative Stiffness
3.) Structural theory (readings, lectures, worked problems)
Properties Of Materials
Tools For Finding the Forces: statics and other hand methods; graphical methods; computer analysis
Elementary Mechanics
Design Theory, Environmental and Service Loads, Codes
Design in Wood and Steel
4.) Design Projects
Putting it all together, using building structure creatively early in the design process.

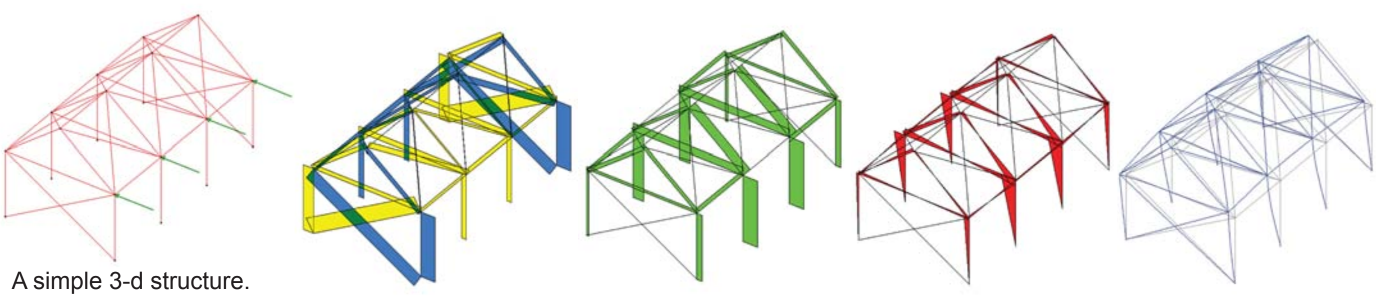
Architecture 4/561 & 4/562: Structures Labs

In the labs, physical models of tents and towers are tested to failure. Spatial models are developed to explore the character of materials and systems. Steel structures and wood roof systems are modeled, analyzed, developed and detailed. The laboratory program begins with a series of interactive computer workshops in which students are given parts of simple structural analysis models and asked to predict the other parts. Most work forward from configuration and loads to force diagrams, but some work in reverse. After recording their predictions, the students run the models, compare and discuss the results. These exercises build facility with the analysis software that will be needed in the later design projects.


Testing the tower with a lateral load

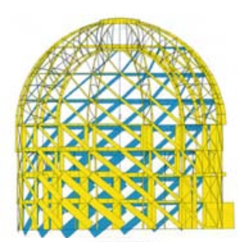
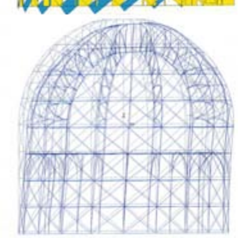

Working forward - predicting force diagrams from configuration and applied loading


Working backward - predicting configuration and applied loading from force diagrams.


A simple 3-d structure.

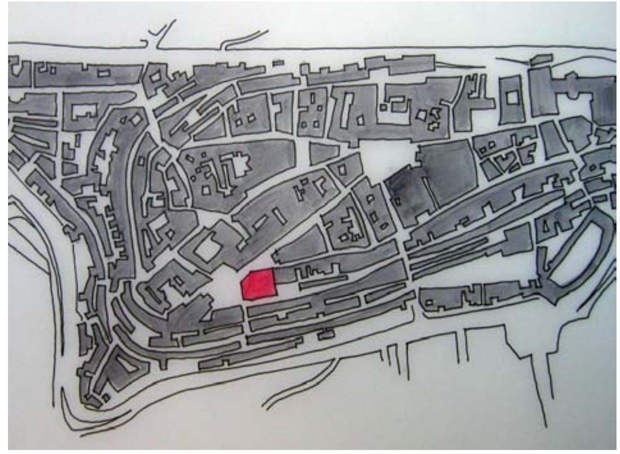


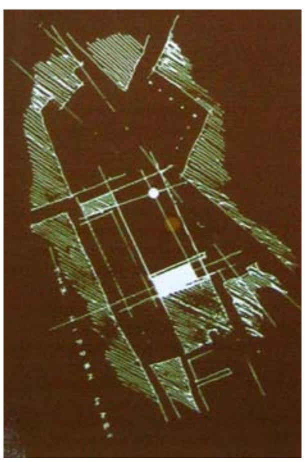


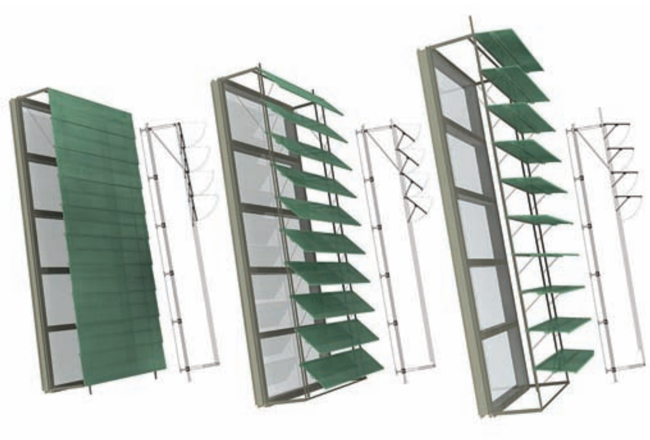



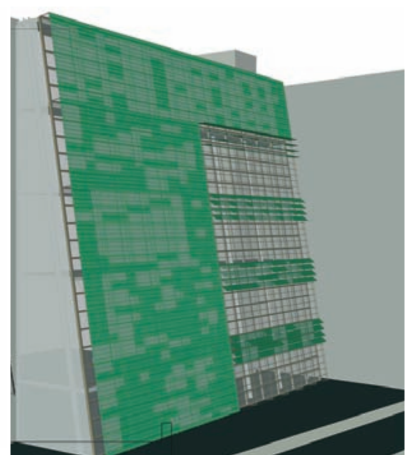
Architecture 4/584: Museo Ricci
Macerata Studio Program 2006-2008

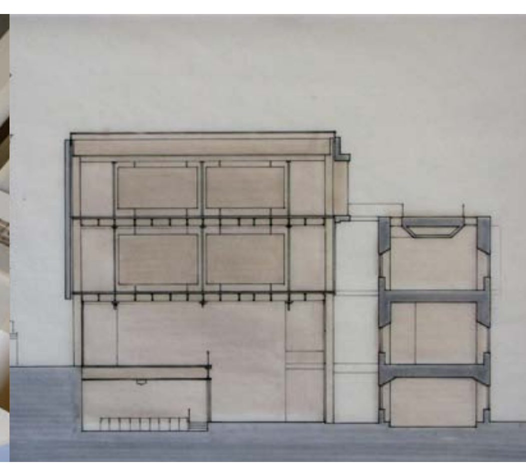
Macerata, a hilltown in the Marche Region of central Italy, has a distinguished collection of 20th century Italian art, awkwardly housed in the Palazzo Ricci. This project proposed a new home for the collection on a prominent site, fronting on a piazza adjacent to the UO study center. Students were asked to consider the evolution of the museum as a building type and explore a contemporary facility in an historic context. Excursions throughout Italy provided the opportunity to visit and study museums of various periods as formative inputs to the work.





