academicJournals

Vol. 9(8), pp. 269-279, 30 April, 2014
DOI: 10.5897/SRE2014.5825
Article Number: BC843CE44207
ISSN 1992-2248 © 2014

http://www.academicjournals.org/SRE

Scientific Research and Essays

Full Length Research Paper

4F_C: A conceptual framework for understanding architectural works

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Received 29 January, 2014; Accepted 10 March, 2014

This paper presents a conceptual framework for understanding an architectural building by qualitatively discerning the complex issues involved in building design and systematically integrating them into a theoretical construct. The premise behind this framework is that, in design, a better understanding of what to design leads to a more informed understanding of how to design, resulting in a more structured and innovative architectural work. Using a grounded theory method, this paper postulates an ontological framework that recasts the Vitruvian triad of *utilitas, venustas*, and *firmitas* into spatial, intellectual, and structural form, respectively. More importantly, it expands this triad to include architectural thinking manifested as a formative concept as an integral component of any architectural work, and situates a design in its related context. Thus, this paper aims to close a gap in many architectural frameworks. The framework provided here offers a level of robust understanding of architecture that can become a foundation for a more effective and rational architectural design practice. This foundation can be used as a basis for structuring architectural forms, as well as describing and analyzing existing works of architecture. Its value exceeds theory framing and extends toward architectural pedagogy as a theoretical framework in teaching design studio.

Key words: Conceptual framework, architectural form, intellectual form.

INTRODUCTION

As a social phenomenon characterized by complexity and linked to multiple bodies of knowledge, architecture belongs to diverse disciplines. Architectural design in particular typifies a multidisciplinary design domain since architecture, engineering, and construction, each dealing with a particular feature of building design and each with its own concepts and interpretations, come together as one (Roseman and Gero, 1997). Furthermore, architectural design is an integrative and interdisciplinary process that calls for a deep understanding of 'what' to design in order to better inform 'how' to design, therefore involving complex requirements of material and immaterial knowledge (Friedman, 1992, 2003). A better understanding of such phenomena requires a multidisciplinary approach that distills concepts across domains and organizes them into a coherent structure, creating what is known as a conceptual framework (Jabareen, 2009). Developing a conceptual framework elucidates the basic concepts of a certain domain and helps to develop a common language within that domain,

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Table 1. Variations of the Vitruvian triad.

Vitruvius	Wotton	Gropius (Modern functionalism)	Norbert-Schulz	Steele
Utilitas	Commodity	Function	Building Task	Task Instrumentality, Shelter and security Social contacts
Venustas	Delight	Expression	Form	Symbolic identification Pleasure
Firmitas	Firmness	Technics	Technics	Growth

providing the uniformity necessary to a better understanding of the phenomena (Shields and Rangarajan, 2013).

This paper postulates such a conceptual framework for understanding 'what' a work of architecture is through the development of a meta-level integration of various conceptions of architectural form. This framework facilitates an understanding of architectural form by expounding its underlying constituents and integrating them into a coherent whole, thus, allowing for a more structured description, interpretation, and generation of proposed works for study, and, consequently, a more structured discourse of architectural design.

Many researchers and theoretician have attempted to formulate a definition of architecture through a determination of its ruling principles (Gharibpour, 2012). However, most of these attempts can be traced back to one of the oldest and most enduring sets of architectural principles, proposed by Vitruviusin his treatise *De Architectura* in the first century BC: *venustas* (beauty), *firmitas* (firmness), and *utilitas* (commodity) (Stein and Spreckelmeyer, 1999). Associated with aesthetics, structure and technology, and function, these three concepts have played an important role in the history of architecture. Different theoreticians have used the same triad with different cultural and historical gradations (Lang, 1987). Among these are Wotton (1624, 1897), Gropius (1947), Norberg-Schulz (1965), and Steele (1973), among others, as summarized in Table 1.

Researchers tend to emphasize one or more of these aspects and use them as a base for understanding architecture. Semper (1851, 2011), for example, emphasized the technical aspects of architecture, explaining its origins and history with four distinctive elements and stages: hearth, roof, enclosure, and mound. Frankl (1973) analyzed architectural styles based on spatial composition, treatment of mass and surface, treatment of optical effects such as light and color, and the relation of design to social function. Researchers in other fields, such as artificial intelligence and design computing, have also proposed schemas to characterize design artifacts. Stiny and Gips (1978), for example, presented anaesthetic algorithm machine for the analysis and generation of designs in art and architecture. Stiny and March (1981) created algorithmic design machines to model the design process. Gero (1990) presented a function-behavior-structure (FBS) framework to describe the three variables of a designed object. Tzonis (1992), similarly, developed the POM system, emphasizing performance, operation, and morphology as representative of the precedents, principles, and rules of architecture. Extending the design machine of Stiny and March (1981), Economou and Riether (2008) also presented a 'Vitruvian machine,' which maps Vitruvius's triad of *venustas*, *firmitas*, and *utilitas* into a formal structure. Dahabreh (2014) presented the AD_M machine emphasizing design desiderata, formal design languages, design thinking, technology, and context as a framework for structuring architectural design knowledge.

