Collaborations in Architecture and Engineering

Collaborations in Architecture and Engineering focuses on team-building and problem-solving between architects and engineers to prepare you for working together in practice. It provides an overview and foundation for interdisciplinary collaboration so that you can create innovative proposals for optimization, performance, and aesthetic goals. It also shows you how to solve real-world problems and how to engage creatively with technological challenges so that you can be a productive member of any team.

The authors, an architect and an engineer, share guidelines learned from their experiences and observations on how to insure productive communication, engage in interdisciplinary discussions, and establish common goals and values. Throughout the book are many case study examples of architect and engineer collaborations—such as those between SANAA and Mutsuro Sasaki, Foster + Partners and Buro Happold, Steven Holl and Guy Nordenson, and SHoP Architects and ARUP. The book also includes a discussion about integrated project delivery (IPD) contracts and administration, so you’ll be ready for better integration.

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Clare Olsen and Sinéad Mac Namara
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The authors co-taught architecture and engineering interdisciplinary design courses at Syracuse University, which were enabled through a generous National Science Foundation grant supporting Innovations in Engineering Education. The rewards of the teaching and learning experiences far out-weighed the challenges. In this book, we share our collaboration experiences as well as those of practitioners and educators, seeking to provide faculty, students, and professionals with the tools and sensibilities to enable positive collaborative experiences.
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Widespread change is occurring in the fields of architecture and engineering. Similar to the typological and stylistic transformations that grew out of the Industrial Revolution, new technologies and materials are revolutionizing the architecture and engineering professions, creating new working methods and sensibilities. In the 1980s, graphic Finite Element Analysis software and Building Information Modeling emerged, followed in the 1990s by Computer Aided Manufacturing software that facilitated digital fabrication. Now, decades later, we can safely say that these technologies have had and will continue to have a profound effect on curricula, design and construction methods as well as the form and performance of the work produced. New cultural, technological and social paradigms have emerged, generating new programs and building types, not to mention increased expectations of the experiences and contributions of the built environment. Consequently, the work—and work life—of architects and engineers is becoming increasingly more complex.

Technological developments in materials, construction techniques (including digital fabrication and offsite construction), and sustainable systems are just a few of the advancements that call for new approaches to design, analysis and construction work. Famously, Moore’s Law predicted that the speed of our computer processor would double every eighteen to twenty-four months. “This extraordinary rate of progress means that our mobile phones now contain computers several hundred times more powerful than the one used to control the Lunar Lander for the Apollo missions.”1 This is an overwhelming but exciting notion that suggests tremendous potential for new technologies in architecture and engineering. Any number of complex forms and material assemblies that would have been too computationally expensive are now within the realm of possibility. However, given the complexity resulting from an aggregation of these systems, navigating this array requires synthesis of multiple specialties and sensibilities.

Perhaps one of the most significant outcomes of the technological shift is a growth in importance of both specialization and collaboration. Although architects are often described as generalists and engineers as specialists, the practices both require high levels of expertise, and projects at multiple scales usually necessitate teams of experts to see them through. Alliances among disciplinary experts lead to greater innovation and boundary-pushing proposals. As a result, specializations hold great value in the professional realm, making team development...
a crucial part of the design and construction process. Large and small firms working at all scales are increasingly forming collaborative design teams at the initial stages of the design process. Finding the “right” collaborators—those with copacetic sensibilities—can take the better part of one’s career. Numerous factors contribute to the success of collaborations and the composition of the design team can make or break a project.

Despite the prevalence of collaboration in the professional realm, working in interdisciplinary groups is not always natural or easy. Personalities as well as pedagogical and professional training all contribute to the success or failure of working partnerships. Communication across disciplines can be frustrating and even adversarial. But interdisciplinary design is not only inevitable, it is essential. “Throughout history, groups of people, often without conscious design, have successfully blended individual and collective effort to create something new and wonderful.” Creative moments occur when making connections across boundaries, what’s commonly referred to as “thinking outside the [disciplinary] box.” Conversations with others outside one’s discipline, approaching problems from a new perspective, have the propensity to fuel game-changing, insightful, exhilarating revelations.

Since the Renaissance period, architects, engineers and constructors have worked together, often bound through contractual obligations. Contracts have changed little in the modern period, until recently. Recognizing the increasing importance of collaboration and the efficiencies provided through Building Information Modeling and other emerging tools, the American Institute of Architects (AIA) offered a new contract type called Integrated Project Delivery in 2008. IPD was developed out of a strong need for change in contractual obligations and the guidelines represent major transformations to management and working modes. Integrated delivery provides the added benefits of shared risks and rewards, easing the tension prevalent in traditional delivery modes that pit aesthetics against cost. Despite the challenges inherent in adopting new delivery methods, a growing number of practitioners recognize their potential to increase collaboration during the design and construction process and reduce costs. As a result, many feel that integrated project delivery will gain momentum and become widely pervasive in the near future. Integrative working methods, digital technologies and sustainable practices are just a handful of the issues transforming the architecture and engineering professions and it is crucial for school curricula to prepare students to be effective in the working realm.

