



Our practice is unusual—it is medium-sized; it does not have autonomous branches; the creative design is centralized in Boston. We have public and private clients in China, Singapore, India, Israel, Hungary, the United States, and Canada. The nature of practicing, the technology, and the construction industry varies greatly in these countries, yet we cope comfortably with this wide spectrum.

The tendency in North American practice is to try to define and detail a building completely before turning it over to a contractor. Then every time you want to adjust something during construction, there are change orders and extra costs. You can mitigate that by establishing up front that certain components or building elements will be undertaken in a design/build process. For the *United States Institute of Peace* building in Washington, we recognized that we could not detail the glass roof without knowing who would build it. Each of the companies specializing in glass 3-D structures has its own technologies and proprietary detailing methods, so the design drawings we presented them expressed intent only. We then paid three short-listed manufacturers to develop schemes with detailed

drawings and costs. We chose the most promising (but not the least expensive) scheme, and then had life-size mockups built to fine-tune the design.

In Singapore, at *Marina Bay Sands*, partnered with a private developer and his powerful management team, we have been fine-tuning the design, working with most major subcontractors, and deploying mockups and other methods in collaboration with almost every trade. Roofs, cladding, glazing systems, structure, and lighting were the outcome of this collaboration. Any attempt on our part to have drawn it ahead of time and independently of contractors would have been impossible. The owners allowed us this flexibility through the way they set up their procurement structure. We have responded opportunistically.

There is danger in this new situation that the contractor and owner might compromise the design intent by opting for a cheaper and weaker detail. In some situations, particularly in Asia, developers derail designs when suggestions are made in the name of “value engineering.” But the advantages of close work with contractors outweigh these dangers.

I much prefer having flexibility during construction; we enjoy it as a matter of course in India, Israel, and Singapore. In Israel, for example, the contractors bid in unit prices—so much per square foot for stone, for concrete, and so on—and then there is an accounting, so if I cancel a piece and add a wall, the overall price is adjusted without complex change orders.

The need for mockups

Our office makes all kinds of models in vast numbers and scales, but we cannot resolve a building with paper, 3-D studies, and physical models. Things come up—the way materials join, a new perception of color and texture, relationships of parts—that cannot be anticipated. In America, within the current bidding system, there is little room for this exploration. All we can do is ask the owner to set up a 2 to 4% contingency for change orders to allow us to make adjustments during construction.

We think that life-size mockups built by the contractors are essential. In *Crystal Bridges Museum of American Art* in Arkansas, we have mockups of the roof, skylights, wood beams, and cable structure: to test the behavior of light through the skylights, the meeting of materials, the water-proofing, and so on. You have to devise contracts that include the mockups (sometimes mockups are built *before* the contractors are on board). Meanwhile, you have to be careful to protect the owner's financial interests by clearly stating design intent, asking bidders to give guaranteed maximum prices, then entering design development with the contractors. Sometimes this means going through several bidding steps.

We are far away from the days of the master builder in which there was common wisdom about construction. We are now dealing with many evolving materials and processes. To be adaptive, I insist that we must be continuously represented on site during construction, and all our clients have recognized the benefits of this.

The American construction management model

Until two decades ago, the prevailing procedure was the lump-sum bidding process, in which complete drawings and specifications were put out for a fixed price and usually awarded to the lowest bidder. As clients recognized the need for involving the contractors and sub-contractors in the design process in order to avoid shocks at the end of the bidding process, the construction management (CM) model slowly replaced the lump-sum bid model for many public and institutional projects. In this arrangement, a contractor is selected as design begins. His fee is defined for preconstruction and construction, when he becomes both the final contractor and the owner's agent. The contractor with his subs then monitors the activities of architects and engineers, providing cost estimates. Rather than complete a set of final drawings and specifications, in the construction management model, the contractor provides, usually at the end of the design development phase, a guaranteed maximum price, and then takes on the responsibility of monitoring the balance of the design while assuring that no deviation will occur from the price. Often, as an incentive, the owner and contractor share in any savings obtained from the maximum price. The job is bid to a series of subcontractors under the umbrella responsibility of the contractor.

At first glance, this sounds promising. The architectural and engineering team benefits from input and professional cost estimating as it proceeds with the design. Sub-contractors are called in for advice, and mockups and tests can be undertaken prior to commitments to particular details or methods. With the guaranteed maximum price, the owner has peace of mind.

But we have found that in reality this procedure delivers less than expected, particularly in the highly inflationary years of the past decade. The guaranteed maximum price provided by the contractor tended to dissolve as one approached the construction document phase. In fact, no matter how carefully the architect attempted to define the intent during the schematic and design

development phases, the development of the design in construction documents all too often deviated from the original design. Moreover, the unexpected market conditions, such as a sudden increase in steel prices, led to dramatic increases above the maximum guaranteed price, and for that matter, led to increases over the unguaranteed estimates provided at the early design phases. CM in reality became "cost plus." In our own practice, *Crystal Bridges*, the *Kauffman Center for the Performing Arts*, and the *Free Library of Philadelphia* went through construction management; that structure for the *United States Institute of Peace* held, through good management, to the guaranteed maximum price.

