The Underlying Geometry in Rudolph M. Schindler's Packard House

Jin-Ho Park*1 and Joung-Lan Park2

1 Professor, Department of Architecture, Inha University, Korea
2 Fulltime Lecturer, Department of Architecture, Dongyang Mirae University, Korea

Abstract
For Rudolph M. Schindler, the role of geometry was a driving force for the consistent and systematic quality underlying most of his works. It provides an order for the formal expressions that encompasses both composition and construction. Among others, the Packard House stands out the most in terms of its unique employment of triangular geometry. By fabricating a scaled model and reworking drawings, this article reveals the underlying geometry of spatial composition of the house. It also discusses that Schindler's treatment of the grid is unique, in comparison to his contemporaries, for instance Frank Lloyd Wright.

Keywords: Schindler; geometry; proportion; grid; Packard House

1. Introduction

Few Architects combined ingenuity of construction and creative space design as well as R. M. Schindler. The Packard House excels all others of its type. (Whitney R. Smith)1

Rudolph M. Schindler's buildings are recognized as icons of twentieth-century design. Less well known is Schindler's synergetic design method, which combines a specific compositional sensibility with the practicalities of physical construction. Schindler's work demonstrates an authoritative and creative commitment to theory and practice2 - his philosophy that "form conceived by the human mind is always founded on geometrical figures," implies that architecture begins with thinking about and reasoning regarding a building, shaping and feeling it in the mind as a structure based on geometric laws. This is the basis of the spatial complexity and compositional consistency in his architecture.3

The Packard House of 1924 is one of his most impressive designs. Based upon a triangular, three-dimensional geometry, it is also one of the most unique. This is because of the impractical configurations generated by unusable angular spaces: triangles are an uncommon aesthetic device in architectural design. Schindler overcomes this through the strategic implementation of a three-sided parti in the ground plan, establishing an immediate trigonometric harmony that is reinforced by the façade. However, beyond these distinctions Schindler's use of geometry remains at best incompletely understood. Sadly, the house was demolished in 2002,4 preventing further analysis of the actual structure (Fig.1.).

![Fig.1. Photo Taken in 2001, a Year before it was Demolished](image)

 Nonetheless, the Packard House has been the subject of countless examinations by Schindler scholars. Esther McCoy5 characterizes the house plan as "Y-shaped." Sarnitz points6 out that "the pitched roof is angled rather more than 45 degrees back from the point...." Barbara Giella7 notes that there were two formal devices in forming the house: first, from the shape of the lot, "the 60 degree angle used for the plan"; and second, the "horizontal regulating lines at a door height of six feet eight inches." Giella also believes Schindler "borrowed" the design from Wright's work. Judith Sheine8 describes the layout as "three wings around a triangular central kitchen on a roughly triangular lot." David Gebhard9 remarked that the design was "quite arbitrary in its exterior geometry." Generally, the commentary has been preoccupied with the exterior. Despite the uniqueness of triangular shapes inherent within the overall design, as yet there has scarcely been an in-depth analysis.

*Contact Author: Jin-Ho Park, Professor,
Department of Architecture, Inha University,
#253 Yonghyun-dong, Nam-gu, Incheon 402-751 Korea
Tel: +82-32-860-7597 Fax: +82-32-866-4624
E-mail: jinhopark@inha.ac.kr
(Received April 16, 2012; accepted February 13, 2013)
This paper investigates the underlying geometry applied to the design of the Packard House. In doing so, it clarifies speculation and corrects common misunderstandings of the architect's design strategy.

2. Description of the Packard House

Designed in 1924, the Packard House in Pasadena, California was a celebrated residential work of R. M. Schindler (Fig.2.). The original owner, a teacher and attorney, commissioned the young Schindler, and he responded with an unconventional triangular composition. For some, the unique, angular interplay of the design was deemed too unusual, avant-garde, and perhaps laissez-faire, for even the socially progressive to accept. However, Rose Marie Packard described it as 'California Living'. She boasted: "We have the maximum of privacy yet the entire house can be thrown open to large group entertaining, adaptability is the word that describes it."

A logical organization is revealed in the layout of the house, immediately discernable upon analysis of the floor plan and façade. The plan is divided into tri-axial zones, with a kitchen located at its hub. Three wings extend radially and embrace the outside yard. From the central point, a spatial distribution of the floor plan is anchored and defined (Fig.3.).