However, most of these models do not account for the crucial components of an architectural work and thus cannot be used as a conceptual framework for architecture. First, as a building symbolic performance is inseparable from time and place (Piotrowski, 2001), the relation of the work to its context and the dynamic role of the context in shaping the building's architectural form and design process are of extreme importance. Accordingly, the context becomes an integral component for understanding what a particular work of architectural design is and must be incorporated within any conceptual framework for architecture. More importantly, architectural design is a reflexive process-in other words, it involves critical reflection on the part of all the constituents of a design situation. Through an internalized design process, designers add to a design situation according to their concepts and reflections (Peponis, 2005), framing it within a context that goes beyond beauty, firmness, and commodity and eventually affecting the final form of a work. Accordingly, design reframing is accomplished through conceptual thinking. This not only affects the structure of the design constituents but also becomes embedded within the form of a work itself, making it imperative to introduce design concepts as part of an answer to what an architectural work is.

Through a qualitative description of a work of

architecture, this paper aims to develop an architectural framework that clarifies the basic concepts involved in any work of architecture and incorporates the context and these design concepts. By no means is this framework intended to be a fully detailed account of what architecture is; rather it lays out the key concepts and constructs and posits some relationships among them. These concepts are the building blocks with which designers reason about architectural form; thus, they govern design intelligence. The framework structures existing academic debates about architecture in terms of a basic taxonomy of concepts and propositions and accordingly allows for sensible debate to take place.

MATERIALS AND METHODS

Jabareen (2009, p. 51) defined a conceptual framework as "a network, or 'a plane,' of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. "The aim of a conceptual framework is to provide an organizing scheme for a phenomenon through the organized structuring of concepts that constitute that phenomenon (Shields and Rangarajan, 2013). The constituent concepts that articulate the respective phenomena support one another and establish a framework-specific philosophy. Conceptual frameworks are based on ontological aspects (that is, what they are), epistemological aspects (that is, how they are), and methodological aspects (that is, how assumptions about them are formed) (Guba and Lincoln, 1994). Of interest here is the ontological aspect of a conceptual framework. In the field of design computing, ontologies are structured conceptualizations of a domain that are defined in terms of the entities in that domain and their relationships (Gero and Kannengiesser, 2007). They present a knowledge set about a subject, and describe the basic objects, classes, properties, and characteristics and the relations between them (Aksamija, 2009).

One of the strongest features of conceptual frameworks is that they assimilate knowledge from several disciplines and integrate them into a theoretical construct (Jabareen, 2009). As such, they are an excellent mechanism for understanding multidisciplinary domains such as architectural design-where art, theory, engineering, and construction, among other disciplines, come together. As conceptual frameworks are formed through qualitative analysis, they do not provide knowledge of hard facts but offer soft interpretations of intentions or concepts (Levering, 2002). They aim neither at providing explanations nor at predicting outcomes that address questions of how and why. Rather, they provide an understanding of what constitutes a certain phenomenon.

Jabareen (2009) proposed building conceptual frameworks from multidisciplinary literature through conceptual framework analysis. A conceptual framework analysis is composed of: 1) identifying and mapping selected data sources; 2) identifying and naming the main concepts within the identified literature or source of data; 3) deconstructing and categorizing the concepts in order to identify the concepts' main attributes, characteristics, assumptions, and roles; and 4) consequently organizing and categorizing the concepts according to their features. The result is an integration of concepts into constructs or mega concepts and the synthesis of these into a conceptual framework. This paper follows the same methodology in constructing the proposed conceptual framework for architecture.

Understanding architecture: Identifying concepts

According to Ulrich (1988), the ability to reason about an artifact depends upon the ability to abstractly categorize that artifact and provide a minimal description of its salient structural aspects. For Tzonis (1992), any intelligent design system should describe the most significant aspects of how artifacts work, how they are made, what they do in respect to what is expected, how they fit into the surrounding environment, and how all these aspects are interrelated. Describing architectural works, however, is not an easy task; buildings can be described according to the context in which they operate, according to their features and properties as designed artifacts, and/or according to the functions they need to perform. Hillier et al. (1984) defined buildings as cultural artifacts that can be regarded as material constructions, spatial arrangements, and objects in a particular style. The fundamental function of spatial organization, labeled by the German theorist, Frankl (1973) as spatial form, is to accommodate human activities that respond to the needs and values of different individuals, groups, and institutions. According to Hendrix (2012), the modern connotation of the word function with respect to buildings is related to the building's use or utility for housing human activities. By designating a projected building to house a certain institution, an architect gives the building a label (e.g. hospital), which defines its functional type. According to Markus (1987), for any building to function effectively (that is, accommodate the functions required by an institution occupying the space of the building), the building must organize people, objects, and activities into meaningful relationships within a space. This spatial form represents what a building does. Thus, it can be inferred that the primary function of a building is the organization of space through the building's formal configuration.

As projected buildings do not exist in reality, building programs are the means through which building sponsors or owners describe and/or prescribe their future buildings to designers and communicate them to users and other stakeholders in the projected building. According to Capille and Psarra (2013), the program is both a trans-spatial and a spatial manifestation: *"The transpatial aspect defines purposes, activities and roles for different groups of people. In this sense, the program can be understood as a social script. The spatial dimensions of program refer to the ways in which this social script is embedded in space through a pattern of distribution, affordances and labeling "*(p. 18). The division of the space inside a building is not adhoc; many buildings have explicit rules about how people, objects, and activities are disposed in space so that the spatial embodiment of these dispositions represents the particular practices or knowledge in a certain field. This insures proper functioning of the institution or building (Markus, 1987). These rules impose restrictions on the location (e.g. adjacencies and proximity, zoning of different functions, accessibility, and movement between spaces). Accordingly, housing functions inside the building are arranged into zones and spatial relations are organized according to the rules that govern the functioning of the institution. A building's operation and performance are also associated with a building's function. Building operations refer to how the form of a building controls, maintains, or channels people, objects, and equipment associated with activities (Tzonis, 1992). According to Zarzar (2003), a building's performance is determined by the functions that the building was intended to carry out.

