theory

Schindler, Symmetry and the Free Public Library, 1920

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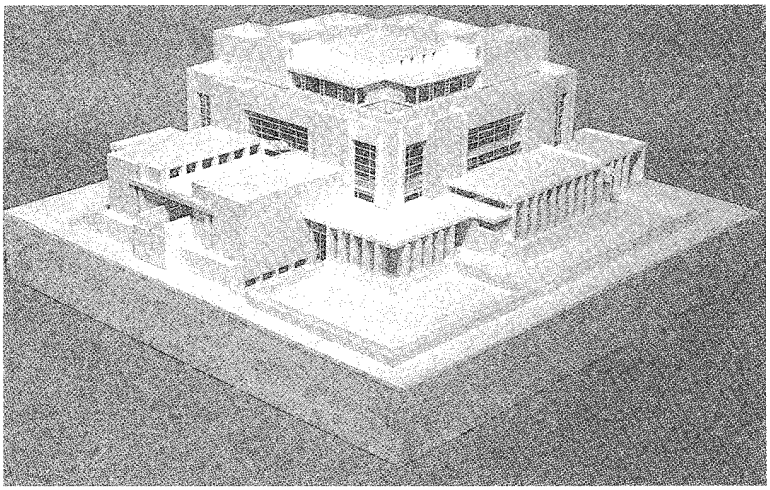
Schindler's Free Public Library competition project of 1920 is analysed. Archival documents are interpreted and an analytic model is constructed. Schindler's standing as a Modernist is considered and his early career is rehearsed, especially his involvement with Frank Lloyd Wright. The formal analysis focuses on the use of symmetry. An interpretation of Schindler's employment of the diagonal axis in the Library is proffered. Historical precedents for diagonal butterfly symmetry in the English free school and the Arts and Crafts movement are examined. A method of analysis using the partial ordering of subsymmetries of the square is applied to the floor plans. In conclusion, the influence of the Library project on Schindler's later work is surveyed.

Rudolph Michael Schindler is one of the outstanding pioneers of Modern architecture in the United States. He is becoming more widely known not only for the unique quality of his individual designs but also for his synergetic design method, combining compositional theory and constructional practice (March and Sheine, 1994). His career records a strong commitment to both theory and practice, a respect and appreciation for the seemingly timeless and universal traditions of architecture, and a sharp wit to transform these lessons of history to topical and local ends.[1] He stands as an American representative of the 'Resistance', those wayward modernists who would not give in to the whitewash of organised Internationalism (Wilson, 1995).

During his lifetime little was written about Schindler, his work remained largely unrecognised and was sometimes just plainly ignored. Hitchcock and Johnson excluded Schindler's works in their International Style exhibition in 1932. Hitchcock (1940) described Schindler's works as 'immature' and 'brutal'. Several decades later, Hitchcock still exposed his ignorance of Schindler's architectural achievements in his Preface to Gebhard's *Schindler* (1971). Belatedly, Philip Johnson has confessed: 'Now I believe that Schindler was a much more important figure than I casually assumed. His place at the crossroads of art and architecture and his variety and originality of design are much greater than I gave him credit for'.[2] (Noever, 1995).

In recent times, Schindler's work has become increasingly important in the architectural world. Hans Hollein (especially), Jakob Bakema, Hermann Hertzberger, Charles Moore, Gustav Peichl and Bruno Zevi have all written in appreciation (see Sarnitz, 1988). To this list must now be added Charles Correa and Lebbeus Woods



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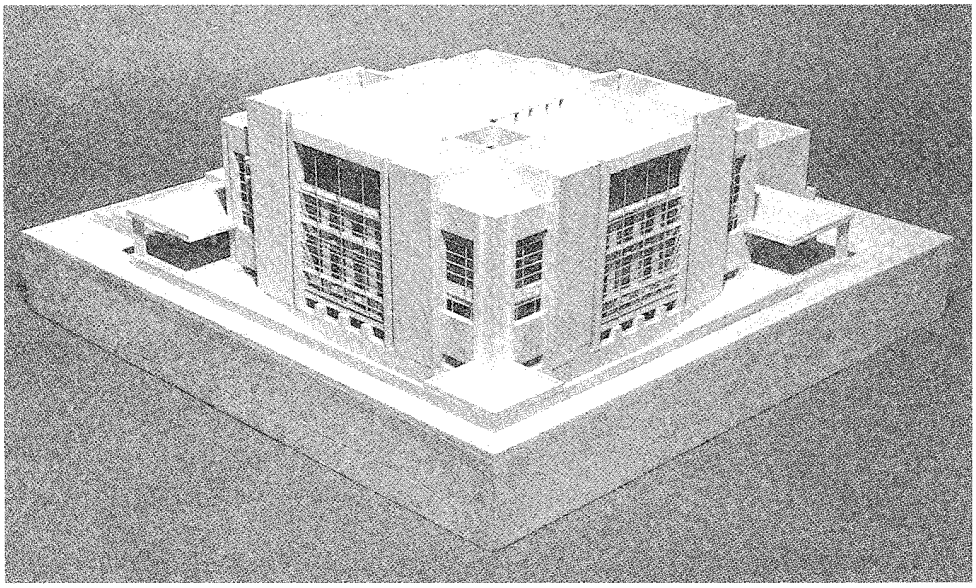

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1. Free Public Library: 1/4 inch scale model reconstruction. Symmetry is the governing principle. 1a. View from south-east with Clinton Avenue elevation to left and Bergen Avenue to right. 1b. View from north-west showing side boundary elevations with ramps down to basement loading platform.

(Noever, 1995). Schindler's work has exerted a profound and lasting influence on many leading Southern Californian architects. Among the current generation, Frank O. Gehry writes that 'the spirit of Schindler warms the works of all of us who were touched by his life', Michael Rotondi speaks of how his imagination, intellect and heart were influenced by contact with Schindler's contributions, and Franklin D. Israel frequently cited in writing and in his buildings his respect for Schindler (Noever, 1995; Israel, 1992).

Schindler's architecture was first highlighted by Esther McCoy (1960) where he was placed appropriately in the company of other Californian pioneers: Bernard Maybeck, Irving Gill, and the two Greene brothers. David Gebhard (1967, 1971) put Schindler on the map with books, touring exhibition, and catalogue.[3] August Sarnitz (1988) made extensive use of the archives collected and preserved by the late David Gebhard at the University of California, Santa Barbara. Most recently, Lionel March and Judith Sheine (1994) edited a *Festschrift* on the many events and contributions designed to celebrate Schindler's centenary at the University of California, Los Angeles, in 1987/88.