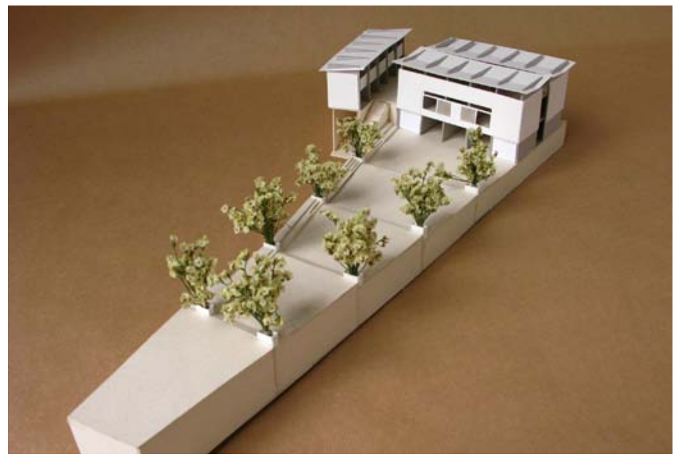


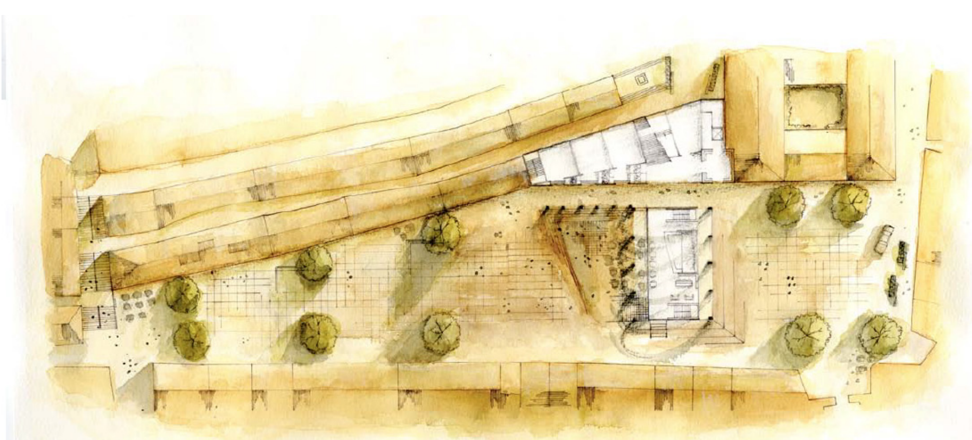




Architecture 4/584: Piazza Mazzini
Macerata Studio Program 2009

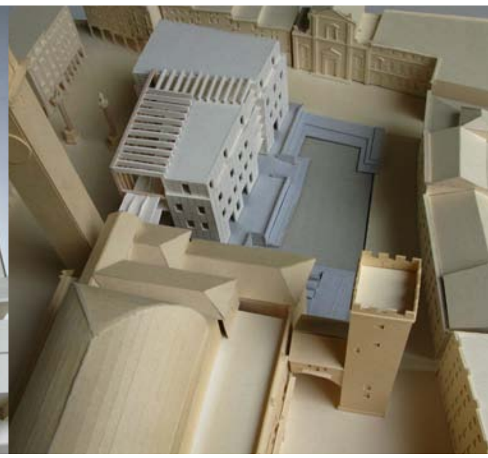
Piazza Mazzini, located just inside the lower city gate, was the historic market square of Macerata. This project proposed bringing the market stalls back from an inappropriate site across town. The piazza slopes considerably down its length, giving the new building an opportunity to form two public spaces, one on the lower level, related to the markets, and one associated with civic functions on the floors above. The companion seminar during this term in residence explored the design attributes of a successful piazza, examining typologically similar spaces throughout the region.

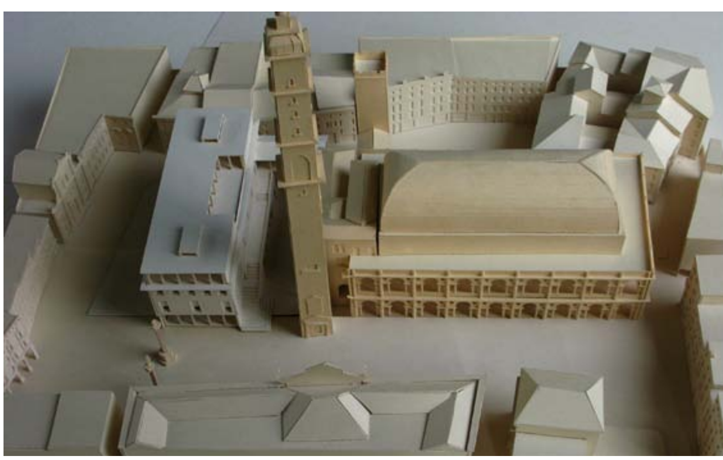


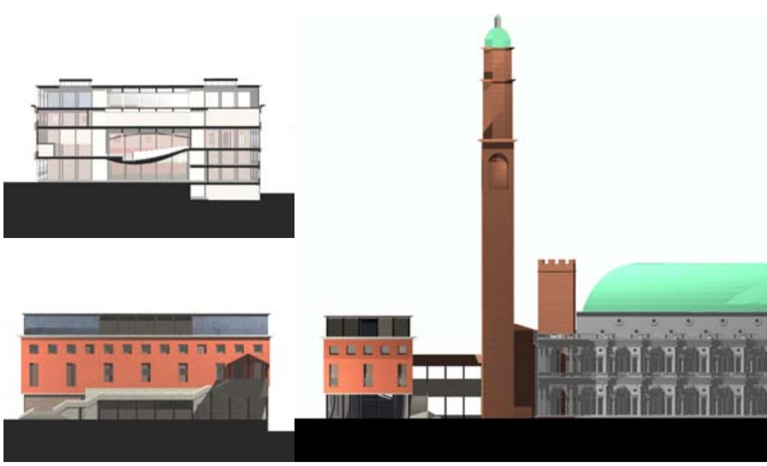


Architecture 4/584: Basilica Palladiana
Vicenza Studio Program 2010-2011

The civic life of Vicenza is found in a subtle network of public spaces wrapping around the landmark Basilica Palladiana. Abutting the historic complex is a city office building of 1946, constructed in a revival style. This project called for its removal and replacement with a contemporary structure housing meeting rooms, exhibit galleries and processional spaces that work cooperatively with the original gothic hall. The multi-level, multi-faceted site required that buildings and open space be formed together. This area has been the focus of numerous design competitions over the years.