The shortcomings of a lump-sum bid and of construction management processes explain why owners have been fascinated by the P3 (Public Private Partnership) turnkey formula. In this process, the public agency, as client, defines their needs and lets a developer/contractor develop the design, prepare the documentation, undertake the construction and in some instances oversee the operation of the project, for a guaranteed lump sum price. However the risk in this formula is enormous for marginalizing the architect's role and responsibility.

Private-public turnkey construction process

A case in point is the *McGill University Health Center* in Montreal, where we were charged with rethinking health-care delivery from first principles. The funder, the Quebec government, imposed a P3 process that the U.S. General Services Administration has been enamored with: Let the developer with the best price design/build a given facility.

There are two ways to do P3 turnkey projects: 1: the owner and his own architect prepare a pre-design that defines the conceptual framework. The selected developer then translates the design in the most efficient way, investing the technical and management know-how and providing a fixed price. 2: The owner and his architect provide a written outline specification and program brief to

which the developer responds with *his* own design developed by his team and with a fixed price.

The outcome in the two processes is obviously very different. In one case, the client-architect dialogue occurs ahead of the P3 process. In the other, it only occurs once the project has been committed to a developer and his design. The dialogue is totally restricted by the fixed price given at the beginning. In the case of McGill, the second alternative was imposed by the Quebec government. A pre-concept design was not allowed prior to the hiring of the developer, because the Quebec government believed that the process would be prejudiced by a pre-design and would result in a more costly scheme. Since the government's objective was to stretch its dollars, it encouraged the developer to find the cheapest possible way to construct while meeting the minimum requirements of the specification. I believed that this procedure by definition excluded the possibility of any creative thinking about innovative design that responds to the evolving character of health care today. I decided to resign. Without the dialogue with the client, the process was too limited. And I did not believe that an outlined spec could address the more subtle qualitative issues of a design. In explaining my move publicly, I suggested that the open-ended public-private process might be suitable only for purely utilitarian buildings like warehouses.

We have seen this marginalization in a continuous shedding of responsibilities by the architectural profession over the past decades, a shedding of the management of the contract, of the responsibility for cost estimating, and of the coordination of construction management. Perhaps the answer will be newly formulated partnerships in which engineering, architecture, and construction management merge into an organization that can provide a wider range of services as a counterpoint to the construction industry. In such newly expanded teams, innovation, cost control, and high performance could regain clients' confidence.



Urban design/zoning

The public-private collaboration around the competition for *Marina Bay Sands* set new standards for protecting the design intent on the part of the Government of Singapore. The Singapore Redevelopment Authority believed that intense public-private collaboration with the developer, within the established urban design and zoning guidelines, would result in a successful shaping of the public realm. Our design submission, from which developers were selected, was a well-detailed set of concept/schematics. The government fixed the price of the land and chose the project for its design, program, and merits, as well as the track record of the team. For the competition submission, our drawings included finishes, geometries, and program. As we went forward, any deviation from the design was monitored by the Urban Redevelopment Authority, who acted as the public's watchdog and thus assured that amenities and design features were preserved.

Nevertheless, the design evolved in response to the industry's capabilities. For example, I had conceived of the internal and external structure as made of precast concrete, but it became clear that local industry couldn't do that well, so we opted for cast-in-place concrete with precast or glass reinforced concrete cladding. The concrete structure, however, ended up being made so inaccurately that we could not clad it, and instead had to render it with a less durable cementitious coating.

The authority of the profession

Many people think that the authority of the architect varies geographically, with greater authority in Europe generally and in Spain and Scandinavia specifically, and with less authority in the United States and Asia. Some of this difference reflects both cultural attitudes and the responding legal structure. On the issue of copyright and rights of the architect, French, British, and recent Canadian law provide considerable protection for the architect's authority, while U.S. law deprives architects of most authority; they have even lesser standing in Asia. Nevertheless, I believe the authority of the architect in practice is more a matter of the reputation and standing of individual firms than something determined by geography.

There is no question that the emergence of "starchitects" has resulted in a vesting of much greater design authority over clients, public or private. Indeed, in seeking leading design firms, clients seem to accept a loss of some authority over the architects' role. Inversely, developers who seek total control will tend to engage firms that are unlikely to challenge them in setting the design framework. Perhaps the greatest challenge facing the profession in the United States today is to regain and rebuild public trust in the profession by architects' acting responsibly and responsively, by increasing the scrutiny of standards and performance, and by opening up the professional discourse, in both academia and the profession, so that it is understandable by the public at large.