The architect

Schindler was born on 10 September 1887, in Vienna, and died on 22 August 1953, in Los Angeles. He studied at the Imperial Institute of Engineering in Vienna from 1906 to 1911. In 1910, a year before he graduated from the school, he studied under Otto Wagner at the Imperial Academy of Fine Arts. During this period, he also joined Adolf Loos's Bauschule. Schindler's early development of architectural thought, then, is indebted to both Wagner and Loos. He was an apprentice in Hans Mayr and

Theodor Mayer's office in Vienna. In June 1914, he came to Chicago to work for Ottenheimer, Stern and Reichert. From 1916 to 1918 he worked on the Buena Shore Club, the largest project of his life. He was fully responsible for its design and the execution (Giella, 1994). In 1918, Schindler joined Frank Lloyd Wright whose portfolio (1910) was significant in Schindler's early development.[4] Schindler worked in Wright's Chicago and Taliesin offices originally on the Imperial Hotel project for Tokyo.

Recently discovered letters between Schindler and Wright[5] show that Schindler was made superintendent of Wright's office in Chicago and then Los Angeles during Wright's long absences in Tokyo. Schindler was responsible for attending to Wright's tax returns as farmer and professional, for dealing with legal matters and office certifications – 'Frank Lloyd Wright, Architect, by Rudolph Schindler, Superintendent', for managing rental properties in Oak Park, and for both initiating and completing projects. In the letters, Wright acknowledges Schindler's design of the Shampay House: 'I hope the Shampay has gone ahead. It is as good or better than they get who go to the School of the Middle West for a ~~Wright House~~ [*sic*] a Lloyd Wright facture – or a facture of the sham. The plan seemed good with the exceptions noted. The money is needed'.[6] And when Wright's lover, Miriam Noel, 'walked out' on him in Tokyo, he writes to Schindler: 'I hope "M" will have the good taste to let my situation in Chicago and at Taliesin then entirely alone. If not, your instinct for proportion and a few others things may help save some of the pieces'. Until now, it has been generally assumed that Schindler came to Los Angeles just to supervise developments on Olive Hill for Aline Barnsdall, the oil heiress (Smith, 1992). In fact, he continued to supply drawings for the Imperial Hotel and to deal with American suppliers.[7] Schindler, like Wright to Sullivan, was more than just another draftsman.

Once in Los Angeles, Schindler soon started his own architectural practice. He lived and worked at the Kings Road House, a co-operative dwelling for two families designed by Schindler and built with Clyde Chase in 1921/22 (Smith, 1987; Sweeney, 1989). Most of the projects for which he was commissioned were relatively small and were located in Southern California. Schindler's architectural theory and method are stated in various articles published later in his career. It is clear that a modular unit system, in his own words a 'reference frame in space', underlies his design method (Schindler, 1946). The reasons for using this system are twofold. First, all locations and sizes of the parts with respect to the whole building are precisely identified during the construction process. Thus, no obscure or arbitrarily unrelated measurements are involved in the unit system. Second, the unit grid system offers the means to visualise 'space forms' in three dimensions: '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 easily but accurately in his imagination'. He recommends 48 inches for the basic unit, to be used with simple multiples and with half, third and quarter subdivisions. Schindler gives two reasons for this choice. First, the unit must be related to the human figure to satisfy all the necessary sizes for rooms, doors, and ceiling heights; second, for practical reasons, the 48 inch module fits the standard dimensions of materials and common construction methods available in California at the time.

In 'Space Architecture', Schindler (1934) explains the meaning of space architecture by contrasting it to past architecture which he regards as nothing but sculptural mass, with space as a by-product. He distinguishes space architects who create space forms for human life from those functionalists and International Style sloganists who emphasise functional concerns without giving full consideration to the meaning of architecture as art. Schindler concludes that modern architecture will be developed by artists who 'can grasp space and space forms as a medium of human expression'. Instead of following conventional details, Schindler (1947) developed his own innovative and simpler constructional system: 'the Schindler Frame'. He considered that the old method of wood frame construction is not suitable for the new space architecture. Sheine (1994) makes a telling comparison between Le Corbusier's seven points and Schindler's approach. Schindler's writings are an integral part of his lifelong practice. They present a systematic account of his total design approach concerning, for example, structure, material, colour, and furniture; that is, together, composition and construction.

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The Free Public Library project

While still working for Wright in Chicago, Schindler entered the Free Public Library competition, Bergen Branch, Jersey City, New Jersey, on 16 August 1920. He failed to be placed, or mentioned. In part this could have been owing to the style of his design [Fig. 1] being unfamiliar and beyond the judges' comprehension. However, it is also true that Schindler did not comply with requirements in the competition guide. The reasons he gave were that he wanted to bring the construction within budget, to get rid of unnecessary space which the Trustees of the Library had required, and to create more usable space with more appropriate functional distribution.

A brief summary of his written description will provide some idea of how Schindler enhanced the programme. Since constructing a 220,000 cubic foot building with $100,000 (45 cents per cubic foot) was difficult to achieve, Schindler proposed a content of 155,000 cubic feet (65 cents per cubic foot) with a balcony floor, eliminating unnecessary building height and providing for 'the future needs of the library'. The competition programme required fireplaces in the reading room, the children's room and the reference room; however, Schindler omitted them in his design. The reason he gives is that they are 'never-used stagesetting devices to make the rooms attractive'. Furthermore, although it was not required in the programme, Schindler designed the children's room low to make it spacious for its occupants.

More details will be described in the following interpretation of the project. This description is based on Schindler's own competition materials which are well preserved at the Schindler Archive in the University of

California, Santa Barbara: the competition programme, Schindler's initial sketch, a set of drawings and a written description of the proposal, and the letter giving the competition results.

Analysis

By scrutinising the original drawings and specifications, by fabricating a scale model, and then by analysing the project from both a historical and theoretical viewpoint, this study attempts to reconstruct one of the most elegant yet forgotten works of the architect.

To begin with, interpretation of the original competition drawings is essential to clarify Schindler's design idea. For interpretative purposes, this material is enhanced through constructing new drawings, both redrawing the original orthographic views and deriving from these perspectives, and through the building of a quarter-inch scale model. In this paper, the analysis focuses on Schindler's use of symmetry. The analysis is in three parts: first, it provides an interpretation of Schindler's employment of the diagonal axis; second, it surveys possible historical influences leading to the diagonal symmetry in Schindler's design; and third, it examines the design with respect to a partial ordering of subsymmetries associated with the symmetry of a square. It is important not only to describe historical and theoretical usages of such symmetry, but also to point out in what manner the symmetrical idea is strategically employed in the project.

