Laying Bare: The Potential of Materials Collections

Robert M. Arens, AIA
California Polytechnic State University at San Luis Obispo

Introduction

A contemporary world defined by diminished resources, the need for greater efficiencies, and advances in technology has brought about a reconsideration of the processes and materials used to create buildings. For educators of architects and related disciplines, these issues may be translated into two pedagogical themes: sustainability and integrated practice, both of which must be engaged if students are to be viable professionals in a changing world. Acknowledging that curricular reform in academia can take years, a small team of colleagues at Cal Poly asked the following questions: Are there modestly-scaled but immediate changes that educators can make to the culture of the architecture school so as to encourage an ethic of sustainability? How can the physical environment of architecture schools be adjusted to inculcate a spirit of integrated practice and collaboration between disciplines? What other types of active learning spaces, besides the studio environment, may inspire the engagement of materials to a higher degree and generate research into materiality?

In response to these questions, a team of educators and librarians created a materials collection to primarily serve faculty and students in the College of Architecture and Environmental Design, which is comprised of the departments of architecture, landscape architecture, architectural engineering, construction management and city/regional planning. By encouraging a heightened sense of materiality in an environment shared by students of different but related disciplines, the team sought to achieve the following objectives:
1. Promote an increased awareness of materials, especially in relation to sustainability.

2. Provide a setting for collaboration between students of architecture and related disciplines where a spirit of integrated practice can develop.

3. Enable developing designers, engineers and managers to follow emerging trends in materials and building products.

Although materials collections are not a new idea, the team sought to refine the concept to meet the needs of educators and students in a changing world. Challenges the team faced were locating the new collection, selecting and obtaining materials, organizing and cataloging the samples, and creating the digital database.

**A Brief History of Materials Collections**

Material collections have existed within the design and construction communities for years, with many architectural offices retaining material samples intended for use on particular projects. Over time the resulting store of tested products (and relationships with product representatives) would become the basis for many future projects. This model worked well in mid-to-large offices with practices that focused on a single sector of the construction industry; these firms had the space and personnel to devote to maintaining this important resource. By the 1990s, however, in-house materials collections were waning. The range of construction materials had burgeoned in the latter decades of the 20th century, and many new materials were developed and distributed by small companies without the ability to supply endless samples. In addition, while many architectural offices were launched about this time, they tended to be small practices based on a wide range of building types and with an intent to take each new project in a different direction. Although these small firms, with their attitude towards material innovation, were the ones who could benefit most greatly from a materials collection, they simply didn’t have the space or staff to maintain one.

As a response to the needs of innovative designers with limited resources, several private materials collections were created, with the purpose of researching, collecting and supplying information on materials. Two examples are Material ConneXion (with offices in New York, Bangkok, Daegu and Milan; begun in 1997) and Materia (with offices in the Netherlands; begun in 2000). Both offer digital information on their websites, physical libraries at their offices (Material ConneXion has 4500 samples, Materia has 1500), and will send samples upon request. Of course, these services are space and labor intensive so their use is limited to members, often requiring an expensive subscription.\(^1\)

As valuable as they are, the services offered by Material ConneXion (figure 3) and Materia are out of geographic and financial reach of most students. In recent years, an increasing number of educational institutions have recognized the benefit of materials collections, and have taken on the task of providing materials samples for student use. The manner in which they are created, organized and managed follows no set pattern, although the impetus for their creation generally originates within architecture schools or design departments. It is certainly not a given that these collections be connected with the academic library, although in many cases information professionals and/or visual resources curators are involved in collection management and decision-making. For example, the University of Texas at Austin’s Materials Lab (figure 4) is located within the School of Architecture and is independent of the university library system.\(^10\) At Harvard University, the collection is located administratively within the Graduate School of Design’s Frances Loeb Library, but is physically located within the school’s woodshop, CNC, and laser cutting facilities.\(^2\)
The efforts at UT Austin and Harvard, as well as California College for the Arts are exceptional in that they have managed to create relatively high-profile materials collections with visual web interfaces that engage the community and enhance access. Collections within other universities tend to be of a lower profile although many are attempting to change that. Material collections have been created at Arizona State University, Clemson University, North Carolina State University, Parsons New School, University of Manitoba, University of Oregon, the University of Texas at Arlington, and University of Washington.

The efforts by these programs are motivated by the realization that the early stages of a professional education are, by necessity, removed from the real world. Until students of architecture, engineering, law, medicine, etc. reach their internships or practicums, they prepare for their future in speculative settings such as lecture halls and classrooms. Architecture programs attempt to compensate for this by providing a studio format for a portion of students’ coursework. Although the studio environment begins to simulate real-life office situations, students often have little contact with other building disciplines and they struggle to integrate material and constructional considerations into their work.

