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EXPLORING INDIVIDUAL STYLE THROUGH WRIGHT'S DESIGNS

Chiu-Shui Chan

Style traditionally has been studied by architectural critics and historians to observe the characteristics of certain forms produced by designers. They concentrate on the interpretation of the social, cultural, and historical context of distinctive expressions embedded in forms to differentiate styles. In this study, style is interpreted from forms of artifacts as well as from a design-processes point of view. It is proposed that a design product is a function of a design process. The style that exists in a design product is caused by repetitious applications of some factors involved in a design process. Frank Lloyd Wright's design works are selected to provide supporting evidence. Results show that styles can be identified by common features caused by the replications of the same sets of design constraints, principles, and methods and the same fixed sequences of design procedures. Thus, it is argued that styles are results of consistent acts in design process.

INTRODUCTION

In aesthetics, style has been considered as the mode of expression and has been used to identify the differences between periods, groups, or individual works. For the historian of culture or the philosopher of history, style manifests the culture as a whole. They study forms and qualities shared by all the arts of a culture during a particular time span. The art historians study the inner correspondences, life-history, and the change of styles. They use style as a criterion to date and to identify the original works and as a way to trace the relationships among groups (Schapiro, 1961). Hence, style provides a structure for the history of art. Art historians create classes such as Impressionism (group style), Baroque art (historical style), or Picasso's Blue Period (individual style) on the assumption that a certain complex of elements common to a group of works is sufficiently stable, distinct, and relevant to justify characterizing it as a style (Ackerman, 1963).

Current concepts of style developed in the fields of music, painting, poetry, sculpture, and architecture can be categorized as having two major branches. One refers to the way of doing things or the process of making a work of art, and the other deals with the product itself or the form of artifacts (Weitz, 1970). The notion of discussing style from the form of artifacts emphasizes the repetitious and constant forms, elements, qualities, or expressions appearing in several artifacts (Schapiro, 1961; Ackerman, 1963; Smithies, 1981). On the other hand, discussions of style based on the way of doing things concentrate on the distinctive and recognizable ways resulting from a series of choices made in the process (Gombrich, 1960; Sparshott, 1965; Gombrich, 1968; Simon, 1970; Meyer, 1979; Akin, 1986).

In this study, the essential object of style is the individual style in architectural design examined from design processes. The purpose of this research is to propose a new paradigm to explain individual style, specifically to explain how a style is generated from design processes.

Style exists in the form of a final product. A form that has an outward appearance and a distinctive shape is referred to as a feature. A style can therefore be identified by a set of common features constantly appearing in a set of designs. Because features are design products generated by some factors in design process, style is operationally defined as the constant features present in design products that result from constant factors in design processes. The factors that may affect the formation of style include: design constraints, design principles, design methods, and certain fixed sequences of procedures used in solving a subproblem or a design issue. The study of these factors in design processes is the major concern in this research.

The proposed operational definition of style implies that style can be identified by the factor of replication. Inasmuch as a style is generated by a process, there are three possibilities: (1) a new style is created (an innovation in style); (2) the same style is maintained (replication of style); or (3) the combination of both (some innovations and some replications). This research focuses on the second possibility -- how style is maintained across products -- to investigate the factors that influence the emergence of styles. To do so, style is first identified by the shared common features that appear in designs, and then the underlying factors that generate these common features are identified. An architect's design works are used as a case study to test and justify the theory that style is generated from design processes.

Three major tasks are involved in this case study. The first task is to collect many designs done by the same architect and to identify the replicated features in these designs. The second task is to trace constant design concepts underlying these constant features. This is accomplished by

collecting data about design concepts explained by the architect, and observing how these concepts are implemented in his or her designs. By doing so, it is possible to get insight into the causes of form repetitions. The last task is to study whether some constant design methods or certain sequences of design processes are used by this architect, and to analyze whether these particular methods or processes yield particular characteristics in forms.

Data used in this study are collected mainly from publications instead of psychological experiments. In most architectural periodicals, architectural designs are presented with photographs and illustrations of the project, together with the author's interpretation. Under these circumstances, it is not difficult to obtain pictures or drawings for a particular design. It is, however, a bit difficult to get data about the design processes, except through protocol analysis, because architects seldom explain their design processes or design methods. If they do so, their explanations given after design are retrospections rather than reflections of what may have actually happened while they were designing. Thus, their given explanations of design processes or methods should be seen as descriptions of their "general" ways of doing things. Therefore, after collecting information available from critics and from the designer's writings and speeches, this case study should be able to provide a picture of an architect's general design processes, methods, and the corresponding features they generate. This should serve the primitive purpose of justifying the operational definition of style. The famous American architect, Frank Lloyd Wright, will be used as the subject of this case study.

Wright is selected as a candidate subject because: (1) Wright's designs possess abundant common features, which reflect a stronger degree of style (Chan, 1990b); (2) Wright had by far the most individualistic style of his generation; and (3) Wright developed a complete vocabulary of his own. The study of his works may facilitate the immediate purposes of demonstrating the concepts developed in this research. Also, the Prairie style was Wright's first style, and the Prairie houses were designed consecutively and intensively within a ten-year period. This period provides a relatively pure context for observations. The task is further aided by the fact that so much has been written by and about him, and thus far more documentation exists for Wright than for most architects in the United States.

It should be emphasized that this case study is to test the proposed theory. If the theory is supported, this case study will serve as a sound base for future studies. Increasing the sample size of the study should strengthen the validity of the theory. The same method has been replicated in a laboratory experiment to study the design processes of an architect to explore how a style is generated in a design process. Similar results from evidences and proofs in that experiment are discussed elsewhere (Chan, 1990b). Thus, the approach described may be applicable to other architects. The concept of individual style implemented in this case study and the explorations of Wright's Prairie houses also should provide us further understanding of Wright's style.

RELATED BACKGROUND OF FRANK LLOYD WRIGHT

Frank Lloyd Wright (1867-1959) can be considered as primarily a residential architect. During his seventy years of architectural production (1888-1959), from the earliest houses Wright was responsible for designing in the employ of Louis Sullivan to the buildings carried to completion by the Taliesin Associated Architects from Wright's extant designs after his death in 1959 (Storrer, 1974), Wright had designed 929 buildings, including designs actually built as well as unexecuted projects (Streich, 1972). Among them, 653 are residential and 276 are non-residen-

tial (Streich, 1972). Approximately 70% of his designs are single-family residential. His residential designs during the years 1901-1910 have been called "Prairie houses." The Prairie houses share some common prominent characteristics dissimilar to those in his late residential designs, the so-called Usonian houses. From 1902 to 1906, he also did three non-residential designs (Yahara Boat Club, Larkin Building, and Unity Temple) that have been discussed by many critics. These three non-residential designs also share certain common characteristics. In this study, examples of Prairie houses and these three non-residential designs have been selected as representative subjects of Wright's early design works.

The following sections present sequential elaborations of the three proposed research tasks. In describing them, an effort has been made to clarify potentially confusing terminology. In architectural journals, different authors use different terms to describe architects' design thoughts. Occasionally, different terms may refer to the same phenomenon; for example, design method sometimes has been used to explain design process, and design process somehow implies design method. To prevent conceptual confusions in this study, the terminologies are defined in context and accompanied with examples collected from Wright's writings as well as from writings on Wright. Architectural terms have been defined so as to maintain general meanings commonly accepted by the field on one hand and to suit the research purposes on the other.

IDENTIFICATION OF REPLICATED FEATURES

The replicated features appearing in Wright's designs are first classified by residential and non-residential groups and then categorized by plan, elevation, wall, materials, and structures. The residential group refers to Prairie houses designed from 1901 to 1910, whereas the non-residential group includes the Yahara Boat Club, Unity Temple, and the Larkin Building designed during the same period, from 1902 to 1906.

Features of Residential Design in Prairie Houses (1901-1910)

1. Floor plan

- At the heart of every Prairie house there was a fireplace, often of brick, always broad and firmly anchored at the center of the composition. From this hearth, all spaces would extend, radiating throughout the site.

- The principal spaces -- living room, dining room, kitchen and entrance hall -- each occupied one axis and usually composed a cross plan (see Figures 13 and 14). The servants' quarters are located next to the kitchen, which often was sealed off from the living area.

- No basement (unless a client asked for it), no attic.

- Interior walls were extended into the landscape to form terraces and courts outside the line of the sill. These terraces and courts were surrounded by low parapets to prevent direct access from outdoors.

