ARCHITECTURAL RESEARCH, Vol. 9, No. 2(December 2007), pp. 11-18

Design Evolution and Spatial Composition of Schindler's Demolished Cabin for Mr. and Mrs. Popenoe of 1922 at Coachella, California

Jin-Ho Park, Hong-Kyu Lee, Yong-Sun Joo and Young-Ho Cho

Associate Professor, Ph.D. Department of Architecture, Inha University
Full-time lecturer, Ph.D., Department of Architecture, Daelim College
Researcher, Ph.D. Department of Architecture, Toyo University, Japan
Professor, Ph.D. Construction Industry Education Center

Abstract

A cabin for Mr. and Mrs. Popenoe of 1922 was designed by the eminent Los Angeles architect, Rudolph M. Schindler. It stands out as an early exemplar of Schindler's most notable work in its unique employment of compositional strategy. Unfortunately, the cabin was demolished before an in-depth research was executed. In addition, there remains no documentary record with regard to the construction process, structural details and the use of materials of the built cabin. However, a set of drawings of the house are housed in the Schindler Archive. Reworking drawings and fabricating a scale model based on the materials obtained from the Archive, this article first depicts the evolution of the design, and then, attempts to investigate underlying principles governing the spatial composition of the cabin.

Keywords : Schindler, Popenoe, Design Evolution, Compositional Principles

1. INTRODUCTION

Rudolph. M. Schindler (1887-1953) was one of the most outstanding pioneers of modern architecture in the United States. He has become more widely recognized not only for the unique quality of his individual designs but also for his methodical design approaches, combining compositional theory and constructional practice (Park, 1996, 2001, 2003, 2004). Among other initiatives, the Popenoe cabin stands out the most in the sense that it preserves Schindler's idiosyncratic notion of compositional strategy. Nevertheless, let alone historical research or architectural discussions of the evolution and development of the design, an in-depth analysis of spatial composition of the cabin is rare.[1]

Sadly, the cabin was later demolished. It has not been known when it was demolished or the reason for the demolition. Yet it is not the purpose of this research. Instead, how the design has been evolved and what sort of spatial ideas and compositional principles Schindler used in the design is the matter of research. Since the cabin no longer exists, the analysis of the cabin in this paper solely relies on the archival materials, including sketches, drawings, details and photographs, housed at the Architectural Drawing Collection, University of California, Santa Barbara. Then, the materials are enhanced through the reconstruction of new drawings and the fabrication of the computer model.

Thus, the aim of the article is two-fold: first, to expose the design evolution based on a set of archival materials; second, to uncover its underlying compositional principles. By doing so, it attempts to bring forth one of the forgotten yet the most elegant works of the architect, works which evince and clarify his design idea and methodology.

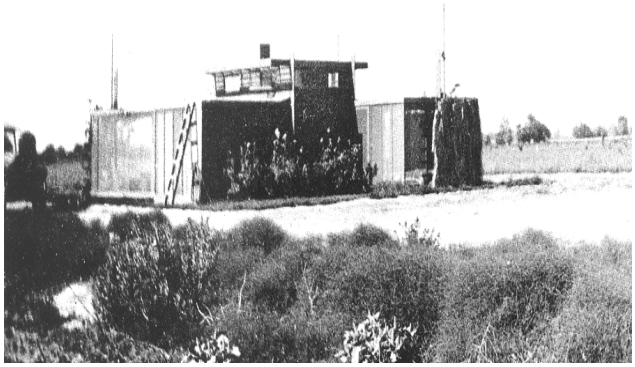


Figure 1. Photo of the cabin before demolition from Judith Sheine's book on *R. M. Schindler* (1998)

2. DESIGN EVOLUTION: THE CLIENT AND THE CABIN

Paul Popenoe, the client for the cabin, was born in Kansas 1888, grew up in California, and died in 1979 at the age of 90. He became American eugenicist and later on, extensively interested in family relations, thus became the founder of modern marriage counseling in the United States. After the marriage with Batty in New York, Paul and Batty headed for California and settled down at the Coachella Valley desert around the Palm Springs area in 1920, and lived there for six years from 1920 to 1926. During this period, Mr. and Mrs. Popenoe lived in a cabin

1 An early symmetric analysis of the cabin was presented in 2001 by the author in an article, "Analysis and Synthesis in Architectural Designs: A Study in Symmetry," published in Nexus Network Journal: Architecture and Mathematics (Vol. 3, No. 1, pp. 85-97). In the article, the house was partly discussed with regard to the notion of symmetry. Accordingly, a more comprehensive as well as detailed analysis of the design evolution and formal characteristics of the house is needed. Earlier, March and Sheine (1995) shortly mentioned the significant employment of symmetry principles in the cabin.

