MAKING MATERIALS MATTER IN LANDSCAPE ARCHITECTURE EDUCATION

YGLESIAS, CAREN
School of Landscape Architecture, Academy *of* Art University, San Francisco, California,
caren.yglesias@gmail.com

1 ABSTRACT

People live in a physical world surrounded by materials that are used to build what we need. Those that study landscape architecture attend accredited programs whose stated mission is to prepare them to enter a licensed design profession that addresses these needs. In this country, curricula are encouraged to have variations ensuring diversity and reflecting regional issues and institutional identities. Nevertheless, all students are required to take a class on "Site Design and Implementation: materials, methods, technologies, application" (LAAB, 2013, p.3.B), where competency means understanding the relationship between materials and methods of construction and design. This paper argues that a comprehensive approach to teaching building materials better serves design students. Rather than focusing on "how-to" guidelines or personal expositions, this approach incorporates the study of history and theory, and *technology and practice – all referring to issues of sustainability. Thus connected, the materials class supplies the vocabulary for thinking about design, perception, and experience. This paper also reviews the research methods used to develop this approach, which is the subject of my recent book,* The Innovative Use of Materials in Architecture and Landscape Architecture: History, Theory and Performance*, (2014). Its fundamental premise is that innovation in design comes less from engineering extraordinary chemical compounds or complex assemblies, and more from asking questions pertinent to current concerns and responding in ways sympathetic to a material's inherent character and capability. Using images of built details, this comprehensive approach helps students develop habits of observation, which lead to life-long learning in professional practice. Limited by a classroom delivery, a more robust student experience would also include activities in the field where the physicality of materials becomes increasingly apparent. In order to make materials matter in landscape architecture education, building materials must be linked to form as companions in design; not as an after-thought, but as a generator.*

1.1 Keywords

building materials, sustainable construct- ion, design education

2 INTRODUCTION

2.1 Materials and Design Education

Materials are physical and their distinct characteristics become known to people through their senses in perception. Seen and touched, sometimes heard, smelled and tasted, design education that leans toward framing the study of materials in terms of their abstract materiality risks forgetting about the physical properties of physical materials (Ingold, 2011, p.19-32). Landscape architecture programs often have fragmented approaches to the study of materials where students learn about them in design studios, construction technology classes, and history seminars that broadly consider the cultural conditions of various times. In many programs materials and methods of construction courses are taught by faculty with some experience in construction or by an adjunct with an active professional practice. The advantage is that their expertise provides students with practical information about building materials and methods used for durable construction, and sometimes with more advanced information on low-impact materials with capabilities of permeability, recyclability, and reflectivity, all important current issues for landscape architecture (www.asla.org/lowimpactmaterials.aspx).

However, landscape architecture is also an academic discipline where a deeper, more comprehensive understanding of any subject means learning its history and related design theories. In the case of building materials, the historic perspective investigates its evolving production and use, and the theoretical perspective explores links between design concepts and materials as they affect user perception and experience. In the United States, academic and professional organizations generally appreciate integrating history, theory, and practice in design education, although it is unclear how this appreciation is supported outside community

design studios. Research in Europe on landscape architecture education, such as the ECLAS Report, Version 26 (September, 2010), concludes that a comprehensive approach is required for students to understand *processes*, and not just acquire *facts*, in order to be well prepared for practice (www.eclas.org/accreditation-advice.php: 4.1). A subject such as building materials requires information about technical facts as well as facts about processes, and the productive inquiry questions "what," "how," *and* "why," which are all grounded in thinking about cultural associations and historical contexts (Murphy, 2005, p.34). In the study of materials, a comprehensive approach supports more informed judgements about the suitable fit of a material choice to its intended application. For students, one lasting benefit of this approach is that they may develop habits of inquiry that continue during the subsequent practice of landscape architecture.

