

# Design Research in Search of Direction in Architecture Pedagogy & Practice

Mitra Kanaani , David Kopec , Linda Thomas-Mobley  
NewSchool of Architecture and Design, San Diego, California

## ABSTRACT:

This paper examines the question: should the design process as currently taught and practiced in architecture be modified to incorporate scientific research? Scientific inquiry informing design allows architects think broadly and assume responsibly for developing building designs that are knowledge-driven. Scientific methodology can be used to ensure that a design is adaptable and integrative within its context as well as perform technically, contribute socially, and remain economically feasible. Does this practice currently exist and if not will architects expose them to greater liability? The general standard in architectural liability is one of “reasonable care.” Individuals performing architectural services are performing professional services; the law imposes upon such persons the duty to exercise a reasonable degree of skill and care, as determined by the standard ordinarily employed in the local community. If the community standards evolve, then it follows that the standards for individual architects would evolve. Changes in an architect’s standard of care should be carefully considered before any major shift in design practice, but arguably, the use of scientific research, which brings with it the ability of the architect to use measurable outcomes to inform the final design, may possibly be the best defense in the event of a dispute.

CONFERENCE THEME: Learning and Design

KEYWORDS: pedagogy, research, liability, change

## INTRODUCTION

The process of architectural design is increasingly con-voluted—intertwined with ever evolving technical and societal expectations. In recent years, much discussion has been dedicated to the topic and role of scientific inquiry or scientific research within the academe and practice of architecture. The act of research within any branch of knowledge is simply the quest for a reliable and replicable truth. The new, potential truth, or theory is then verified to determine how closely it resembles reality.

### I. IS DESIGN RESEARCH?

Juxtaposing theory to reality is not new to the profession or discipline; Luis Kahn believed that during the design and construction of a building the role of the architect should be to shepherd the development of the design from the immeasurable to the measurable, and ultimately back to the immeasurable for society (Twombly, 2003). Kahn’s description of the designers’ task during the measurable phase is strikingly similar to a researcher’s task during scientific-inquiry. The first immeasurable according to Kahn’s is the intuitive aspects of design that give architecture meaning. A highly subjective process, intuition is a cluster of self-interpreted emotions that are commonly expressed as a feeling followed by cognitive thought that attempts to give meaning to that feeling. In this immeasurable phase of the progression, the cluster of emotions and subsequent feeling are neither reliable, since we cannot be sure an interpretation is accurate; nor replicable, because the resulting design based on a particular feeling is not likely to yield the same design in another instance.

Following Kahn’s immeasurable phase is the measurable. The measurable phase includes isolating, examining, and measuring a given set of variables within a design idea. Any skilled practitioner in the world can achieve the measurable phase with a high probability that the results will be similar to the first set of measurements. The process is predicated upon the practice of correcting for external

variables that may interfere with standardization. Once measured, according to Kahn, the building is built and takes on an immeasurable quality related to its meaning, this is expressed as the second and final immeasurable phase.

Generally, the first immeasurable phase is conceived of in the design studio and then the measurable phase occurs once the design has been visually communicated to the implementer. This sequence of design and then build tends to be most familiar to designers. What if an immeasurable abstract idea embarks on a measurable process of form making, with consideration of materiality, detailing, and construction, all within the studio? The result would be that the poetics of design could be expressed from the beginning of the design through to the building's magnificence as an artifact. Put another way, the first phase of immeasurable can be combined with the measurable phase in the studio. This alternative paradigm allows the building to finally evolve as an artifact with immeasurable qualities. As Louis Kahn believed:

A building has to start in the unmeasurable aura and go through the measurable to be accomplished. It is the only way you can build. The only way you can get it into being is through the measurable. You must follow the laws, but in the end, when the building becomes part of the living, it evokes unmeasurable qualities. The design involving quantities of brick, method of construction, engineering is ended and the spirit of its existence takes over. (Kahn, quoted in Green, Louis I. Kahn, Architect, 3).

Essentially, Kahn believed that every aspect of a building design must meet the requirements and expectations of its occupants; and, it is through this evaluation that the building will be judged by society.