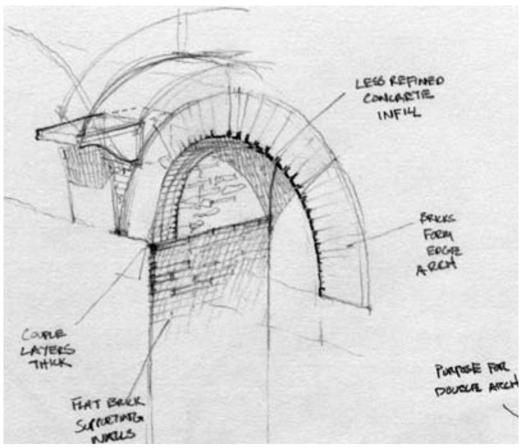


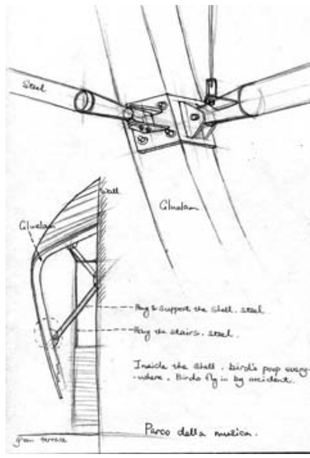


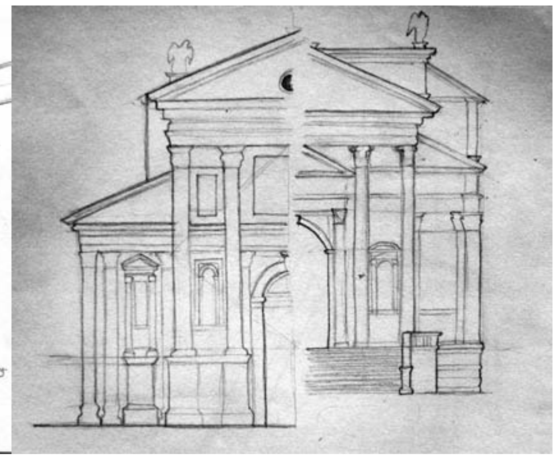


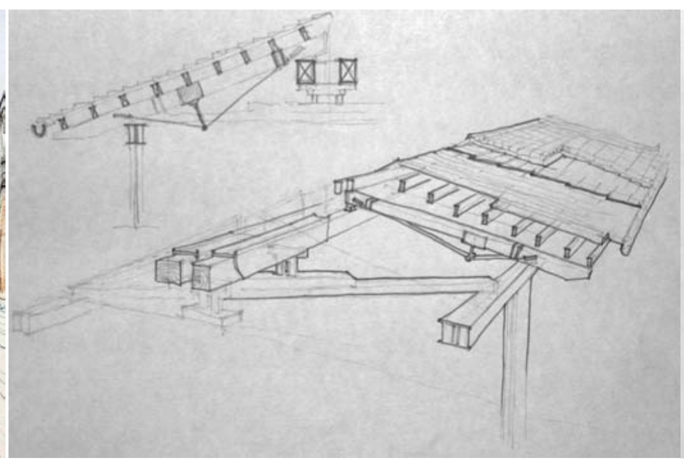
Architecture 4/507: Material and Detail: Time and Place
Vicenza Studio Program 2010-2011

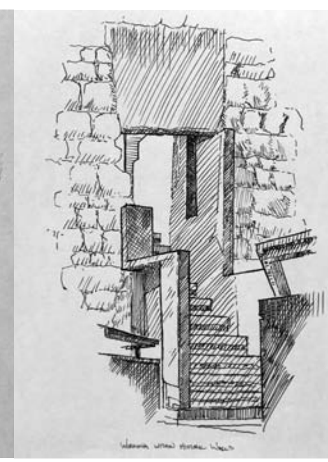
The spring quarter in Italy begins with weeks in Rome and Florence before taking up residence in Vicenza. Additional visits include Siena, Bologna, Verona, Venice, and five days in Ticino and Graubünden. This seminar explored building traditions from Aggripa to Zumthor using the classic medium of the travel sketchbook. Students were assigned specific analytical drawings for each day in the field. They examined building and façade organizations, the material components and details that characterized significant buildings and their contexts. This was repeated across the visits, spanning a great range of time and place.

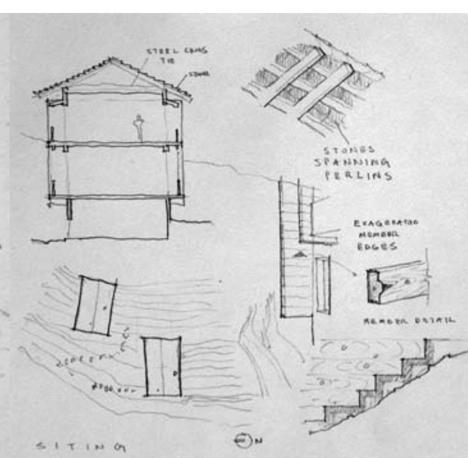


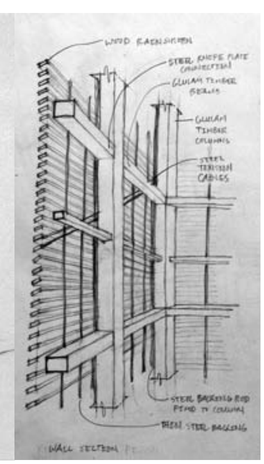












Zero Sum Gained: Moving Our Existing Building Stock Toward Net Energy Equilibrium

Interim summary of the teaching/research initiative supported by the Meyer Fund for Sustainable Environments.
Donald B. Corner, Principal Investigator

The Challenge:

With support form the Meyer fund for Sustainable Environments and participation by students of architecture at the University of Oregon, we have been exploring protocols for the deep energy retrofit of existing buildings. The motivation for this effort is summarized in two, often adopted maxims:

> The cheapest and cleanest source of power is the energy we never have to use.
> (Center for American Progress, 2009, p 43.)