- There was a major shape in the plan that was long and narrow. This elongated shape led to stringing out rooms in their longest possible form, creating an extended horizontal line. Therefore, much of a Wright house was only one room in depth. Rooms, hence,
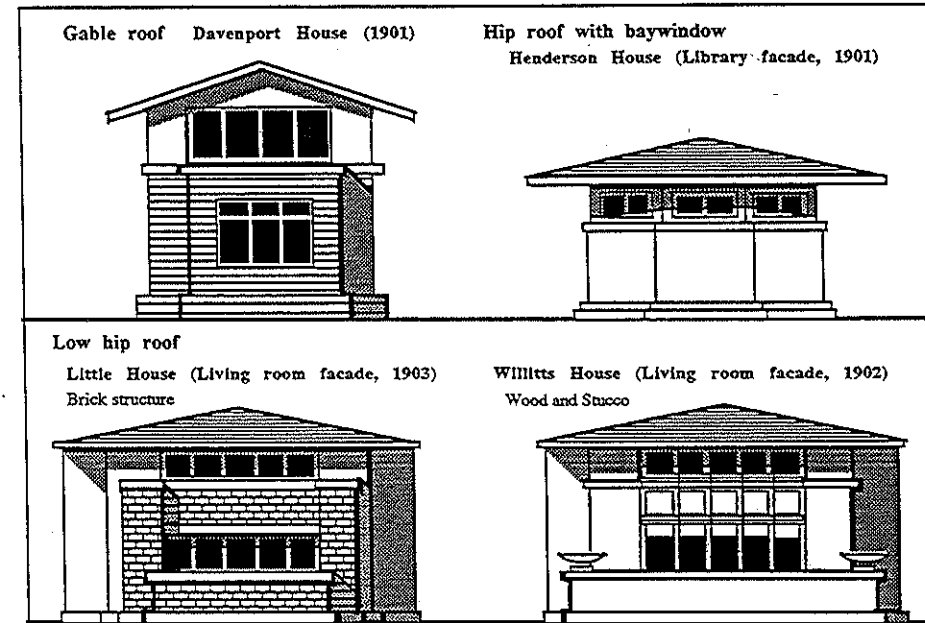
FIGURE 1. Examples of Wright's elevations.

have light from both sides, cross ventilation, large exposure to the outside, and access to different parts of the site.

2. Elevation (see Figure 1)

- The roof overhangs were deep and thin-edged.

- The windows, often casement windows opening out, were continuous ribbons of glass, starting directly at the underside of the roof and continuing down to a common, horizontal sill line.

- The houses had a base, called a water table by Wright. They were surrounded with gradually descending terraces that finally brought the floor line down to natural grade.

- The parapets of the terraces had continuous horizontal copings of concrete or limestone that often would become planting boxes or planting urns.

- There would be a central element somewhat taller than the rest -- a bedroom area or sometimes a two-story living room. From this tall, central mass, wings would extend in all directions -- first roof planes, then the wall, the planes of parapets or porches, and finally the low slabs of terraces -- so that the entire house had several horizontal elements or planes.

3. Walls

- Walls were screens or vertical planes, never the sides of a box. Often there were corner windows.

- There was a horizontal band inside at the height of a door opening. This band continued all the way around the walls and finally emerged on the exterior as the roof fascia. All added heights were developed above this low plane, so that many rooms would have low ceilinged areas (usually around the fireplace).

4. Material and Structure

- Most houses either were built of brick or were plaster-surfaced, wood-trimmed structures.

- Oak was used in the floors, doors, and wooden trim, as well as in the furniture, window frames, and lighting fixtures.

Features of Non-residential Designs (1902-1906)

The Yahara Boat Club project has never been erected. The Larkin Building and Unity Temple are two designs of outstanding importance done during the period of the Prairie houses.

- Yahara Boat Club (Madison, Wisconsin, 1902): The Yahara Boat Club consisted of a simple, rectangular block, topped by a long band of glass, and finished off with a deeply cantilevered, flat, slablike roof. The entire composition sat on an extended base of retaining walls. The horizontal character that dominated Prairie houses was found in the horizontal roof plane and the long side walls.

- Larkin Building (Buffalo, New York, 1904): The Larkin Building was as vertical as the Boat Club was horizontal. The exterior and interior materials were both of brick, with floors and ceilings of concrete. The inner court was lit by a skylight above. The principles of the Prairie House, in which a solid core is surrounded by spaces, were dismissed here. Stairs looking like towers were located in the corners.

- Unity Temple (Oak Park, Illinois, 1906): The entire building was of poured concrete. It was not horizontal in emphasis. It had a solid base, topped by a band of windows that, in turn, were held down by the projecting lid of a flat roof slab. The volumes were vertical. Skylights were used to light the central space. Stairs, looking like massive blocks, were in the four corners of the building.

Common features found in these three projects include a symmetric floor plan, flat roof, and massive corner blocks. Factors that generated these features are discussed in the following sections.

IDENTIFICATION OF DESIGN PRINCIPLES AND CONSTRAINTS

Design Concepts

Studied from a psychological point of view, design concepts and design principles are interchangeable. It is useful, however, to differentiate these terms. Specifically, design concepts refer to some general and abstract ideas about how to design a part of a building or the building as a whole. For example, Wright wrote in his autobiography: *I had an idea that the horizontal planes in buildings, those planes parallel to earth, identify themselves with the ground -- make the building belong to the ground. I began putting this idea to work* (Wright, 1943, 140). This is his retrospective view of one of the design concepts developed originally for his Prairie houses. The concept, in short, is the expression of horizontality. Wright had called it the Earth Line and associated it with emotional qualities, identification with the earth, stability, and shelter (Blake, 1960). Therefore, a design concept is a piece of knowledge; it is abstract and sometimes metaphysical.

Design Principles

A design concept can be a design principle. A concept may be used once, but a principle should be used for many designs and is referred to as the consistent application of certain design concepts in designer's works. For instance, the concept of horizontal is categorized as one of Wright's design principles because it has been used in all Prairie houses. Design principles also can be seen as several design concepts combined together and used in many designs. They are fundamental guidelines and are philosophical in nature. For example, Wright had formulated six design concepts, which he called six propositions, early in 1894 and first published them in 1908 (Wright, 1908). These propositions were to: (1) show simplicity; (2) achieve individuality of houses; (3) have a building grown from its site; (4) express color schemes from nature; (5) show the nature of materials; and (6) have the character of a house. In 1931, he mentioned the concepts of Prairie houses again and listed nine items, which he called motives and indications (Wright, 1931). These motives were to: (1) achieve simplicity; (2) associate the building with its site; (3) eliminate the room as a box; (4) set houses on a platform; (5) achieve plasticity; (6) use a mono-material; (7) incorporate heating, lighting, and plumbing as a whole system; (8) incorporate furnishings with the building; and (9) eliminate the decorator. Later, in his 1932 autobiography (first edition), he once again mentioned three concepts of Prairie houses -- simplicity, plasticity, and the nature of materials. Among these publications, the concepts of simplicity, plasticity, and the nature of materials are repeatedly emphasized and, hence, illustrate Wright's design principles for Prairie Houses. As expressed in his autobiography, his explanations on these three principles are as follows (Wright, 1943; 144-149):

Simplicity. Wright said: *One must achieve simplicity as a perfectly realized part of some organic whole. Only as a feature or any part becomes a harmonious element in the harmonious whole does it arrive at the state of simplicity* (Wright, 1943). One of his apprentices, Charles E. White, Jr., wrote in 1904 that *His (Wright's) tendency of the last two years (1902-1904) has been to simplify and reduce to the 'lowest elements' in his design* (White 1971). This shows that Wright had tried to achieve this design principle in his early works.

Plasticity and continuity. On plasticity and continuity, Wright said: *Plasticity may be seen in the expressive flesh-covering of the skeleton as contrasted with the articulation of the skeleton itself. In my work the idea of plasticity may now be seen as the element of continuity .... Let walls, ceilings,*

floors become seen as component parts of each other, their surfaces flowing into each other .... I have since concentrated on plasticity as physical continuity, using it as a practical working principle within the very nature of the building itself in the effort to accomplish this great thing called architecture ....
(Wright, 1943)

The nature of materials. Prairie Houses might be grouped in various ways, by plan, by size and cost, by location, by materials, or even by roof types. But basic to Wright's architecture is his feeling for the nature of materials. He said: *Bring out the nature of the materials, let their nature intimately into your scheme. Strip the wood of varnish and let it alone; stain it. Develop the natural texture of the plastering and stain it. Reveal the nature of the wood, plaster, brick or stone in your designs; they are all by nature friendly and beautiful* (Wright, 1908). He also said that *The materials of which the building is built will go far to determine its appropriate mass, its outline and, especially, proportion. The expression of structure as a pattern must be true to the nature of the materials out of which it was made* (Wright, 1943; 345). Hence, the innate characteristics of the materials became a principle medium of expression.

Design Constraints

Design constraints are more specific information used in design. They are defined as certain functional requirements that must be fulfilled in designing a design unit or a group of design units. They also can be defined in a negative sense as certain requirements that must be avoided. Thus, design constraints represent design rules, relations, conventions, structural properties, and natural laws to be considered in a design.

Design concepts, principles, and constraints also can be explained in terms of level of abstraction. Concepts and principles are more abstract than constraints, and could be represented by propositions. But concepts are ideas developed for a particular design, whereas principles are groups of concepts that are general in character and are used in different types of designs. Although design constraints are more specific, they have attributes and values. The following constraints that Wright used in designing the floor plans of Prairie Houses are identified from his writings.

Constraints used in making floor plans

Wright (1928) had mentioned that the several factors most important in making the plans -- after general purpose or scheme or "project" -- are materials, building methods, scale, articulation, and expression or style. These six factors can be seen as six design constraints he used while he was working on floor plans.

According to Wright, the general purpose of the building comes before anything. Then, among the other five factors, scale is the most important one, which dominates the making of plans. Then, materials determine the structural method and consequently resolve and affect scale. Different building methods yield different forms and shapes, and ultimately shape the plans. For articulation, he argued that each separate portion of the building devoted to a special purpose should assert itself as an individual factor (unit) in the whole (building). Finally, after all is set, the architect emphasizes what he loves, and that is expression.