If we are to embrace the scientific view of research within architecture, Kahn has already given us the genesis of a framework. The initial design exercise would and should be free from the constraints inherent in the research process. Once a design has been imagined it would be evaluated for its ability to satisfy society's expectations. During this measurable phase, objective inquiry will determine if the immeasurable first concept can withstand societal demands and scrutiny; if not, the architect must revert to the immeasurable. This perspective, demands that the architect create a design by developing ideas that are then vetted against data representing society's expectations; thus yielding to the development of intuitive and meaningful design solutions. In this way, Architectural design is a reflection of the societal trends and expectations with the outcome demonstrating available industrial and technological means related to its circumstance. This kind of architectural process supports Aristotle's notion that architecture imitates human action and life (Shusterman, 1997). The question is therefore, should the design process as currently taught and practiced be expanded to incorporate scientific research?

## 1.1 CURRENT TRENDS IN RESEARCHING THE BUILT ENVIRONMENT

Aspects of scientific inquiry are entering the built environment's consciousness from multiple entryways including construction education, engineering, psychobiology (the study of human-environment interactions), and information management technologies. The ways in which these peripheral disciplines and professions influence architectural design is becoming more profound, and thus society's expectations of modern buildings has increased. For example, a smart building may be expected to self-monitor weather conditions and respond in a way that the negative effects will be minimized. Smart buildings are also expected to comply with issues of human health, safety, and welfare, as well as enhance the psychobiological experience of the occupant. This might happen by the building sensing that carbon dioxide levels have become too high and thus allow more exterior oxygen into the building. Similarly, among the most profound advancements within the past two decades are in relation to information technologies. Updated buildings are expected to have standard internal communication systems that cause the building systems to respond to a crisis and external communication systems to alert emergency personnel. Currently, heat-detecting sensors can cause a building to close or open programmed doors while notifying the fire department of the potential threat.

The way in which a technological development performs under differing conditions, and responds to societal demands is an area requiring exploration. This need necessitates that some of the

immeasurable aspects of design to become measured. These technological demands, however, must be balanced with the expressive needs of a building's identity and remain congruent with its contextual fabric, while satisfying the global community's demands for sustainable practices. These multiple, and sometimes conflicting, factors complicate the design process so much so, that the discipline and practice of architecture is in a constant state of flux. The result is a bifurcation within the profession whereby the non-analytical thinker runs the risk of omitting one or more vital factors within the design. Is the answer, to require a rejoining of the industry? What if scientific research were required to be a part of every building design?

## 2. REQUIRING SCIENTIFIC INQUIRY IN BUILD-ING DESIGN

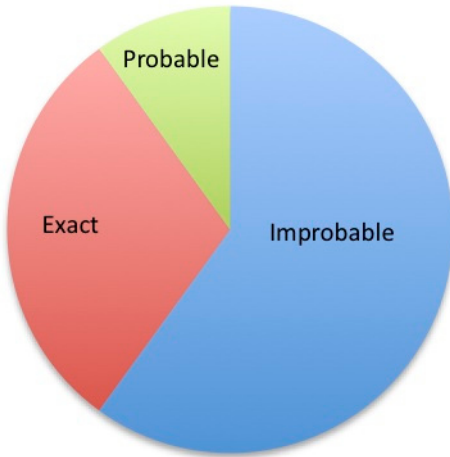
Although a shift in the design processes of practicing architects maybe desirable and almost inevitable, strategic implementation of these additional competencies for the future members of the profession will be necessary. Who shall take on the responsibility for the implementation of this shift is unknown, but the implementers should include leaders from the academe and practicing architects to be successful.

Society's demands on the profession of architecture may have the too-late-to-notice result of causing additional legal responsibility for the already heavily burdened practicing architect. The extent to which exposure to liability may be affected by a shift in design methods is generally related to tort law as opposed to the more familiar contract law. With a contract, the parties can stipulate who requires what duties—and how the risk will be shared. On the other hand, tort law is intended to protect the general disinterested public; when injury occurs to persons, property and most recently, economic gain. Under tort law, the liability imposed is a duty of “reasonable care” for others. For architects, the definition of “reasonable care” has evolved over time, but remains within the realm of health, safety and welfare. Courts view health as the biological and psychological conditions that result in physical or psychological injury; safety as those aspects of the environment that can cause physical and psychological harm; and welfare as the healthy social and physical interactions of the people within the building. It is this broad tort theory of responsibility that may be enlarged as new requirements for designers to use scientific research are incorporated.