The material construction (that is, the structural form) shapes the space and signifies how to construct the physicality of the building. The material construction of the building involves engineering and construction aspects (Rosenman and Gero, 1997): structural engineering addresses concepts of stability and support of the building and accordingly is concerned with various structural systems, materials, and technology. Mechanical and electrical engineering are concerned with the operation of a building. They intersect with the functionality of the building in terms of serviceability and the provision of suitable conditions for functioning. Accordingly, mechanical and electrical engineering are concerned with electromechanical systems. The materialization of

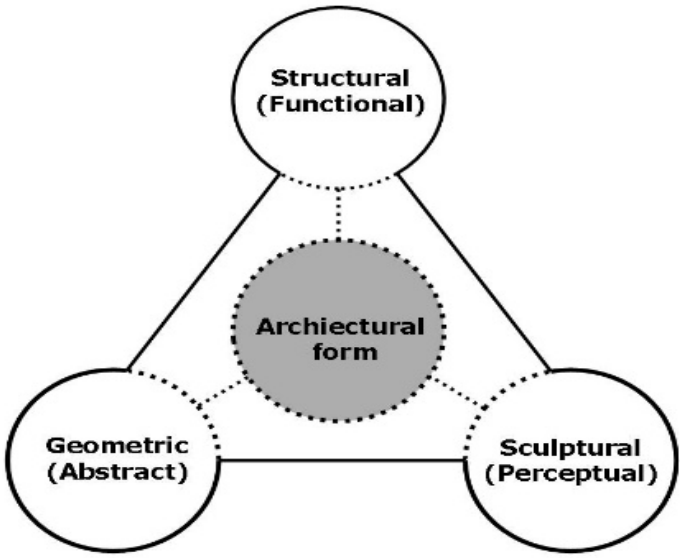

Figure 1. The components of architectural form as proposed by Vitruvius.

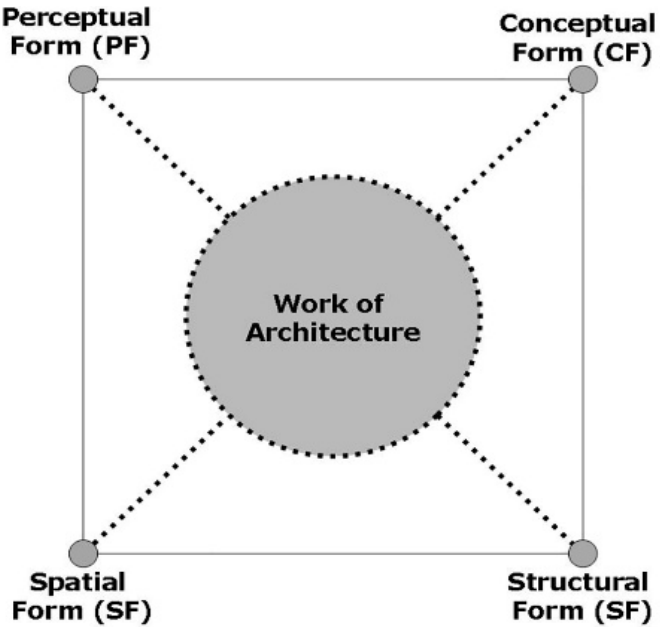

Figure 2. Four types of form defining a work of architecture.

architectural work into built form is the responsibility of contractors and involves the process of transforming raw materials by means of engineering knowledge and technical know-how. Contractors are concerned with constructability, the relationships between physical elements, and the operations and sequence of operations required to construct the building. In other words, contractors concern themselves with concepts such as availability, composition, stability, time, place, and so on.

Material construction also has visual qualities that depend on the materials used, the color, and the surface texture, as well as aspects of construction and detailing that characterize space such as moldings, grooves, changes in materials, and so on. These elements add cultural significance and aesthetic appeal. Through material construction, buildings organize and structure space and transmit social meaning through their physical form. This point confirms with what Hiller's (2007) statement that:

"A building then becomes socially significant . . . in two ways: first, by elaborating spaces into socially workable patterns to generate and constrain some socially sanctioned-and therefore normative-pattern of encounter and avoidance; and second, by elaborating physical forms and surfaces into patterns through which culturally and aesthetically sanctioned identities are expressed." (p. 24)

Material constructions have formal attributes such as design elements, architectural vocabulary, design principles, and so on that not only are material in nature but also have a cognitive, conceptual, and affective dimension (Peponis, 2005). In that sense, material constructions have abstract and architectonic aspects, usually expressed geometrically (Unwin, 2003), that signify how to logically and formally structure the materiality of the building. In this sense, architecture can be regarded as an intellectual activity consisting of underlying conceptual systems (Unwin, 2008) that structure the building elements and organize the material construction. These generate the formal properties of the building and accordingly subdivide the space of the building into a spatial pattern. The distinction between the abstract and the material was made 500 years ago by Alberti in the 15th century in his *Ten Books on Architecture*. He distinguished between a building's geometry and material construction where the function of geometry (lineaments in Alberti's terms) is to *"prescribe, and appropriately place, exact numbers, a proper scale, and a graceful order for whole buildings and each of the constituent parts"* (as cited in Dahabreh, 2006, p. 179).

