Material libraries: promoting materiality and interdisciplinary collaboration

R. Arens, AIA  
California Polytechnic State University at San Luis Obispo, USA

Abstract

To be contemporary, buildings must employ sustainable materials and methods and synthesize them using innovation tectonic strategies. The best way to achieve this is through the intersection of analytical and design expertise that results when architects, engineers and managers work collaboratively in interdisciplinary teams. This paper outlines how a Materials Library was created and is being used to promote a greater awareness of materials and a heightened appreciation of collaboration between students of various disciplines. The first part of this presentation examines the rationale behind the Materials Library, and the second part discusses its creation by faculty at Cal Poly.

Keywords: materials, education, sustainability, interdisciplinary, collaboration, database, research, curriculum.

1 Introduction

Simply put, the two issues weighing most heavily on the future of the built environment are sustainability and integrated practice. It follows then, that the education of architects, engineers, construction managers and all others involved in the creation of the built environment will have to change to make these two issues central to their curricula. Acknowledging the lengthy process of thoughtful curricular reform, this presentation looks at an effort by faculty and students at California Polytechnic State University to use materials as a platform to introduce small, but immediate measures to address these issues. Specifically, we created a new materials library intended to (1) promote an increased awareness of materials, especially in relation to sustainability, and (2) provide a setting for collaboration between students of architecture and related disciplines where a spirit of integrated practice can develop.
2 Materials as an Agent for Curricular Reform

Our decision to use materials as the change agent was inspired by a number of sources, among them the argument for an architecture of the senses articulated by Juhani Pallasmaa. In his various related essays such as “Eyes of the Skin”, “Six Themes for the Next Millennium”, and “Hapticity and Time”, Pallasmaa argues that the task of architecture “is to create embodied and lived existential metaphors that concretize and structure our being in the world”. To accomplish this, architects must resist the ocular-centric tendencies of contemporary culture and pursue what Pallasmaa refers to as “haptic architecture,” 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. The detachment of construction from the realities of matter and craft further turns architecture into stage sets for the eye, and into a scenography devoid of the authenticity of matter and construction.”[1]

“Every significant experience of architecture is multi-sensory; qualities of matter, space and scale are measure by the eye, ear, nose, skin, tongue, skeleton and muscle.” Pallasmaa continues: “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.”[2]

2.1 Materials and the Environment

While its imperative that designers be aware of the tactile qualities of architecture, they must also be cognizant of the social and environmental impacts of building materials. This is no easy task, since its estimated that a greater number of new materials and products have been developed in the last twenty years than in the entire prior history of materials science.

In Material Architecture, John Fernandez underscores the heightened relationship between building 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. Therefore, the ecology of the built environment becomes one aspect of the study of materials for buildings”. [3]

Not only is the scope of this task, that is understanding materials in holistic terms, extremely daunting, its also a task that is constantly changing as materials both enter the market or become obsolete. It’s clear to us that the focus can’t be
on specific materials, but rather be on a methodology that can be used by students throughout their careers to research and evaluated materials.

2.2 Materials as a Form of Research

We are also inspired by architects and engineers who view research into new materials as an opportunity rather than a burden, and who are not only comfortable with advances in technology and materials, but who see this research as an integral component of the design process.

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.” [4] On this last point, Herzog echoes Pallasmaa and his argument for a haptic architecture. Herzog continues: “Our work has always been conceived to appeal to all five senses, consciously involving also tactile issues and even smell. This clearly demonstrates that we believe in an architecture that stresses its material and physical conditions to perform successfully, in conscious contrast to an architecture based on illustration and imagery.” [5]

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.

2.3 The Verge of Integrated Practice

The future of architecture is currently being shaped not only by Herzog and de Meuron, but also by practices such as KieranTimberlake, Gehry and Associates, Morphosis and others who are developing 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.