The three wings form the playroom, parent's room, and living room, each with porches. Each porch opens directly onto the patios. Windows are abundant and patio doors have minimal wall planes. Schindler explained, "The three-winged plan treats the exterior walls not as facades of a convex mass, but as inside walls of outdoor rooms (patios)." The design of the house makes maximum use of available light and prevailing breezes so necessary to capture the California climate. The children's playroom is oriented to the south to encourage the penetration of maximum sunlight. A beautifully structured A-frame ceiling enhances the spaciousness of the living room. The parent's room and the living room are located 30° west and east of north, respectively. Schindler positioned the entry, garage, and service court on the north. A service porch on the north between the living room and parents' room leads out from the kitchen to the service court. The basic geometry is also repeated throughout the components of the house, including chairs, breakfast table, and lighting fixtures.

The roof of the house is pitched steeply, withstanding high velocity winds, and providing coolness in the summer and warmth in the winter. Although Schindler originally intended to cover the roof with thin sheets of copper, for reasons of economy he used roll roofing in the final design.

The basic layout of the house as an equilateral triangle was derived from the shape of the site, which is roughly triangular. The tri-axis is drawn on the site plan as shown in Fig.4. The orientation and placement of all Schindler houses are determined by their respective lots; according to Schindler, "The conventional house is conceived as a solid mass growing out of the ground. The space house as a space form becomes a part of a room formed by the lot, the surroundings, contours, and firmament."

The Packard House is characterized by the co-existence of two geometric figures of spatial ordering: an equilateral triangle and a square. The equilateral
triangle forms the basic parti of the house, starting from the floor plan, and then rising to the façade. One half of the equilateral triangle, with sides of 1 and $\sqrt{3}$ and a hypotenuse of 2, governs the placement of the elements of the house. Set along the north-south axis, the points of the triangle serve as foci for laying out Schindler’s space reference frame. Schindler calls the points ”sillcocks”. As a matter of fact, sillcocks are the small water faucets typically located on the outside of the house. These sillcocks provide water for many uses such as watering flowers or washing cars. Perhaps Schindler started designing the house with basic building systems in mind from the beginning stage of the design.

The square units of the space reference frame are set from the sides of the triangle to form rooms. These grids are seen on his drawings (Fig.5.). This notion is summarized in his 1946 article, ”Reference Frames in Space,” in which Schindler proposes that the space architect use 48 in. x 48 in. x 48 in. ”units” of space to mentally define spaces and to consider their relationships with one another.

The dimensions of rooms are proportioned according to this space reference frame. Schindler marks his unit system on working drawings in the form of a 48 in. square grid. Each wing is numbered and lettered on the working drawings to identify locations and sizes of the parts with respect to the whole. Although in his unpublished lecture notes for the Church School of Art written in 1916 he recommended not only squares for the unit shape but also the rectangle, triangle, circle, etc., he himself preferred to use the square grid.

Schindler's preference for the square grid is significant. Unlike F. L. Wright, who used rectangular, circular, and hexagonal grids, Schindler thought that while it was "possible to work with a grid, which is not rectangular… [t]o depart from this simple frame of reference of space, however, would be justified only by the most compelling reasons for it would result in tricky patterns and complicate three-dimensional thinking.” Schindler's rejection of other grid types was a rational decision, because although other grids provide many opportunities for variations and emphasis, they create other problems. The Packard House is a prime example of Schindler's preference for simplicity. Here, he does not overlap unit grids even when planning angles. Instead, he separates each wing with its own unit grid lines. Schindler rationalized the juxtaposition of the rooms even in an angular arrangement. He understood clearly that angled or hybrid forms could create a number of different patterns resulting in more intriguing spatial forms. Schindler's insistence on the square grid distinguished his approach from that of Wright's in his application of a unit system. Unlike Wright who used various geometric unit modules including triangular modules, Schindler consistently used the 48 in. square unit module.

![Fig.5. The Packard House, 1924, the Ground Floor Plan with the 48 in. Square Unit Grid. Redrawn by the Author from Garland, Drawing no. 2513 [E. Entrance, B. Bedroom, BA. Bathroom, P. Porch, L. Living Room, K. Kitchen, PA. Playroom, D. Dining Room]](image)

![Fig.6. Left, Schindler's Discontinuous Grids in the Design of the Packard House; Right, Wright's Non-Orthogonal Isometric Grids](image)