designed by Schindler until they moved to Los Angeles.[2] While staying at the cabin, Popenoe wrote his first family book *Modern Marriage* in 1925. Nevertheless, there is no evidence about how Schindler was commissioned to design a new cabin for Mr. and Mrs. Popenoe. The relationship between Schindler and Popenoe is seldom mentioned anywhere.[3] It is a matter of speculation that since Popenoe used to live in Los Angeles before his marriage, he must have known Schindler in Los Angeles or Clyde Chase who lived and worked together with Schindler as a contractor in the Kings Road House.[4]

A set of twelve drawings of the cabin are documented in the Schindler Archive. It provides critical evidence that in 1922, Schindler worked on the design of the cabin from May to August. Among the drawings, the schematic design dated May 1922 includes sketches of plans and elevations (Figure 2).[5] The scheme appears to be an initial design of the cabin that in fact looks completely different from the final design. This initial scheme was designed as a single story high desert cabin whose roof was available perhaps for sunbathing. The May drawings show that the cabin is enclosed by the thick walls but open to the 'jungle' yard. The exterior walls are very thick so that they look like adobe walls that give excellent thermal mass in a harsh desert climate.[6] The yard is an enclosed and secluded garden with a pond that provides an inward-facing outdoor space. Schindler must have thought the Taos Pueblo that he saw in New Mexico and the 1915 Thomas Paul Martin Residence project that he designed in Taos. The overall spatial plan of the scheme looks 'self-contained', rather than opening out to the natural beauty of the surrounding environment. A bedroom directly connects to the entry terrace and the court, while the other rooms including the bath, kitchen and living opens as a single room. A bedroom, kitchen and bathroom are lit from the above clerestory windows. The roof is enclosed by the wooded structure covered with canvas. The structure is regulated in 4-foot apart. The design is very similar to the rooftop tent structure of the Kings Road House (Figure 5a).

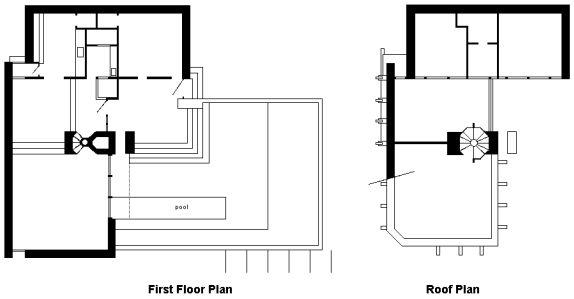


Figure 2. Floor and roof plan dated May 1922

A single sketch of the July floor plan (Figure 3) is the basis for the final August scheme (Figure 4). The July and August schemes are almost identical except for a few minor details and spatial configurations. Basically, the floor plan of the cabin relies on the cross-axial tripartite configuration for the central part of the cabin. A partial cross design of the living room is located at the center of the cabin and surrounded by other rooms, including the kitchen, bedrooms and a utility room at each corner.

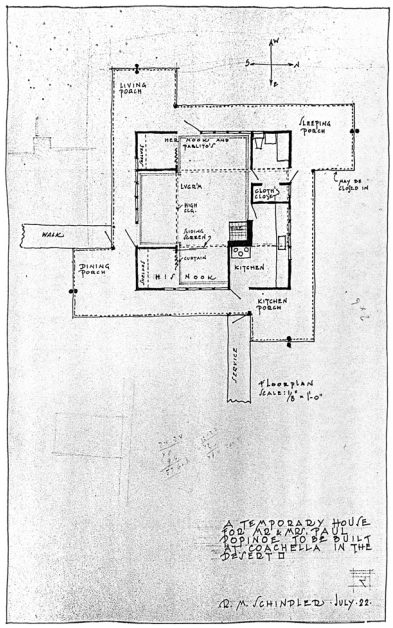


Figure 3. Figure 3. Schindler's original sketch of the first floor plan, July 1922

---

2 The life story of Paul Popenoe was well summarized by his son, David Popenoe, under the title, "Remembering My Father, Paul Popenoe – An Intellectual Portrait of "The Man Who Saved Marriages." Also, visit the website http://www.popenoe.com/PaulPopenoe.htm

3 Other than original drawings, only one correspondence dated October 26, 1922 with regard to Popenoe's ideas on building finishes remains in the Schindler Archive as follows: "For exterior, a dark natural stain made of cottonseed oil anx taf, or something of the sort. As Clyde will doubtless have told you, some sort of oil compound seems to be absolutely necessary in this climate to preserve the wood. We would figure on using the same stuff on the interior wood-work and ceilings. Bathroom, ivory enamel. Kitchen, washable flat paint, tan. Other rooms, washable flat paint, rather dark gray. I expect to start in on painting the first of the week. I have just finished putting a glue size on the wallboard, and will be grateful for any comments you can make."