About the process used for the Federal Building in San Francisco Thom Mayne of Morphosis observes, “We did no two-dimensional drawings for this project. Three-dimensional models provided continuity from the initial concept to construction documents. The design model connects directly with the Permasteelisa Group, which continued through the design process, blurring the line between the architect and the sub-contractor. The model feeds directly into prototyping; and finally, into the fabrication and assembly of the construction. This environment is no longer linear. It allows us to continually move back and
forth between micro and macro.” [6] To hear Mayne tell it, the future is here and it is both demanding and liberating. He writes, “The tools we now utilize simplify potentialities and make them logical, allowing us to produce spaces that even ten years ago would have been difficult to conceive, much less build. Our conceptual thinking is increasingly embedding tectonic, constructional, and material design parameters.” [7]

3 Creating an Active, Interdisciplinary Materials Library

The question is not whether architectural education has a responsibility to respond to these changes in the profession, the vexing question is how. A compelling argument can be made that a complete and radical rethinking of architectural education is necessary. Daniel Friedman makes such an argument when he asks, “What would happen if each architecture school dismantled not just its current curriculum, but also its entire instructional apparatus? What would happen if schools acknowledged design as an epistemology more so than a skill; reoriented the development of individual expertise to the ethos of the team; and elevated building technology, engineering, construction economics, and professional practice to the same cultural status as visual composition?” [8]

Recognizing both the validity of Friedman’s questions and the overwhelming scope of a complete reformulation of architectural education, the Department of Architecture at Cal Poly looked at its program and formulated some more modest questions: How can we create an environment that encourages the ethics of sustainability and inculcates a spirit of collaboration between disciplines? What other types of active learning spaces, besides the studio environment, can inspire the engagement of materials to a higher degree and generate research into materiality?

3.1 The Materials Library at Cal Poly

The Architecture Department at Cal Poly is fortunate in that it belongs to a College that includes most of the disciplines mentioned by Thom Mayne and Jacques Herzog. Along with architecture, the College includes architectural engineering, construction management, landscape architecture and city planning. Although the inclusion of all the design and construction disciplines in one college is beginning to translate into interdisciplinary efforts, departments still suffer from insularity.

In Materials for Design, Mike Ashby and Kara Johnson observe that, “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”. [9]
In 2007, we initiated a Materials Library that we believe has the potential to become a setting for information gathering and innovation, the measures suggested by Ashby and Johnson as necessary to bridge the gap between designers and engineers. The Library is loosely modeled on the Materials ConneXion, the largest global resource of new materials, which provided us with a viable construct to use as a point of departure. [10]

3.2 The Physical Component of the Library

When setting out to create the Materials Library, we made the physical collection of materials our highest priority so as to encourage our students’ appreciation and awareness of materiality. The collections area is a work in progress. Currently we hold about 400 samples with plans to expand these holdings to 2000. Since it is impossible to have a physical sample of every material, the emphasis of the collection is on new materials, green materials and smart materials. We encourage students to browse the collection, touch and smell the samples, feel their weight and tactility; in other words, consider the haptic possibilities that open up when a designer or engineer engages a material for the first (or fiftieth) time. A browsing collection offers serendipity: students may begin by looking for a specific material but leave the Library with two or three other materials in hand for future projects.

The meeting area is an active learning space for groups and individuals to meet and examine materials. This is considered the ‘think tank” component of the space, and it is designed to be flexible enough for individual research, class meetings and presentations by manufacturers. Also included in this area is an exhibition area. Here, exhibits of all types can be created: materials can be pulled from the collection and given special prominence, juxtapositions can be created across materials classifications, and new materials or products can be highlighted. This area, like the active learning area, was designed to be flexible in anticipation of exhibits we’ve yet to imagine.

3.3 The Digital Component of the Library

Materials are physical and cultural artifacts that are loaded with information of many types, some understandable through empirical means and others only through intellectual engagement. To help students understand a material’s origin, means of production, performance, etc. a searchable database was created as a complement to the physical collection. Data entries were created for each material sample in the collection, and this information is linked back to the physical sample with a barcode. The database serves the purpose of facilitating the checkout and inventory of samples, but more importantly it interfaces with two important stages of student design projects: in the early stage of a project students use the database to browse broad ranges of materials; in later stages of design projects, students use the database to access performance characteristics of the materials they’ve selected.

In both of these scenarios, the database is meant to interface with the physical collection as students move back and forth between the two different,
but related learning experiences. The database allows materials in the collection to be searched and studied from any computer, thus supplementing the hand-on experience of physical samples with information that allows the student to understand the place of a particular material in the large context of an increasingly complex material culture. In the future when Building Information Models are more widely used by students, the database will provide an important linkable resource.

4 Conclusion

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 discussions occur at Cal Poly, we saw an opportunity 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 Library, with its physical and digital components, is positioned to promote a culture of materiality and interdisciplinary cooperation, harbingers of future curricular reform.

References

[7] Ibid.