In designing the Packard House, Schindler did not record the dimensions of every individual space on his working drawings. Commonly, he marked only the width and length of major rooms with simple whole numbers. Although they are not always rectangular, Schindler approximated their dimensions and, at times, overlooked dimensions of minor or insignificant spaces, including the bath and storage rooms, which were not marked on the drawings. Other spaces were interlocked, overlapped, or zigzagged; Schindler converted these room sizes into rational numbers. Dimensions of irregularly shaped rooms were approximated by adopting whole numbers and labeling dimensions ”a x b” on the drawings. It is possible that he assumed that simple whole numbers would make it easier to visualize space-form in the context of his space reference frame. Room measurements are integers derived from the unit module with multiples and fractions (1/2, 1/3, and 1/4). It is certain that Schindler used approximate measures of room sizes in a rational manner, using the space reference frame to determine the sizes of each room and, probably, their
proportional relationships. In later projects, Schindler increasingly integrated simple geometric patterns into his unit system. The Beach House for Olga Zacsek is prominent among these geometric designs (Fig. 7). Although it seems to form a butterfly pattern, the house, which is set on a rectangular site, manifests the equilateral triangle. While rooms are in various shapes, Schindler provided the dimensions of the rooms with whole numbers, such as 20 ft. x 16 ft. for the living room, 9 ft. x 8 ft. for the kitchen, 8 ft. x 7 ft. for one bedroom, and 12 ft. x 10 ft. for another bedroom. Schindler's standard unit system of numbers and letters was not presented on the drawings. However, this by no means implies that the method remained in his mind without being used. His instructions for using the method in the design process are made 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".

The residence of A. van Dekker built in 1947 is another example of Schindler's experimental application of this geometric paradigm. Situated on a rectangular site, the house is regulated by angles of 30°, 60°, 90°, and 120°. A close examination of preliminary sketches shows that the scheme developed gradually, using progressively larger angles: first 30°, then 60°, and finally, 90°. Possibly, the method of employing the various angles is a result of the drafting equipment he used, such as the T-square and 30°-60° and 45° triangles (Fig. 8). Combinations of these two standard draftsmen's triangles on the horizontal T-square produce multiples of 15°, the dominant angles in Schindler's designs. Here again, Schindler did not overlap his 48 in. grid; each wing preserves disparate grid matrices.

Fig. 7. The Beach House for Olga Zacsek built in 1936/38. Equilateral triangles are embedded in the floor plan, and are clearly apparent in the ¼ scale model.

3. Façade and Roof

In the Packard House, the equilateral triangle is apparent in both the façade and the cross section of the living room, and serves to juxtapose the façade symmetrically. Although the gabled roof is a result of local restrictions and client requirements, the façade represents a bold expression of the architect's three-dimensional triangular schema of the house in total.

Fig. 8. A. van Dekker in 1947. Progressive Development of the Scheme Using 30°, 60°, and 90° in the Final Scheme.
Lines CF, DG, and EH subdivide the side of the equilateral triangle in half, respectively. The FG line indicates the height of the ceiling fascia, forming the ceiling height of the house 6 ft.-8 in. from the floor level, an exceptional ceiling height. Typically in Schindler’s houses, the ceiling height is 8 ft. and the door height is 6 ft. 8 in. The truncated roof forms another equilateral triangle (EFG). Sides EF, FG, and GE of the roof triangle measure 12 ft. (3 modules.). Here again, all measurements use Schindler's 4-ft. unit module and its sub-modules (12 in., 16 in., and 24 in.). Although the triangular schema naturally involves a lot of angles with irrational dimensions, Schindler labels all dimensions using whole numbers.

The three-dimensional roof shape is further dissected from a simple equilateral triangular prism (Fig.11.). Four bottom corner points of the prism are truncated according to the hypotenuse of the equilateral triangle. Here Sarnitz’s observation of the 45° angles was wrong. The roof is placed on top of the living room where one end of the truncated prism meets the top of the kitchen, and the other, the top of the living room alcove. The vertical module of the house, which is 2 ft. (1/2 module), regulates all vertical heights of details including furniture, window and door mullions, and the width of the copper roofing. The geometric roof shape is reflected in Schindler’s later projects, particularly the Tischler House of 1949-50.

![Fig.11. The Truncated Roof Geometry is Based on the Equilateral Triangle. The Roof Cover with Thin Sheets of Copper and the Tall Window Bays to the Front are Regulated by the 2 ft. Sub-Module](image)

In architecture, the use of equilateral triangles both in the plan and façade is rare. However, this unusual approach was used by Dutch architects, and might have been known to Vienna and German circles – and therefore to Schindler. Although systematic methods vary, its history can be traced to the medieval idea of the triangular grid used in the planning of space. Hendrik Petrus Berlage’s use of the “Egyptian” triangle in the elevational treatment of his celebrated Amsterdam Stock Exchange Building in 1898 remains a prime example of a contemporary application of the triangular grid. Berlage's 1908 essay, "The Foundations and Development of Architecture," provides an excellent summary of geometrical and proportional understanding at the turn of the century, both in terms of historical analysis and design synthesis. His theory and works are well known in Viennese architectural circles. Other architects approached the use of triangular designs in various ways. J. L. M. Lauwerik, noted for his labyrinth of rectangular spirals, used triangles with 4:5:6 proportions. De Grook and De Bazel employed $\sqrt{2}$:1 triangle. Later, De Klerk employed the Egyptian triangle in his 1910 competition project, "Reincarnatie," using square gridlines overlapped by 45° rotational grids.