> Considering all impacts, the greenest building available is the one you already own.
> (Anonymous)

The first of these speaks to energy efficiency as the primary response to the challenges of climate change and sustainability. During the course of our investigations, numerous studies have re-affirmed this priority.

> In the nation's pursuit of energy affordability, climate change mitigation, and energy security, energy efficiency stands out as the single most promising resource.
> (McKinsey, 2009, page 109.)

The second general claim is much harder to substantiate as each existing building offers a unique set of economic and environmental conditions. A compelling summary of the opportunity is offered in the document "Rebuilding America" from the Center for American Progress and Energy Future Coalition.

> Deep building retrofits can cut energy use by 20 to 40 percent with proven techniques and off-the-shelf technologies. Best of all, they can pay for themselves from the energy they save. "Rebuilding America," a national program to cut energy waste in buildings, could reduce energy bills economy-wide by hundreds of billion dollars annually. Energy efficiency retrofits also create good local construction jobs across the country at a time when well over a million construction workers sit idle in a sagging housing market. Demand for the manufactured products needed to retrofit buildings will also result in jobs by revitalizing the manufacturing sector and contributing to sustainable, long-term economic growth.
> (Center for American Progress, 2009, page 1.)

For our purposes we have adopted a more ambitious goal of zero net energy use in buildings, rather than the 20-40% reductions cited above. The environmental challenge we face demands this performance level from all new construction, so in our advocacy for building retrofit we must aspire to the same level. This goal may not always be attainable, but it brings into play a deeper set of strategies that must be explored and developed.

The Charge:

The systems and techniques through which we can effectively rehabilitate our building stocks are as complex as the buildings themselves and as diverse as their many owners. A very broad base of participation is needed in the search for effective solutions. A wealth of supporting information is needed to stimulate that participation. These points are confronted in both of the studies referenced above. In particular, the understood barriers to deep energy retrofit include:

- Poor availability of information for consumers about their energy consumption.
- Perceived cost of retrofits, and a lack of knowledge about available solutions.
- Disaggregated energy efficiency markets where many small decisions about purchasing, materials, operations and maintenance are required in order to realize savings.
  (Center for American Progress, 2009, p 2.)

To overcome these barriers, any successful approach must deliver quality information to a largely disaggregated set of actors. The charge that we adopted for our work derives from a 2008 report to congress by the National Institute of Building Sciences:

> Recommendation #7:
>
> Develop and establish a new set of self-diagnostic protocols for the prioritization and optimization of high-performance building attributes. There are no guidelines for assessing which high-performance features can be sought given their particular contexts, and for developing a proper hierarchy among the various attributes for optimization. The optimization of several attributes rather than the maximization or minimization of individual attributes is the hallmark of a high-performance building. With the aid of standard setting bodies, guidance should be developed that can be used during the earliest stages of project planning. Such a document would at least proffer a coherent means for acknowledging the attributes of a high-performance building, and encourage the implementation of context-appropriate attributes.
> (NIBS, 2008, page 23.)

Identifying multiple performance improvements, matching them to each other, and to the unique characteristics of the building, are fundamentally "grass roots" activities. Inputs come from architects, engineers, system representatives, tradesmen and material suppliers. To succeed we must embrace rather than regret the diversity of actors in our building culture. To paraphrase John F.C. Turner's seminal writing, argued originally in reference to housing (Turner, 1977):

> The economy of [building retrofit] is a matter of personal and local resourcefulness rather than centrally controlled, industrial productivity.

The task is to facilitate resourcefulness; matching a range of known and new techniques to the particular circumstances of the climate, site and structure. To advance this broad agenda we must do two things:

A. *Engage as many people as possible in the search for appropriate solutions.*
B. *Adopt an effective means to share the results.*

Retrofit Strategies As Patterns:

Addressing the second element of the "charge" first, we have approached the documentation of retrofit strategies in the form of "patterns," borrowing liberally from the structures developed by Christopher Alexander and his many colleagues (Alexander, et. al., 1977). Each of Alexander's patterns has the form: *context / conflict / resolution*. Within a specific physical or cultural context, there are conflicting environmental forces at work and the pattern proposes a means to resolve those conflicts to make a more effective and supportive place. This conceptual structure is particularly appropriate to building retrofit. First, the problem is <u>fundamentally</u> context driven. Each building use, configuration and construction type presents a specific set of problems and opportunities. Retrofit strategies must be explicitly tailored to the motivating conditions. Second, retrofit inevitably leads to conflicts. In new construction we are free to pursue myriad climate based design strategies in their pure forms: mass walls, cool towers, stack vents, etc. In retrofit, the ideal diagrams and the given conditions will not always match. Finally, the resolution proposed must always be understood to be an hypothesis. A good pattern contains within its argument case evidence to support the proposed solution. This case evidence must be subject to review by the larger building science community.

One of Alexander's original concepts for <u>A Pattern Language</u> was a loose leaf notebook that would invite individual designers to add, adjust, or replace critical patterns based on local project conditions and their own experience. As the manuscript surpassed 1500 pages, this important process attribute was dropped in favor of a bound volume, for practical reasons. The obvious, open invitation to revise or criticize was sacrificed. The contemporary alternative to the cumbersome ring binder is the wiki. We now have a practical means to engage a vast number of investigators in the testing and refinement of shared concepts. There is a great synergy between the logic of patterns and sharing through networks on the world wide web. The very concept of the wiki grew out of Ward Cunningham's web based "Portland Pattern Repository" in which Alexander's methodology was used to stimulate collective innovation in computer software (Cunningham, PUARL, 2009). There are now comparable examples in a wide range of fields (ibid.). We propose to use this same dynamic to address the first element of our charge. We propose to use the structure of patterns to seed broad participation in the search for effective means of building retrofit.