2.2 The Pedagogical Situation

CELA annual conferences have a dedicated track for research on design education and pedagogy. Searching the Abstracts in this track from the past five years, not a single title included the word "material." Recent articles in *Landscape Journal* are also focused elsewhere, with the exception of "Form, Utility, and the Aesthetics of Thrift in Design Education" by Catherine Dee, where the "neglect of 'form' and material practice in teaching institutions" is noted and a case is made for teaching materials as craft (2010, p.21). Prehaps scholars consider this void filled in part by the publications on landscape materials and detailing by Niall Kirkwood (1999 and 2004) and more recently by Ryan, Allen and Rand's *Detailing for Landscape Architects* (2011). The study of the physical landscape has not been neglected with many books including Dee's work on aesthetic, spatial, and experiential concepts (2001), and on all issues of site sustainability by Meg Calkins (2009). Also, many books on building materials for architecture are helpful to landscape architecture students, such as Victoria Ballard Bell and Patrick Rand's *Materials for Design* (2006 and 2014), and on design education, such as Marco Frascari's *Eleven Exercises in the Art of Architectural Drawing* (2011). None of these books, however, address or propose approaches to teaching materials. This gap in landscape architecture education pedagogy may have the benefit of allowing great academic freedom for the subject instructor, but the comprehensive approach that is reviewed in this paper is intended to not only provide a more meaningful study of the subject for the student, but also to allow this understanding to have a greater impact in their work on other subjects and especially in the design studio.

3 A COMPREHENSIVE APPROACH

3.1 The History of the Use of Materials

For designers, there is great value in knowing past situations before proposing future applications. Lasting techniques can be appreciated and potential errors avoided. While most materials weather and age, they do not have histories *per se* because history is a cultural construct of the human past. Nevertheless, there is a history to the use of every material. Research into the ways a particular material has evolved over time may refer to narrative accounts, which are evidence of then current practices (Deming and Swaffield, 2011, p.165). The treatises of natural philosophers, such as Pliny the Elder's *Natural History*, written in the first century CE, and of material philosophers, such as Lucretius's *On the Nature of Things*, written in the previous century, are examples appropriate to Western societies. Pliny's work gives a thorough account of horticulture, agriculture, geology, and building materials and practices along with often vivid commentary on the ethical use of each material that reflected current social conditions. Lucretius' poem, based on the scientific theories of Epicurus, considered the impact materials have on the thinking and sensations of people. Architectural treatises by architects from that time are a surviving source of information on garden design, plants, water management, city planning, and the design of the public realm. The most important treatise is Vitruvius' *Ten Books on Architecture*, finished before 27 BCE, which is the oldest complete account on design from antiquity. Little survived between this book and Leon Battista Alberti's *On the Art of Building in Ten Books,* written around 1450, a seminal book of the Renaissance. The second chapter on materials is particularly helpful because it not only describes physical materials including timber, stone, brick, lime, sand, metals and glass, but also explains methods professionals should employ in design and appropriate building techniques for durable construction. Essential writers in English from the nineteenth-century include landscape architects John Claudius Loudon in England and Andrew Jackson Downing in America, whose copius work covered the theory and practice of gardening and landscape architecture with many illustrations of assemblies and details, and examples of built projects.

The intention of these treatise writers was to record current building practices. Their aim was not necessarily objectivity, but rather the

epistemological status of their particular subject, which provides an insightful review that is helpful today (Ricoeur, 1984, p.204). Beyond this, another reason for studying these treatises is to help students broaden and refine the terminology they use to think and talk about their work. Things have names, and those words have etymological roots and linguistic patterns that reveal their unique and transcendent characteristics (Kripke, 1991). Good dictionaries include quotations from literature tracing the popular use of common words and their changing definitions. A valuable book that documents the evolution of landscape terms is Therese O'Malley's *Keywords of American Landscape Design* (2010), although its content is limited to the seventeenth to mid-nineteenth centuries. Students are not automatically literate regarding landscape elements and their accurate definitions, and a more precise understanding of what the words they use *mean* will help them understand and construct the *meaning* of their design proposals and its supporting elements.

