



1997

Frank Lloyd Wright's Hanna House: Recommendations for a Seismic Strengthening Program

Carolyn Ruddell Samuels
University of Pennsylvania

Follow this and additional works at: http://repository.upenn.edu/hp_theses

 Part of the [Historic Preservation and Conservation Commons](#)

Samuels, Carolyn Ruddell, "Frank Lloyd Wright's Hanna House: Recommendations for a Seismic Strengthening Program" (1997).
Theses (Historic Preservation). 282.

http://repository.upenn.edu/hp_theses/282

Copyright note: Penn School of Design permits distribution and display of this student work by University of Pennsylvania Libraries.

Suggested Citation:

Samuels, Carolyn Ruddell (1997). *Frank Lloyd Wright's Hanna House: Recommendations for a Seismic Strengthening Program*. (Masters Thesis).
University of Pennsylvania, Philadelphia, PA.

This paper is posted at ScholarlyCommons. http://repository.upenn.edu/hp_theses/282

For more information, please contact libraryrepository@pobox.upenn.edu.

Frank Lloyd Wright's Hanna House: Recommendations for a Seismic Strengthening Program

Disciplines

Historic Preservation and Conservation

Comments

Copyright note: Penn School of Design permits distribution and display of this student work by University of Pennsylvania Libraries.

Suggested Citation:

Samuels, Carolyn Ruddell (1997). *Frank Lloyd Wright's Hanna House: Recommendations for a Seismic Strengthening Program*. (Masters Thesis). University of Pennsylvania, Philadelphia, PA.

E NE
TS
NA
02
1997
S193

**UNIVERSITY
PENNSYLVANIA
LIBRARIES**



FRANK LLOYD WRIGHT'S HANNA HOUSE:
RECOMMENDATIONS FOR A SEISMIC STRENGTHENING PROGRAM

Carolyn Ruddell Samuels

A THESIS

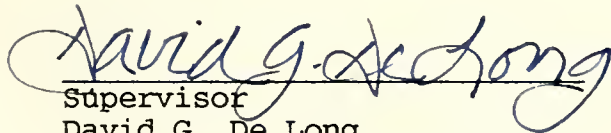
in

Historic Preservation

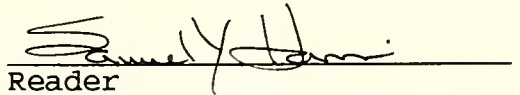
Presented to the faculties of the University in
Partial Fulfillment of the Requirement for the Degree of

MASTER OF SCIENCE

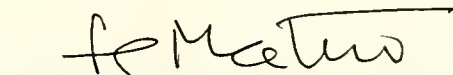
1997



Supervisor
David G. De Long
Professor of Architecture



Reader
Samuel Y. Harris
Adjunct Associate Professor
of Architecture


Graduate Group Chairman
Frank G. Matero

Fine Arts / NA / 02 / 1997 / 5193

UNIVERSITY
OF
PENNSYLVANIA
LIBRARIES

TABLE OF CONTENTS

DEDICATION. . . . .	.iii
ILLUSTRATIONS	iv
INTRODUCTION.	1
CHAPTER 1	
The Design and Construction History of the Hanna House	9
CHAPTER 2	
The Design and Construction History of the Bazett House. . . . .	.39
CHAPTER 3	
San Francisco Bay Area Earthquake Environment . . .	.48
CHAPTER 4	
Ordinances and Policies Governing Hanna House . . .	.60
CHAPTER 5	
Conclusions . . . . .	.72
CHAPTER 6	
Recommendations . . . . .	.89
BIBLIOGRAPHY . . . . .	.99
INDEX . . . . .	.105

To my family:

Bob, Jill, Jane & Jeff

ILLUSTRATIONS

ILLUSTRATION 1	
Location of the Hanna and Bazett Houses on the San Francisco Peninsula	2
ILLUSTRATION 2	
Plan of The Hanna House . . . . .	.18
ILLUSTRATION 3	
Hanna House Foundation Detail . . . . .	.27
ILLUSTRATION 4	
Hanna House Roof Support. . . . .	.31
ILLUSTRATION 5	
Plan of The Bazett House. . . . .	.41
ILLUSTRATION 6	
Location of the San Andreas Fault on the San Francisco Peninsula . . . . .	.49