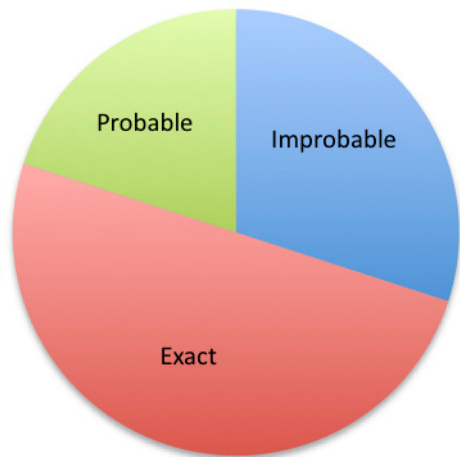
### 2.1 DESIGN AND CIRCUMSTANTIAL CONTINGENCIES

One way of defining or delineating the components of a design process is through the lens of Circumstantial Contingency Theory, which provides a structure to address deficiencies through improvements and later to form a strategy for future research (Donaldson, 2001). Within a design paradigm there are several types of circumstantial contingencies of the built environment. These contingencies fall into three groups of participat-ing variables: “exact” contingencies, “probable” contingencies, and “improbable” contingencies. An “exact” contingency is related to the active and projective per-formance expectations of the building that are both quantitative and qualitative. Examples of “exact” contin-gencies are the building's structural, acoustical, and environmental performance. Compare “exact” to “probable” contingencies which are related to the building's passive needs that are intangible, such as cultural reflections as demonstrated through symbols and iconography, social perceptions pertaining to ideas of beauty, and personal demands for a positive and gratifying experience within the building. It is the “probable” contingencies that lead to meaning of place and place attachment (Kopec, 2006). Furthermore, an “improbable” contingency is highly subjective and individualistic by nature. This contingency is related to the individual thoughts and aspirations of the architect, and will often require explanation. Renzo Piano's Centre Cultural Tjibaou, for example, while being a well-regarded design requires explanation as to his thoughts and intentions. His peers continually critique Piano's work in relation to these thoughts and intentions.

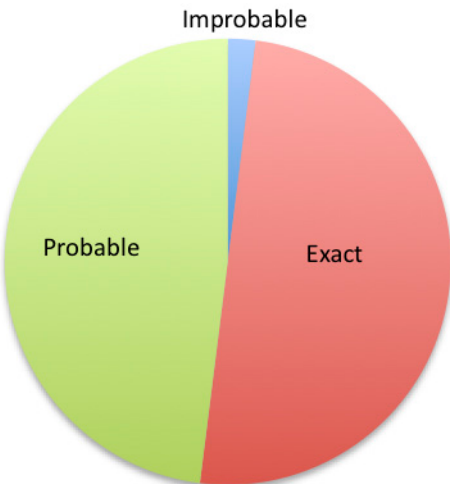
In short, “exact” contingencies demand objective re-search methods that contain measurable variables for an outcome that is reliable and replicable. “Probable” contingencies are more subjective and thus require a high degree of precision of the variables being researched. With “probable” contingencies the research outcome is reliable, but the subjective nature of the variables, such as differing perspectives of people changing with location, often render a subset of the research variables non-replicable.



**Figure 1a:** Speculative interpretation of primary stakeholders views-The Academe



**Figure 1b:** Speculative interpretation of primary stakeholders views-The Profession



**Figure 1c:** Speculative interpretation of primary stakeholders views-Society

“Improbable” contingencies, while personal and emotionally driven, may be deconstructed through a reductionist approach into objective parts of a whole. This deconstruction may diminish the essence of thought and purpose. According to Gestalt theory interpreted for the built environment by Kopec, (2006) the whole is greater than the sum of its parts, meaning that the full value of thought and purpose will diminish when broken apart. From the three contingencies, much discourse has been initiated within the academe, profession, and society at large with regard to the role of the architect, and the relative emphasis placed on—and prioritization given to—these three groups of contingencies through-out the design process.