3.2 Theories of Materials

Other philosophers, especially in the field of phenomenology, offer ways to consider the cultural significance and related symbolism societies have associated with particular materials. Martin Heidegger's essay "Building Dwelling Thinking" in *Poetry Language Thought* (1971) and Maurice Merleau-Ponty's *The Phenomenology of Perception* (1962) contribute to this investigation, and Gaston Bachelard's writings are particularly accessible to design students. In addition to his *The Poetics of Space* (1964), Bachelard wrote twenty-two books, of which five were on poetic images – material and dynamic – inspired by the transformative materials of earth, fire, water, and air (Jones, 1991, p.11). These base materials were first described by Empedocles in the fifth century BCE, as the doctrine of the four elements. Then, and for many centuries, the philosophical study of these elements was a way to understand the composition of the physical world and to understand the causes of change. Through literary references, Bachelard used these elements as an entree into understanding sensory experience because they are both materials and processes in themselves, and serve as vehicles that change matter into materials. The relationship between fire and metal, for instance, can lead to thinking of various metals as more than a choice between lamp post colors, or to considering air and stone as contrasting material objects in green roof design. Theories of materials studied by these philosophers examine cultural context, which cannot be neglected in studios where students design for the intended experience of others. Fundamental questions of dwelling, especially needed in this Digital Age that is so full of abstraction and simulation, are particularly addressed in Bachelard's work.

Given that students are likely to focus on materials and methods of construction in a single class in a single semester, and yet they possess unlimited access to the full scope of human knowledge on their smart phones, a comprehensive approach that includes strategies to select and filter resources may develop lasting habits of research. Further, developing diagonistic strategies sharpens intuition, especially if students have the opportunity to evaluate built work (Deming and Swaffield, 2011, p.187-189). At a minimum, the study of every material should distinguish between its technical properties and its varying qualities for students to understand which aspects are basic and permanent, and which are open to change and innovation.

For example, methods of manufacturing brick have changed only slightly over centuries, gradually improving consistency, durability, and recycling potential. Nevertheless, any walk around a historic district will likely provide many examples of stable brick walls that are over a hundred years old and are likely to last another hundred years, and ten-year-old brick pavement that is cracked and needs replacing. Understanding the fundamental properties of brick, its technical production and conventional methods for durable construction, gives students the opportunity to question performative requirements and to discover opportunities for innovation. In the case of brick, this is not the bold but uninformed decision to use a stacking bond pattern that is prone to uneven settlement, especially in locations vulnerable to seismic activity, but perhaps of investigating the use of a microclimate created by the radiant heat from a south-facing brick wall, or the use of self-healing cement content in brick mortar that can flex with slight movement without failure. Beyond developing technical proficiency, a student might then wonder about *why* to use brick as opposed to another material. That theoritical question taps into the human dimension of a hand-placed brick and its cultural associations.

3.3 Sustainable Performance

Issues of sustainability – extraction methods, pre-consumer manufacturing, transportation distance, construction practices, use, and post-consumer recycling and repurposing – arise with each material differently (Calkins,

2009). Making design decisions about materials requires some information about each of these steps. Many students will not work in large offices where thorough research is done on every specified material and product, and even there, this work is sometimes not done thoroughly. Large or small, many firms rely on product representatives and suppliers who claim that certain sustainability standards have been met. The hasty professional depends on this information; the more thorough will know to ask for verification.

No class or book can remain current regarding the extensive research on sustainable materials and methods that is underway in this country and others. The U.S. government is continually publishing reports about materials used for construction, with information about supply sources and likely demand, alternatives, costs, building code compliance and performative quantitative data (see for instance, www.epa.gov). Students are familiar with seeking information online, but are often ill-equipped to search for pertinent resources regarding materials and data regarding consumption. Classes on materials can include resources such as online links to provide access to the most up-to-date information.