To Wright, scale is tightly related to three other factors: human proportions, the nature of material, and the method of building. All together, they determine the overall shape of plan.
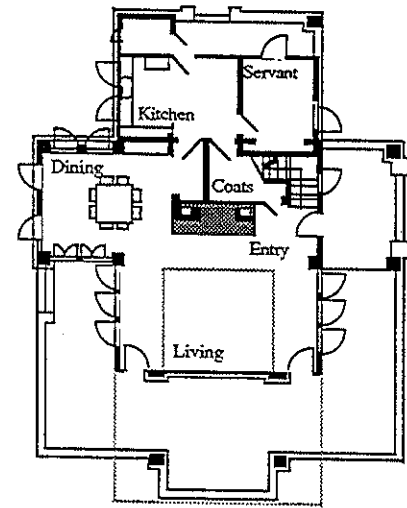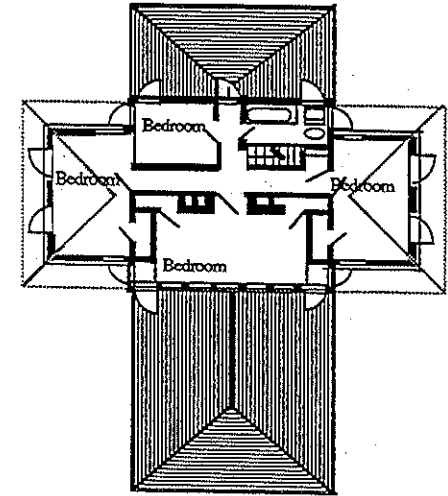
FIGURE 2. Charles S. Ross House, Delavan Lake, Wisconsin, 1902.

The articulation and expression are subordinate to these three factors. Hence, a certain priority existed while Wright was considering these design factors.

According to Manson, *Whenever the client could afford to give him carte blanche, he thought in terms of brick and stone, but he had, more often, to work out his ideas in wood and stucco.... These things are all, however, variations on a single theme (which is symmetry)* (Manson, 1958, 111). Here, Manson reported a couple of things, that Wright often would use brick and stone as materials, and another design constraint, symmetry. The example given by Manson is Willitts House (1902). In Willitts House, Manson indicated that Wright had established the precedent for Prairie Houses with symmetrical wings.

Although these six factors (constraints) are interrelated and complicated in nature, Wright had a method for handling them. His method was to use a unit-system by which all the factors (constraints) are addressed and tied together. On the basis of the unit system, he would then develop a geometric pattern for the plan. Thus an integrated floor plan is anticipated. This design method will be discussed in the next section.

Constraints used to determine the wall location

Several scholars indicate that Wright's major innovation was to design interior spaces that were not enclosed in the traditional sense. This is the so-called "destruction of the box" (Scully, 1960; Brooks, 1984). For example, in the Ross House (see Figure 2) and the Willitts House, the living and dining rooms overlap at their corners. Wright then created a diagonal view between rooms
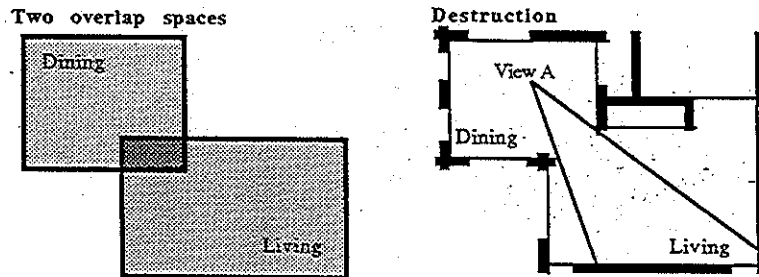
FIGURE 3. Destruction of the box.

and then obliterated all corners. The dissolved corners were left for circulation or for corner windows. The wall, which no longer served to connect the corners, became more like a screen that delimits or defines a space rather than enclosing it (see Figure 3). This can be seen as a constraint that Wright used in handling the detail plan, and is interpreted as a local constraint applied at local level or is used in determining the room shapes. This concept, according to Wright, was first implemented in the plan of Unity Temple (Wright, 1953).

IDENTIFICATION OF DESIGN METHODS AND DESIGN PROCESS

Design Methods

A design method refers to a manner of design procedure. It can be seen as a systematic means used in a particular stage to process a task. The design methods used by Frank Lloyd Wright, according to explanations given by Wright himself, his apprentices, and critics, can be categorized into the methods for making floor plans, elevations, and forms, and for determining forms.

In making floor plans: unit system and grid system

a. Unit system of design

Charles E. White, Jr., one of Wright's apprentices, had pointed out in a letter to his friend in 1904 that:

All his (Wright's) plans are composed of units grouped in a symmetrical and systematic way. The unit usually employed is the casement window unit of about the following proportions (see the right hand part of Figure 4). These units are varied in size and number to suit each particular case, and the unit decided upon, is consistently carried through every portion of the plan.
(White, 1971)

Wright wrote in 1908 that:

In laying out the ground plans for even the more insignificant of these buildings a simple axial law and order and the ordered spacing upon a system of certain structural units definitely established for each structure in accord with its scheme of practical construction
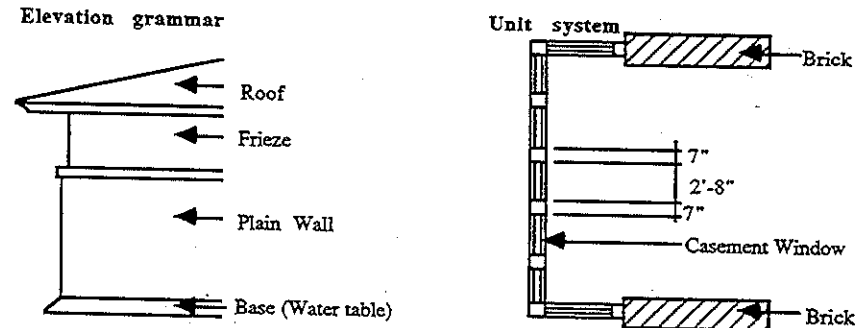
FIGURE 4. Unit system and module used by Wright.

and aesthetic proportion, is practiced as an expedient to simplify the technical difficulties of execution, and although the symmetry may not be obvious always the balance is usually maintained.
(Wright, 1908)

Wright also wrote in 1925 that:

All the buildings I have ever built, large and small, are fabricated upon a unit system — as the pile of a rug is stitched into the warp. Thus each structure is an ordered fabric. Rhythm, consistent scale of parts, and economy of construction are greatly facilitated by this simple expedient — a mechanical one absorbed in a final result to which it has given a more consistent texture, a more tenuous quality as a whole.
(Wright, 1925; 57)

b. Grid system

Streich (1972) had reported that Wright consistently used a geometric grid (rectangles, triangles, diamonds, hexagons, etc.) as a basis for developing his floor plan. The grid system and the unit system of design are physically correlated with each other in making plans. They are used by Wright to handle design factors being considered in his design of plans. Wright indicated that:

The scale or unit-of-size of the various parts varies with the specific purpose of the building and the materials used to build it. The only sure way to hold all to scale is to adopt a unit-system, unit-lines crossing the paper both ways, spaced as pre-determined, say 4'-0" on centers (grid system) — or 2'-8" (casement window size in unit system) or whatever seems to yield the proper scale for the proposed purpose.
(Wright, 1928)

It seemed to Wright that the development of a grid system was based on the specific purpose of the building, its proportions, materials, and the structural methods used to build it. Examples of Wright's various grid systems for different materials and building methods are collected in Table 1.

TABLE 1. Wright's various grid systems.

Material	Building method	Grid system	Example
Wood	Plaster surfaced, wood trimmed. (Lath and Plaster.)	4'-0" (grid) unit works with 16" centers for the length of lath.	Coonley House (1907)
Concrete	Cast block and slab	7'-0" (grid) horizontal divisions. Multiple of 16" unit for lumber work.	Unity Temple (1906)
Brick	Brick-pier	4'-6" grid.	Martin House (1904) Ullman House (1910)
Concrete support and floor slabs	Steel-and-glass	4'-0" grid.	
Pre-cast blocks	Double-wall construction	Multiple of 16" square both horizontal and vertical.	Ennis House (1923)
Concrete	Concrete slab	Multiple of 7'-0".	Merchandise Building
Concrete and brick	Concrete mushroom column and brick extension curtain wall.	20'-0" grid system both ways and a vertical unit of a brick course of 3.5".	Capital Journal Project (1931) Johnson Office Building (1936)

In making forms

a. Froebel Kindergarten system

Rectangular spaces, along with geometric blocks, are used as space-planning units and means for form determination. In Wright's autobiography (1943), he praises the positive aspects of his Froebel Kindergarten education, to which he attributes much that governed his own method of design. The Froebel system consists of geometric blocks and colored cardboard shapes with which the child makes patterns and constructions upon a squared unit grid. The first system consists of a single cube, sphere, and cylinder and only when the potential of this system is completely mastered is an additional system meted out. The emphasis is upon pure geometric forms and the abstract, symmetrical patterns they produce upon the grid (Manson, 1958; Scully, 1960; MacCormac, 1974). Because of the manipulation of blocks upon a grid system, forms are proportionally and symmetrically interlocked and expressed massively. This geometric proclivity, relying on a grid system, is one of the characteristics that, according to Manson, has clearly been reflected in the Unity Temple and Larkin Building.

b. Roof as a determining factor

Rorick proposed that the forms of Prairie houses are defined by roofs. He analyzed the rules used by Wright in generating forms and applied them in a computer program that successfully imitated Wright's style. He reported that rules used in generating forms include: (1) the major forms of the building are defined by the roofs (simple roofs over more complex plans); (2) there is a major form (roof) that is long and narrow; it is the lowest roof (Rorick, 1975, 57).