To complicate matters further, arguably built environment stakeholders, who include the academe, the pro-fession, and society at large, determine the relative importance given to the three design contingencies (see Figure 1a-c).

Twenty-first century practice, as well as cutting-edge pedagogy, demands greater understanding of methodologies and the unique scientific inquiry of adapting to projective modes of design processes.

Additionally, it is becoming vital for a practitioner to be proficient and access the flow of information derived from peripheral disciplines and practices, as well as possibilities brought about by the gamut of academic, professional and societal expectations. The result of scientific-oriented design in recent decades uncovered that, what was long held to be immeasurable could now be measured with the development of techniques and sophisticated tools (Galtung 2006). It just maybe through the use of measurable attributes; architects are able to redefine the profession to withstand overwhelming complexity and negative judicial ramifications.

The academe being more theory oriented tends to emphasize the improbable, while the profession places a higher emphasis on exactness. Conversely society often has little regard for the improbable and places importance on probable and exact. It is this discrepancy in perspective that often leads to disagreement and in some cases confusion.

## 2.2 ARCHITECT LIABILITY

When one thinks of judicial ramifications “architect liability” is at the top of the list of concerns and when one studies architect liability, a discussion of the historical, super-human genius known as the master builder emerges. Reportedly, this person was the individual responsible for the entire building procurement process; including pre-design, design, material selection, cost management, planning, scheduling and ultimately construction of the structure. Even after the building was complete the master builder continued to be responsible. Tort liability of the master builder was severe, and literal. Master builders were held to the strict liability theory of ancient Babylon. According to the Babylonian Code of Hammurabi of 1775 B.C.E., a master builder was directly responsible for any harm resulting from the structure designed. The remedy granted an injured party was easy to calculate—the same injury suffered by the aggrieved party was inflicted upon the master builder. This strict liability idea was continued under the Roman doctrine of *lex talionis* or an eye for an eye, a tooth for a tooth (Edwards, 1971).

During the Renaissance Era not only was Western Civilization’s collective thought experiencing a rebirth, architects such as Filippo Brunelleschi and Andrea Palladio reinvented the master builder’s role. The new process reemerged as two distinct processes: design, which was now the purview of the architect; and construction, relegated to a new entity responsible for implementation. It was believed that the architect should provide the basic design and the constructor should rely on commonly understood engineering principles to complete the project (Trotter, 1999). This idea has continued to exist in some form until the present day.

Under early American law, liability of the architect was limited. Privity of contract determined the scope of an architect’s liability to third parties for breach of contractual duties. This doctrine of *privity of contract* was reflected in business practice because the architect was not liable to parties outside of a contract unless the architect committed fraud or was involved in collusion. Even those parties bound by a contract had narrowly defined duties to signatories to the contract (Trotter, 1999). Unless negligence was involved, without a contract the architect seemed immune from legal liability.

Historically, the architect was released from liability at the “substantial completion” phase based on two main defenses, the lack of privity between the design professional and the injured party and acceptance of the work by the owner. This practice persevered in America until the 1960s when the laws of torts and contracts experienced a major transformation.

Currently, privity of contract is no longer a bar to a negligence lawsuit against an architect. This means anyone claiming that the architect was negligent can prevail in a lawsuit. The law still gives some protection to the architect, even though an architect is required to perform contracted for duties without negligence, the owner cannot take an alternate route and use tort law to impose additional duties on the architect. Since the 1960s, because of key factors such as the increase in litigation; financial leveraging prompting the necessity to shift the burden of funding unexpected events away from the owner; the addition of more parties to the project causing fragmentation and defensiveness; the expectation of the architect has increased. The architect is required to provide almost flawless drawings and specifications with greater levels of detail than ever before (Trotter, 1999). Likewise, the architect is also responsible to comply with research-based evidence as it applies to human health and safety.

It is no secret that the liability of design professionals including architects has increased exponentially in the past decade. Reasons for the increase cannot be placed solely on the highly litigious culture that has evolved in the last century in this country. Additional drivers such as the neglect of individual practitioners to remain current, to evolving technologies and societal expectations are also to blame. For example, society demands greater design research that at times, seems to rise to the level of scientific inquiry.