A comprehensive approach that studies the history of the production and use of building materials, theories that examine their significance, technological information and practical applications help students understand the opportunities and consequences of their design work. And the more they know about facts and processes, the more likely sustainable performance can be achieved. Talented students are anxious to "push the envelope" and a grateful society will appreciate this effort as long as it is not merely an exercise in egotistical vanity and a search for novelty, but rather questioning, and resolving, the true issues of design.

3.4 Limitations to This Approach

Teaching materials in a classroom has a predictable limitation. Even with well-prepared students, engaging lectures with informative images and lively discussions, the setting is interior and the topic is "out there." Many students have never worked on a construction site or even been to one, and many programs do not have wood, glass, or metal shops, design/build courses, or collections of sample materials further diminishing student opportunities to work with materials physically. In their daily lives, many students do not know what they are seeing when they notice cracked brick pavers, rust on concrete surfaces, or splintered wood benches. Even if they instinctively know that some material has failed, they lack the vocabulary to articulate and evaluate the design, construction, and maintenance issues, and to allow this observation to inform their design work. Teaching materials in a comprehensive manner acquaints students with technical vocabulary, inherent characteristics of materials, standard methods of construction, and issues of sustainability, and may give them experience designing and drawing details, but they remain removed from the physicality of actual materials. Field trips to projects under construction, to brick yards and stone quarries, to salvage yards for metal reclamation and re-purposing centers with stockpiles of heavy timber, stone block, and terra cotta ornament, and to building supply warehouses – especially those that supply "green" products – provides an extremely valuable added dimension to the study of materials. Seeing excavators in operation, concrete crushers turning demolished slabs into aggregate, or even discussing soil boring reports with structural engineers is beneficial and deepens the understanding of materials. If these field activities cannot be part of the course, then case study analysis assignments of local built projects that are either superior or disastrous examples of the use of materials can support the deeper learning experience for the student.

4 THE METHOD BEHIND A COMPREHENSIVE APPROACH

4.1 Writing about Materials

This comprehensive approach to teaching materials developed over many years. Classes varied in size and level with undergraduate and graduate students together studying architecture, landscape architecture, and urban design, and sometimes had an additional expectation of incorporating the preparation of construction documents. No single book was found that could be used as a class text. In an effort to fill this gap, my research in this field was recently published as *The Innovative Use of Materials in Architecture and Landscape Architecture: History, Theory and Performance*, (2014). Some familiar research methods were used in its preparation. A thorough literature review was conducted of relevant books on building materials that ranged from technical encyclopedias (Brady et al., 2002) and architectural guides (McMorrough, 2006) to books on material philosophy, treatises on design theory, and cultural studies. Clearly, there are favorite topics in books on building materials – concrete, wood, masonry, metals, and plastics – while other materials such as glass, ceramics, and vegetation are generally ignored because they are considered more

specialized. Some materials are so deeply connected with the fundamental tools of landscape architecture, such as shaping earth and managing water, that they are not thought of as distinct materials. Information from these books was organized in a spreadsheet and sorted by material.

4.2 Images of Materials

There are choices about what kind of images to use when teaching about materials. Typically, books on materials include photographs of significant built projects or profile professional firms who experiment with materials. These types of books may familiarize students with projects and firms, but do not necessarily provide information about materials and their strategic use. A student can imitate without understanding what they see. Images of built project details, on the other hand, show the formed material surface and often joinery methods, giving students illustrations of practical applications while avoiding distracting judgments about the overall design. In the mid-nineteenth century, the term "details" was "usually applied to the drawings on a larger scale for the use of builders, and generally called *working drawings*" (Gwilt, 1982, p.1187). For a drawing to "work," the image had to be of a sufficient scale with dimensions, material representation, and technical information for the design to be constructed. For the student, looking at built details allows examination of particular materials free from programmatic issues. The student can consider the material first, and then the application in context. Looking at photographs of built details also helps students develop habits of critical observation by looking at images that are free of rendered illusion and not distorted by distance. John Locke's evaluation of the camera obscura described one benefit of looking in this manner because it "allows the subject to guarantee and police the correspondence between exterior world and interior representation and to exclude anything disorderly or unruly" (Crary, 1998, p.42-43).