Interpretation

Diagonal symmetry is the governing principle in the Library Project. Along with Schindler's fundamental 48 inch unit system [Fig. 2], diagonal symmetry guides all the major decisions of the spatial composition and, even further, the architectural details. Even though Schindler does not make explicit the 48 inch unit system as he does in later projects, his reference frame is implicitly superimposed on the 100x100 foot site as given. The rational integration of the reference frame and symmetries related to the square throughout the whole scheme gives the design unity [Figs. 1, 3 and 4]. Schindler's

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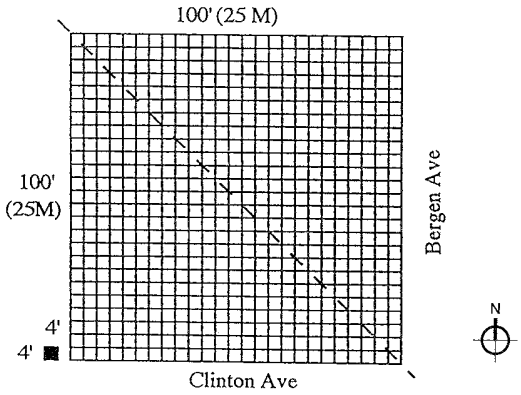

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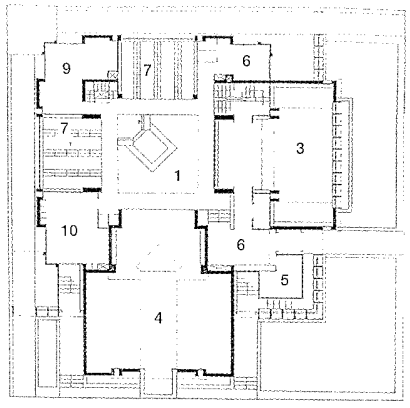

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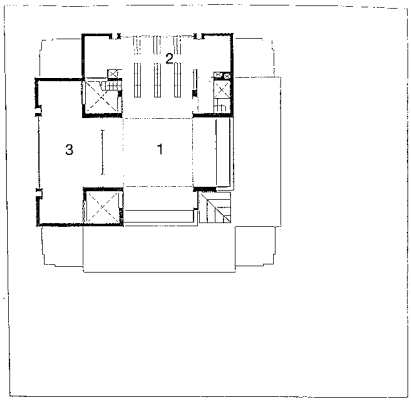

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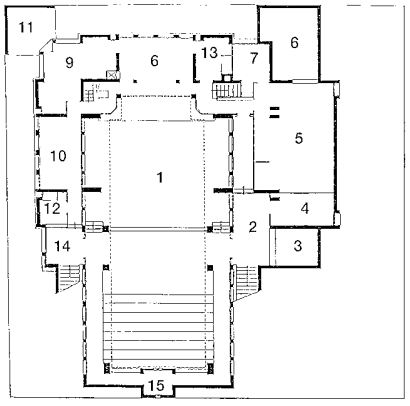

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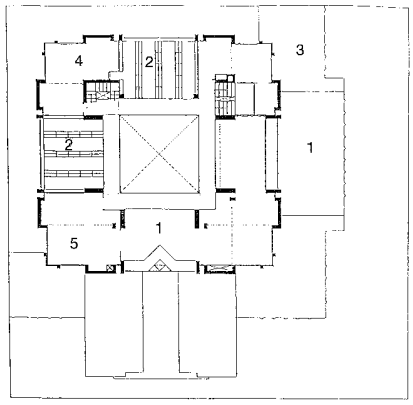

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2. Site for the Free Public Library Competition with the diagonal and Schindler's 48 inch planning module superimposed.

3. Floor plans redrawn by author with North American floor level nomenclature.

3a. Basement floor.
1 Auditorium.
2 Vestibule.
3 Women's rest room.
5 Coal.
7 Janitor.
8 Stage.
9 Work room.
10 Classroom.
11 Platform.
12 Men's rest room.
13 Men's rest room.
14 Entrance.
15 Booth.

3b. First floor.
1 Delivery room.
2 Catalogue.
3 Reading room.
4 Children's room.
5 Checker's room.
6 Vestibule.
7 Stack.
8 Women's rest room.
9 Office.
10 Staff room.

3c. Balcony level.
1 Exhibition area.
2 Stack.
3 Rest room.
4 Work room.
5 Store.

3d. Second floor.
1 Reference room.
2 Special collection.
3 Study.

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preoccupation with using the diagonal layout is clearly shown in his initial thumbnail sketch on the cover of the competition programme [Fig. 5]. Further discussion on how Schindler interprets the programmatic needs spatially will identify this concept in more detail.

Two exterior ramp areas arranged in the rear [Figs. 1b and 3b] show Schindler's conscious use of diagonal axial approach. The competition programme required: first, that the building be placed 'back from the lot line on Bergen Avenue 20 feet; from Clinton Avenue 6 feet; from the north side of the lot line 10 feet; from the rear line 20 feet'; and second, that 'in addition to the two main entrances to the basement there should be an entrance in the rear area with provision for putting in coal'.

Instead of following the programme regulation, Schindler approached these requirements differently, as shown in his initial sketch. Concerning building placement, he wrote: 'The location of the building is toward the innermost corner of the lot, rather than in the central arrangement suggested in the "Instruction to the Architect". The latter cuts the lot into three strips through the building, and wastes as much ground behind as is left in front; while the corner placing of the building serves as the foreground with two dimensions rather than one, and appropriately provides the frame needed to outline fittingly a building of so public a character'. Instead of mentioning a basement entrance for the coal bins, he suggested an alternative function: 'The workroom has been completed by a shipping platform, in view of the increasing use of auto-libraries, as well as of the general necessity for a convenient shipping point'. His approach is evident in the reconstructed drawings where the building is seen to be set 8 feet from the rear boundary from the centre line of the outer wall of the building. This strategy provides, first, a spacious foreground in front of the building without wasting any rear ground area and, second, instead of a coal bin entrance in the rear, it accommodates two 6-foot wide ramps, symmetrically arranged on the diagonal [Figs. 1b and 3b], for the shipping platform [Fig. 3a].

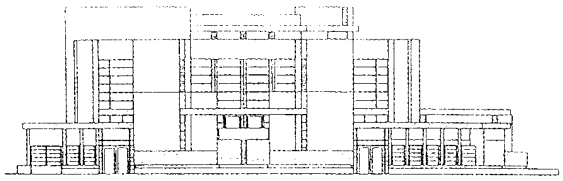
Two parts of the stack room are symmetrically arranged as open stack sections [Figs. 3b and c]. Schindler describes the advantage of this 'unusual arrangement'. On the one hand, it aids the staff supervision of every stack aisle. On the other, it adds to the reader's convenience in accessing the card catalogue to the book stack. From the reconstructed drawings, the dimension of each book-stack room is 20x16 feet. This is further divided at five foot intervals for the three double-faced stacks. For the double-faced stacks, the dimensions are 15 feet long, about 20 inches wide and 7 feet 6 inches high – the ceiling height. With the construction of the model, it is possible to examine and conceive a concise overall design of details, structure, and material. The design of the book stack is structurally integrated with floor and fenestration design; even the aisle surrounding the central courtyard is a part of this structural system. The constructional method of double-faced stacks foreshadows many later built-in furniture systems by Schindler. [Fig. 6] shows the book stacks and the floor structure.