4 The Schindlers built a two family house with his friends, Clyde Chase and his wife Marian. The house, known as the Kings Road House, had been used as Schindler's house and studio. Clyde Chase worked with Schindler as a contractor until the Chases moved on to Florida.

5 The July drawing indicates that this cabin is for Mr. and Mrs. P. 'Popinoe'. It is probably misspelled name of Popenoe. David Gebhard (1980) also misspelled Popenoe's name as 'Popinoff'. See Garland Architectural Archives, The Architectural Drawings of R.M. Schindler: the Architectural Drawing Collection, University Art Museum, University of California, Santa Barbara, edited by David Gebhard (New York: Garland Pub., 1993): Drawing no. 2659-2670.

6 It has been known that Adobe Walls absorb solar heat during the day and at night, thus radiating their heat back into the cool night sky and leaving the home at a comfortable temperature.

In the August plan, his as well as her room is expanded to nook areas, eliminating curtain walls between the rooms. Thin curtain walls and sliding doors serve not only as space divider but also as spatial flow, providing flexibility in a small internal space. Although the design at times creates privacy problem, it optimizes the maximum use of space. David Popenoe, son of Paul Popenoe, writes about the dilemma: "[Mr. and Mrs. Popenoe] shared a cabin with one of my father's associates, and their domestic area was separated from his by only a sheet. My mother's consequent deep embarrassment at performing marital activities virtually "in public" was something that was hard for my father to fathom."[7]

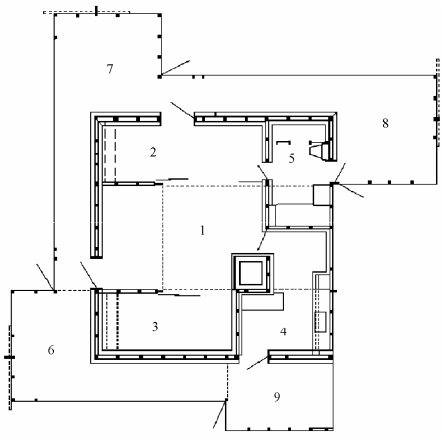


Figure 4. First floor plan, August 1922 (1. Living Room, 2. Her Room, 3. His Room, 4. Kitchen, 5. Bath Room, 6. Dining Porch, 7. Living Porch, 8. Sleeping Porch, and 9. Kitchen Porch)

Four screened porches, each with its own entrance door, are situated in a spiral manner around the main body of the cabin, creating transitional spaces from outdoors to indoors. Each porch has its own directional view and patio. According to the July drawing, four porches including Living, Sleeping, Kitchen, and Dining Porch are connected by corridors. The four porches and corridors are designed so that they can be closed when desired.

There are subtle changes in the porches and corridors in the August plan. The July plan shows all of the porches are equal in size and design, while having an entry way and a service way. Each porch is supported by double circular posts. The August drawing indicates that each porch is in different size and has its own door screen. Unlike the July drawing where the corridors are designed all around the main cabin, the corridor between the Sleeping and the Kitchen porch is eliminated in the August plan. Each porch is defined by rectangular structural posts with the louver screen except for the Kitchen porch, while a post for the Kitchen porch is removed. In fact, this project is one of three cabins (the cabin for Popenoe, the cabin for Philip Lovell, and the Carton Park House) that Schindler developed during the period (Figure 5). The basic character of the designs derives from that of the Kings Road House (1921-2) where "a marriage between the solid permanent cave and the open lightweight tent" is a key feature. The three cabins have in common their designs and the use of materials (in Gebhard's words, "the cave-tent shelter of concrete, wood and canvas"), which relate the projects to the climate, region and the surroundings.

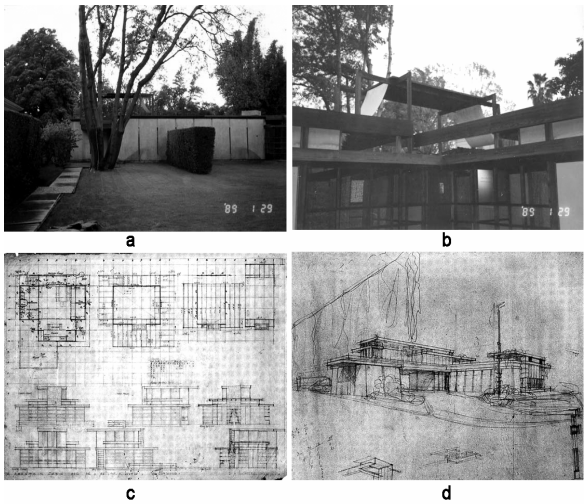


Figure 5. a. Courtyard view of the Kings Road House of 1921-22; b. Rooftop sleeping porch of the Kings Road House; c. Plans and elevations of a Cabin for Philip Lovell of 1926; d. A sketch of the Carton Park House of 1925

Interesting enough, Schindler strategically places the pinwheel ground plan at a 45 degree angle to the boundaries of the lot as he did in both the How house of 1925 and the Oliver house of 1931 (Figure 6). Each room is planned with its own patio and garden in different directions. It allows each room private gardens to look out toward the different views from a different porch, thus providing diverse spatial experiences in such a small cabin. As the July plan indicates, the cabin is originally intended to be orthogonally placed along a point of the compass. However, the final August plan shows that Schindler places the house in South part of lot at a 45 degree angle to the boundaries.