### **3. RESEARCH RESOURCES, EVIDENCE AND TOOLS FOR FORM-MAKING**

Research in architecture relies on resources from various disciplines, including but not limited to natural and social sciences. Currently, intellectual data from behavioral science, biology, mathematics, and physics, constitute the bulk of resources available to the architect. The viability and credibility of this data has been revealed from those projects where it has become assimilated into the design process. The collected and aggregated data is analyzed and evaluated based on a series and interconnectivity of selected logics in response to the unique context of a project and governing laws. The relationship between research and law are not mutually exclusive. The law often facilitates research in terms of what should be 'reasonable' and research informs the law by clarifying what is actually 'reasonable'.

The use of research within design has been limited thus allowing other disciplines to arrive at architecturally relevant research findings, which has in turn informed litigation patterns. This remains so because design-oriented research differs in logic and meaning from scientific inquiry. As stated above, fundamental principles of research are the ideas of reliability and replicability. Hence, logic within this context is a derivative of viable and credible findings obtained from a rigorously implemented research method from which the results have been critically analyzed and vetted. Within the design process a logical conclusion might be based on opinion, preference or assumptions related to precedence studies that were also based on discretionary assumptions. This is not to say that opinion, preference, and assumptions have no place within architectural research; in deed, the artistic process calls upon self-reflections to stimulate the creative process, which are thusly reflected within a design. However, this subjective process only accounts for one piece of the greater architectural process and is given little credence within the judicial system. The courts often rely on empirical evidence that can only be obtained from rigorous research when determining fault.

Throughout the design process an architect must remain responsive to the moral and ethical obligation to satisfy societal standards and expectations for public health and safety. These standards and expectations have been developed based on empirical research obtained through quantitative and qualitative measures, and in many cases enforced through the judicial system. This reality has the capacity to transform design logic and intent, and thus drive the design outcome. However, this need not be the case. Rules and regulations can be reconceptualized as opportunities for the expansion of creativity. Hence, the regimented scientific inquiry incorporated into a design process should be embraced and seen as an opportunity for nurturing a higher level of design creativity and productivity. Acceptance of this fact as an inevitable phenomenon or trend is a cultural transformation for mainstream architects.

#### **3.1 CURRENT PRACTICES IN FORM-MAKING**

The current practice of form-making encourages morphogenetic techniques in design through simulation and modeling which have been enhanced by Architectural Computer Evaluation software. Various computer software have introduced a dynamic mode to design that allows for continual examination based on temporal and situational changes. More specifically, any given design can be evaluated against an area's temporal or climatic ecology. Through an examination of temporal factors we can see the way natural daylight effects interior spaces throughout the course of a day and throughout the year. We can also measure the building response in terms of heat gain or loss, potential distractions arising from the sun's reflections from the building, and the length and types of shadowing created by the building (i.e. the new proposed building could impede the performance of an existing building during select times within a year because of shadowing). Climatic conditions

is another variable that can be measured through computer simulations and modeling. Blizzards, ice storms, hurricanes, blistering heat are only a few climatic conditions that effect buildings. Hence a buildings performance in Boston would be different in Phoenix. Through computer simulations and modeling we can identify areas where design can be modified to compensate for the changes.

#### **4. CHALLENGES OF DESIGN THEORY IN PRACTICE AND PEDAGOGY**

Today the licensed architect holds greater accountability by society and the judicial system. As previously noted, the process and expectations of architectural design and practice, as well as pedagogy are amidst evolutionary challenges that include the emergence of new, innovative, and energy efficient materials, along with novel techniques of construction and compliance with the latest rules and regulations. Adding to this are the changes in program types and the demand for life cycle evaluations that require continued learning and consideration. Hence, the architecture profession, along with the educational institutions within advanced societies is becoming more accountable for the empirical research and scientific inquiries to justify a prominent presence, market compliance, and human health, safety, and welfare.