Schindler's book-stack design is reminiscent of Pierre-François-Henri Labrouste's Bibliothèque Nationale of 1854/75 [Fig. 7], in which the architect designed the library's closed-stack section with a series of connecting galleries, and a grid-iron floor in which light penetrates through the floor of the stacks and aisles. For its time, Labrouste's adaptation of an iron structure was not only an example of the new aesthetics of metal usage, but it also demonstrated novel spatial organisation, as well as a method of economic production. Similarly, Schindler emphasises the economical aspects of his proposal, the importance of lighting, and the spatial advantages for the supervisor and the reader in design. Schindler may have incorporated his knowledge of nineteenth-century French rationalist architecture into his library project. Although the whole structural system is documented systematically, a simple but important question still remains: what kind of material is used for the floors of the stacks? There is no indication of floor materials. The floor design of the balcony level in the section drawing differs from other floor designs. Moreover, the floor is thin, only four inches thick. Although the exact use of floor material cannot be determined, three possible materials Schindler might have used are explored in the model construction: cast-iron, wood, or glass blocks [Fig. 8].

On the first floor [Fig. 3b], the delivery desk and the delivery room in the central part of the first floor are arranged along the diagonal axis to supervise the stacks and the reading room and children's room near the desk. Two spaces are expanded for the children's room in the east wing and the reading room in the south wing. The dimensions of two extended areas from the main building for the reading room and children's room are 36x25 feet and 36x15 feet respectively, depending on the distance between the inside walls. Where dimensions are not multiples or simple divisions of the 48 inch unit system, they remain valid as deviations from the unit system. Schindler (1946) remarked: 'It is not necessary that the designer be completely enslaved by the grid. I have found that occasionally a space form may be improved by deviating slightly from the unit. Such sparing deviation does not invalidate the system as a whole but merely reveals the limits inherent in all mechanical schemes'.

The symmetrical distribution of these two rooms gives compositional balance and answers programmatic requirements; however, in a formal sense, it breaks the diagonal symmetry by the variation in room size. This asymmetry does not depend on the arbitrariness of a personal taste which rejects symmetry (an important doctrine of Modernism for some Internationalists); instead the asymmetrical design is generated from a profound understanding of the laws of symmetry. Symmetrical design does not lose its validity; on the contrary, the resulting asymmetry produces an abundance of symmetries within the parts while negating the symmetry of the whole. Schindler understands and implements this paradox.

At the balcony floor level [Fig. 3c], the arrangement is similar to the classical configurations of centralised church plans. Indeed, Wright's own adaptation of this motif in Oak Park's Unity Temple is evoked. The balcony floor in the Library is based on a 60x60 foot square. The basic *parti* for this floor is a plan divided into nine smaller 20x20



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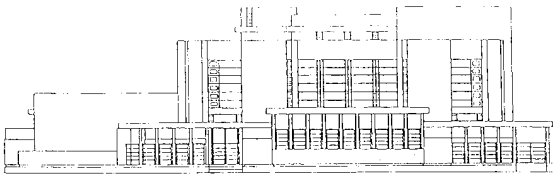

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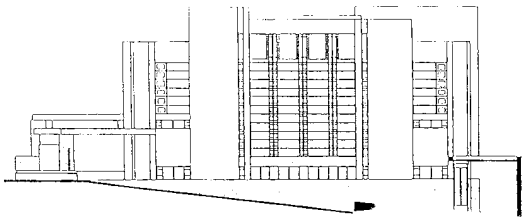

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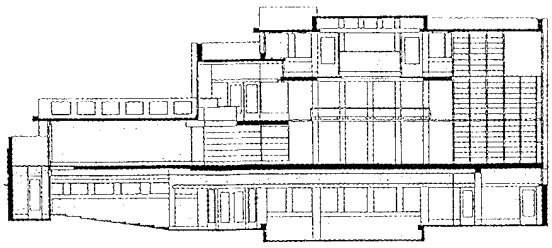

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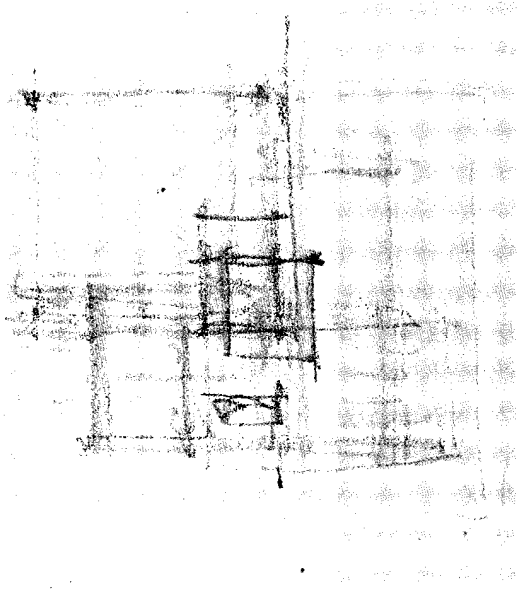

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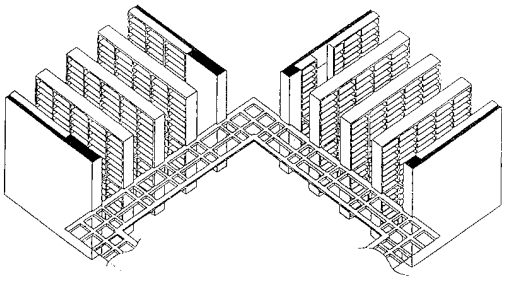

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4. Elevations and long section.
4a. South, to Clinton Avenue.
4b. East, to Bergen Avenue.
4c. North, showing one of the ramps to the basement platform.
4d. North and south section taken through the basement auditorium and the first floor children's room (left), delivery room (centre) and stack (right).
5. Schindler's initial sketch made on the competition programme cover.
6. Book stacks: axonometric view. The construction method foreshadows that of Schindler's built-in furniture.
7. Bibliothèque Nationale, 1854/75. Schindler's book-stack design evokes Labrouste's of 1854/75.
8. Model showing book stack and aisle floor made up of glass blocks.