In making elevations: elevation grammar

After floor plans had been developed and forms generated, Wright would use a technique to finish the elevations. This technique is an application of a grammar. Charles White, one of Wright's apprentices, pointed out in a letter to a friend in 1904 that:
> *His (Wright's) grammar, which he may be said to have invented, is such as he used in the Winslow house, consisting of a base, a straight piece of wall up to the second story window sills, a frieze from this front to the roof, and a cornice with a wide overhang. He never cuts anything above the cornice line, like dormers. Here is his grammar (see the left part of Figure 4), roughly sketched, and all his buildings today are built along these lines.* (White, 1971)

Wright had mentioned his own grammar in 1908:
> *There is good, substantial preparation at the ground for all the buildings and it is the first grammatical expression of all the types. This preparation, or water table, is to these buildings what the stylobate was to the ancient Greek temple .... with this innovation established, one horizontal stripe of raw material, the foundation wall above ground, was eliminated and the complete grammar of type one made possible. A simple, unbroken wall surface from foot to level of second story sill was thus secured, a change of material occurring at that point to form the simple frieze that characterizes the earlier buildings .... the matter of fenestration .... as elementary constituents of the structure grouped in rhythmical fashion .... The groups are managed, whenever required, so that overhanging eaves do not shade them .... soon the guillotine window became apparent, and I waged a determined battle for casements swinging out .... with the grammar so far established came an expression pure and simple.* (Wright, 1908)

Again in 1954, he said that *Every house worth considering as a work of art must have a grammar of its own. 'Grammar' in this sense, means the same thing in any construction -- whether it be of words or of stone or wood. It is the shape relationship between the various elements that enter into the constitution of the thing. The grammar of the house is its manifest articulation of all its parts* (Wright, 1954).

In determining form: Perspective proof

After elevations were determined, Wright would check the whole form by perspective renderings. Hence, perspective drawings appear late in Wright's process of design. Wright had said: *No man ever built a building worthy of the name of architecture, who fashioned it in perspective sketch to his taste and then fudged the plan to suit.* Wright indicated that *Such methods produce mere scene-painting. A perspective may be a proof but it is no nurture* (Wright, 1908). Thus, to Wright, perspectives are used to present ideas rather than to generate ideas (Connors, 1984).

Wright also was always faithful to his belief that when a building is organized in an organic way with right proportions, then the picturesqueness of the building will take care of itself. Buildings are seen from ground level, but their view is determined by the conditions of approach. So, sometimes after the plan with section or elevation was completed, he would construct a little perspective proof of the building to see what the building would look like, and then returned to plans for corrections and revisions. For example, in planning the Ullman House in Oak Park in 1904, two study drawings had shown messy plans. In one drawing, he covered the plan with a series of radiant lines that stemmed from a vantage point. These lines were used to construct a perspective proof shown in another drawing. It seems that Wright was discontented with the result, hence the plan was pulled and stretched on the living room wing (Connors, 1984). It was exactly the final drawing shown in the Architectural Record (Wright, 1928). It is not clear whether in this particular instance, the resulting form is determined by the perspective rendering, but it is possible that perspectives are used to perceive the generated form and possibly for remedying it.

In the design of Unity Temple, the perspective drawings were done at the very end of the design. In this instance Wright used perspectives to present and convey his design to clients. For instance, the drawing later printed in the Wasmuth portfolio of 1910, according to Connors, came after the design was completed and Wright was concerned with presenting the building rather than shaping it (Connors, 1984). Wright mentioned in his autobiography that after the plans, sections, and elevations were completed, *We have enough now on paper to make a perspective drawing to go with the plan for the committee of 'good men and true' to see. Usually a committee has only the sketch to consider. But it is impossible to present a 'sketch' when working in this method. The building as a whole must be all in order before the 'sketch' not after it* (Wright, 1943, 51). It is clear that only after the form or the mass had been generated would Wright develop a perspective to confirm the visual condition of the building or to show his concept.

Design Processes

Design process refers to the sequential states of accomplishing a design work. A design process is the concatenation of states in which design methods are applied to complete certain tasks. A designer may have his or her own method of approaching a design. Such methods are called methods of design processes. Sometimes, a method of design process is a particular sequence of doing design. In this section, an attempt is made to sketch out Wright's design process by analyzing some documentation provided by his apprentices, clients, or Wright himself.[1] It is hoped that this will put all the information together to give a clear picture about Wright's particular method of design.

White's Interpretation

Charles E. White, Wright's apprentice in the Oak Park office, wrote in 1904:

His (Wright's) process in getting up a new design is the reverse of that usually employed. Most men outline the strictly utilitarian requirements, choose their style, and then mold the design along those lines, whereas Wright develops his unit (unit system) first, then fits his design to the requirements as much as possible, or rather, fits the requirements to the design. I do not mean by this that he ignores the requirements, but rather that he approaches his work in a broad minded architectural way, and never allows any of the petty wants of his client to interfere with the architectural expression of his design.
(White, 1971)
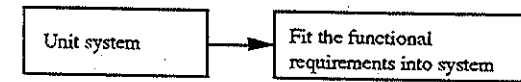
FIGURE 5. White's description of Wright's design process.
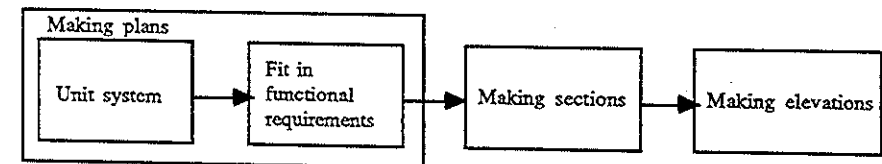
FIGURE 6. Combination of Howe's and White's description of Wright's process.

White's message about Wright's design process can be diagramed in Figure 5.

White's interpretation refers to designs for the early Prairie houses. But he only indicated Wright's process of designing plans, which is to have a unit system first and then fit in functions. White did not explain how Wright would generate forms, nor how Wright would use grid system and elevation grammar. But one thing obvious is that, unless a floor plan has been developed to a certain extent, the elevation cannot be worked out. Therefore, it is inferred that Wright would develop a grid system first for a floor plan, then apply the elevation grammar to handle elevation. This is confirmed by Wright's writing in 1908 and by a note by John Howe, Wright's former apprentice in Taliesin West. Wright said:

I have endeavored .... to establish a harmonious relationship between ground plan and elevation of these buildings, considering the one as a solution and the other an expression of the conditions of a problem of which the whole is a project. I have tried to establish an organic integrity to begin with, forming the basis for the subsequent working out of a significant grammatical expression and making the whole, as nearly as I could, consistent.
(Wright, 1908)

Howe's Interpretation

Howe noted in 1980 that,

With any building, Mr. Wright designed in plan, first and foremost. Then he moved (to) a section, and then the elevations were the result of the plan and the section. His buildings really were designed from the inside out .... Mr. Wright would establish the grammar of the buildings from working on the elevations.
(Lipman, 1986; 25)
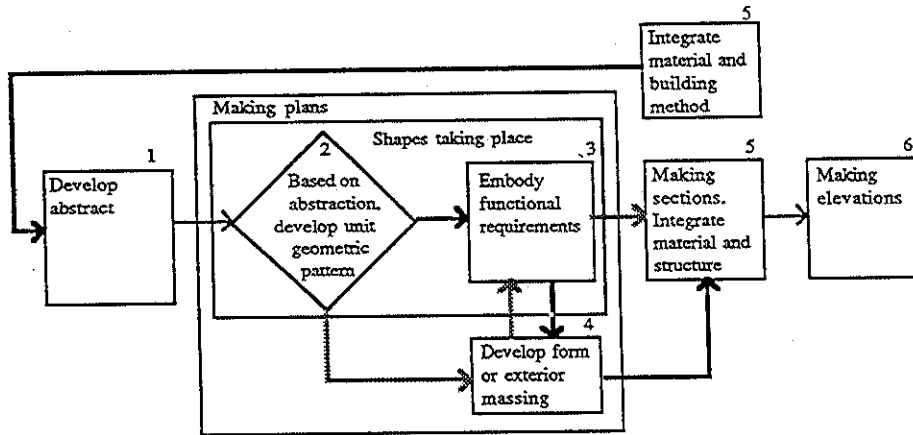
FIGURE 7. Scully's description of Wright's process.

Two messages of Howe's note are important. One reveals Wright's process, which is that plan comes first, then section, and finally elevation. Perspective drawing is not mentioned as having been used in design. This confirms that perspective drawings are not used as means for developing concepts, but rather for communicating concepts. The other message is that Wright's grammar of the buildings only refers to elevations. Combining White's and Howe's description, a process diagram is shown in Figure 6.