During the past three decades, notable architects such as Grimshaw, Herzog, Piano and others have pursued performance forms in their design projects that reflect a commitment to social and environmental objectives, and active pursuit of scientific inquiries as they pertain to technological advancements. Additionally, active involvements of research institutions (e.g. Massachusetts Institute of Technology, Cornell University, and Lawrence Technological University to name just a few) have developed solid research programs that have successfully combined traditional design processes with scientific inquiry. As a result, the created form works in harmony with measurable objectives and immeasurable aesthetic aspirations. From an analysis of select works by Grimshaw, Herzog, Piano we can better identify where and how solid research methods can be built into the design process without compromise to the immeasurable.

##### **4.1 GRIMSHAW**

Nicholas Grimshaw's British Pavilion in Seville, Spain is an example of how to pursue empirical scientific inquiry as part of the design process. The main concept of this building was inspired by technological achievements expressed within the architecture for climate control, specifically for the extreme microclimate of Seville. Being the hottest place in Europe, the architectural design needed to be responsive to the extreme heat of a hot and arid climate. The building incorporated several structural and architectural features such as a waterfall on the façade of the eastern facing wall. Water runs planar with the wall upon the large glazed area. The water wall is powered by solar panels located on the roof, and the effect is the creation of two cool zones. The first zone is the exterior holding area for the visitors awaiting admission to the building. The second zone is within the interior space. This particular feature not only moderates the climate through passive (solar powered) energy sources, but also inspires an associative visual and thermal cooling effect that sets a tone for the overall character of the building. The latter effect is obtained from the volume of water that spills over the wall, which then absorbs almost all the infrared components of light, while allowing the rest of the visible spectrum to enter the building. Likewise, the falling water contributes to the building's aesthetics by creating focused skin transparency.

On the western wall, which receives direct sun light during the hottest part of the day, are stacks of shipping containers filled with water. This feature provides thermal insulation to the building because of the water's capacity to absorb heat. The north and south walls are composed of PVC coated fabrics, similar to the sails of yachts, that are fixed to bowed steel tubes. The building's south side is composed of a second layer of sail-cloth angled similarly to louver strips. This second layer provides added protection from the sun's effect on the facade (Eco-Tech, 1988).

Grimshaw's main theme for the building's design was climate and energy. His early sketches demonstrate the inception of passively moderated space between the extreme outside temperature of Seville, and the interior air-conditioned pods. The idea was then researched using the scientific method whereby different surfaces of the building were tested to ascertain each surface's response to



the sun's angle. As a result of ecological and climatic analysis and studies, a performative enclosure was designed. The performative and intelligent enclosure of this building thus allows the skin of the building to actively compensate through morphogenetic means for the deleterious effects of the sun and other natural elements (e.g. water and wind). The resultant architecture was the creation of a technical biosphere, with different morphing abilities that can transform or simply move from one state to another in a continuum of time and space.

#### 4.2 THOMAS HERZOG

Herzog's Youth Education Center, Guest Building in Windberg Germany, demonstrates an elaborate distribution of topological requirements for interior spaces. This is related to the type of building, and 24-hour programmed use of space. In other words, the allocation of the interior spaces was based on the function, disposition, use within a 24 hour cycle, and duration of time in the space. These factors thus led to the distribution of spaces within the interior volume of the building and overall ambiance of those spaces.

The interior uses and composition of interior spaces influenced the development of the exterior design and overall energy concept. Interior spaces were programmed and material selected based on temperature curves along the south-facing exterior wall of the building. Herzog used the positioning of auxiliary spaces to shield primary spaces, which he positioned deeper within the building in order to shield them from external temperature extremes. The northern tract, which tends to be colder, was dedicated to interior auxiliary functions such as circulation route, storage spaces and sanitary facilities. These spaces shield the interior primary functional spaces of the building and are able to withstand lower average temperature because the occupants only use those spaces for short and intermittent periods of time.

One of the main outcomes for this building was to use the sun as a source of internal heating. The use of translucent thermal and insulation material, as well as the external projection and incorporation of louvers to this facade was done to create thermal energy storage within two extreme temperatures. The design intent was to create a duality of functions for the enclosure system using the familiar concept of a trombe wall for heat storage, and as a barrier to heat loss. This was accomplished in an innovative, novel, and aesthetically pleasing manner (Kolarevic-Malkawi, 2005).