Strategy (Pattern) Prototypes:

Attached to the end of this document is a formatting template for the prototypical strategy, or pattern, document. However similar the two may be, the title "strategy" will be used here to distinguish these concepts from Alexander's "patterns." The essential components are:

Title:
Captures distinct and important aspects of the strategy in a brief, evocative title.

Context:
Describes the building use type, spatial configuration, plan, section, and construction conditions that give rise to the problem that this strategy will attempt to resolve. Initially the context should be described with enough specific detail to be certain that all of the conditions that contribute the problem have been identified. Over time, it may be discovered that a certain strategy has application across a number of building types and the context statement can therefore be framed more generally.

Problem:
A succinct statement of the problem, followed by an expanded outline of the parameters or design conditions that cause the problem to appear.

Strategy:
A clear lead sentence that makes a compact statement of what this strategy directs you to do in response to the problem.

An evocative diagram should be provided that graphically captures the essence of the strategy.

Performance Goals:
Describes the design parameters for a successful application of the strategy: what, where, how, how much, etc. Identifies the level of energy savings that can be expected and the depth of intervention into the building that will be required to achieve them. Cautions or qualifications should be included; factors that might limit the effectiveness of the strategy, or make it hard to implement.

Supporting Strategies:
The "smaller" or later strategies that will complement this strategy. For example, a strategy that admits daylight should be complemented by one that raises the reflectivity of interior surfaces.

Case Evidence:
Examples of the strategy in use, with a comprehensive inventory of the essential materials and systems that are need to make it work. Quantitative measures of performance should be included with links to sources that can expand on and/or verify the performance history.

The Question of a Language:

The process through which Alexander's "patterns" should be combined to form a coherent building "language" remains a hotly debated aspect of the method. There is, in general, a hierarchy, with ideas that shape the city coming before those that shape individual buildings. However, as the design becomes more developed, the closely associated patterns begin to interact. Adjustments must be made in one to make room for another. This is fundamental to integrative design. It takes time to discover which ideas must be given preference. Building retrofit presents this same difficulty to an extreme degree. Should we change the size and shape of openings in the wall, or simply upgrade the quality and performance of the windows? Each good strategy will save energy, but the cost effectiveness will change according to other strategies that may also be in play. There are rules of thumb that help to organize energy strategies. Generally, it is best to reduce the loads or losses in a building before adding renewable energy systems to the design. However, the interactions between strategies are many and a clear hierarchy in the applications is virtually impossible to construct.

To provide some guidance as to the proper role of a given strategy, each example has been “scored” in terms of a simple 9-square matrix that is described in the template and the appendix. The rows of cells, from bottom to top refer to the amount of energy that the strategy will conserve. The columns, from left to right characterize the depth of intervention into the building (and the co-related expenditure) that is required to realize the strategy. The lower left cell would thus represents a simple change that offers modest energy savings, starting, for example, with swapping out the electric light sources. The upper right cell represents a significant modification to part of the building to support on-site power generation, integrated with other complementary strategies.

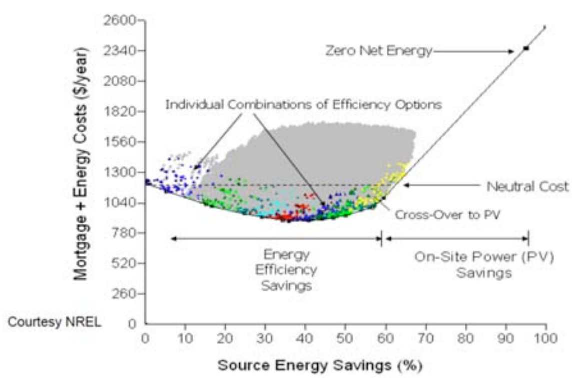
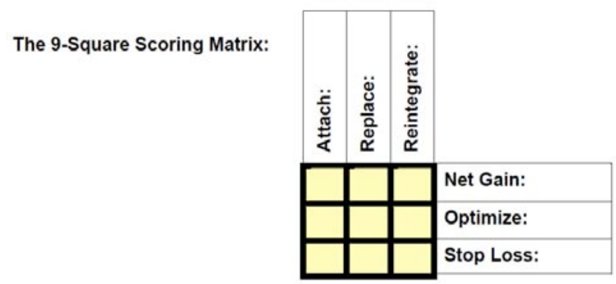


Illustration of NREL software output prepared by Mike Keesee, SMUD, 2009.

In practice, the interactions are sufficiently complex that energy modeling software must be used to test alternative paths to maximum savings. A particularly vivid example is provided by the Building Energy Optimization software developed at NREL (BEopt for residential, Opt-E-Plus for commercial) (Christensen, et. al., 2005). The programs test the combinations and permutations of energy strategies available and plots the total results on a graph of energy savings (%) versus expenditures for mortgage and utilities ($/year). “The optimum path [to zero net energy] is defined as the lower bound of results from all possible building designs.” (Ibid.) This produces a now iconic curve that has three distinct segments that correspond to the three rows of our simple scoring matrix.

First comes the application of simple efficiency measures, all of which contribute to a linear reduction in energy use and a reduction in mortgage/utility payments that is more than enough to pay for the measures. These measures are scored in the lowest, or “stop loss” row of the 9-square matrix. Next, the curve begins to flatten out as further efficiencies cost more to realize. After passing through a point of minimum annual payments, further reductions in energy use begin to cost more than the energy itself. In this central region of the curve the possible combinations of strategies are many and it is an effort to evaluate them. Strategies that appear in this zone are scored in the middle row of the matrix, which is labeled “optimize.” Finally the cost curve begins to climb steeply, passing through the point where the cost of further efficiency equals the cost of producing PV energy. All subsequent strategies in this sector involve on-site energy production in greater amounts until zero net energy is reached. These strategies are scored in the top row of the matrix as “net gain” measures. “Net gain” here implies that all of the envelope losses have been minimized and the strategies begin to chip away at the irreducible connected loads that result from building activities, leading to or perhaps beyond zero net energy.



The Call for Research:

The great power of the “pattern” format lies in the intellectual effort of deriving or compiling the “performance goals” for each strategy. Backing up the argument in each strategy is at the least a process of framing pragmatic research questions. For example, the strategy might suggest raising the heads of window openings so that the daylight can penetrate more deeply into existing office space. This immediately calls for quantitative guidance. How much will it cost to alter the openings in various classes of wall construction? Will the reduction of electric lighting loads pay for it? Would it be better to select a strategy that optimizes the existing openings through the use of reflectors and light shelves? A great deal of this information may already be available in the research and building communities, but in a disaggregated form that might not allow it to bear directly on the specific decisions a retrofit designer must face. How do we sift and sort this information into the right places? How do we inspire others to fill in the gaps, confirm the merits of a strategy, or promote a better alternative? Clearly we will have to turn many hands to the task. This is where the genius of Ward Cunningham’s web-based “pattern repository” comes into play.