Consequently, the form of the material construction can be read as a structural form of utilitarian nature that supports the building's or structure's space, a perceptual form related to the articulation of surfaces and pertaining to sensory perception and experience, and a conceptual or logical form that orders the elements and regulates the material form. These three kinds of forms are related to the material structure described by Vitruvius's model of the structural, sculptural, and geometric, as identified by Agudin (1995) (Figure 1).

The spatial form of an architectural building and its structural, perceptual, and conceptual forms are interrelated and cannot be separated. Each affects and conditions the other, and all exist simultaneously in every work of architecture. Together they constitute architectural form (Figure 2). It should be noted that the categorical distinction between spatial and physical form, or between the two aspects of physical form (that is, structural and intellectual), is not intended to capture two or more kinds of organization. Rather this distinction recognizes the different aspects of a building that become important depending upon the kinds of questions one asks (Bafna, 2012).

Hendrix (2012) distinguished between two functions of form in architecture: a communicative function, which involves expression and representation as fulfilled by perceptual and conceptual forms, and an instrumental function, which is expressed in terms of utility and technology through spatial and structural forms, respectively. Accordingly, the constituent forms of architecture can be regrouped into three forms: spatial, which is related to utility; intellectual, which combines conceptual and perceptual forms and relates to the agency of the intellect; and structural, which relates to technology and construction (Figure 3).

These three forms are synthesized through the design process, which can be defined as an intentional process that begins with a conceptual description of a situation requiring action and develops toward a concrete, syntactic description of an artifact as a response to that situation (Meyer and Fenves, 1992). This process involves critical reflection upon the situation, framing it in a way that goes

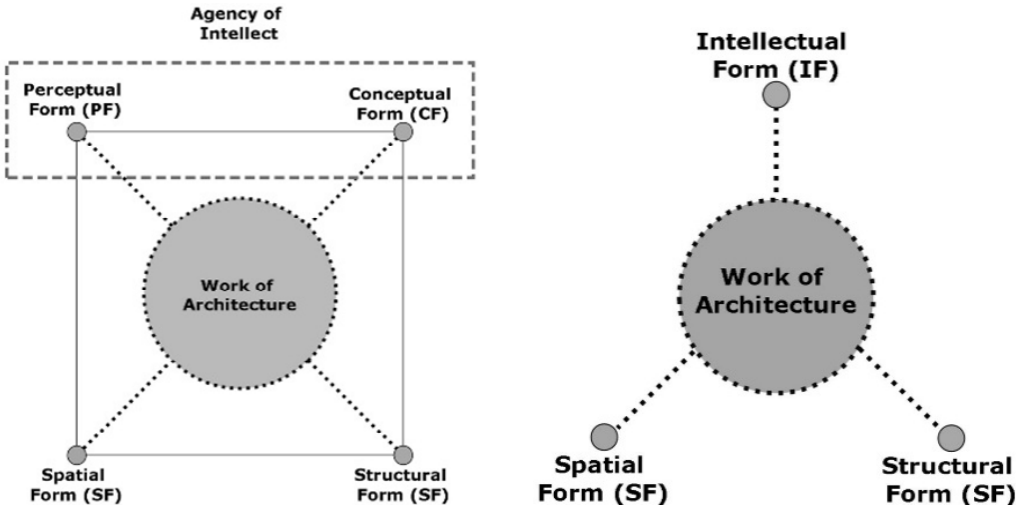

Figure 3. Architectural work understood as spatial, intellectual, and structural forms.

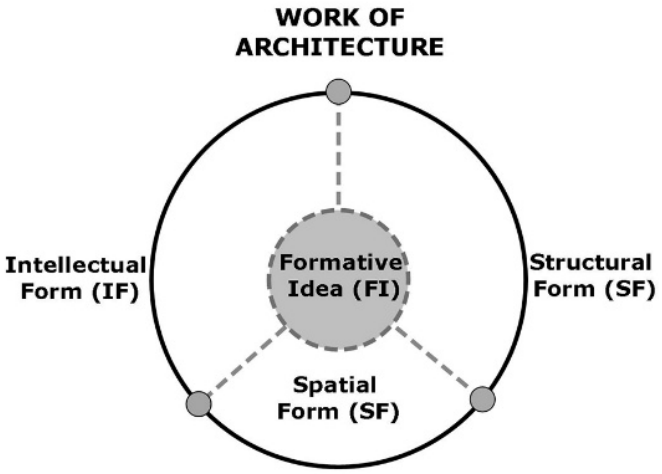

Figure 4. Intellectual form as the integrator of architectural work.

beyond the immediate conditions and leads to new understanding (Dahabreh and Ghanimeh, 2012). This new understanding necessitates the reformulation of several design constituents (e.g., structural form, instrumental form, and spatial form) in an innovative manner to address the conditions of the new situation. Moreover, the synthesized architectural form becomes an object in its own right requiring investigation and examination.