#### 4.3 KAHN'S DAYLIGHTING CONCEPT

Louis Kahn's daylighting concept used for the Kimbell Museum revolved around the use of leafs which would provide natural lighting within exhibition halls, by direct-ing indirect light from the roof. Thomas Herzog later adopted a similar concept for his design of Sprawling Design Center, Exhibition Hall in Linz Austria. Herzog expanded on the roof-leaf concept by incorporating an advanced light-transmitting roof that was first tested using scientific simulation techniques.

Renzo Piano also built upon this concept when he de-signed Menil Museum in Houston Texas. The roof-leaf system was composed of roof-panels' integrated within a plastic grid. This system introduced indirect luminous radiation from the northern hemisphere into the building. Conversely, during the summer months the system controlled excessive heat gain through a 16 mm deep retro-reflecting grid coated by a thin layer of aluminum, which prevents excessive heat from penetrating the building's internal spaces.

The roof leaf concept was subjected to numerous modeling and simulation studies involving a host of atmospheric conditions in order to develop and maximize a new roofing system that would facilitate and control light and solar energy. Likewise, the geometry of the plastic grid was determined by computer programs, while considering the angulations and elevations of the sun throughout the seasons. This was measured in relation to the orientation of the respective building, and slope of the roof.



## CONCLUSION

Using scientific research in design demands that architects think more broadly and assume responsibility for developing building designs that are knowledge-driven. Knowledge should be used to ensure that a design is adaptable and integrative within its context as well as perform technically, contribute socially, and remain economically feasible. Architects must be cognizant of their design's impact on the physical and social environment. While architectural liability is governed by the individual states, the general standard is one of reasonable care. Specifically, individuals performing architectural and engineering services are performing professional services, and the law imposes upon such persons the duty to exercise a reasonable degree of skill and care, as determined by the degree of skill and are ordinarily employed by their respective professions under similar conditions and surrounding circumstances (Housing Authority, 1989). In essence, the standard is relative to other architects in the community. If the community standards change, then it follows that the standards for individual architects should change, although not necessarily immediately. Resulting changes in an architect's ordinary standard of care should be carefully considered before any major shift in design practice, but the use of scientific research, which brings with it the ability of the architect to use measurable outcomes to inform the final design, it is possibly the best defense in the event of a lawsuit.

The three case studies above illustrate a fundamental shift in the practice of architecture, by demonstrating how research methods can be incorporated into the design process. Each example shows that a design was conceived; it was then evaluated and subjected to a research method in order to enhance a performance objective for the building, and thus constructed. Admittedly, the examples are limited to natural day lighting and thermal conditions, but the process of crosschecking a design against sets of performance criteria is the same. Ideally, a building would have multiple performance criteria that include response patterns to climate and geography, the psychobiology of the human condition, and the capacity of the building to facilitate and be responsive to various information technologies. The design inquiry should lead to a design outcome derived from viable and performative criteria, which can then be measured and compared to alternatives. Kahn, Hertzog, and Grimshaw are only three examples of how architects have incorporated these kinds of measurable research methods into the creative design process.

In Kahn's summary of stages within the design process as a means of inquiry for "finding of form" exists a highly desirable model that embraces and incorporates scientific methods throughout the design process. However, many architects believe that an invisible dynamic within the evolution of architecture currently blurs Kahn's original expression. They believe that scientific and scholarly inquiry—phase two in Kahn's process—shapes the physical context of design away from the form-finding process. In actuality, the inception of a design idea is followed by a hypothesis or research objective from which a research methodology can be identified. The creative architect can develop a broadly defined performance agenda for his or her work and thus arrive at a series of performance objectives. These objectives can be used to support a range of assessment tools, which enable the architect to be better equipped with evaluative feedback. This feedback can then be used to guide subsequent designs. Such a comprehensive approach to design will yield optimum outcomes that promote productive and satisfying environments while limiting exposure to liability.

There is no doubt that a need exists for this new breed of architects who can design from a holistic knowledge base. To better prepare the next generation of architects to meet evolving trends, the role of the academe will need to foster intellectual growth by altering the existing culture of narrow definitions about the design process used by the profession to a much broader and holistic paradigm that includes research and research methods. The call today is to stand upon the shoulders of these giants and to incorporate research methods into the design process.

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