Scully's interpretation

According to Vincent Scully, Wright's processes of design have certain sequences (Scully, 1960, 13):

- His primary concern was abstract: first, usually, in the abstraction of the space, taking shape as it did out of his double will to embody its use and to form it into a rhythmically geometric pattern.

- Second, he wished both to enclose the hollow so created and to extend it or the expression of it to the exterior through the sculptural massing of the building as a whole. Sometimes, as in the earliest works of his several phases, a concern for the exterior massing may have preceded that for the interior space.

- Having made his building visually integral in both its voids and solids, he then wished to build it of such materials and in such a way as to make it structurally integral as well. In some of his later projects, the structural principle may come first in the process, but when we survey his work in general we find that structural integration tended to come last at any stage in his development, and that he himself was most specifically pleased
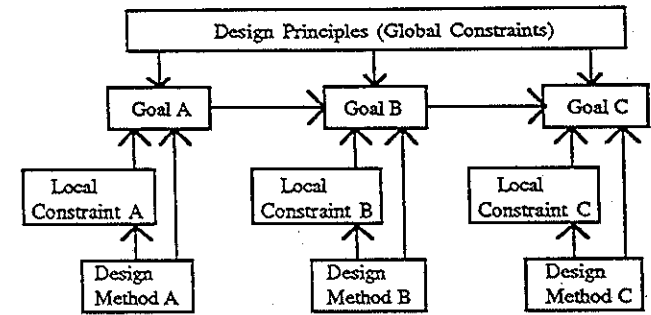
FIGURE 8. A general model shows relationships in process.
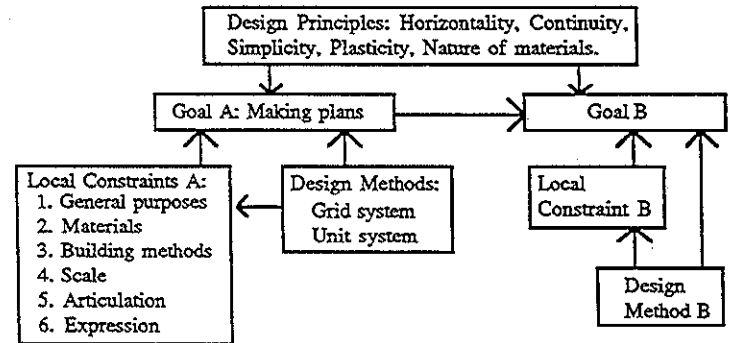
FIGURE 9. Example of Wright's design process.

with any building when its structural rather than simply its spatial and sculptural aspects were intrinsic to the whole.

What Scully mentioned can be represented by a diagram to visualize the processing sequences as shown in Figure 7. This figure, which also incorporates White's and Howe's interpretations, displays Wright's Process of design. In it, blocks stand for stages. Stages 2 and 3 together belong to a plan-making stage in which a general shape is formed, in accordance with White and Howe. Stage 4 develops building form and sometimes (as Scully has implied occurred in the Prairie houses period) happens before stage 3. Thus, two branches are noted after stage 2. Stage 5 is the period of integrating materials and structures into the building mass. In referring to Howe's interpretation, it is inferred that this is the task that Wright would have pursued in the section-making stage. And, although Scully indicated that these stage 5 activities occasionally occurred at the very beginning of design in Wright's later projects, this does not mean that sections were developed at the beginning. Instead, it indicates that an abstract idea of a unity of materials and structural methods is considered first in some instances, for example, the Johnson Wax Building (1936) and the Guggenheim Museum (1946).

FIGURE 10. Wright's design process in Prairie houses.
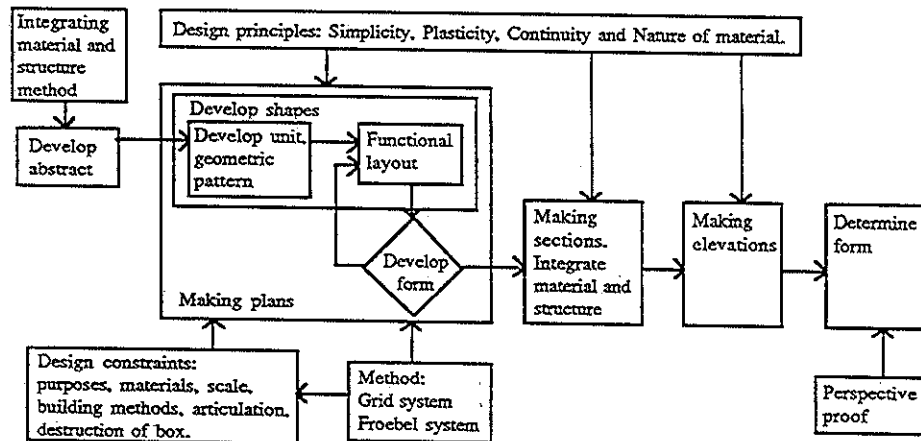
FIGURE 11. Wright's design process in later period.

The diagram in Figure 7 shows that the first stage is to develop an abstract of the design. This proceeding of developing abstraction at the very beginning can be confirmed by some of Wright's writings. For instance, he said:

before the plan is a plan it is a concept in some creative mind.... Therefore conceive the building in the imagination, not on paper but in the mind, thoroughly -- before touching paper.
(Wright, 1928)

RECONSTRUCTION OF WRIGHT'S DESIGN PROCESS

A design process also can be explained as a series of design goals to be achieved. For each goal, there is a set of design constraints used for solution generation and testing (Chan, 1989; Chan, 1990a). There also is a set of design principles that serve as a guide for supervising the direction of design. These principles remain unchanged throughout the whole process and are treated as global constraints. This concept, illustrated in Figure 8, explains the design process in general. But Wright had special design methods in handling design constraints to accomplish a goal. Thus, in the lower part of the model in Figure 8, design methods used at different stages are included.

Wright had indicated that there are six factors he would consider in making plans, and the unit system and the grid system are the methods used to handle all of them. Meanwhile, he would achieve the design principles of horizontality, simplicity, plasticity, continuity, and the nature of materials. Fitting these details into the model, Wright's example of making plans is shown specifically in Figure 9.

Studies of White, Howe, Scully, and Wright's own writings reflect that what has been found so far about Wright's design process can be classified into two approaches, associated with Wright's early and lat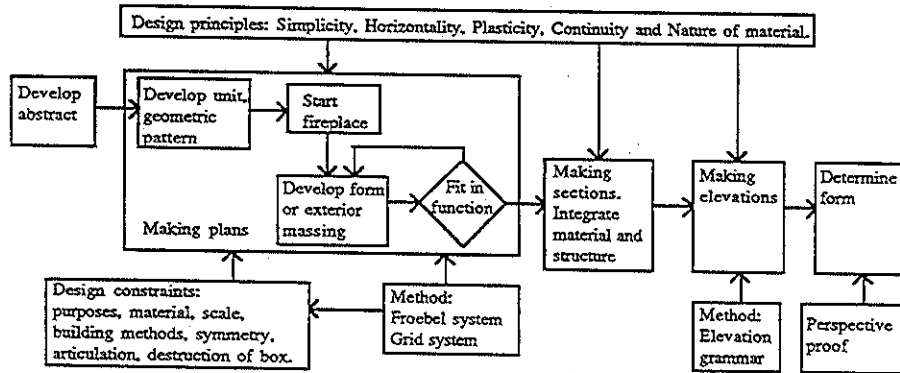e periods of designs. The first approach applies to Wright's Prairie-house period (see Figure 10). In designing these projects, Wright would first conceive in his mind an abstract that is possibly an architectural program of the building. Then, on the basis of the abstract and considering the material and the structural method used, he would develop a grid system that best suited the whole purposes. Materials were determined by considering budget constraints. If the budget was not tight, he would start working with brick and stone. But often he had to use wood and stucco. After the grid system had been decided, he started to make plans. Wright often referred to the fireplace as the "heart" of the house. And, for almost all of his Prairie houses, the fireplace is located right in the center. Hence, it seems that Wright would use 'fireplace in the center' as a starting point in making plans. While making plans, the concern of mass was developed before the functional layouts were fitted in. Shapes were planned in alignment with grids. Then the whole building was integrated during the section-making stage. The elevation is the result of the application of elevation grammar on plans.

The second approach belongs to Wright's design process other than and later than Prairie houses (See Figure 11). In this figure, the sequences in making plans are changed. According to Scully, Wright would concentrate on the functional arrangements first and develop the form later. The sets of design principles and design constraints are different from what he had used earlier. For example, horizontality and symmetry are not major considerations in his late projects. In the development of elevation stage, the elevation grammar may not be the same as for the Prairie houses. In some projects, the development of an integrated structural method and materials occurs at very early stage, as in the Johnson Wax Building (Lipman, 1986). Hence, the form developed and the elevation generated do not share the characteristics of the Prairie Houses.

FIGURE 12. The grid system (above) and tartan (below) of Ross House.

GENERAL DISCUSSION

Results of how factors of design constraints, principles, methods, and procedures affect the product forms and, therefore, produce common features are discussed in this section. Discussions also are summarized in the last columns of Tables 3 and 4.