This process of reformulation involves the exploration of aesthetic aims through the manipulation of form and evaluation of the proposal against the design desiderata (Peponis, 2005). This type of thinking is known in architectural design literature as the design concept. It refers to *"how the various aspects of the requirements of a building can be brought together in a specific thought that directly influences the design and its configuration"* (McGinty, 1979, p. 215). As such, design concepts are formative ideas that designers use to influence or give form to design (Clark and Pause, 1996). Formative ideas include additional aims or inflections of aims brought about by designers in the course of design, as well as the aims of design as intrinsic to the designed object; therefore they cannot be initiated before the design process begins (Peponis and Wineman, 2002). According to Schumacher (2011), this type of theoretical reformulation and innovation differentiates architecture from mere building. This theoretical intent manifests itself in the choices made in the design process and is embedded in the final form of the building. Essentially, one can detect in the form of the building the conceptual input. Consequently, an architectural building has an abstract and conceptual aspect (that is, a formative idea) that integrates the spatial, structural, and intellectual forms into a unified whole, providing a logical order that governs and organizes the material construction and expressing how a designer reasons about the design situation and what he or she has added. Thus, the diagram of architectural form in Figure 3 can be recast to integrate the formative idea as the heart of any architectural work (Figure 4).

Kolodner (1993) defined a case as "a contextualized piece of knowledge representing an experience that teaches a lesson fundamental to achieving the goals of the reasoner" (p. 13). In light of Kolodner's statement that reasoning about any case cannot be separated from context (that is, the situation under which the case evolved and took place), the final constituent of the conceptual framework is the context under which architectural work was conceived and in which it exists. The inclusion of context as part of the understanding of a work of architecture stems from the fact that humans exist in a natural physical environment and operate in a socio-cultural one that prescribes their values and goals. Both of these environments establish human needs, whether perceived or real, physical or nonphysical. When the surrounding conditions do not meet the needs of humans, designers "devise courses of action aimed at changing existing situations into preferred ones" (Simon, 1998. p. 112), accordingly, creating new artifacts that belong to a techno-physical environment (Rosenman and Gero, 1998). Thus, the satisfaction of human needs belonging to one or more of the contextual environments becomes the motivation behind the initiation of the architectural design process. These motivations become the goals the work is designed to accomplish. They define the requirements that state what properties-functional or constructional-an artifact should have from the perspective of the goals of the stakeholders (Greefhorst and Poper, 2011).

Additionally, context plays a proscriptive role in architectural design. By being constrictive in terms of its physical or techno-physical nature (e.g., topography and climate) or controlling by setting rules and regulations for design (e.g., building codes and

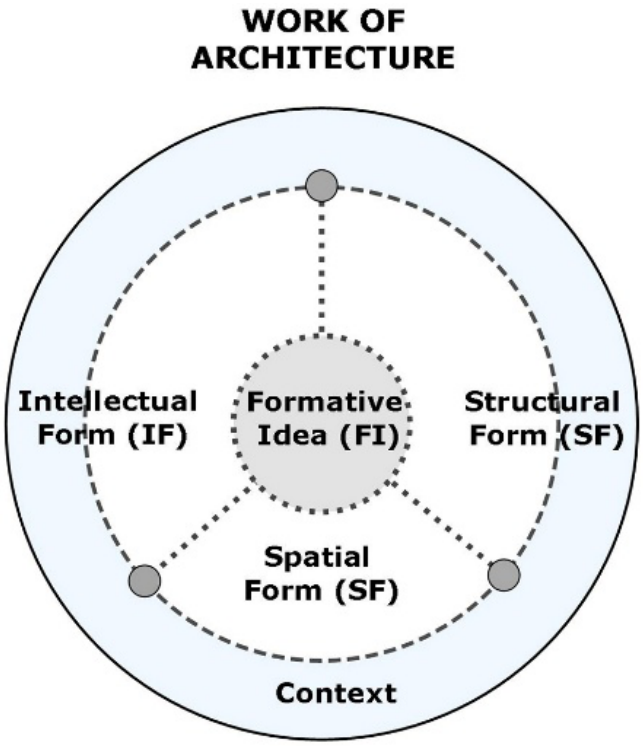

Figure 5. Architectural work as an integration of the five concepts.

Figure 6. The Smith house.

zoning), context constrains the design, specifying what should not or cannot be done. Finally, building operation and performance are conditioned by the circumstances of the surrounding context. As such, understanding what a work of architecture is cannot be complete without understanding the conditions under which conception, formation, and materialization take place. The final conceptual framework is presented in Figure 5.

According to the conceptual framework presented in this paper, an architectural building can be understood as a material construction molded though a formative idea, structured by intellectual requirements, that regulates functional requirements and mathematical and physical necessities (technology and construction)-all within the constraints of a context. In order to elaborate on the practical application of this framework, a case study is described and analyzed using the main components of the framework.

Case study: Smith house

The Smith House (1965, 1967) was built as a vacation house for Fredrick and Carole Smith and their two children. Overlooking the Long Island South, the house stands as a white, painted, stand-alone rectilinear block on one-and-a-half acres along the rocky coastline of Darien, Connecticut. It is constructed of vertical wood siding, steel Lally columns, and glass with brick for the chimney (Figure 6). The three floors of the house (Figure 7) are occupied by a two-story living room and dining room, which open to outdoor terraces; a kitchen with service areas on the ground floor; an entrance area, a master bedroom and accompanying bathroom, two individual bedrooms and a bathroom, a guestroom, and library/play balcony overlooking the living room. The house is topped by an outdoor roof deck.