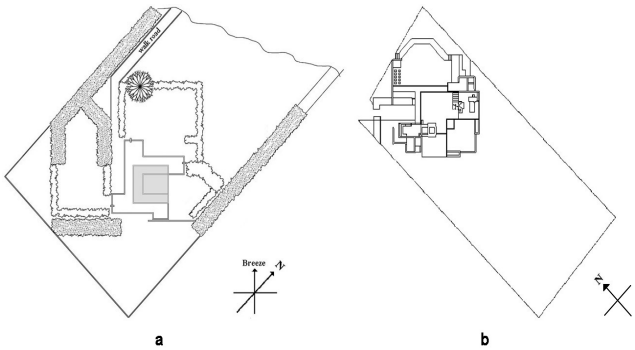


Figure 6. a. Plot plan of the Popenoe House, August 1922: b. Plot plan of the How House of 1925

7 See David Popenoe, "Remembering My Father, Paul Popenoe – An Intellectual Portrait of "The Man Who Saved Marriages."

Wall studs and ceiling and floor joists are spaced with 2 x 6 studs in every 24 inches on center allowing a larger cavity for wall insulation. The continuous 10-inch battenboards are laid horizontally on exterior walls (Figure 7). The horizontal band of the battenboards appears to incorporate the heights of all structural elements as well as details including built-in furniture, windows and doors. The ceiling height is typically 6-foot and then, 3-foot clerestory level is added to pop up above the ceiling in the Living room. Here, 4-foot wide and 1-foot 6-inch tall clerestory windows are placed right below the 2 x 8 roof joists allowing daylight into the Living, Kitchen and Bathroom that otherwise would depend on artificial light. Schindler is at liberty to fully glaze these clerestories as window walls in a desert environment.

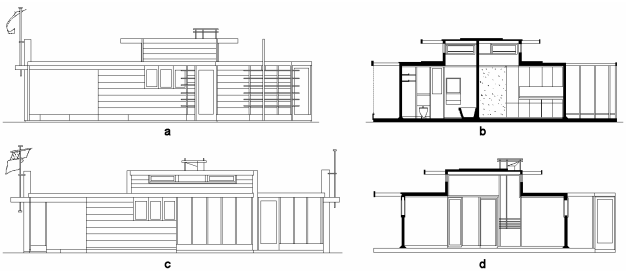


Figure 7. a. South elevation; b. Section through kitchen; c. East Elevation; d. West-East section.

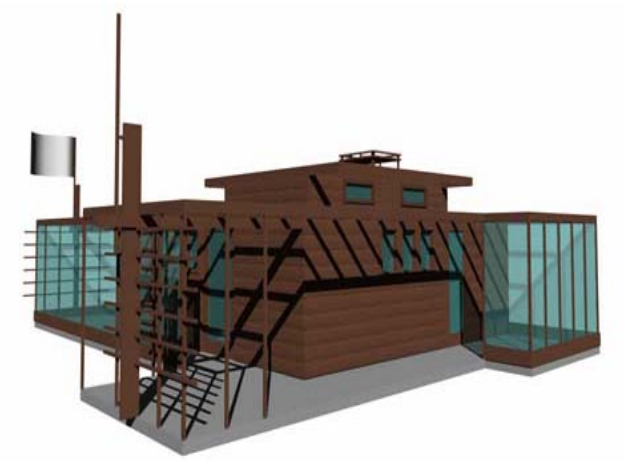


Figure 8. 3-D computer reconstruction of the cabin

3. PROPORTIONAL DESIGN

Schindler argues that the architect who wishes to deal with the phenomenon of space has to have not only an innate talent, but also a method to visualize the space forms in his mind, and thereby, improve his mental image of the space. Schindler started using the space reference frame as early as 1920,[8] although a comprehensive summary of his system was not published until 1946, in his article, "Reference Frames in Space." In it, he says: "you must realize that 'proportion' is not any more a simple mathematical relationship (Golden Rules, etc) which can be applied universally in all buildings as it was in classical times. Proportion is an alive and expressive tool in the hands of the modern architect who uses its variations freely to give each building its own individual feeling." Proportion was inherent in his notion of space architecture as a technique of spatial organization. The importance of the system was emphasized as early as 1916 in Schindler's lecture notes in Church School, Chicago, where he asserted that architects should be "conscious" of mathematical concepts in their works, and especially the application of proportion.[9]