Results from Design Methods

Grid system

The unit system is the basic module of the whole composition. By using the unit, a grid system is developed, considering the nature of materials, building method, and scale. The grid used in designing the Ross House, for example, is shown in the upper part of Figure 12. The use of a grid system has two effects. First, the grid system provides a norm for controlling the proportion of each part of the building and the relationships among parts. Second, the grid system integrates the nature of material and the construction methods. For instance, the nature of material determines the distance of the bay of columns. The construction methods determine both the dimension of bays and the size of columns. Overall, using a grid system not only has addressed the various constraints of material, scale, proportion, and the construction methods, but also has controlled the size and placement of each element in the plan.

Wright used the grid system method in almost every design throughout his career, even in his later period of Usonian houses. According to Twombly, Wright consistently used a two-by-four-foot horizontal module of grid. This grid system governs the entire plan in the drawings and on the floor, so that the contractor can easily locate doors and windows and reduce labor and waste because the materials are plywood that came in four-foot cuts. All the objects are centered on, aligned with, or related to the grid or its subdivisions (Twombly, 1979).

The grid system is sometimes composed with rectangular blocks rather than squares, and these set up a tartan. The tartan effect results from the fact that certain lines in the grid, due to Wright's alignment of some major and minor elements in the design, receive more emphasis than others. The tartan used in designing the Ross House is shown in the lower part of Figure 12. Manson and MacCormac also have shown that approximate models of the Larkin Building, Unity Temple, Ross House, Barton House, and Evans House can be constructed with different patterns of grids and tartans (Manson, 1953; MacCormac, 1968).

The three-dimensional forms of the Larkin Building and the Unity Temple revealed characteristics of a possible usage of the Froebel system to generate blocks of geometric forms that symmetrically and massively lay upon the grid system. Manson has pointed out that the two-dimensional and three-dimensional schemes of the Froebelian exercises bear a distinct resemblance to Wright's designs carried out from 1900 to 1910 (Manson, 1958, 7). This indicates that the form generation can be the result of the method -- the Froebel system of manipulating blocks on grids. This inference is challenged by Van Zanten, however, who argued that the Froebelian experience may be historically dubious. He pointed out that the influence of the Froebel kindergarten blocks is doubtful in its validity and is a tremendously resilient myth (Van Zanten, 1988).
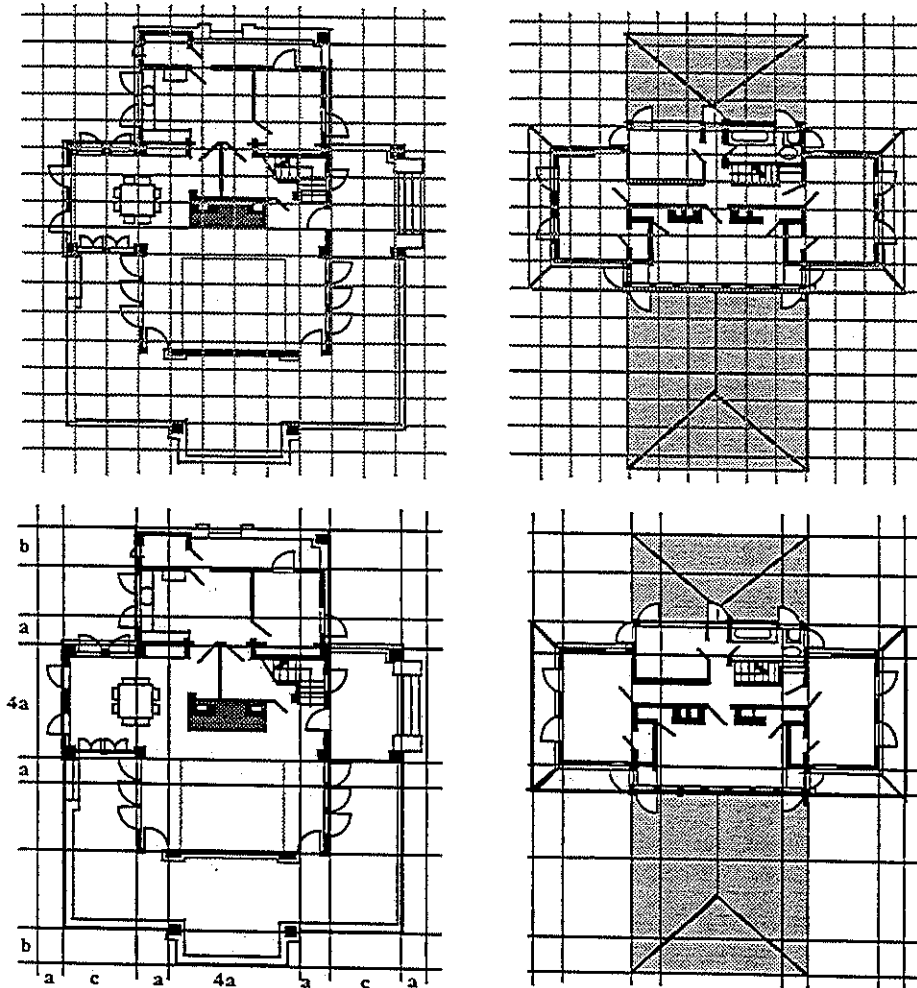
Elevation grammar

Wright said, *I have endeavored to establish a harmonious relationship between ground plan and elevation of these buildings, considering the one as a solution and the other as an expression* (Wright, 1943). To him, the elevation is a response to the plan. And the elevation grammar he used is an invention of a personal idiom. Using this grammar, the resulting elevations have shown some common and recognizable characteristics in his Prairie Houses. They all have a base, a plain wall, an odd number of casement windows and a low hip roof raised right above the window. The terrace, which is extended forward from the living room or entrance hall, always consists of a base, a plain wall, and a coping. These characteristics did not appear in his non-residential designs because he did not apply the same elevation grammar as for houses.

Results from Design Principles

Three examples will serve to describe how a design principle can yield a particular feature. The first example relates to the principle of simplicity. Wright wrote in 1908: *A building should contain as few rooms as will meet the conditions which give it rise and under which we live, and which the architect should strive continually to simplify .... Beside the entry and necessary workrooms there need be but three rooms on the ground floor of any house, living room, dining room, and kitchen, with the possible addition of a 'social office' ....* (Wright, 1908). This explains that Wright adapted the principle of simplicity for the ground floor plan of his Prairie houses. It turns out that, in most of his Prairie houses, living and social quarters are located on the first floor, whereas bedrooms are arranged on upper floors.

The second example relates to the principles of plasticity and continuity. Wright had tried to develop a form of wood trim to embody this principle. He said, *I entirely eliminate the wooden trim. I did make it 'plastic', that is to say, light and continuously flowing instead of the prevailing heavy cut and butt carpenter work .... The trim thus became only a single, flat, narrow horizontal band running around the room walls at the top of the windows and doors and another one at the floors* (Wright, 1966, 36). Thus, these continuous bands of wood are results of the principle of plasticity and continuity.

The third example explains how a consistent application of a principle will yield a consistent characteristic of a form expression. In Prairie houses, space is a horizontally moving entity, always in layers parallel to the earth. As discussed earlier, this is the result of the principle of horizontality. But this principle is not always appropriate for public buildings. Wright had to find and develop different principles for public buildings. Therefore, for the Larkin Building and for Unity Temple, Wright began to test the possibilities of space-in-motion up and down, as well as sideways (Blake, 1960). It turns out that the vertical character of the Larkin Building and Unity Temple results from the application of the same principle -- the principle of changing horizontal to vertical.

Results from Design Constraints

A conception of a particular constraint in a design would yield certain features. Two examples will provide an explanation.

FIGURE 13. Examples of some similar solutions.

Material as a design constraint

To Wright, different materials have different architectural expressions. For wood structures, Wright would express the wooden skeleton and use light-colored stucco panels to fill in the surface between the darker stripping (Wright's term for trim). This can be found in Willitts House and Coonley House (Scully, 1960). For concrete, Wright provided three solutions. First, he would express the corner pillars as heavy massive supports for the roof (Wils, 1985), or in Hitchcock's term, the broad corner piers (Hitchcock, 1942). This solution appeared first at the Yahara Boat Club (1902), later at Unity Temple (1906), and again in a residential project of "A Fireproof House for $5,000" (1906). Second, roofs are flat slabs and cantilever out above the windows. This solution is the common character of Unity Temple and "A Fireproof House for $5,000." Third, floors are strung between pillars to hold up the parapets. Sometimes the floors protrude for several feet, forming balconies that cantilever from the wall without any visible form of support (Wils, 1985). This solution was repeated in his later designs, the Kaufmann House (1936) and Johnson Wax building (1936).

Articulation as a design constraint

In Wright's residential designs, each part of the building is either separate from the others or extended from the surface. The separation of a part from the others can be explained as each principal space, which is a block, occupying its own place on one axis. As a result, the living room, dining room, and kitchen together form an L plan or a T plan. Along with the reception area (called the entrance hall from 1903 onward), the whole plan becomes a cruciform that can be seen as the result of articulating principal spaces. The articulation also can be explained as the extension of a part from the surface. This is found in his linear plan, in which the principal space protrudes several feet to distinguish itself. Thus, the exterior forms project internal spaces.