Intellectual, spatial, and structural forms, along with the formative idea presented earlier, are used to structure the description and analysis of the Smith House, both qualitatively and visually. The generic antecedent of the house is a rectilinear block. The intellectual form of the house encompasses both perceptual and conceptual forms. Conceptually, the house was conceived as a rectilinear block configured by manipulation of the most basic architectural elements: column, plane, and mass. The block's inherent geometric order of axes, regulating lines, and symmetry structure the relationships between elements and the spatial and physical massing of the house. The allocation of walls, columns, subdivisions, and additions, as well as the overall massing, is based on ideal geometries and is disciplined through Meier's use of modules and proportional systems such as the 1:√2 ratio. Externally, however, the block does not remain in its platonic state. Meier articulates the mass through additions and subtractions: one side of the block is partially subtracted to emphasize the main stairs whereas two masses are subtracted from the opposite side to create terraces on the ground and first floors. A vertical chimney stands opposite the entrance ramp, and a stair projects outside the block in diagonal relation to the main stairs inside (Figure 8). Perceptually, Meier affirms the dominance of an ideal and abstract aspect of his design through the colorlessness and a-contextualization of the free-standing mass of the house. The wood framing is painted in white, giving the impression of a totally white mass. The outer skin is articulated by window fenestration on one side and the expansive use of glass on the other (Figure 9).

The interior volume of the house is articulated into a distinctive spatial form. Horizontally, the volume is split into three sub-volumes using two planes. Vertically, the interior space is split into two volumetric systems. First, there is a dynamic and expansive volumetric system created by subtracting and interlocking slabs, thus, generating spatial interpenetrations and double volumes (Figure 10a). Second, there is a static volumetric system made of compact and cellular small volumes (Figure 10b). As these cellular volumes are expressed individually-and can only be experienced through sequential progression from one volume to another or via a

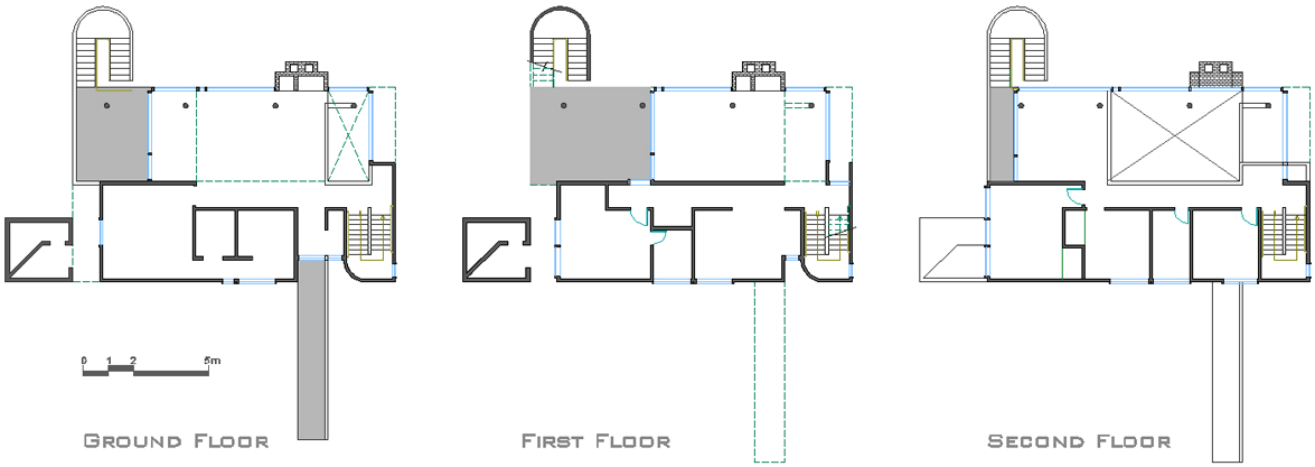

Figure 7. The layout of the Smith house. Redrawn by Author.

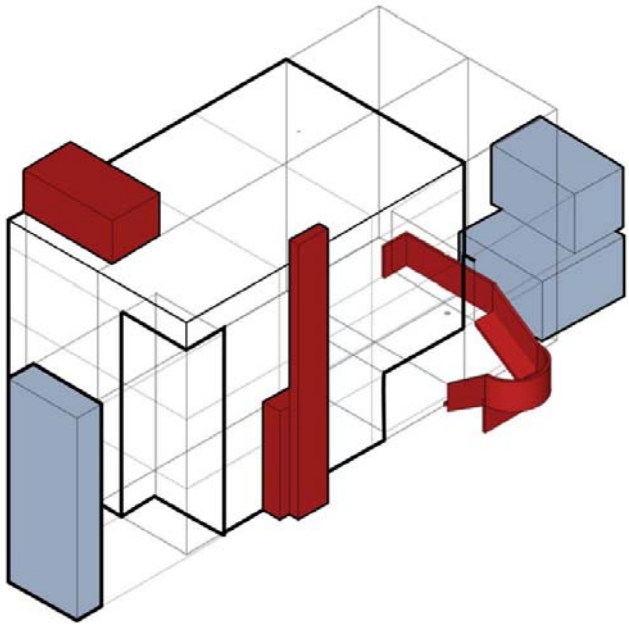

Figure 8. Animation and articulation of the house.