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Architecture 4/507: Green Building Technology: Deep Energy Retrofit

This seminar investigated building retrofit opportunities in multi-family housing, suburban office buildings, schools and big-box commercial structures - all large components of our existing inventory. It was an early step in the teaching/research initiative supported with Meyer funds. The students articulated retrofit strategies as “patterns.” The first page of such a pattern is reproduced below.

Roof Vaults

Context: Deep buildings with low flat roofs

This strategy extends the arguments expressed in Top Light. It applies to building types such as schools and low-rise office complexes, in which high levels of visual acuity are required at work desks throughout the plan and for which the predominant solution is electric lighting. It is particularly applicable to buildings that have a hierarchical structural systems composed of girders, beams and roof decks of moderate span. School buildings with wood joists or tongue and groove decking over larger timber spans are a common example. Commercial buildings with corrugated steel deck over wide flange steel beams, or one-way concrete slabs and beams, are also excellent candidates. Buildings with single layer structural systems, such as closely spaced steel bar joists, are difficult candidates for this approach.

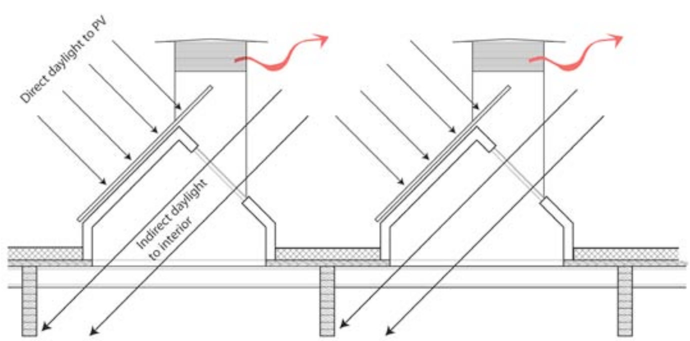
This strategy applies particularly to buildings with relatively short floor to roof (structure) heights. In taller spaces many of the same benefits can be achieved working within the existing building volume.

As expressed in Top Light, the potential contribution of this strategy to overall building energy performance diminishes as the number of stories increases. In such buildings it must be complemented by enhanced performance from the perimeter (High Light and Deep Light).

When evaluating the benefit of this strategy, one must first estimate the improvement that could come from the less intrusive strategies: increasing the reflectivity of interior spaces (Bouncing Light), optimizing the desk layout (Working with Light), and admitting daylight through simple roof punctures (Top Light).

Problem:

In order to reach the highest levels of energy performance (net zero), deep buildings with broad flat roofs must be reconfigured to optimize the use of daylight, natural ventilation and solar power generation.



Strategy:

Cut away portions of the roof deck to install three dimensional roof vaults that admit and distribute daylight, provide for stack ventilation and create a roofscape that supports collector arrays.

Performance Goals:

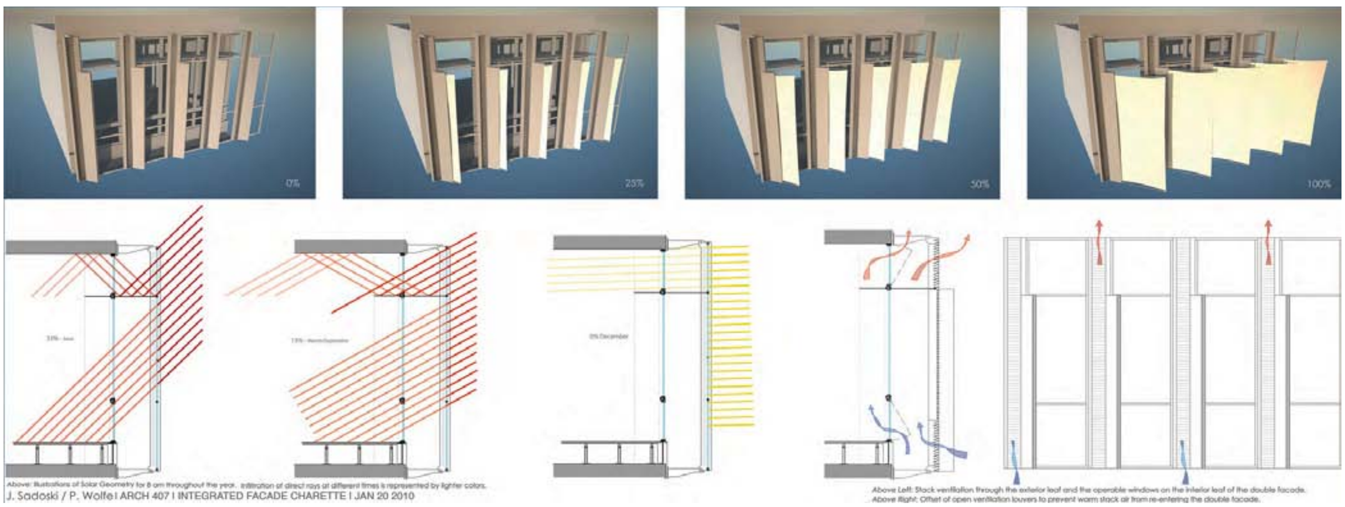
Discuss the optimization of the daylighting system: aperture no larger than necessary replace electric lighting, orientation to the part of the sky that is desired, good diffusion of the light in the space using the for of the roof vault.