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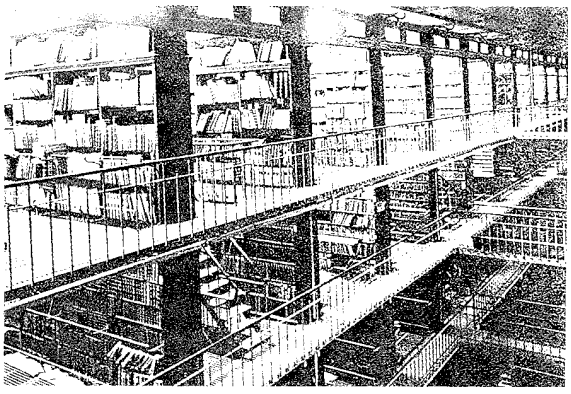

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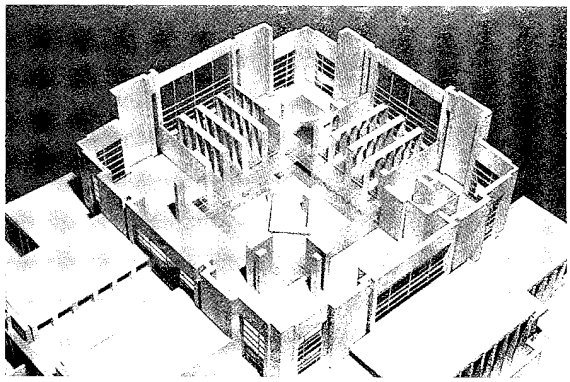

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foot squares. Around the open central hall, spaces are distributed about the diagonal axis; for example, the north-west part is for the book stacks and the south-east part is for the exhibition room. On the second floor [Fig. 3d], two rooms for the special collection on the north side and the study room on the west side are controlled by the diagonal axis. The remaining space is a characteristically Schindleresque L-shape on this axis for the reference room, as is the detailed design of the 8x8 foot skylight at this level.

Even though Schindler's own floor plans show an elaboration of local symmetries, the use of diagonal symmetry as a main governing principle becomes clearer in the model reconstruction [Figs. 1 and 8] and the derived perspectives [Fig. 9].

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Historical analogy

In discussing Schindler's use of diagonal symmetry, it is worth looking for historical precedents of the diagonal axis concept that might have been sources for Schindler's interest. Schindler would have been well accustomed to orthogonal bilateral symmetry from the Wagnerschule and the pervasive influence of the Beaux-Arts tradition.[8] Throughout history, diagonal axial symmetry has been used in design not so much in architectural composition, but more in ornamental design (see March, 1995). The use of diagonal symmetry for architectural composition is largely a modern development.

One of the most striking early uses of diagonal symmetry is Ledoux's Montmorency Palace of 1770 [Fig. 10a]. In this particular building, Ledoux employed a diagonal axial scheme within a perfect square. Most of the main spaces and two projected wings in Ledoux's plan are diagonally arranged in a strict manner. The emphasis of the diagonal axis is highlighted by the entrance position in the plan, whereas Schindler in the Library project employs separate orthogonally disposed entrances [Fig. 10b]: two main entrances to the basement auditorium on Clinton Avenue, and the other entrance for the main floor on Bergen Avenue. The resemblances between Ledoux's plan and that of Schindler are telling. Loos held Ledoux in high regard, as he did the English.

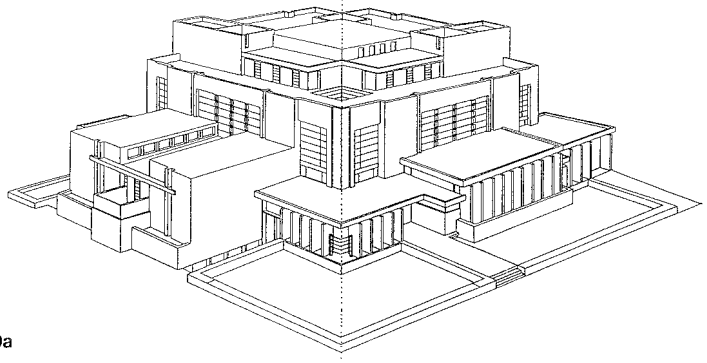
English domestic architecture of the free school and the Arts and Crafts movement were enthusiastically embraced by the circles in which Schindler had moved as a student in Vienna (Sarnitz, 1994). The Continental Movement is probably best exemplified by Hermann Muthesius, through his publications and designs. Adolf Loos 'thanked Muthesius in print for *Das Englische Haus*' (Banham, 1980). Muthesius' contribution was crucial to the promotion of English free school concepts. Several of the houses he illustrated make use of the diagonal axis. James D. Kornwolf (1972, pp. 216-238) describes this development in the historical context as a series of sequences on the diagonal axes: Edward Prior's 'Barn' of 1896 [Fig. 11a], Baillie Scott's 'Dulce Domum' of 1901 [Fig. 11b], and later, Hermann Muthesius' own Freudenberg House of 1907/8 [Fig. 11c]. Kornwolf argues that Prior's 'Barn' is 'only the first of a number of similarly diagonal axial schemes of Baroque origin'. Baillie Scott (1906) himself acknowledges that his design was very much influenced by Prior's. Kornwolf points out that Muthesius, having learned to use diagonal axes from English domestic architecture, applied them to his own designs. Recording these schemes in his books, Muthesius ensured the awareness of such symmetry within the Continental Movement. Kenneth Frampton (1980) also suggests that the butterfly plan-form of Hermann Muthesius' Freudenberg House was influenced by Edward Prior's 'Barn'. Frank Lloyd Wright, whose influence on Schindler's early architectural development was significant, uses the butterfly theme early in his career. The Henry Cooper House of 1887 in La Grange, Illinois, is arranged on a 45° axis with a square hall in the middle and two wings embracing a garden: one for the library and music room, and the other for the family sitting room.[9]

The American journal *The Craftsman* published 29 essays on modern country homes in England by the architect and garden city planner, Barry Parker, between 1910 and 1912 (Hawkes, 1986). Several of Parker's plans are based on the butterfly: the house 'Letchworth' in Horsted Keynes; 'St Brighid's' in Letchworth; and, in an essay entitled 'Symmetry in Building: the Result of Sincerity', a pair of L-shaped houses arranged diagonally on a corner lot in which Parker specifically calls attention to the advantages that the arrangement provides for a spacious setback from the corner. Schindler's argument for breaking the competition rules precisely! These examples must surely count among those that might have made Schindler aware of the potential for using diagonal axes at the domestic scale. Schindler transforms this predominantly domestic idea into one for a free-standing civic building.

Subshape analysis

In this analysis, a method is introduced to show how various types of symmetry, or subsymmetries, are superimposed in different floors in the project. In his lectures on the fundamentals of architectonics, Lionel March discusses the mathematical structure of symmetry groups in analysing architectural designs (March and Steadman, 1971; March, 1995, 1997 forthcoming; see also Grossman and Magnus, 1964; Baglivo and Graver, 1976). March's emphasis has two aspects. Analytically, he explains that by looking at architectural designs in this way, symmetry which may be superimposed in several layers in a design and which is not immediately recognisable may be articulated and become transparent. Synthetically, he believes that architectural design and mathematical knowledge are intimately connected, and that designers can only benefit from being aware of the group operations and spatial transformations associated with symmetry in relation to compositional and thematic development.