INTRODUCTION

The fifteen-second 7.1 Loma Prieta Earthquake which struck the San Francisco Bay Region on October 17, 1989, was the most powerful earthquake felt on the San Francisco Peninsula since the 1906 Earthquake and Fire. Within the earthquake's parameters sat two homes designed by Frank Lloyd Wright (1867-1959) (Illustration 1). Although the two homes are located within 30 miles of each other, one was quite damaged by the earthquake and one was not.

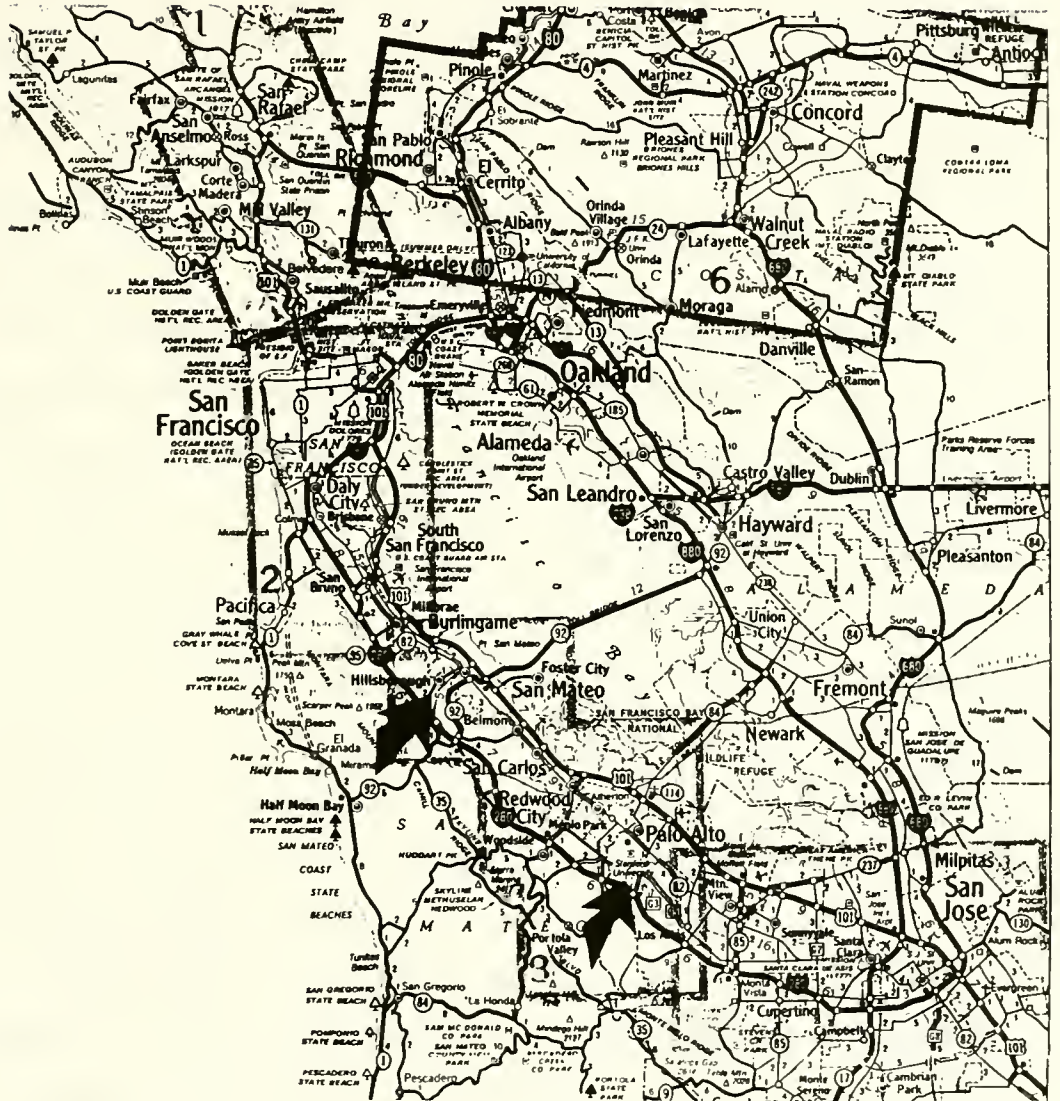
Of these two homes designed by Wright, one home was built in 1940 for Sydney and Louise Bazett in Hillsborough, California. The other was constructed in 1937 for Paul and Jean Hanna just thirty miles south of the Bazett house, on the Stanford University campus.