4. Conclusion

Schindler used two basic geometric shapes in the Packard House, the square and the equilateral triangle. Where the triangle is a pro-generative device used to determine the shape of the house, the square is a proportional tool used for scalar measures of facades and plans. Thus, the square grid applied to a three-dimensional building takes the form of a regular proportioning system, although it remains invisible in the building itself.

Based on the present analysis, it is apparent that many descriptions regarding the Packard House are incorrect. For example, David Gebhard's claim that the exterior geometry of the house is "arbitrary" is inaccurate, because it has been demonstrated that all geometric decisions were rationally determined. Ester McCoy's description of the house as "Y-shaped" appears too vague, since a very specific form has been seen to underlie the layout of the house. Giella's observation that Schindler's triangular motif was "derived from Wright's own contemporary experiment in polygonal and triangular forms" is implausible, since Wright's designs of the same period do not exhibit any significant use of a triangular grid; Wright used the triangular grid much later.

It is truly a shame that the Packard House was not preserved. Fortunately, the original idea expressed in the house will remain appreciated, underscoring Schindler's metaphysical conception of immaterial eternity. In lecture notes following his 1912 Manifesto, in a discussion of monumentality, Schindler wrote: "Essential parts [built] for eternity" [do] not mean "durable material but the eternal conception of room." In other words, "The timelessness of architecture is in [its] form and its expression." For Schindler, the quest of the architectural process is to build something tangible out of a mental conception. Through his legacy, a genesis of triangular geometry in architecture lives on.

Acknowledgements

This work was supported by an INHA University Research Grant. The early draft of this article was presented at the NNJ Conference Mexico City. The author thanks Kim Williams for reading early drafts of this article.

References

1) Alofsin, A. (1993) Frank Lloyd Wright: The Lost Years, 1910-22. Chicago and London: The University of Chicago Press.  2) Berlage, H. P. (1996) Thoughts on Style 1886-1909. Whyte I. B. (Intro.), Whyte I. B. and Wit W. (Trs.) Santa Monica: The Getty Center.
3) Eaton, L. (1998) Fractal Geometry in the Late Work of Frank Lloyd Wright: The Palmer House. NEXUS II: Architecture and Mathematics, Fucecchio: Edizioni Dell’Erba.

4) Frank, S. (1984) J.L.M. Lauwericks and the Dutch School of Proportion,* AA Files 7.

5) Garland Architectural Archives (1993) The Architectural Drawings of R.M. Schindler: The Architectural Drawing Collection, University Art Museum, University of California, Santa Barbara, David Gebhard, ed. New York: Garland Publication.

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

7) Gebhard, D. (1993) The Architectural Drawings of R.M. Schindler, Eds. New York: Garland Pub.

8) Giella, B. (1985) R. M. Schindler's Thirties Style: Its Character (1931-1937) and International Sources (1906-1937) (Ph.D. diss.,) New York: Columbia University.

9) Kokoschka, O. (1971) Ma Vie, French translation (Paris, 1986).

10) Mallgrave, H. F. (Ed.) (1993) Otto Wagner, Santa Monica: The MIT Press.

11) March, L. and Steadman, P. (1971) The Geometry of Environment, Cambridge: The MIT Press.

12) March, L. (1994) Proportion is an Alive and Expressive Tool," in Lionel March and Judith Sheine (Eds.), R.M. Schindler: Composition and Construction, London: Academy Editions.

13) March, L (1995) Sources of characteristic spatial relation in Frank Lloyd Wright's decorative designs, in The Phoenix Papers, Volume 2, Natural Pattern of Structure, L. Johnson (Eds.) Tempe, AZ: The Herberger Center for Design Excellence.

14) McCoy, E. (1987) Five California Architects, Los Angeles: Hennessey + Ingalls, Inc.

15) Munz, L. and Kunstler, G. (1966) Adolf Loos: Pioneer of Modern Architecture, London: Thames and Hudson.