In his non-residential designs of the Larkin Building and Unity Temple, the staircases, resembling towers, are located in the corners. Wright wrote: *I worked to get that something into the Larkin Building, interested now also in the principle of articulation as related to that order* (Wright, 1943, 151). His answer was to build the stair towers free of the central block and to push them into the corner[2] to form independent elements for communication and escape, but also as air intakes for the ventilating system. Thus the tower-like massive blocks resolved from the effort of articulation, and were applied again in Unity Temple. This result of articulation also makes the inner court of the Larkin Building and the great hall of the Temple both extend forward and explore the full length outside. The function of each part of the buildings is well expressed.

These two examples of the material and articulation constraints explain: (1) how a constraint provides the generation of a form; (2) how the application of the same constraints yields the same resulting forms. Hence, by using the same constraints in different designs, the generated solutions will embody forms with similarities.

Results from Other Factors

Presolution Models

A presolution model is a design solution that is generated previously and is used on later designs (Foz, 1972; Chan, 1990a). The application of presolution models will maintain similar forms across designs and, thus, constant features will appear. In 1903, Wright designed the Barton House in Buffalo. The theme of Barton house is similar to the Walser House he designed in Chicago, a reduction of the Prairie House formula to a tight, symmetrical plan with a side entrance and street elevation made up of a self-contained tripartite window for the living room on the first floor, a continuous strip of casements above, and the capping eaves. Manson pointed out that *the Walser-Barton part was a scheme that Wright often used as the answer to the problem of fitting a Prairie House to a narrow lot and a limited budget; but, because neither of these conditions existed on Summit Avenue (where the Barton House is located), it is puzzling why he used it there except as an expediency, so as to get to work as soon as possible upon the main house* (Manson, 1958; 140). Regardless of why the site condition did not affect the design solution, this example displays the application of presolution model, in this instance the similar plan arrangement, that provides similarities for the resulting forms. Also, several instances can be found where the arrangements of the principal spaces in floor plans are almost identical, for instance, the Martin House (1903) and Horner House (1908); the Little House (1903) and Barton House (1903); and the Davenport House (1901) and Ingalls House (1909) (see Figure 13).

TABLE 2. Houses designed by Wright from 1889 - 1894.

Project	Date	Bay window location	Polygonal element	Source
Oak Park House	1889	Living Rm, Entry Rm.		Manson
L. Sullivan House	1890	Shown in photography.		Storrer
Charnley sum House	1890	Shown in photography.	Octagonal bay	Storrer
Charnley House	1891	Dining Rm.		Storrer
MacHarg House	1891	<No plan available.>		Storrer
McArthur House	1892	Dining rm, Parlor, Living Rm.	Polygonal bay	Manson
Blossom House	1892	<None>		Manson
Emmond House	1892	Reception, Living Rm, Terrace.	Polygonal bay, roof	Manson
T. Gale House	1892	Living, Dining Rm.	Polygonal roof. Octagonal bay.	Steiner
Parker House	1892	Living, Dining Rm.	Polygonal roof. Octagonal bay.	Steiner
Harlan House	1892	Library.		Manson
A. Sullivan House	1892	Shown in photography.		Storrer
W. Gale House	1893	Living Rm, Staircase.		Manson
Wooley House	1893	Parlor.	Polygonal dormer, bay.	Steiner
Winslow House	1893	Living Rm.		Manson
Bagley House	1894	Dining Rm.	Octagonal library.	Manson
Goan House	1894	Shown in photography.		Storrer

Another example of using a presolution model is the mushroom column Wright developed for the Johnson Wax Building of 1936. The section of mushroom column was initially developed for the Capital Journal Newspaper Building Project of 1931. In the mid-1950s, Wright transformed this solution of a great mushroom column-filled space into two more schemes. The first one appeared in the initial version of the Freund Y Cia Department Store project in San Salvador, El Salvador in 1954. The second one is the 1955 design of an expandable tent-like headquarters for the Lendurt Electric Company in San Mateo, California. The repetition of the same solution therefore generates similar forms (mushroom image) across designs.

The Use of Partial Forms

Different individuals have different tastes and favor certain geometric forms. For example, Le Corbusier would prefer the free curve, whereas John Portman would favor the cylinder. The use of a specific form in designs will mark an idiosyncrasy of the architect. Although the preference may change with time, the consistent application of the same form within a specific span of time labels the designer's style. For instance, the polygon used in Wright's Bootlegged Houses (1889-1894) and the low hip roof in Prairie Houses are the most prominent and consistent forms applied in those two periods.

1. Polygon

A better example that explains the use of partial form to yield a particular feature is found in Wright's preference for the polygon in the period before the turn of the century. According to Manson (1958), polygonal bay window and inglenooks were features that Wright was to incorporate again and again in his plans of 1890. From 1889 to 1894, Wright had designed 17 residences (Storrer, 1974) around the area of Oak Park, a Chicago suburb, while with the firm of Adler & Sullivan. From studying the published floor plan drawings (Manson, 1958; Steiner,
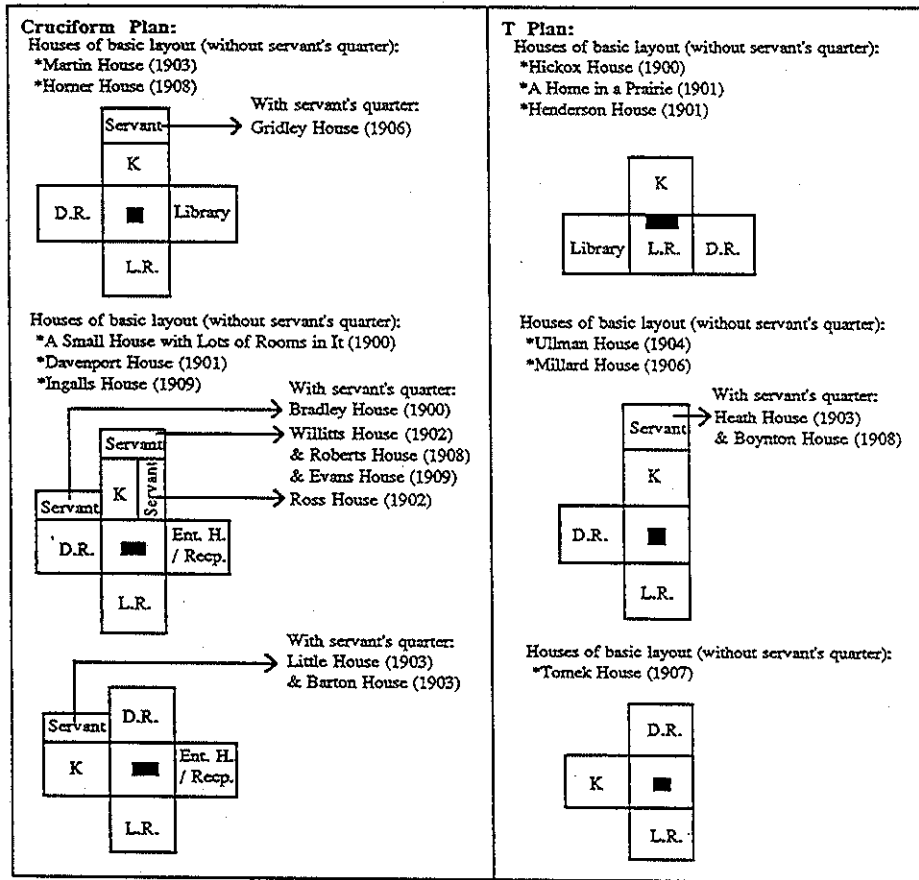
Cruciform Plan:
Houses of basic layout (without servant's quarter):
*Martin House (1903)
*Homer House (1908)

With servant's quarter:
→ Gridley House (1906)

	Servant	
	K	
D.R.	■	Library
	L.R.	

Houses of basic layout (without servant's quarter):
*A Small House with Lots of Rooms in It (1900)
*Davenport House (1901)
*Ingalls House (1909)

With servant's quarter:
→ Bradley House (1900)
→ Willitts House (1902)
   & Roberts House (1908)
   & Evans House (1909)
→ Ross House (1902)

With servant's quarter:
→ Little House (1903)
   & Barton House (1903)

T Plan:
Houses of basic layout (without servant's quarter):
*Hickox House (1900)
*A Home in a Prairie (1901)
*Henderson House (1901)

| K |
| Library | L.R. | D.R. |

Houses of basic layout (without servant's quarter):
*Ullman House (1904)
*Millard House (1906)

With servant's quarter:
→ Heath House (1903)
   & Boynton House (1908)

Houses of basic layout (without servant's quarter):
*Tomek House (1907)

FIGURE 14. A summary of Wright's typically topological arrangements.

1982) and photographs (Storrer, 1974), it is found that the inglenook is used in three projects only -- his own Oak Park House of 1889, Blossom House of 1892, and Bagley House of 1894. On the other hand, at least one bay window of polygonal shape (see Table 2) appeared in 15 of the 17 designs[3]. This 88% occurrence demonstrates that a polygonal bay window is a significant feature during this period. Wright's predilection for the polygon continues to be evident in his later Prairie Houses period, although not in every design project.