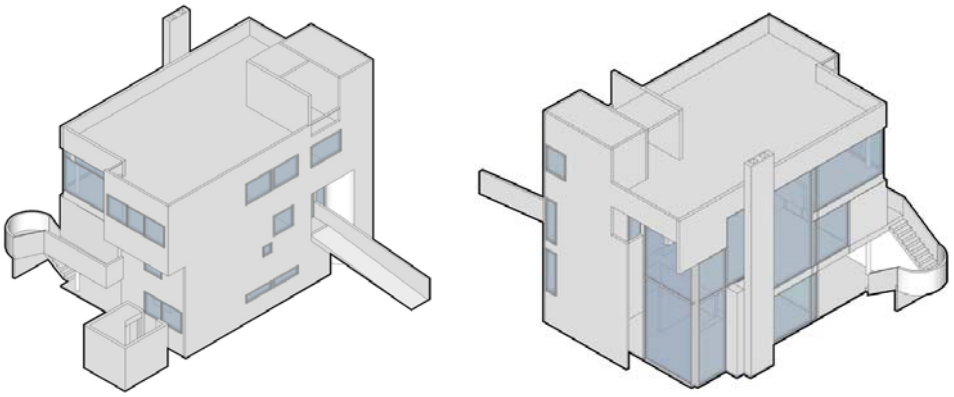

Figure 9. The dual treatment of the outer skin.

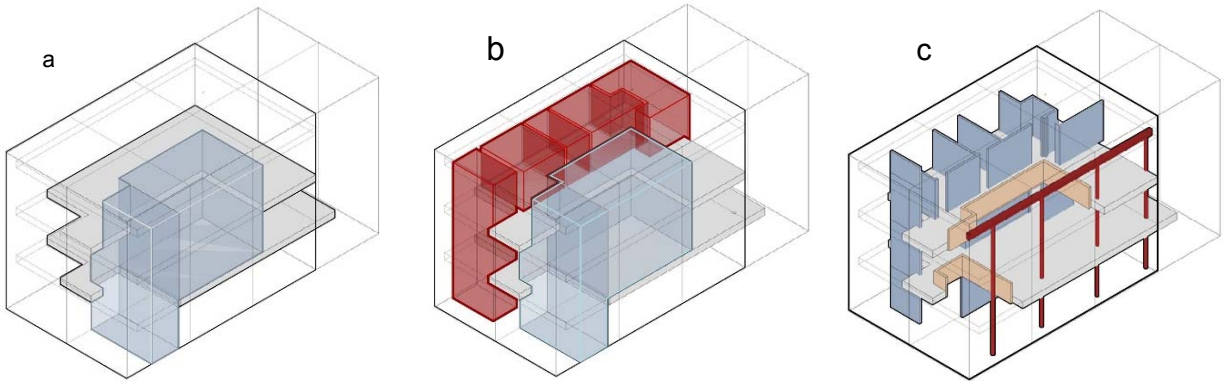

Figure 10. The internal volumetric subdivision of the house.

connecting volume-Meier organized them linearly and inserted a transitional volume that connects the separate volumes and mediates between the cellular and expansive systems. These linearly layered volumetric systems are demarcated by columns and walls (Figure 10c). Inside the house, they express a programmatic separation of the public and private. The cellular volumetric system houses the private activities such as the bedrooms, bathrooms, kitchen, and service areas whereas the expansive zone houses the open spaces such as living areas, the library, and the dining area. The corridor running parallel to the main axis of the house mediates these functional zones on each floor.

The structural form of the house enables the creation of the volumetric systems through the use of a dual structural system. Wood-framed bearing walls surround and support the enclosed cellular system while steel columns and support beams form the structure of the continuous volumetric system (Figure 10c). Meier designed the house in direct contrast with the context such that the whiteness and machine aesthetic of the mass contrasts with the natural green setting of the house. Through this contrast, Meier creates a state of tension and reconciliation between the natural and the man-made, a composite order such that the man-made points to the natural and acts as a stage for appreciating nature.

The question that remains is, Why did Meier design the house in this manner? A partial answer to this question can be traced back to commentary by Colin Rowe (1975), who saw the design of the house as a dialectic scheme between the ideal and abstract (which have to do with formal design systems and principles) and the real and analytic (which have to do with design desiderata made up of constraints drawn from the site and program, circulation and entrance, and structure and enclosure). Thus, the basic formative idea of the house can be identified as the duality of binary oppositions, a duality that divides functions into public and private, enabling the reading of a single block intellectually as mass and surface. It also structures the spatial form into cellular and open volumes, necessitating the use of a dual structural system, and creates a state of tension between the natural and man-made. Table 2 summarizes the description and analysis of the house.