Because of the importance of the unit system in the space reference frame,[10] the measure of the basic unit was critical. Although there were a few exceptions,[11] Schindler recommended that 48 inches (4-foot) be the basic unit to be used, with simple multiples and with 1/2, 1/3, and 1/4 subdivisions. 1/3 and 1/4 subdivisions were most often used for vertical modules in his work. The 48 inches unit module with its multiples and subdivisions formed the basis of all dimensions of the rooms Schindler designs. Accordingly, with the system, it was possible for him to derive all necessary architectural dimensions not only for major rooms but also for minor details, including doors and furniture. With a closer look, all rooms and details of the cabin are based on Schindler's unit system with three fractions including 1/2, 1/3, and 1/4 of 48 inches.

The design of the cabin on a rectangular site is simple, both structurally and spatially. However, in its transparent interplay of forms, it is perhaps one of the most conspicuous examples of Schindler's lifelong use of proportions and symmetry to govern spatial organization. By the time the Popenoe cabin was designed, Schindler was determined to consistently use his own unit system that he could invariably apply to composition as well as construction. Although Schindler used different unit grids earlier, for examples 2-foot square unit for the log house

8 Schindler's Free Public Library project in 1920 attests to the application of his space reference frame. Park, J. (1996). "Schindler, Symmetry and the Free Public Library, 1920", *Architectural Research Quarterly*, 2(2) pp. 72-83.

9 Schindler's early adoption of row theory, described in his 1916 lecture notes, has been interpreted in Park (2003). The row system is an important component in the development of those reference frames in space that are so clearly evident in his architectural drawings. Schindler employs a system in which rectangular dimensions are arranged in "rows." Refer to Park, J. (2003) "Rudolph M. Schindler: Proportion, Scale, and the 'Row'." *Nexus Network Journal: Architecture and Mathematics*, 5(2).

10 His proportional method was explicitly described in his article, "Reference Frames in Space," published in 1946.

11 For example, Schindler used a 5-foot unit module in the Schindler Shelter project. Schindler's use of the unit system in the Shelter project was substantially discussed in Park (2004). "An Integral Approach to Design Strategies and Construction System: Rudolph M. Schindler's Panel Post Construction," *Journal of Architectural Education*, 57(4), pp.29-38.

and 6-foot 6-inch square unit for the Buena Shore Club in laying out the plans, the Popenoe cabin plans were clearly set out over a 4-foot square grid. The grid lines of the cabin were drawn on the back side of the drawings with red pen. However, Schindler's typical methods where numbers and letters were laid out on the floor plan grid in sequence and the vertical module was identified with an elevation grade are not shown on the drawings of the cabin.

The primary configuration of the cabin lies within a 22-foot by 22-foot square over which is laid a 48-inch module grid system (Figure 9a). The main body of the cabin is planned within the square. For the layout of the cabin, the sides of the square are subdivided into 6-foot, 10-foot and 6-foot segments, concentrically, which produces an A-B-A rhythm of the parts that relate to each other as 3:5:3. It forms the symmetrical layout of the tripartite structure. The *parti,* or underlying geometrical scheme, is a tool that governs spaces with regularity and shows the extreme clarity of its geometrical origin (Figure 9b).

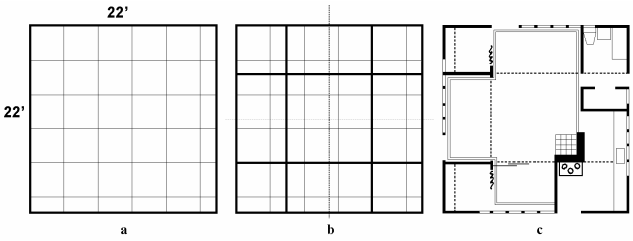


Figure 9. The basic *parti* of the plan (a, the basic *parti* with the unit system; b, the D_4 subdivision of the *parti*; c. the July plan)

Based on the *parti*, which is composed of nine plan components, the major rooms of the cabin are assigned and then adjusted for functional needs. The seemingly random spatial arrangement of the final design is in contrast with the complete geometric regularity of the *parti*. A similar plan arrangement is found in the classical configurations of central church plans. As a matter of fact, this tripartite cruciform *parti* echoes his early work, the Free Public Library of 1920 (Figure 10).[12]

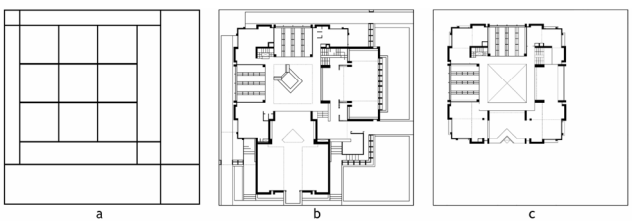


Figure 10. The Free Public Library of 1920: a. Basic *Parti*; b. First Floor Plan of the Library; c. Balcony Floor Plan of the Library

[12] See Park, J. (1996). "Schindler, Symmetry and the Free Public Library, 1920", *Architectural Research Quarterly*, 2(2) pp. 72-83.