The following analysis starts by illustrating a partial order of the subsymmetries of the symmetry of the square [Fig. 12]. The symmetry group of a square includes not only reflections in its four axes but also rotations through 0°, 90°, 180°, and 270°, respectively. These eight transformations are the 'elements' of the



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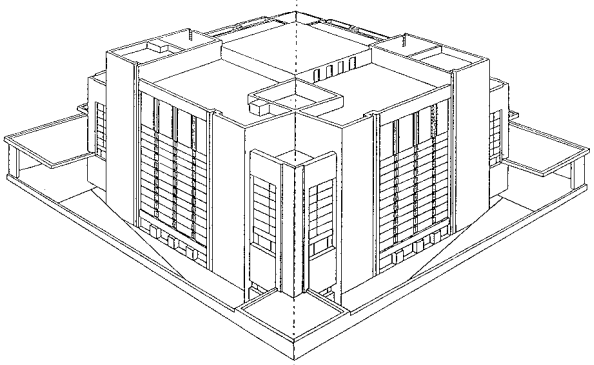

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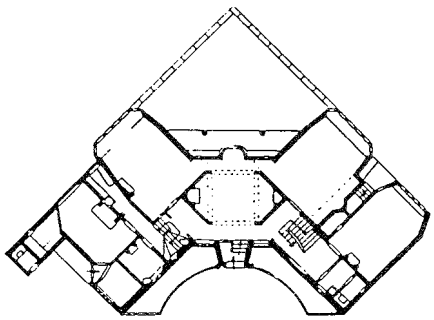

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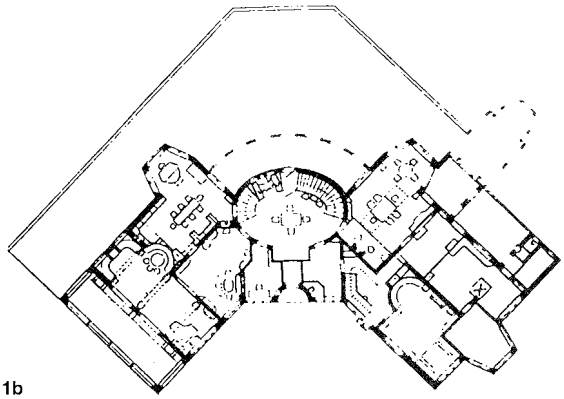

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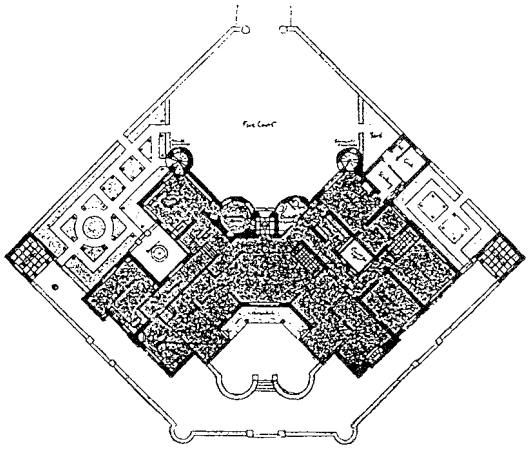

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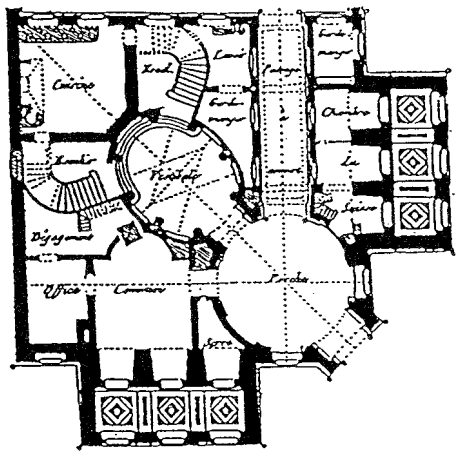
9. Perspectives clearly demonstrating the governing principle of diagonal symmetry.
9a. From the south-east junction of Clinton and Bergen Avenues.
9b. From the south-west boundaries.

10. A telling resemblance in diagonal symmetries.
10a. Ledoux's Montmorency Palace plan, 1770.
10b. Schindler's Free Public Library plan, 1920.
11. English 'free school' and 'Continental Movement' examples.
11a. Edward Prior, 'Barn', 1896.
11b. Baillie Scott, Dulce Domum, 1901.
11c. Hermann Muthesius, Freudenberg House, 1907/8.



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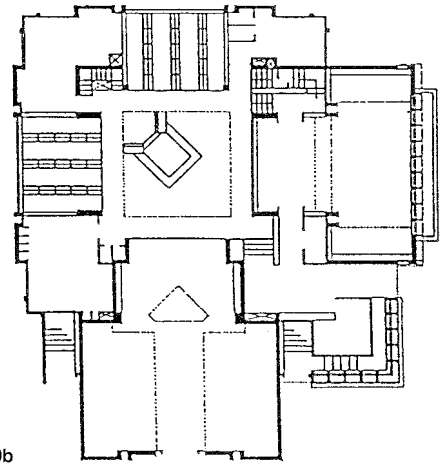

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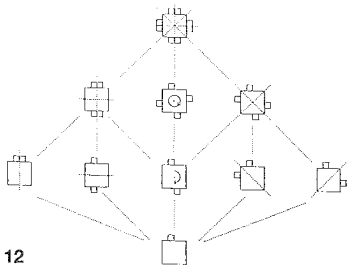

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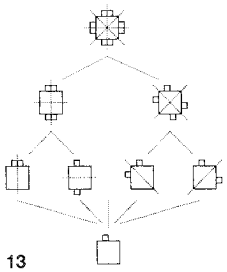

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12. Diagram of subsymmetries of the square.
13. The diagram without the purely rotational subsymmetries. Schindler uses dihedral symmetry, not cyclic.
14. Diagram of subsymmetries in the Free Public Library, first floor plan. A similar diagram may be constructed for each floor level.
15. How House, 1925, site plan. Schindler emphasised the importance of the diagonal by setting the house at 45 degrees to the boundaries.
16. Two schemes for the Schindler Shelter, 1933/38. An example of cyclic, pinwheel symmetry.