16) Park, J. (2000) Subsymmetry analysis of architectural designs: some examples," Environment and Planning B: Planning and Design, 27(1), pp.121-136.

17) Park, J. (2000) Subsymmetry analysis of architectural designs: some examples," Environment and Planning B: Planning and Design, 27(1), pp.37-54.

18) Sarnitz, A. (1998) R.M. Schindler, architect (1887-1953): a pupil of Otto Wagner, between international style and space architecture, (New York: Rizzoli, New York, 1988): 26.

19) Sheine, Judith Sheine, R. M. Schindler, (Los Angeles and New York: Phaidon Press, 2001): 123.

20) David Gebhard, RM Schindler (Santa Barbara and Salt Lake City: Peregrine Smith, Inc., 1980): 37-38.

21) The site is located on Gainsborough Drive, east of San Gabriel Blvd, Pasadena, California.

22) Elizabeth T. T. Smith, E, et al. The Architecture of R.M. Schindler. (Los Angeles: The Museum of Contemporary Art, 2001).

23) 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. 2519.

24) Schindler wrote, “Miter treatment of gables and flattened ridge to adapt the high room, used as interior space form, to a snowless climate.”

25) Gebhard, 1980, pp.62.

26) See Garland no. 2522.

27) Rudolph M. Schindler (1949), Answer to questionnaire from the school of Architecture, University of Southern California, R.M. Schindler Papers. The Architectural Drawing Collection, The University of California, Santa Barbara. The strong relationship between lot and house-form stems from his 1916 Church School lecture notes.

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

29) Schindler's early admiration of Wright's architecture was shown in his paper 'Space Architecture' (1934 and 1935). He wrote that 'shortly after my revelation in the mountains, a librarian in Vienna handed me a portfolio – the work of Frank Lloyd Wright. Immediately I realized – here was a man who had taken hold of this new medium. Here was "space architecture".' In 1918, Schindler joined Frank Lloyd Wright whose Wasmuth portfolio (1910) was significant in Schindler's early development. Schindler worked in Wright's Chicago and Taliesin offices originally on the Imperial Hotel project for Tokyo. Rudolph M. Schindler, "Space Architecture," Dune Forum (Feb. 1934): 44-46; and California Arts and Architecture (Jan. 1935): 19. Schindler (1946). In Wright's early work triangular planning is not evident. According to Leonard K. Eaton, Wright's Desert Camp in 1927 is known as the first building executed with a triangular planning module. See Leonard K. Eaton, "Fractal Geometry in the Late Work of Frank Lloyd Wright: The Palmer House," NEXUS II: Architecture and Mathematics, Fucecchio: Edizioni Dell’Erba,
Perhaps the St Mark Tower of 1929 is one of the best known examples of triangular grids. Wright's use of triangular planning grids is more prevalent in his later work, for example, the Palmer House of 1950-51. See Lionel March L. and Philip Steadman, *The Geometry of Environment*, (Cambridge: The MIT Press, 1971).

In the case of Wright, he introduced various types of grid such as the rhomboid, hexagonal, circular grid, and so on. For example, he provided the use of the hexagonal grid in the Hanna House with a particular reason: "we call it Honey-comb House because the structure was fashioned upon a hexagonal unit system. The hexagonal is better suited to human movement than the rectangle." It seems that Wright used the hexagonal system as the appropriateness of functional ease.

The reason that he missed out the grid is noted in his words, "...even though I have been forced, frequently, to make duplicate conventionally measured plans without grid line ..." (Schindler, 1946).

Refer to Frank Lloyd Wright, "In the Cause of Architecture — 1. The Logic of the Plan," *The Architectural Record*, (1928).

William A. Storrer summarized Wright's use of various unit modules in his book, *The Frank Lloyd Wright Companion*, (Chicago and London: The University of Chicago Press, 1993).

The Beach House for Olga Zacsek was built in 1936/38 but demolished. See Anthony Alofsin, *Frank Lloyd Wright: The Lost Years, 1910-22* (Chicago and London: The University of Chicago Press, 1993). His designs with variations. See Hendrik Petrus Berlage: *Thoughts on Style*, (1996): 14.

In Wright's early work triangular planning is not evident, although a hexagonal grid is clearly shown in the Hanna House of 1936. Leonard K. Eaton (1998) presents an analysis of Wright's use of the triangle. According to him, Wright's Desert Camp is known as the first building executed with a triangular planning module in 1927. Wright's use of triangular planning grids is more prevalent in his later work, for example, the Palmer House of 1950-51. Schindler, 1916 lecture notes, Lecture VI: "Planning."