It is Schindler's common practice that he uses the space reference frame to measure room sizes. In his preliminary sketches, room sizes with whole numbers on drawings are commonly presented. These numbers are increments of unit multiples with subdivisions. At times, various rooms are not rectangular in shape but interlocked, overlapped, and, even, zigzagged. It is certain that Schindler did an approximate measure of the room sizes in a rational manner with his space reference frame, thus determining the sizes of each room. However, the Popenoe house is not the case. Schindler did not provide any room dimension on the drawings. Schindler's standard unit system of numbers and letters was not presented either. It is, by no means, that the method was not used but in his mind. His instructions of using the method in the design process is lucid in his own words: "And last, but most important for the 'space architect', it must be a unit which he can carry palpably in his mind in order to be able to deal with space forms freely but accurately in his imagination". A series of schema (Figure 11) illustrate that the dimensions of each room can be easily identified with whole numbers. Room sizes are integers derived from the unit module with multiples and fractions.

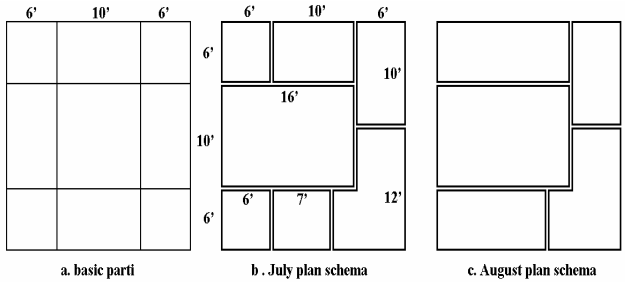


Figure 11. The evolution of the first floor plan configuration of the Popenoe House

4. SUBSYMMETRY DESIGN

Schindler made frequent use of subsymmetry in his design as a major compositional theme. From the beginning of his career, it played a significant role in the formation of his designs. Schindler's approach is unique in that several layers of subsymmetry are manifested in the parts of the design. Such complexity arises from a multiple superimposition of subsymmetry with architectural elements. Manifold use of subsymmetry principles also increases multiple subsequent design variations. As a result, subsymmetry is hardly distinguishable at the first sight, despite an overt employment of the principle.

Schindler's obsessive use of the theme was realized in the Popenoe house. First of all, the previously mentioned concentric spatial schema itself forms an absolute four-fold symmetry with the square, invoking a classical design vocabulary. The July plan shows that four screened porches connected by the 4 feet wide corridors are disposed in the pinwheel type of symmetry around the central square plan. These wrap around the primary square. However, the Au-

gust plan removes the corridor between the Sleeping porch and the Kitchen porch. Nevertheless, the length of the porch wings increase in increments of 3 feet, 4 feet, 6 feet, and 10 feet as one moves clock-wise around the cabin (Figure 12a). The entire floor plan forms a spiral shape, which reinforces the impression of rotation. As Schindler always insisted, the spiral forms and their proportional relations have nothing to do with the golden section ratios. The spiraling of the porches is supported by the porch columns. Since four porches have the same height, the house does not represent a three-dimensional form of the spiral.

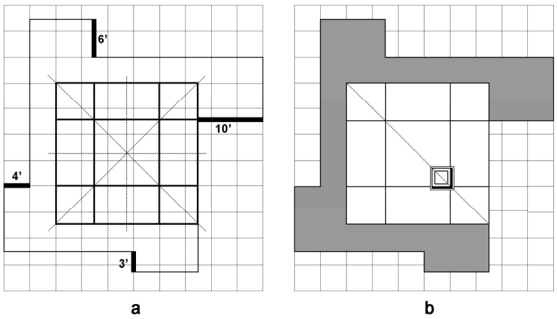


Figure 12. a, the basic *parti* with the pinwheel type of symmetry; b, the fireplace set along the diagonal axis

Whereas the basic composition of the four porches seems to derive from the strict pinwheel type of symmetry, the final design is not absolute. The architect's original idea for the composition is clearly shown in Figure 12a, where four porches, including the corridors, entrance doors and window openings, are determined by cyclic symmetry. Thus we see how the asymmetric final design derives from a disciplined understanding of the principle of rotational symmetry and is not merely arbitrary.