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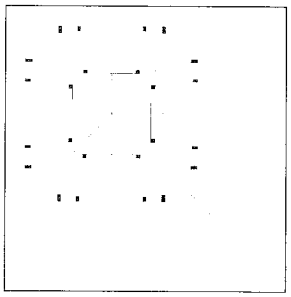

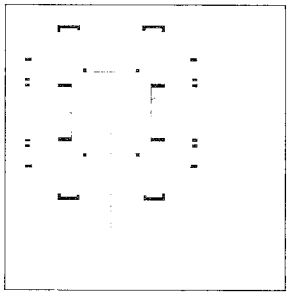

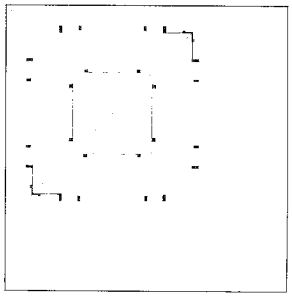

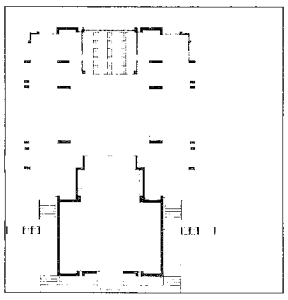

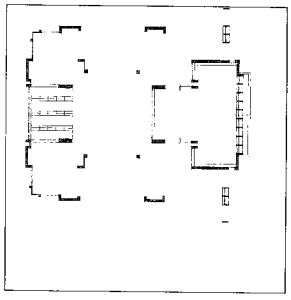

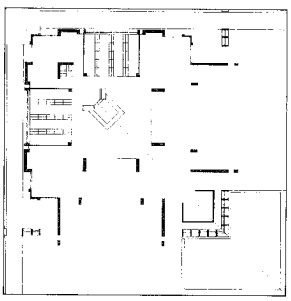

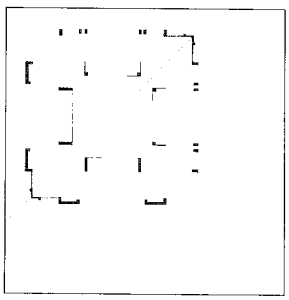

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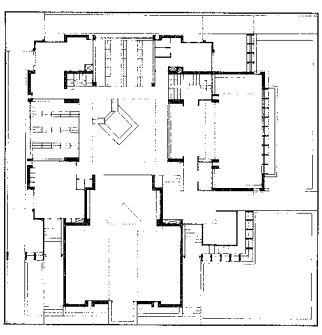

group. The diagram illustrates all the possible subsymmetries: some with four elements, some with two, and just one, the identity, or asymmetry, with one element. The structure of the diagram can be accounted for in two ways: from top to bottom, subsymmetries are 'subtracted' from the full symmetry of the square; and conversely, from the bottom to the top, subsymmetries are 'added' to achieve higher orders of symmetry. Such a reading is analogous to a lattice diagram of subsets of a set, or subshapes of a shape.

Starting from the top of the diagram, level 1 represents the full symmetry of the square with four rotations and four reflections. Level 2 consists of two reflective subsymmetries: one shows two orthogonal axes, and the other shows two diagonal axes at 45° to the orthogonal. Both of these subsymmetries produce a half-turn, or two rotations, through 180°. The third subsymmetry shows four quarter-turns, or 90° rotations. It typifies the 'pin-wheel' symmetry of architects. At level 3, there are five subsymmetries, four with reflective symmetry and one with the rotation of a half-turn. There are two subsymmetries with reflections on the orthogonal, simple bilateral symmetry, and two subsymmetries with reflections on the diagonal, and one subsymmetry through two half-turns, or 180° rotations. The bottom level is called the 'unit element' or the 'identity' of the group. It has no reflection axes, and no rotation less than the full-turn through 360°.

The analytic diagram of each floor plan is classified by following this partial ordering of subsymmetries of the square. The basement floor plan as a whole shape does not possess the full symmetry of a square, but there are some subshapes within it which conform to the full symmetry of a square. Other subshapes conform to other subsymmetries. By extracting subshapes which maximise the representation of a particular subsymmetry of the square, a diagram may be constructed to illustrate the overlay of symmetries involved in the overall plan at each level. The analysis has been repeated for the four floor levels including the balcony level, but only the main floor plan is illustrated here.[10] It is noteworthy that the purely rotational subsymmetries are not present, that neither the quarter-turn nor the half-turn symmetries are to be found in subshapes without also being accompanied by reflections.[11] Technically, this means that Schindler uses dihedral symmetry, but not cyclic (March and Steadman, 1971).

In the lattice diagram of the first floor plan [Figs. 13 and 14], the subshapes of the plan are partially ordered with the full symmetry of square of order eight at the top; at the next level, there are two reflective symmetries of order four – one orthogonal along two axes, and the other diagonal along two axes; and, at the level below, there are four reflective symmetries of order two each along a single axis, either orthogonal or diagonal. At the bottom of the diagram is shown the floor plan itself which represents the 'identity'. The diagram illustrates how various subsymmetries are superimposed. A similar diagram may be constructed for each floor level, including basement and roof. The balcony level is particularly compelling since it is contained within a square envelope, with a double-height square void in the centre. The second floor reasserts the predominance of the diagonal axis by being contained by a thick L-shaped envelope.

This analysis is not intended to imply that Schindler went through this subsymmetry procedure step by step to come up with his basic design, but it surely shows that he had a very profound appreciation of the structure of symmetry and how he might exploit that knowledge formally.[12]

Schindler, Symmetry and the Free Public Library, 1920
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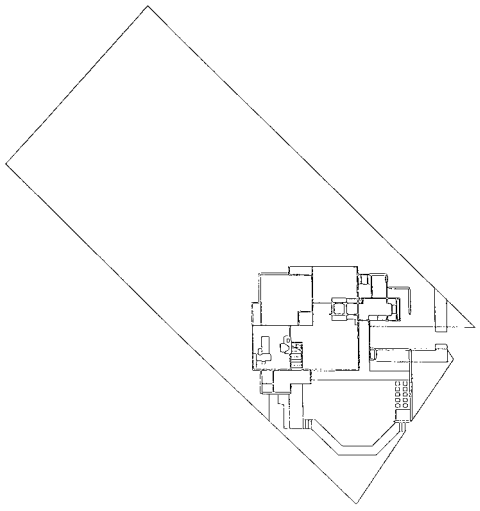
Conclusion

Although Schindler did not win the competition, the Library project represents a significant turning point in his architectural career because its design explores and clarifies his formal methodology. It is apparent that Schindler's emphasis on diagonal symmetry in this public



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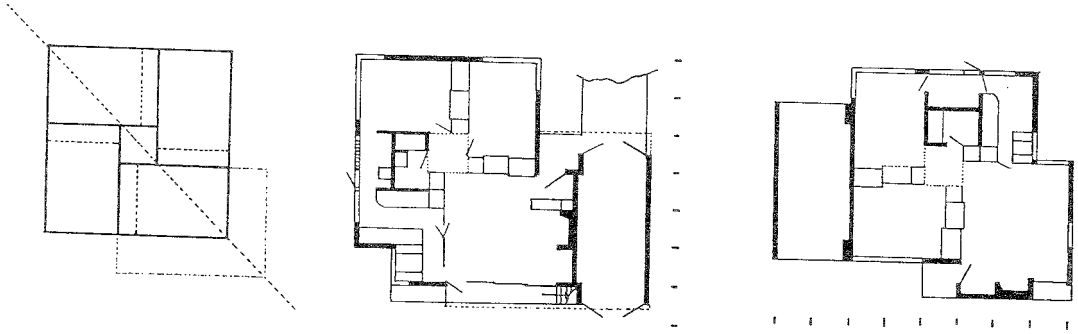

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Schindler, Symmetry and the Free Public Library, 1920
Jin-Ho Park

project is unconventional for the period. Further, his layering of additional subsymmetries is executed with masterly skill. He continued to develop the use of diagonal symmetry in his later work, most notably the How House in 1925, residences for Elizabeth Van Patten in 1934/35 and Mildred Southall in 1938, a beach house for Olga Zaczek in 1936/38, and the Bethlehem Baptist Church in 1944 (see Gebhard, 1993).