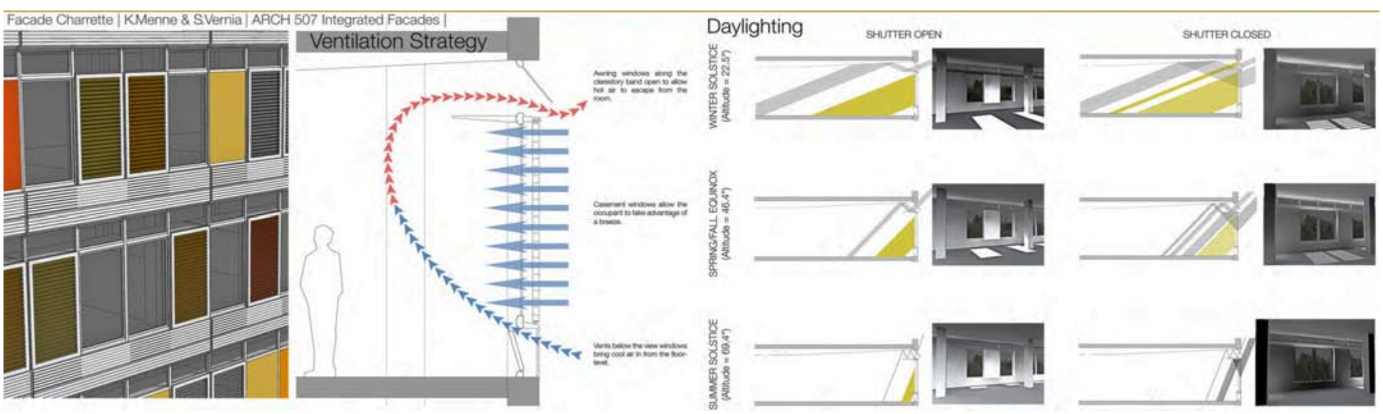
Describe how to integrate the stack ventilation with the spatial advantages of extra vertical height. Shape the stack exit to take advantage of assistance from prevailing winds.

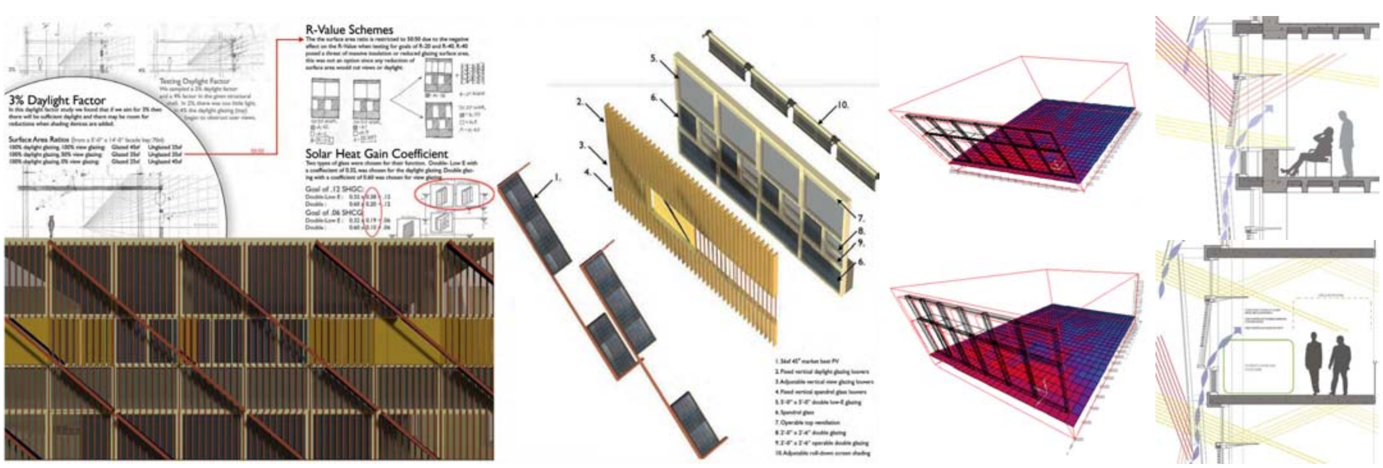
Provide optimal tilt angles for the PV array, and demonstrate how that relates to the overall form of the roof vault.

Architecture 4/507: Green Building Technology: Integrated Façade Design

This advanced seminar focused on the analysis and design of high performance facades, measured in terms of thermal transfer, daylighting, solar control, natural ventilation and building-integrated renewable energy. Team taught with Mark Perepelitza of ZGF Architects, the course included technical support by Glumac Engineering of Portland, Oregon.
The seminar, an associated studio, and a design charette with 64 participants comprised the inaugural events of the "Activated Facades Research Program," developed by Professor Corner and funded by Glumac.



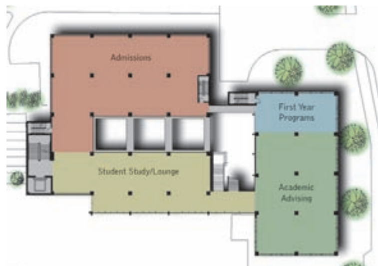




Architecture 4/584: Workplaces:
Daylighting and Deep Energy Retrofit

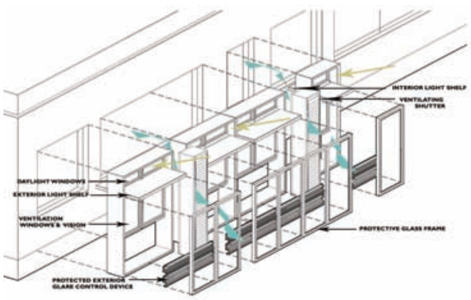
An intermediate studio examined the retrofit of Oregon Hall, a 1970’s era office building located at the east entry of the campus. Student life administrators advocate its conversion to an attractive reception and “one stop” services center. With a deep plan and fixed, tinted glazing, the building also presents retrofit challenges that are characteristic of a great many inefficient workplaces scattered across the American landscape. This exploratory project was coordinated with the “Activated Facades Research Program” funded by Glumac Engnineering.