Hanna House survived the Loma Prieta Earthquake but sustained serious damage. The damage was so extensive that Hanna House stands unoccupied today. What caused the earthquake damage to Hanna House? Research for this thesis indicates that it was the additional weight of the subsequent remodels and additions to Hanna House over the years that increased its potential for the severe earthquake damage we see today.

A diligent, conscientious and well-documented effort must be made to install an appropriate seismic repair and strengthening program within the building's current existing structural frame. Hanna House must be made habitable again and available to the public because it is an important building to the history of architecture and art. Hanna House

ILLUSTRATION 1

Location of the Hanna and Bazett House
On The San Francisco Peninsula*



*Reproduced from: Gousha Travel Productions. Map, San Francisco Peninsula. San Jose: H.M. Gousha, 1989.

is the only west coast residential structure designed by Wright open to the public. We are fortunate indeed to have this important structure located on the San Francisco Peninsula. Hanna House endures as a distinct architectural achievement throughout Wright's long and productive career because it is the first constructed structure Wright designed as a Usonian along a six-sided hexagonal grid or honeycomb floor plan. Not only is Hanna House important architecturally, it is important for researchers because an extensive and careful documentation record has been established.

The design and construction history of Hanna House is particularly well-documented. In addition to the correspondence and drawings held at the Getty Foundation Frank Lloyd Wright Archives in Malibu, California and the Frank Lloyd Wright Foundation at Taliesin West, Scottsdale, Arizona, researchers are indebted to the Hannas for the labor of their carefully written book, Frank Lloyd Wright's Hanna House. The Clients' Report¹. Professor and Mrs. Hanna wrote with affection and warmth about the entire construction project carefully describing and clearly detailing each step in the design and construction phases of their cherished home.

In addition, it is significant that Professor and Mrs. Hanna were the sole residents of their unique home. The Hannas were able then to supervise the subsequent modifications or additions made over the years to assure that they were made in accordance with Wright's

¹ Paul R. Hanna and Jean S. Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report (Carbondale: Southern Illinois University Press, 1981).

original Usonian design. Documenting their long association with Wright and their experiences constructing and living in their home, the Hannas collected and organized their extensive and detailed archive of correspondence, construction drawings, legal documents, bills, payrolls, magazine and newspaper articles and photographs.

These records, have been donated to Stanford University. and cataloged as the Archives Special Collection 280, Hanna-Honeycomb House. For the remainder of this paper however, the Archives will be called Stanford University Archives.

Hanna House was deeded to Stanford University in 1987 by Professor and Mrs. Hanna thus preserving the structure in the future from owners who may not be as sensitive to maintaining Wright's original design and philosophy. The donation of both Hanna House and Professor and Mrs. Hannas' extensive records to the same institution, Stanford University, provides a unique and thorough research opportunity.

Further, the entire January 1963 issue of House Beautiful including fifty-nine pages of text and photographs was devoted to the description of Hanna House². The issue included numerous construction photographs, quotes and correspondence from Wright, extensive interviews of Professor and Mrs. Hanna and 1963 photographs, both interior and exterior, of Hanna House.

Hanna House is remarkable also in its number of awards. In 1960, the American Institute of Architects recognized Hanna House as one of Wright's seventeen significant

² House Beautiful, "A Great Frank Lloyd Wright House," House Beautiful 105 January 1963, 54-113.

buildings³. Hanna House was not only listed on the Department of the Interior National Register of Historic Places January 7, 1978, but it was also designated by the National Park Service as a National Landmark in 1989⁴. This important National Landmark is located in the most severe earthquake region of the United States.