The How House stands out from all his other works of this period in its conspicuous and transparent play around the diagonal axis overlaying a 48 inch reference frame. It seems likely that the How House derives from themes in the unbuilt Library Project. The use of both the modular and symmetrical systems in the How House is extremely subtle (March, 1994). Schindler increases the importance of the diagonal axis by setting the orthogonal lines of the ground plan at a 45° angle to the boundaries of the lot and the road frontage [Fig. 15]. The diagonal symmetry is further enriched in the Bethlehem Baptist Church. The whole structure in the main church, including seating areas, the choir, tower, and ceiling are diagonally planned. In particular, the ceiling structure of the church follows that of the How House. The application of diagonal axes and compositional form radiating from the central cube-like space are similarly found in both projects.

Notable for its absence in this particular analysis, Schindler's interest in the cyclic symmetry of the pinwheel is developed in projects following after Library, such as the Popenoe House of 1922, and the Schindler Shelters of 1933/38 (Gebhard, 1993). The pinwheel type of symmetry is a major compositional issue along with some other local symmetries in both projects. For the Popenoe House (March, 1994, p. 128), the main building is a square with four porches arranged in pinwheel formation.[13]

In the Schindler Shelter low-cost housing system [Fig. 16], he exploits various schemes. Variations are mainly governed by pinwheel type symmetry. In the overall arrangements, the *parti* is based on a 5x5 module square from which the living room extends. A garage may be added at any corner. Diagonal symmetry is investigated as a compositional principle between schemes. In the two shown, the structural pattern and their space distributions are almost exactly mirrored along a diagonal axis. Superficially, they may look different, but closer observation shows that they are almost identical, except for the garage space.

To sum up, the Free Public Library project is an early example of Schindler's use of a disciplined methodology. It begins to synthesise theory and method into a practised form. Through the exploration of a constructed model and analysis of archival documentation, his unique design method, including the play of symmetry over a unit reference frame, is appreciated. It seems that this early design, more than any other, forms the groundwork of his future career and establishes the foundations for his developing ideas.

Notes

1. Schindler would have been familiar with Loos' way of looking at traditional architecture in regard to modern development. Henry Kulka (1960) describes the notion quoting Loos' own words: 'Do not be afraid to be called old-fashioned; it is only permissible to alter traditional building methods if one can improve upon them. The truth, even if hundreds of years old, has more spiritual connection with us than the lie which strides besides us ... Tradition is a reservoir of strength from countless generations, and the firm foundation for a healthy future'.

2. Admittedly, for the 1954 memorial exhibition of Schindler's work, Johnson wrote that Schindler 'was among the great pioneers of modern architecture in this country. His work was not only great in itself, but had a lasting influence for good in later modern developments. His single-minded devotion to the main principles of architecture was extraordinary and should serve as an example to the younger architects of our time'. Source: University of Santa Barbara Architectural Drawing Collection.

3. The exhibition was shown in London at the RIBA in 1969 and Schindler's work received positive reviews from critics as diverse as Marcus Binney in *Country Life*, Walter Segal in the *RIBA Journal*, and Sherban Cantacuzino in *The Architectural Review*.

4. Schindler's early admiration of Wright's architecture is shown in his paper 'Space Architecture' (1934). He writes: '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".'

5. Some 60 letters were discovered interleaved in magazines in the Pauline Schindler archives by Maureen Mary in 1994, acting as archivist for the Schindler family. While most of the archive has now been removed to the Architectural Drawings Collection at UC, Santa Barbara, the Wright-Schindler correspondence is now with the Getty Foundation. I am grateful to Maureen Mary for access to this information.

6. Lionel March has contributed the following note. The unusual phrase 'facture of a sham' may be a quotation remembered from an article by Whistler on shoddy, but profitable, products which Wright could have read in *The Saturday Review* while working for J. L. Silsbee. From the evidence of the newly discovered correspondence, the design of the Shampay House, while carried out in Wright's office, is clearly an independent design by Schindler. Bruce Pfeiffer (1985, pp.192-195) suggests that the project 'reveals an interesting transition in the residential work of Frank Lloyd Wright', and that some elements 'point directly to the Usonian houses that would come 14 years later'. In an earlier letter from Tokyo, Wright puns: 'The Shampay – (I hope he won't

be shamming when it comes to paying) plan has arrived ...'. In fact, Schindler handled the suit after Shampay failed to pay!

7. Information based on Wright-Schindler letters from Lionel March and Maureen Mary.

8. See March and Sheine (1994, p. 49, figures B, C) where Schindler's student project for a post office in the Beaux Arts style is illustrated.

9. Neil Levine (1982) points out that the 'butterfly plan,' as it was called in late-Victorian England, had an obvious source in the project for a townhouse by Viollet-le-Duc published in his 17th *Entretiens* (1872, English translation by Bucknall, 1889) and explains more about Wright's subsequent use of diagonal axis up to his later designs.

10. For figures showing an analysis of each floor level see Park (1995).

11. There are some architectural examples of using diagonal symmetry just later than Schindler's Library project. Mendelsohn, Schindler's exact contemporary, for whom Richard Neutra was working at the time he was corresponding with Schindler (McCoy, 1979), explores the use of diagonal symmetry in the Double House of 1922. Also at this time, Wright developed various textile block patterns for his Los Angeles residences. In the Ennis House of 1922/24, the pattern of the unit concrete block indicates a strong diagonal. Closer examination shows that the pattern design is slightly off the axis.

12. Giella (1985) provides Schindler's college records. These indicate that he excelled in his mathematics and his ornamental design classes which were taught by the same person.

13. Schindler's use of pinwheel symmetry in an individual building is earlier than Wright's. March (1994) states: 'Frank Lloyd Wright does not use this symmetry for a parti until the St. Mark's Tower of 1929', see also March and Steadman (1971, pp. 79-86).

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Acknowledgements

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Biography

Jin-Ho Park is a doctoral student in the graduate programme at the University of California, Los Angeles. He is the 1996/7 R. M. Schindler Fellow of the Beata Inaya Trust Fund.