The academy has a profound obligation to not only prepare students for professional practice, but to instill values that define a trajectory and future for the fields. Theorist and educator Dana Cuff reminds us that, “The ethos of a profession is born in schools.” Despite this, she goes on to say that there is a “general mismatch between the ethos of professional ideals and values (emphasized in schools) and the circumstances of professional work.” This has been a long-standing topic of discussion at national architecture and engineering education conferences.

Although interdisciplinary course work is advocated by both the architecture and engineering accreditation boards (National Architectural Accrediting Board (NAAB) and ABET, respectively) as one way to address professional preparedness, curricular differences
can hinder course outcomes. However, when designed well, interdisciplinary courses can prove to be pivotal in students’ educational careers. Engineering curricula don’t often provide many opportunities for open-ended design despite the fact that the real world is full of these sorts of problems. By the same token, architecture curricula require varying amounts of technical course work, but through interdisciplinary collaborations, students benefit greatly from conceptualizing projects with a higher level of technical proficiency. These synergies enhance both architecture and engineering programs by enabling students to design innovative projects with real-world possibility.

For schools that strive to impart creativity and technical skills to produce innovative design proposals augmented by integrated systems, interdisciplinary courses are necessary and crucial in the effort to impart a more holistic understanding of the practices of architecture and engineering. Furthermore, the integration of systems and design through studies of efficiencies in structure, energy or constructability, for example, contribute to a more thorough understanding of sustainability and ecology. Through the process of sharing and developing expertise, students not only gain confidence in their abilities, they also become better designers. Without question, interdisciplinary experiences are vital to preparing students for meaningful design collaborations in the professional realm.

Recognizing the importance and complexity of interdisciplinary collaboration, this text addresses the challenges and rewards of cross-disciplinary partnerships and provides real-world case studies to illustrate multiple types of collaborative working methods. It is helpful to better understand the professions and their contexts and in Chapter 2, we discuss differences and commonalities between architecture and engineering. In Chapters 3 to 12, we provide in-depth accounts of projects designed by prominent architects and engineers, demonstrating the power of integrated design to realize innovative and award-winning work. In Chapters 13 and 14, we provide an overview of platforms for interdisciplinary collaboration in practice. Finally, Chapter 15 focuses on the state of collaboration in academia, describing the ways in which schools have been both reactive and proactive in preparing students for integrated delivery methods, which will be helpful for teachers and students endeavoring to experiment with interdisciplinary design.

More broadly, the book asks fundamental questions about the current state of education and the professions of architecture and engineering. In this post-digital era where large and small offices alike are adopting new technologies and progressive project delivery methods, we reflect on how best to prepare students and offices for an evolving practice. How can architectural educators instill the importance of aesthetic design goals while emphasizing systems and sustainability? How might engineering educators foster innovation and non-linear thinking to better align education with the practice? These topics and more will be explored in Collaborations.
Notes


3 The AIA is the preeminent architectural professional advocacy organization.


5 Ibid., p. 44.

6 ABET originally stood for Accreditation Board for Engineering and Technology, but the organization officially changed the name to ABET in 2005.
When one considers the Gothic cathedrals, boundary-pushing structures and exquisite feats of architecture, it is extraordinary to the modern designer that these structures were conceived, engineered, and built under the direction of one profession, that of the stone mason. Ever since the Industrial Revolution, the proliferation of specializations required to realize a work of architecture has continued apace with an expansion of disciplinary knowledge, capabilities, and tactics. There are good reasons for this, of course: modern society requires new, widely diverse programs and building types, and an ever more complex range of technologies are available for the design, construction and maintenance of buildings. But it is worth reminding ourselves that as the professions of the architect and engineer diverged, they also became more reliant on one another for their disciplinary expertise while working towards common goals in the form of safe, habitable, beautiful buildings. Writing in the late 1800s, the great architectural historian and critic, Viollet-le-Duc, who made careful study of those very same Gothic cathedrals, cautioned his contemporaries:

A little reflection will show us the interests of the two professions will be saved by their union... Whether the engineer acquires a little of our knowledge and love for artistic form... or whether the architect enters upon the scientific studies and adopts the practical methods of the engineer; whether both thus succeed in uniting their faculties, knowledge, and appliances, and thereby realize an art truly characteristic of our times, the result cannot fail to be advantageous to the public and creditable to the age.1

This book focuses on collaboration between architects and engineers, generally structural engineers, but in some cases also mechanical engineers. Before initiating a discussion on collaboration between these professions, it is helpful to learn about the disciplinary and educational contexts that contribute to the ethos of architecture and engineering practitioners. This chapter provides a discussion about differences in the practices, highlighting the cultural, economic and historical contexts for collaboration.