The team at Cal Poly conceived the materials collection as a supplement to the studio environment, as a way to stimulate interdisciplinary interaction and as a means to build student awareness of the complex world of materials. Embedded in these objectives are four themes which inspired our efforts: materials and the senses, materials and the environment, materials as a form of research, and materials as an impetus to collaboration.

**Materials and the Senses**

The creation of the materials collection was inspired by, among other things, the argument for an architecture of the senses articu-
lated by Juhani Pallasmaa. In several related essays, Pallasmaa argues that the task of architecture is to create embodied and lived existential metaphors that structure our being in the world.\textsuperscript{4} If architecture is to achieve this end, architects must resist the visually dominant tendencies of contemporary culture and pursue what Pallasmaa refers to as “haptic architecture,” that is, an architecture created for all five senses. “Our culture of control and speed has favored an architecture of the eye, with its instantaneous imagery and distant impact,” Pallasmaa writes. “As buildings lose their plasticity and their connection with the language and wisdom of the body, they become isolated in the cool and distant realm of vision.”\textsuperscript{5} In contrast, he argues that “every significant experience of architecture is multi-sensory...Haptic architecture promotes slowness and intimacy, appreciated and comprehended gradually as images of the body and the skin. The architecture of the eye detaches and controls, whereas haptic architecture engages and unites.”\textsuperscript{6}

**Materials and the Environment**

While it is imperative that designers be aware of the sensate qualities of materials, they must also be cognizant of their social and environmental impacts. This is no easy task, since a contemporary building is not only comprised of traditional materials (stone, brick, timber, etc.) which are well understood from years of use, but also of materials born of modern processes (glass, aluminum, engineered lumber, etc.) which became routinely used in the second half of the twentieth century, and newer nontraditional materials (neoprene and silicone, glass and fiber reinforced composites, polymer concretes, etc.) which have only emerged in the last twenty or so years.

In *Material Architecture*, John Fernandez underscores the heightened relationship between materials and the environment. He writes, “Today, improving the environment requires a reconsideration of the contribution of materials in the process. One such issue is the relationship between the production and consumption of materials and the service lifetime of buildings. Yet, buildings constitute an enormous store of materials used in construction – primarily due to their long lives. Understanding and designing within an organized ecology of the built environment, and not just for a single project’s needs, requires more information about the material flows for construction.”\textsuperscript{7} Not only is the scope of this task (that is, understanding materials in holistic terms), extremely daunting, it is also a task that is constantly changing as materials both enter the market or become obsolete. It is clear to us that the focus cannot be on specific materials, but rather must be on a methodology that can be used by students throughout their careers to research and evaluate materials.

**Materials as a Form of Research**

The creation of the materials collection was also inspired by architects and engineers who view research into new materials as an opportunity rather than a burden; these designers are not only comfortable with advances in technology and materials, but also see this research as an integral component of the design process. For example, Jacques Herzog and Pierre de Meuron focus much of their creative energy on the use of innovative materials. Herzog has written, “We look for materials that are as intelligent, as virtuoso, as complex as natural phenomena, materials that not only tickle the retina of the astonished art critic, but that are really efficient and appeal to all of our senses.”\textsuperscript{8} On this last point, Herzog echoes Pallasmaa’s argument for a haptic architecture.

The interest in materiality by these architects and others is in part propelled by two trends: the appropriation of materials developed for other fields by architecture, and a growing concern for resource management and material ecology. To engage these trends, designers must work with a steady hand and
a willingness to research the intersection of new materials and their effective, sustainable incorporation into built works. Herzog writes: “This is a strategy that gives us the freedom to reinvent architecture with each new project rather than consolidating our style. It also means we are constantly intensifying our research into materials and surfaces sometimes alone and sometimes in collaboration with various manufacturers, laboratories, with artists and even with biologists.”

Herzog’s words underscore the fact that unless architects are willing to devote all of their time to the research and development of materials, they’ll have to engage other disciplines. This active collaboration, of course, is also at the heart of integrated practice.