2. Roofs

Wright used gable roofs in several of his early Prairie houses, for example, the Bradley House (1900), A Small House with Lots of Room in It (1901), Hickox House (1900), Foster House (1900), and Davenport House (1901), and Dana House (1903). Wright mentioned in 1910:

A study of the drawings will show that the buildings presented fall readily into three groups having a family resemblance; the low-pitched hip roofs, heaped together in pyramidal fashion, or presenting quiet, unbroken sky lines; the low roofs with simple pediments countering on long ridges; and those topped with a simple slab .... of the second type, the Bradley, Hickox, Davenport, and Dana houses are typical (Wright, 1941). But the low hip gable roof with wide eaves appears in most of his Prairie Houses. The earliest occurrence of this kind can be traced back to the Winslow House in 1893. Manson's study indicated that "the most important innovation in the Winslow House is its roof. Here, in unambiguous form, that low, generous hip with wide eaves that is to become the keynote of the Prairie House makes its appearance.
(Manson, 1958; 62)

Neither Wright, nor any other source, has explained how this form (low and generous hip with wide eaves) was first generated. Manson (1958) inferred that it may have been suggested by the roof forms of traditional Japanese architecture. It also can be inferred that this solution, which precluded the use of attic space for anything, was partly suggested by Wright's objection to the attic. In his autobiography, Wright expressed his disapproval of putting attics and basements into residences (Wright, 1943). Regardless of the explanation, the repeated use of such a solution on most of his residential designs marks a prominent feature of the Prairie Houses. This is another example showing how the replication of presolution models manifests style, it also illustrates that Wright was fond of the particular roof form in his residential design, and that signifies his style.

Manson classified the designs of the five-year period from 1889 to 1894 as Wright's "bootlegged houses." If one would identify Wright's style of this period, the preference for a partial form -- polygonal bay window -- marks an obvious feature, versus the low hip roof of his Prairie Houses.

Design schemata

The design units (or architectural programs) used by Wright in Prairie houses were quite similar across designs. Usually, they consist of a living room, dining room, kitchen, servant's quarters, two or three bedrooms, a reception room, and a library (sometimes called a study room) or a music room, depending upon the client's interest and desire. It is found that Wright used similar topological arrangements in Prairie houses. The locations of principal spaces (living room, dining room, kitchen, entrance, and servant's space) have certain similarities, and their interrelations have a certain regularity. For example, Wright's prototypical space plan can be described as having a living room on the South, dining room on the West, kitchen on the North, servant's room further North, and fireplace at the center. The East is left for the entrance. If the entrance is a terrace, a T plan is formed. Here, the terrace is treated as a negative space that is open and without enclosure. If the entrance is a porch, or enclosed to form a reception hall, then a cruciform is shaped. Sometimes this reception hall or entrance hall is replaced by a study room or a library. In both the cruciform plan and the T plan, the location of kitchen and dining room are interchangeable. Typical plans found in such topological arrangements are shown in Figure 14.

TABLE 3. Common features of Prairie houses.

	Common features	Result from:
Plan	1. Fireplace at the center. 2. Principle spaces (LR, DR, K, Entrance) Each one occupies one end of an axis. 3. No basement, no attic. 4. Walls are extended to form terraces and courts. 5. A major shape in plan that is long and narrow.	Articulation (DC) Articulation (DC)
Elevation	1. Overhang gable roof or low hip roof. 2. A ribbon of casement windows. 3. A base of the house. 4. Coping of terraces. 5. Horizontal elements (roof, wall, parapet, porch, terrace).	Horizontal (DP) Elevation grammar (DM) Elevation grammar (DM) Elevation grammar (DM)
Wall	1. Walls are screens. 2. Continuous horizontal band around the wall, above doors.	Horizontal (DP) Destruction of box (DC)
Material	1. Most houses are wood trimmed with white stucco. 2. Oak is the major material.	Plasticity (DP) Material (DC)

* DC = Design Constraint, DM = Design Method, DP = Design Principle.

TABLE 4. Common features among three non-residential designs.

	Yahara Boat Club	Larkin Building	Unity Temple	Result from:
Plan	Simple block and rectangular shape.	Stories are laid out around an inner court. The inner court, lit by a huge skylight, located in the center.	Galleries are laid around the auditorium court space. Court is lit by skylight.	Site condition (DC) (Smoky air and noisy site)
	Symmetric plan.	Symmetric plan.	Symmetric plan.	Symmetry (DC)
Elevation	Flat slab roof. Cantilevered.	Flat slab roof.	Flat slab roof. Cantilevered.	Nature of materials (DP)
	A long band of windows.		A band of windows.	
	A continuous sill.	A continuous sill.	A continuous sill.	Plasticity (DP)
	Building sits on an extended base of retaining walls.		Has a solid base.	
	Dominant horizontal character (Horizontal roof plane and long side walls)	Vertical movement	Vertical movement.	Horizontal / vertical (DP)
	Massive corner block.	Massive corner block. (Brick corner stair tower)	Massive corner block. (Corner stair tower).	Articulation (DC) Fire escaping (DC)
Material		Exterior and interior are both of brick, with floors and ceilings of concrete.	Poured concrete.	Budget (DC)

* DC = Design Constraint, DM = Design Method, DP = Design Principle.

It is not clear whether Wright repeated the same design processes to reach the same layouts in these projects in Figure 14, or whether Wright had certain fixed spatial layout schemata, so that each time, the instantiation of these schemata from memory caused the same topological layout. The term schema explains many phenomena very well. For example, the central fireplace and the base (watertable) are constant features in Prairie house design. These two features can be seen as two constraint schemata, both described by Wright. In his writings, he referred to the fireplace as the heart of the house. He also indicated in his autobiography his desire to *get the unwholesome basement up out of the ground, entirely above it, as a low pedestal for the living portion of the home, making the foundation itself visible as a low masonry platform on the ground on which the building would stand* (Wright, 1943).

CONCLUSION

Examples collected in this research elaborated Wright's work to demonstrate how design-related activities (constraints, principles, methods, and procedures) influence the generation of certain common features by which an individual style is defined. Summaries of the common features in residential and non-residential projects, together with the causative factors discovered in Wright's works, are listed in Table 3 and Table 4.

This study explains how consistent processes and constant applications lead to the appearance of similar products. It also demonstrates that a product is a function of a process. A form that appears in products is caused by a factor in the design process. Thus, it is argued that an individual style is identified either by the common features in products or by the common factors in design processes. Findings and evidences collected in this research suggest that Wright's Prairie Houses style can be defined as:

- The repeated forms of a low hip roof, a band of casement windows, coping of terraces, extended terraces with a low parapet, a continuous band of sill, a continuous watertable, a symmetrical wing facade, planting urns, a massive brick chimney, and corner blocks.

- The repeated absence of elements: basement and attic.

- The repeated use of a fixed set of design constraints (e.g., material, scale, building method, articulation, symmetry, and destruction of box), and design principles (e.g., simplicity, plasticity, horizontality, and continuity).

- The repeated use of the design methods of the grid system and use of elevation grammar.

- The repeated use of a fixed sequences of design procedures (e.g., from design abstract to floor plan, section, elevation, perspective renderings, and to floor plan again, if necessary).

It was found in this study that for different building types, some of the factors changed while others remained. For example, the grid system, the tartan system (design methods), articulation (constraint), and the sequences of procedures (from floor plan to section to elevation) are consistently used across building types (residential vs non-residential). Yet, the horizontality constraint is changed to the vertical in two examples of non-residential buildings. Thus, the application of different factors in design will generate quite different features. But, the repetitions

of factors (causing forces), after all, define an individual style. Another factor determining style is a predilection for certain geometric forms, which also would manifest style. For example, Wright was fond of overhanging low hip roofs, planting urns, and coping low terraces in residential designs and of a band of casement windows in both residential and non-residential buildings. His preference for these elements makes them obvious in form. All these forms together define Wright's idiosyncratic style.

NOTES

1. Wright once reported his design processes for Unity Temple (1904) in the first edition of his autobiography of 1932. But this description was written some eighteen years later, and cannot be regarded as a reflection of the real thinking processes that occurred while he was designing the Temple. Instead, it is a retrospection of what may be logically related events in design. Thus, this information is used as data for reference rather than for analysis.

2. According to Einbinder, the solution locating stairs in the corners first appeared in the design of the Larkin Building. And it is the result of a design constraint -- escaping fire (Einbinder, 1986).

3. Blossom House of 1892 is the only one without a polygonal shape. One (MacHarg House of 1891) cannot be judged because no information was available.

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CHANGING LIVES/CHANGING SPACES: AN INVESTIGATION OF THE RELATIONSHIPS BETWEEN GENDER ORIENTATION AND BEHAVIORS, AND SPATIAL PREFERENCES IN RESIDENTIAL KITCHENS

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Changing gender roles are affecting traditional assumptions about the spaces where men and women interact. It has been argued that as women increase their public profile, they will seek more open home spaces that allow multiple uses to occur simultaneously. This exploratory study investigates whether and how demographic characteristics, gender orientation and behaviors are related to spatial preferences in residential kitchens. A sample of 36 married couples in various life stages was drawn from a midwestern university city. Data were collected via an interview protocol with four three-dimensional scale models that simulated various residential kitchen, dining, and living spaces. The study provides initial empirical support for a connection between physical space, indicated by kitchen openness, and social patterns, indicated by gender behaviors. The findings suggest a correspondence between gender behaviors and preference for multipurpose kitchen spaces, rather than between beliefs about gender and spatial preferences. Since housing trends are beginning to change, and since gender behaviors are undergoing change, it follows that house form and gender issues will become increasingly linked in the years ahead.