As part of this book project research, librarians at ASLA headquarters made available winning national award competition submissions kept on file. Each entry contains written descriptions and up to fifteen photographs as part of the submission package. Many of these projects have photographes and site plan drawings published when *Landscape Architecture Magazine* does a feature piece, but frequently the photographs of details are not included. For this book research, a second spreadsheet was prepared organizing hundreds of projects and thousands of photographs of all awarded projects since 2005. The spreadsheet recorded the designer, project name and location, and completion date, and was sorted by material with added comments. The intent was to focus primarily on American landscape architects and built projects in the United States, because students are more likely to visit these places, and some day to work for these firms.

Additional images were added to the file following personal interviews at many small, mid- size, and large landscape architecture firms who generously opened their project files and shared their work. Sometimes innovative uses of materials were found on projects not submitted for an award, or on a small job that was the initial place of experimentation. Other firms were approached at professional conferences and academic symposia, and many later contributed photographs of their work for consideration. Also, professionals suggested interesting investigations being conducted by others. Using photographs of built work substantiates an insistence that materials are physical, and that when they are well-used, are evidence that the construction is durable.

5 A SAMPLE INVESTIGATION

5.1 Wood

If wood as a building material is studied following this comprehensive approach, then the subject begins with thinking about the general properties of trees. Trees are about half earth (carbon) and half air (oxygen and hydrogen), which accounts for their solid and liquid materiality, and makes some wood species better suited for certain purposes than others (Brady et al., 2002, p.1042). Of the estimated 10,000 species worldwide, about 50 hardwoods and 30 softwoods are commercially viable in the United States. Because a materials and methods of construction class is not a tree identification course, students do not need to be familiar with 80 species, only the ones that are well-adapted to the local climate and weather, and to know which produce extractives making them naturally resistant to pests, rot, and decay for more sustainable construction. They also need to know which joining techniques, treatments, and finishes suit the situation and anticipated maintenance procedures.

Using wood as a material must consider the "vital actions" of a tree that are part of the living activities of growth and sap production. Knowing the inherent characteristics of various species assists in the proper selection of wood types for the intended application. For example, there are four tree species that are sustainable choices in the temperate mid-Atlantic region: Bald cypress

(*Taxodium distichum*), Black locust (*Robinia pseudoacacia*), Eastern red cedar (*Juniperus virginiana*), and Eastern white oak (*Quercus alba*). They all have decay- and rot-resistance capabilities, but cannot be used interchangeably. Frank Lloyd Wright called cypress the "eternal wood" and used Louisiana "tidewater" cypress for cladding many house exteriors which have survived for decades, but the wood may be difficult to procure. Cedars are fast growing trees making their weaker lumber limited to short spans, which is ideal for furniture, but not wide, plant-bearing arbors or pergolas. Black locust is very durable and available in three grades, but is slightly poisonous if ingested, and must be carefully used in public places. White oak is less common than red oak and more expensive, but longer-lasting.

Students also need to know something of the structural properties of wood. Different species have different proportions of lignin that gives wood compressive strength, and cellulose structure that gives tensile strength. Few materials have as many practical applications as wood, which can be used vertically as posts, horizontally as beams, and as a surface with boards or planks. The spanning capability of wood has limits and requires structural calculations. Wood constructions deflect with weight, wind, and other forces, and this barely perceptible "give" makes it a good choice for a more comfortable walking experience when compared to concrete, for instance.

As a natural resource, wood is generally considered to be renewable, but there are many reservations about sustainably harvesting old-growth and second-growth forests and the consequent ecological disruption to forest habitats. The quality of wood from single species tree plantations is diminished because there is less competition for light and nutrients, which changes the structural strength of wood. Guidelines for sustainable design encourage repurposing timber from demolished structures, but that practice must take into account the transportation distance and erection difficulties of long elements. Also, recovering "sinker" logs can adversely affect wetlands because of the heavy equipment required to retrieve them (Calkins, 2009, p.294-299).