**Materials as an Impetus to Collaboration**

The idea that the materials collection could foster interdisciplinary interaction was inspired by architects like Herzog and de Meuron, who are shaping the process by which buildings are conceived and constructed. They are among a group of progressive practices such as KieranTimberlake, Gehry and Associates, SANAA, SHoP, Morphosis and others who are integrating new modes of design and production while engaging materials in unprecedented ways. Not only do buildings by these architects look different, they are different. The new modes used to produce them employ a more synthetic work and information flow between interdisciplinary team members. Although relationships between architects, engineers, contractors, fabricators and material scientists have always been implicit in the architectural process, these relationships are becoming much more direct, with less division of labor between disciplines. Stephen Kieran and James Timberlake write, “Rather than the imposition of architectural vision on contemporary modes of construction, the process must be a broadly based fusion of all possibilities and capacities across the entire spectrum of those who make architecture. We need a new vision of process, not just product. Along with architects, the vision must include those who own and use architecture, those who assemble buildings, and those who develop materials and engineer the new products that become our architecture.”

This evolution of the relationship between the participants of the design and construction process is most commonly known as integrated practice. It represents a new work flow and project delivery that takes advantages of recently developed software like Building Information Modeling and digital fabrication equipment like Computer Numerical Control machine tools to allow real-time collaboration between architects, contractors, engi-
neers, fabricators and others. Of course, this process requires disciplines to work together and communicate productively, skills not necessarily taught in architecture and engineering programs. In fact, many universities have separate classes for each discipline, even for those subjects held in common, such as materials. On one hand, this is expected and desirable for it allows classes to be highly specialized for their respective disciplines. While this specialization is somewhat justified, the result is that students develop different languages to discuss the same topics, a potential impediment to future collaboration which will inevitably occur when students enter their respective professions and work together on building projects.

In *Materials for Design*, Mike Ashby and Kara Johnson address this potential shortcoming when they write, “Bridging the gap in information and methods is not simple. The technical terms used by engineers are not the normal language of designers – indeed they may find them meaningless. Designers, on the other hand, express their ideas and describe materials in ways that to the engineer sometimes seem bewilderingly vague and qualitative. The first step in bridging the gap is to explore how each group ‘uses’ materials and the nature of the information about materials that each requires. The second is to explore methods, and, ultimately design tools that weave the two strands of thinking into an integrated fabric.”

The objective, then, is not necessarily to encourage the disciplines think alike, but rather to develop in students the willingness and ability to communicate their respective expertise in a productive way. The materials collection has the potential to be a learning tool not just for materials and their characteristics, but also for communication between disciplines. It may be one method of bringing different views of materiality together into a richer, more integrated way of thinking.

The Materials Collection at Cal Poly

After a careful search of appropriate spaces at Cal Poly, we decided to locate the Poly, the materials collection in the Hay Media Resource Center (MRC), a facility which serves all departments in the College of Architecture and Environmental Design. As a college-wide resource, it serves students of architecture, landscape architecture, architectural engineering, construction management and city/regional planning. In addition to hosting the materials collection, the MRC provides a visual resource collection of slides and digital images, as well as a small collection of books, periodicals, and drawings.

Although there existed a small 150 square foot materials library since 1976, the present facility took form in 2007. Today, the materials collection (figure 5) is a space of roughly 900 square feet, which is divided between the collection storage space (500 square feet), a meeting space (250 square feet), and a small exhibition area (150 square feet). The collection currently holds approximately 5000 samples. Since physical space will remain limited, the emphasis of the collection is on new materials, green materials and smart materials. The meeting area is an active learning space, designed to be flexible enough for individual research, class meetings and presentations by manufacturers. The exhibition area is also a flexible space to accommodate a wide range of exhibits.

The collection is actually comprised of two integrally-linked components: the physical collection of material samples (figure 6) and a digital database used for web-based searches and circulation (figure 7). The physical collection is open and students are encouraged to browse, touch and smell the samples, feel their weight and tactility; i.e. consider the haptic possibilities that open up when a designer or engineer engages a material for the first time. In addition, the opportunity for browsing the collection offers serendipity: students may begin by looking for a specific
material, but often leave with several other materials in hand for future projects.

Challenges Aspects of the Project

The need to organize the collection to allow for browsing, but also focused searches proved to be a challenge. In looking at the approaches used by other material collections, we noted that the majority of those in the academic settings chose the Construction Specification Institute’s CSI MasterFormat system, the current North American standard for organizing construction product information.12 The drawback to this system is that it categorizes materials in terms of their use and ignores their properties. It the aim of a materials collection is a deeper understanding of materials, then a classification system addressing intrinsic properties and performance characteristics would be of greater benefit to students as it would allow for a design to envision potential uses. Material collections that serve designers outside of the Architecture/Engineering/Construction realm have taken this approach (Material Connexion, Materia, Harvard and CCA are examples). Considering all options, the team at Cal Poly decided to adopt the CSI system for the immediate future given its role as the long-standing norm in the profession and its familiarity among students and faculty in all departments in our college. Eventually it may be more appropriate to move to a system that classifies materials by properties, although no standard classification scheme of this type currently exists.