Globalization

We used to think of certain countries as having construction industries full of skilled workers able to provide superior construction: well-crafted concrete buildings in Japan, precise high-tech construction in Europe, and so on. Globalization, however, has changed this. On the one hand, we have migrant labor carrying out construction in many countries, so that “local craftsmen” is an outmoded concept. My projects in Israel are constructed with Turkish, Romanian, Chinese, and Taiwanese labor. The project in Singapore has a workforce of Chinese, Indian, Bangladeshi, Malay, and Koreans. At the same time, highly specialized subcontractors are working internationally. The roof of the Peace Institute was built by Seele in Germany, and that of the *Kauffman Center for the Performing Arts* by Novum, also of Germany; our project in Singapore is being constructed by a wide range of highly specialized sub-contractors of assemblies in at least a dozen countries. On our construction sites, no matter where, you might find German, British, Italian, Australian, Chinese, and Korean skilled workers and engineers assembling highly sophisticated component parts manufactured in their respective countries.

Yet in my own experience, the willingness and enthusiasm of these specialized contractors seems to vary geographically. There is more experimentation and innovation, it appears, in Europe, the Gulf states, and Southeast Asia than there appears to be in the United States. Moreover, it seems that these

global players display a pride of ownership that transcends the marketplace we find in the America. It should not be surprising that the most complex components in U.S. buildings today are being made by European sub-contractors. One wonders what it will take to rejuvenate innovation in our home territory.

There is, of course, an enormous difference between low-paid imported labor living in camps and working long shifts seven days a week, as in the Gulf states or Asia, and the unionized and non-unionized well-paid North American workers receiving extensive benefits. Yet, the work ethic, the pride in the making, has somehow eroded here. In the final analysis, quality seems to result from construction project leadership.

The expanded design team

In contrast to forty years ago, now we work with design teams that are overwhelmingly specialized, with a wide range of consultants. It is dizzying to read the list of what are now considered essential consultants in any large project. Over and above the architects and basic engineers are consultants for “code,” security, lighting (sometimes interior and exterior), specialist programming, A/V and IT services, landscape, kitchen services, elevators and circulation, acoustics, theater and hospital needs, signage and graphics, interiors and industrial design—the list goes on. Specialization is now unavoidable, but architects, I believe, must remain the generalists in charge.

The role of the architect today is to manage this wide array of specialists. If we are not managing this extended team, the architectural quality of the final building will slip through our fingers. In our practice, we invest a lot of energy in selecting, guiding, controlling, and integrating the product of each specialist. This requires intense collaboration with the acousticians, lighting and landscape designers, structural or service engineers, and so on. In an age when engineering and building systems are integrated into the architectural concept, when sustainability is required, and advanced technology creates smart buildings, the inclusion of these team members early on is essential. We involve engineers in competitions and as a concept emerges, so that their input informs and influences our scheme. We try to avoid locking into concepts that then must be challenged and forced to change in response to fundamental environmental or engineering concerns. Much has been said about the tension and conflict between architects and, for example, acousticians or engineers, but it seems to me that conflicts occur when these people refuse to dance—to respectfully accommodate each other's specialized needs.

Of late, there has been an attempt by project managers and developers to take over control of the expanded team, relegating the architect to being one of the specialist skilled providers, with the project manager acting as the integrator. We refuse to relegate this responsibility and insist on a leading role in the day-to-day management and the selection and integration of the expanded specialist team. We discourage consultants from communicating with our clients without our involvement.

Sustainability and integrative building systems

There is a link, I believe, between architecture conceived as integration of multiple building systems, and the objective of creating sustainable buildings. Therefore, structural and environment engineers must be players from day one. Only thus can a deep understanding of the building systems

that come under their influence be integrated into architectural concepts and systems that make the organic whole. This differs from what I would call the "cladding school of design," the prevailing building methodology today, creating architecture with invisible interstitial spaces provided for the distribution of the chaos of mechanical and electrical systems, structure, and a multitude of other services. The cladding school allows for the separation of architecture from the richest possible experiences. This school produces a redundancy of resources and skin-deep spaces, deprived of tectonic depth and the experiential complexity of their networks.

Working on the *Ben Gurion Airport* in Tel Aviv, as well as with SOM on the *Toronto Pearson International Airport*, we tried to make, metaphorically, the bones and the arteries, the skin and the nervous system, all part of the language of the architecture. They are there to be seen and enjoyed for what they are. My favorite analogy is to liken traditional architecture until the end of the 19th century to a singular system in which masonry provided both bones and skin. In our time, the organism of the contemporary building with the advent of air conditioning, environment controls, and safety requirements, is more akin to a multilayer diagram of the human body; veins and arteries, digestive systems, brain and nerve system, bones, skin, and glands all work in unison.

Implications for architectural education

Many architectural schools have been caught up in the form- and space-making without an adequate grounding in engineering, structural, and environmental issues. How do we bring these elements into the studio so that students can understand that form-making is a synthesis of a whole chain of inputs, external and internal? While the studio cannot and should not imitate practice, our responsibility, as we have moved away from the idea of student as apprentice, is nevertheless to bring these voices and disciplines into the formative phases of architects' education.