Schindler increases the importance of the axial juxtaposition by setting the central fireplace diagonally. As shown in Figure 12b, the 3-foot by 3-foot wide and 11-foot tall fireplace is set along the diagonal axis. This diagram illustrates that the diagonal of the square defines the axis of the living space. The fireplace could have been located on any side in the living room, yet Schindler has chosen to place it in the corner of the living area. The diagonal setting provides the dynamic sense of spatial depth and spatial experience of openness. In addition, the details of the fireplace reiterate the architect's use of the diagonal symmetry as shown in Figure 13.

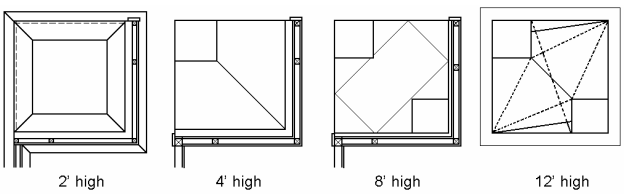


Figure 13. Plans of Fireplace in various height

The symmetric juxtapositions of the design are further sophisticated by the arrangement of the ceiling structure, orthogonally (Figure 14). It reinforces the interplay of various subsymmetries along a central point. Above the ceiling structure, a rectangular volume in part of the living room, kitchen and clothes closet is raised 3 feet, which is highlighted as indicated in Figure 14a. It is set along an orthogonal axis. Functionally, this accommodates clerestory windows to bring light into the center of the cabin. The cantilevered roof is extended 4 feet from the clerestory window.

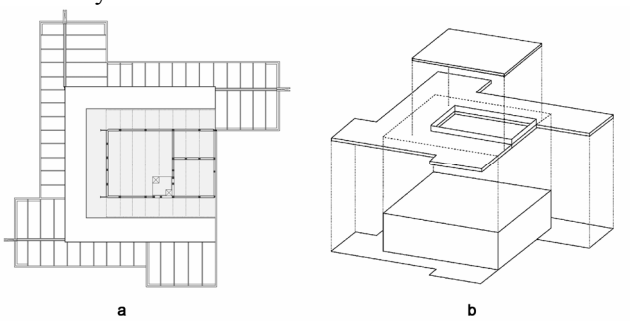


Figure 14. a: The 3-foot high raised ceiling design, Dihedral subsymmetry along a horizontal orthogonal axis: b, Exploded axonometric volume of the house

The floor plan as a whole exhibits no symmetry. It can be said that in the final design, there is an abundance of subsymmetries within the parts while the strict symmetry of the whole is negated. This approach is outside the classical design lexicon, in which the strict symmetrical disposition of the building parts is emphasized and where the combination of local and global symmetry is the driving force behind the organization of the design. Although the plan does not exploit all the possibilities of the subsymmetries of the square, various subsymmetries with rotation and reflection are superimposed in a single story design, extremely rare in architectural design. It is evident that Schindler initially set up a symmetrical frame for the project, only to break it, arriving at a final, asymmetrical design that meets all the functional requirements.

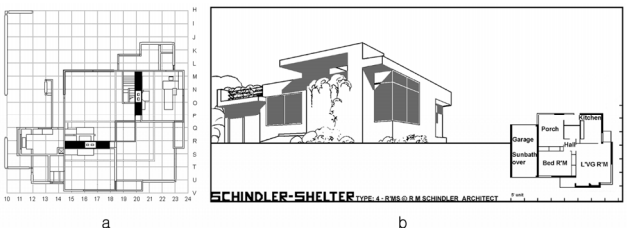
Through the research of other Schindler's works, it turns out that Schindler's layering of various subsymmetries has been developed from his earlier project and influenced on the later projects with masterly skills; most notably, the Free Public Library of 1920, the How house of 1925, and the Schindler Shelters of 1933-42.

Schindler's unsuccessful competition project, the 1920 Free Public Library, particularly shows similar approaches to the cabin. When each floor plan of the library is carefully analyzed, it illustrates the overlay of various orthogonal and diagonal subsymmetries, except for the rotational symmetry. The library project demonstrates a masterful comprehension of symmetrical operations and

proportional organization (Figure 10).[13]

Later on, the symmetrical design is subtly developed in his 1925 How House and also the Schindler Shelters of 1933-42. Whereas the cabin is composed through the superimposition of a variety of subsymmetries, the How House is mainly determined by reflective symmetry along a diagonal axis.[14] Like the cabin, Schindler reinforces the significance of the diagonal axis by setting the ground plan of the house at a 45 degree angle to the boundaries of the lot and the road frontage (Figure 6b). Although the overall spatial setting of the house is based on the diagonal axis, strictly speaking, the floor plan of the house does not conform to symmetry along the diagonal axis. Yet, the symmetry is broken by additional spaces such as the kitchen and the entrance hall (Figure 15a).