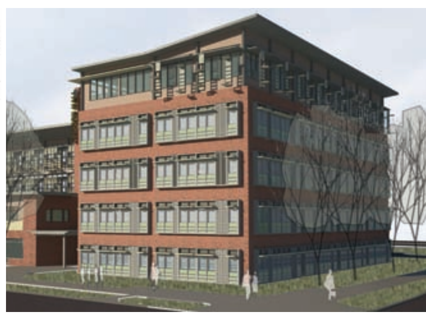
existing floor plan

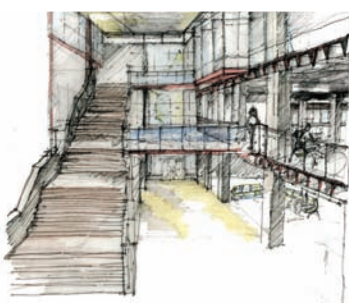


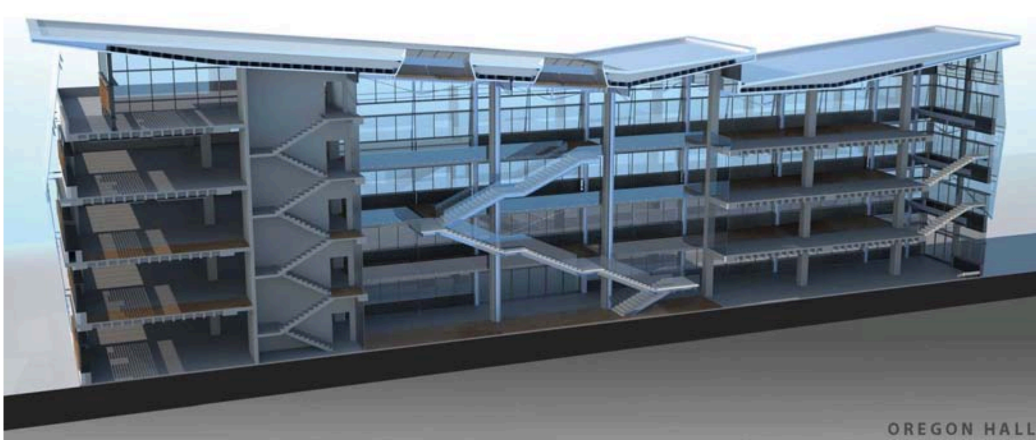
student proposal

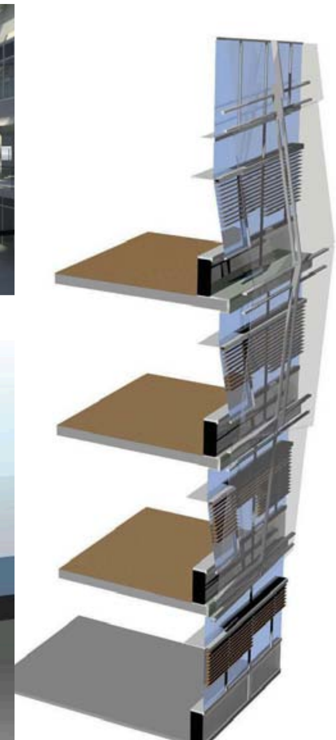
corresponding elevations





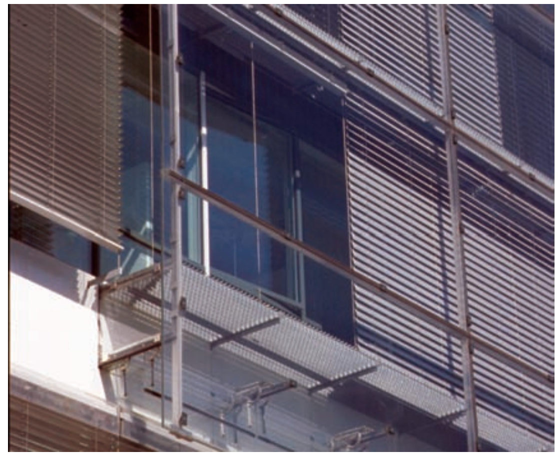






Active Envelopes: Double Skin Facades and Their Application to the Pacific Northwest.
John Yeon Fellowship, University of Oregon, 2005

Case studies of high performance building facades were conducted in the United States, Great Britain, Germany, Austria, Switzerland and Italy. Office interviews were held at Arup, Buro Happold, Behnisch and Partners, Transsolar, and the Renzo Piano Building Workshop, Genoa. The findings have been published in the inaugural issue of *The Journal of Building Enclosure Design*, and presented through invited lectures and recurring coursework.



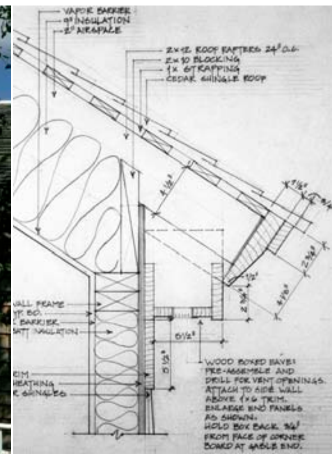






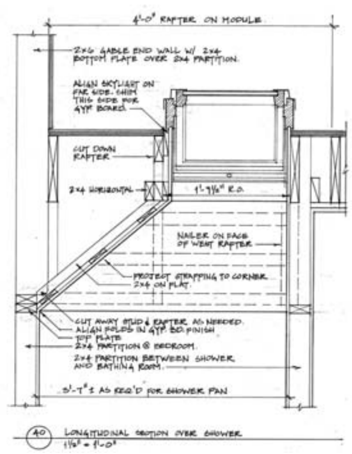

Professional Practice

Architectural projects, executed largely in the summer months, have been a valuable complement to teaching. Careful recording of the design and construction processes has provided case examples for the basic building construction, structures, and building envelope courses. Many of these projects are found within the historic villages of Martha's Vineyard, Massachusetts. The University housing project, located just off the Oregon campus, was a first cost and energy efficiency comparison of various prefabrication techniques: open wall panels, closed panels, SIPS and attic trusses. The project also tested the ability to reach a higher residential density within the structure of existing zoning.



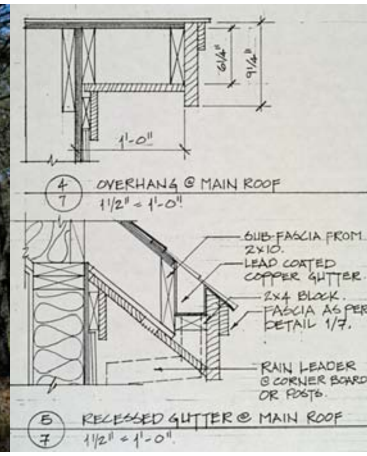
Captain Jethro Ripley House
featured in *Patterns of Home*

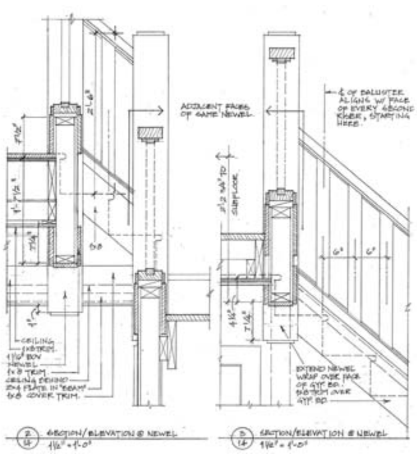
DeBraganca Residence



David McCullough - Home office/Studio


Meyer Residence






University Experimental Housing