RESULTS AND DISCUSSION

Table 2 shows the theoretical density and repleteness of the Smith House are unraveled and made discrete through the application of the conceptual framework. The constituents of the framework provide an explicit and systematic review of specific concepts related directly to the design of the house. They constitute the main categories according to which the house is described and analyzed, and they frame and structure the qualitative description, stipulating the type of representations needed to express the description. Furthermore, the conceptual framework provides two added values. First, the use of spatial form instead of function or utility as in the Vitruvian triad shifts the focus toward the quality and geometry of space in terms of 3-D volume and visual articulation, away from the qualitative description of activities housed within a space. This enables a better description, both verbal and geometric (that is, diagrammatic), of the functionality of the house and provides a more formal, representative means for manipulation and design in projected future designs. In other words, the provision of functions as 3-D volumes facilitates the formal manipulation and design of projected spaces. Second, the transfer from aesthetics in the Vitruvian triad, which involve appreciation of sensible characteristics of an object or an emotional response to these characteristics, to the intellectual form of an object signifies an intellectual shift toward seeing beyond the sensible appearance and accessing the principles of creation and underlying logic through the application of intelligence. Accordingly, the description and analysis of the Smith House here is concerned with identifying the elements of its design, their relationships, and the principles governing these relationships instead of describing the physicality of the house.

More importantly, a description and analysis of the house based solely on the Vitruvian triad would not address the concept behind the design of the house. The concept of duality guides the design of the house, giving rise to some of the house's properties, which structure the interaction of the intellectual, spatial, and structural forms, uniting them in the final form of the building. Identifying the formative idea of duality explains why the house took its final form and how intellectual, spatial, and structural forms were integrated to express the concept in the built form. By explaining why, the formative idea addresses

Table 2. Summary of the description and analysis of the Smith house.

Conceptual framework		Questions asked	
Formative idea		How did the final form come about and how was everything integrated and reflected upon?	Duality of binary oppositions
Intellectual form	Conceptual form	What are the architectonics of the building in terms of elements, principles, and transformation processes?	Single block Columns, planes, and mass
	Perceptual form	What is the materiality of the building and visual expression in terms of construction and final finish?	Single abstract form with machine-like detailing
Spatial form		What functions are housed and expressed volumetrically with their relationships?	Private/cellular volumetric system Public/continuous volumetric system
Structural form		How was the building constructed and supported?	Load-bearing walls Column and beam
Context			Contrast and tension

the issue of what the designer is trying to achieve over and above the constraints of the functional requirements and particularities of the design language. In that sense, buildings can be perceived as formations with systematic formal aspects such that the various elements that make up their form are not circumstantially brought together but are organized under the systemizing influence of a formative idea.

As seen from the case study, addressing a work of architecture through forms, allows the construction of a framework which answers questions that deal with what to design, how to design it, and how to construct it. The framework categorically identifies the kind of knowledge needed for each question, including the substantive knowledge necessary for understanding what to design, the procedural knowledge addressing how to design, and the reflexive knowledge related to concept formation and critical thinking.

Thus, within the conceptual framework, the Smith House can be understood as a material construction formed by the concept of duality, which structures a specific form comprised of platonic forms juxtaposed in asymmetrical but balanced composition and animated by the use of the basic architectural elements such as point, line, plane, and mass. This form regulates functional requirements into private and public zones, expressed as cellular and continuous volumes that are constructed by a dual structural system of load-bearing walls, columns, and beams. The well-crafted form is then set in contrast with a natural, all-green setting.

Conclusions

This paper proposed a conceptual framework for understanding architectural works. The conceptual framework comprised spatial form, intellectual form, structural form, formative idea, and context. The bridges between the different domains present a structure of the different concepts that constitute an architectural work and enable the understanding of what is a work of architecture. The main thrust of this framework is that it expands the traditional triad of *venustas*, *firmitas*, and *utilitas* to include how to conceptually think about an architectural work. The framework reintroduces context as an integral concept in understanding what a work of architecture is. As such, through its main constituents, the framework answers five basic questions pertaining to analyzing, synthesizing, and evaluating any architectural work: What does a building do and what is the logic of its spatial organization? How is a building physically constructed? How is a building intellectually (that is, formally) structured? Why does a building take its final form? Finally, under what conditions does it take this form? By presenting the basic concepts of designing any work of architecture as forms, this framework avoids the ambiguity of terms such as function and aesthetics and refocuses the attention of the designer on the geometry and visual representations of forms that can be visually expressed, manipulated and articulated.

In that sense, using forms to abstract the materiality of a work of architecture, captures underlying ideas and concepts and represents them visually. The visualization and expression of these forms diagrammatically enables the framework to act as a posteriori framework for architectural analysis and criticism by providing a systematic description and interpretation of built works of architecture. Such a framework can also be used a priori structure to support architects in the conceptual stages of design where it draws the attention of designers to the

basic aspects that need addressing at the beginning of the design process. As such, it is of pedagogical value as a didactic tool for teaching in a design studio or as a framework for architectural morphology.

The 4F_C framework, through the clarification of concepts, depicts the underlying status quo of an architectural work and enables communication between interested communities. By explicating the status quo, this paper offers a platform for structured debate concerning the nature of architecture and architectural works. Further, the shortfalls in the existing body of knowledge open up venues for further reflection and investigation.

Finally, the conceptual framework is a generic, meta-level framework that only describes generalized concepts of relevant and interrelated knowledge necessary for architectural design. This framework provides a new foundation for the development of a more intelligent knowledge-based design model that is relevant for architectural design. Furthermore, each of the concepts within the framework can be further broken down into smaller and more detailed schemas and frames for investigation and modeling.

Conflict of Interests

The author(s) have not declared any conflict of interests.

ACKNOWLEDGEMENT

This research has been made possible by a research grant from the University of Jordan.

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