Schindler increases the significance of the principles by employing the overall housing organization as a whole. In his later unbuilt housing project, the Schindler Shelters (1933-42), Schindler utilizes symmetry operations, in particular rotation and reflection, to guide interior room organizations and also to generate plan prototypes as well as their variations (Figure 15b).[15] Basically, the housing unit prototype is divided into four functional zones and a central hall. The kitchen, bathroom, and laundry are grouped as a functional unit to concentrate the plumbing system into a single wall. The remaining functional units are rooms configured in a pinwheel shape by flexible closet partitions to form the living room and two bedrooms. Along with four different housing prototypes for different households, Schindler achieved a variety of unit plans, by rotating and mirroring the basic unit and adding a garage in different positions. Schindler applied the principles to a standard unit with its typological variations and the grouping of multiple units into a larger assemblage. When a standard unit and its variations are arranged in a mixture at a larger site, possibilities of their groupings will be considerably increased.



a b

Figure 15. a. Floor Plan of the How House of 1925; b. A 4-room unit prototype of the Schindler Shelters of 1933-42

[13] For the detailed symmetric analysis of the library, see Park, J. (1996).

[14] Refer to Park, J. (2000). "Subsymmetry Analysis of Architectural Designs: Some Examples", *Environment and Planning: Planning and Design B*, 27(1), pp.121-136.

[15] Refer to Park, J. (2004).

5. CONCLUSION

To sum up, this study has revealed the evolution of the architect's design ideas in the development of the project, and his favored architectural language — a language of which the intentions, structural and spatial logic offer a unique case. In the project, Schindler preferred the light wooden tent structure to the pueblo adobe style of the thick walls in the desert cabin. This choice later on became a prototype for other designs such as the Carton Park Ranch House of 1925 and the cabin for Philip Lovell of 1926.

This study has also interpreted underlying compositional principles employed in the design through the analysis of the original drawings and the fabrication of a computer model. The formal analysis turns out that the cabin is unique among other Schindler's work of this period in its striking formal and spatial composition. The interplay of ideas of proportion and symmetry is one of the major compositional strategies throughout Schindler's career. The unit system proves to be an integrated proportional system whereas the notion of symmetry serves as the underlying strategy of its spatial order.

In particular, the hybrid use of various subsymmetries and proportional designs in a single project is astonishing in Schindler's work. At first glance, Schindler's design seems to deny the use of symmetry; yet a closer look reveals Schindler strategically overlays various subsymmetries over the 4-foot unit grid in a design. Despite an almost obsessive concern for symmetry in its individual parts, the formal analysis demonstrates how various symmetry operations are hierarchically employed in each part of the design. Besides, the fundamental 48-inch unit system and symmetry operations determine all the major decisions of the spatial organization as well as the architectural details.

REFERENCES

Garland Architectural Archives, The Architectural Drawings of R.M. Schindler: the Architectural Drawing Collection, University Art Museum, University of California, Santa Barbara, edited by David Gebhard (New York: Garland Pub., 1993)

Gebhard, D. (1980). RM Schindler, Peregrine Smith, Santa Barbara and Salt Lake City.

March, L. and Sheine, J. (1995). RM Schindler: Composition and Construction, Academy Press, London.

Park, J. (1996) "Schindler, Symmetry and the Free Public Library, 1920" Architectural Research Quarterly. Vol. 2, pp.72-83.

Park, J. (2000). "Subsymmetry Analysis of Architectural Designs: Some Examples", *Environment and Planning: Planning and Design B*, 27(1), pp.121-136.

Park, J. (2001). "Analysis and Synthesis in Architectural Designs: A Study in Symmetry," Nexus Network Journal: Architecture and Mathematics, Vol. 3, No. 1, pp. 85-97.

Park, J. (2003) “Rudolph M. Schindler: Proportion, Scale, and the ‘Row’.” Nexus Network Journal: Architecture and Mathematics, Vol. 5 no. 2.

Park, J. (2004). “An Integral Approach to Design Strategies and Construction System: Rudolph M. Schindler’s Panel Post Construction,” Journal of Architectural Education, Vol. 57. No 4, pp.29-38.

Sarnitz, A. (1988). R.M. Schindler, architect (1887-1953): a pupil of Otto Wagner, between international style and space architecture, Rizzoli, New York.

Schindler, R. M. (1946). "Reference Frames in Space", Architect and Engineer 165, pp.10, 40, 44-45.

Sheine, J. (1998). R. M. Schindler (Obras y Proyectos / Works and Projects), Editorial Gustavo Gili, Barcelona.

Sheine, J. (2001). R. M. Schindler, Phaidon Press, London and New York.

(Data of Submission : 2007. 1.25)