Another challenge was the selection of content and software for the digital component of the collection, i.e. the database used to catalog, search, and check out materials. Unable to locate a widely used set of standards for such a collection, we created a loose set of custom rules for populating the data fields to include basic information such as the name of the material, its manufacturer and their contact information, the CSI MasterFormat number, a local call number, and an image of the material (see the figure above). In the future, we hope to expand the fields to include composition, form and use, manufacturing process and sustainable properties.

Just as no standard existed for the content of the database, neither did affordable software that could capably handle visually rich en-
tries, robust search functions, and meet ADA requirements. Most library-based software was incapable of supporting the level of visual images we intended, while most museum software was priced well beyond our means. Discussion with colleagues in the visual resource community have lead to several possibilities, but we have yet to make a decision or implement a system.

**Next Steps**

In Fall 2008, modest integration of the materials collection into the life of the architecture program was begun when its use was made integral to a Materials and Methods course taught by the author. Additionally, many students now visit the collection on their own to browse and check out materials for their studio projects. This integration and should increase when a complementary database has been created to promote browsing from any computer. The exhibit area has to-date been under utilized, and planned future efforts include class projects to create rotating exhibits intended to appeal to students as well as non-architects.

Plans are envisioned to make the collection and exhibition area more visible to and useful for students in other disciplines of CAED, and in fact, the entire university. One way to accomplish this is with increased web-presence and a completed database. Another is to develop those areas of the collection most relevant to students of engineering, landscape architecture, and construction management (not to mention art, packaging, material science, etc.). This will entail adding materials beyond those traditionally used by architects, but in a world where creativity often calls for materials crossing-over from one field to another, a far-reaching collection will benefit all who engage it, regardless of their particular discipline. The materials collection has the potential to be useful in coursework throughout the campus and one hope is that the creators begin to see outcomes they never anticipated.

With its emphasis on building products, the materials collection is a fitting venue for presentations by product representatives and industry professionals, and plans are being made for a program of regularly scheduled presentations. There is also the possibility of inviting design and construction professionals from the Central Coast of California to participate in these presentations, and indeed, use the entire materials collection and database. In return, Cal Poly may request their financial support and assistance in securing donations of mock-ups that are often required for large building projects. These assemblies, often of the exterior building envelope, could be displayed in the courtyard adjacent to the MRC. When these initiatives eventually occur they will increase the interaction between students and the profession, benefiting both groups.

In the short term, the most pressing need is the completion of a searchable online database with web access, the functionality of which is intended to complement the physical collection. While the “tactile and sensory immediacy” of the items themselves is fundamental to the success of the collection, the additional search functionality which allows users to delve into the collection from varied angles (composition, use, form, manufacturing techniques, etc.) makes the user experience much richer and bring students in contact with the complex web of factors and information which surrounds the selection of materials. Of course, another reason for the digital database is a practical one: it will aid library staff in the management and circulation of the collection.

**Conclusions**

Although the necessity to reformulate architectural education in response to the ecological and technological changes that are transforming practice is pressing, thoughtful curricular reform will likely take years. While larger curricular developments occur at Cal Poly, the project team saw an oppor-
tunity to create a learning space for use by all disciplines in the college, that would not only encourage increased awareness of new materials, but also promote interdisciplinary exchange between students of architecture, engineering, construction management and landscape architecture.

Although currently in its infancy, the materials collection, with its physical and forthcoming digital components, is positioned to promote a culture of materiality and interdisciplinary, and in doing so encourage an increased awareness of sustainability and integrated practice. Once integrated with courses in every department in the college, we believe we have the opportunity to develop in students both the to knowledge to select materials for existing uses, the vision to use materials in new ways, and the ability to research materials which have yet to be developed.

Acknowledgements

The author would like to thank Vickie Aubourg, Director of the Hay Media Resource Center, for her contributions to all aspects of this project, and Leanne Hindmarch, Architectural Librarian for the Robert E. Kennedy Library, for her help with database strategies and aspects of this paper.

Portions of this paper appear in the proceedings of the 2008 Annual Meeting of the Association of Collegiate Schools of Architecture and a forthcoming issue of Art Documentation.

Notes

13. Schroepfer, 43.