Thus introduced, students can now consider the evolving use of wood as a building material. Wood has been used by many cultures because it was readily available and could be worked with few tools by relatively unskilled labor. Traditionally, the lessons of wood-working depended on time-tested traditions. Architects (who were the general designers then) were responsible for knowing when to harvest trees, how long to allow cut lumber to air-dry and in what conditions, how to test for structural integrity, and what wood species were best for specific purposes. For example, Vitruvius wrote about nine tree species noting, for instance, that straight fir was used for framing, dense oak for underground construction, alder for underwater pilings, and larch for paneling near fireplaces (II.IX.1). Pliny the Elder summarized a general appreciation saying that "trees and forests were thought of as her [the Earth's] ultimate gift to mankind" (XII.1).

When considering a theory of wood as a material, different societies developed cultural associations related to the properties of wood, methods of joining, and the degree of finishing. For example, rustic structures made of minimally treated wood and retains its bark are still used in National Parks, and even some areas in New York's Central Park (Eastern red cedar and Black locust are used in the Ramble and North Woods for benches, bridges, and railings; in the Shakespeare Garden for fencing and benches; and in Strawberry Fields for the entrance pergolas) because using wood in a more rustic state conveys a heightened sense of being close to nature (Miller, 2003, p.167 and www.centralparknyc.org). Highly crafted and finished wood surfaces, on the other hand, suggest refinement. At either extreme, design details showing how to connect wood elements need to minimize exposing cut ends to the weather and to slightly slope horizontal surfaces where exposed to rain; and that finishing products are needed to protect wood from damaging ultraviolet light (Fiest, 1983: 185-186).

5.2 Santa Fe Railyard Park and Plaza Utility Poles

One example of an innovative use of wood in landscape architecture is Ken Smith's design for utility poles at the Santa Fe Railyard Park and Plaza. The site's desert ecology called for the minimal visual presence of technology and mechanical equipment, but park programming required artificial light for public use after dark. The question was how to conceal the power line and conduit to utility pole light fixtures. The innovative use of the material came from understanding that wood scraps are processed and assembled into glued-laminated structural elements – typically beams – and that the beam could be turned vertically and used as a post. Then the conduit could run inside a cavity or raceway void in the assembly. This response was only possible because the designer understood the technical capability of reconstituted wood waste, and appreciated the role this seemly insignificant detail

would have on the entire aesthetic perception of the park experience. Even unseen requirements of utility pole construction – they extend seven feet into the ground – supports associations to the way trees are rooted and are reminiscent of the way people can become grounded to place, especially in this design whose intent was to also restore degraded ecological processes (Smith, 2010). Knowing this, a different material could have been used for the poles, such as hollow metal tubes, but there would be a noticable difference. This innovative use linked technical capability to tangible and intangible associations of wood as a material, with a more satisfying result.

6 CONCLUSION

A comprehensive approach to teaching building materials that includes the history of its use and theories based on inherent characteristics, along with technical facts and practical applications, better prepares students to understand the relationship between design and materials. Seeing images of how materials have been used effectively, strategically, and creatively is also important because their design work can take inspiration and develop from thinking about materials that are well-suited to particular applications. This approach cultivates their instincts for what is naturally appropriate versus what is artificially forced, and is therefore less likely to last. Professionals contend with clients, costs, and schedules, which are subjects most academic programs cannot cover extensively, but there is a great disadvantage to marginalizing the study of building materials and their sustainable applications. All landscape architecture must withstand the forces of nature and the rigors of public use, especially in urban settings, and the material elements that become the visual and tactile vocabulary of design not only make places, but also engage the user's imagination – consciously or not. Making materials matter in landscape architecture education is important because materials are inescapably linked to form as companions in design.

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