The Bazett House is in good repair today; however, Hanna House stands damaged, vacant and barricaded from the public. As a result of the damage this nationally-acclaimed structure sustained during the Loma Prieta Earthquake, the future of Hanna House is in question. Because of the similarities in location, age, design and construction, a comparison between the Bazett House and the Hanna House will assist in designing a seismic restoration plan for Hanna House. Funds are accumulating now to make this possible.

Stanford University and the Federal Emergency Management Agency (FEMA) reached agreement in March, 1994, on sharing the cost of the 1989 Loma Prieta Earthquake damage to the Stanford University Campus. In this agreement, FEMA approved approximately \$600,000 for a seismic repair of Hanna House. In addition to the FEMA funds, the University has \$400,000 in hand for the restoration. Organizers are in the process of developing a fund-raising drive to raise the remaining

³ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 123.

⁴ National Park Service, Landmark Status Report prepared by Carolyn Pitts, 9 February 1989, Historical Division. San Francisco: Western Region of the National Park Service, 1989; U.S. Representative Paul N. McCloskey to Professor Paul R. Hanna, Washington, D.C., Letter, 15 November 1978.

funds necessary from the private sector⁵. There is much to coordinate at this historic site.

When an important historic structure suffers earthquake damage, there are many important issues to integrate. Historic preservation is concerned with the complicated issue of restoring the damaged property while retaining as much of the historic site and original construction materials as possible. At the same time attention is being given to preserving the appearance, historic character, historic fabric, charm and often the original function of the structure, seismic strengthening systems need to be incorporated to provide public safety⁶. Maintaining the historic integrity of a building, while at the same time strengthening that structure which is regularly subjected to strong quaking forces, is a complicated design problem. The situation places special structural, architectural and economic constraints on the project⁷. The ideal goal is to rehabilitate the historic structure with as little destruction of historic fabric as possible. However, because the area of seismic rehabilitation is only now emerging as an engineering discipline, there are few established criteria for the repair

⁵ Karen Bartholomew. "Stanford, FEMA Agree on Sharing Quake Repair Tab." Stanford University Campus Report. 26 March 1994, 1; Mary Madison. "Quake-Damaged Hanna House Gets Face-Lift." San Francisco Chronicle. 8 March 1996.

⁶ Loring Wyllie, "The Balance between Historic Preservation and Seismic Safety-Can We Achieve It?" The Seismic Retrofit of Historic Buildings Conference. (San Francisco: Western Region of the National Park Service, 1991), 5-1.

⁷ Gary C. Hart, "Defining and Quantifying an Adequate Level of Safety for Historic Buildings," The Seismic Retrofit of Historic Buildings Conference. (San Francisco: Western Region of the National Park Service, 1991), 22-2.

or strengthening of earthquake-damaged buildings⁸. A repair and restoration program will be recommended for Hanna House based on the research reported in this thesis.

My research then included analyzing the history and circumstances around the design and construction of both Hanna House and the Bazett House. Chapters 1 and 2 will discuss the design and construction history of both Hanna House and the Bazett House. Chapter 3 will discuss the earthquake climate along the San Francisco Peninsula. Discussions here will include the location and formation of the San Andreas Fault and the 1989 earthquake activity. In that same chapter, the earthquake damage to Hanna House will be described. Chapter 4 will survey the regulations governing restoration of historic Hanna House. Chapter 5 will report the conclusions of this research and Chapter 6 will make recommendations for an appropriate restoration program.

Due to the location of Hanna House, this unique and acclaimed structure presents us with a complex challenge in historic preservation. Hanna House, an important structure in architecture history and historic preservation, is located in an active earthquake region and continues to be at risk in future earthquakes. There are few examples to use for guidance when planning a restoration of an historic structure located in an active earthquake region. The majority of past

⁸ Eric Elsesser, "Repair of Five Historic Buildings Damaged by the Loma Prieta Earthquake," The Seismic Retrofit of Historic Buildings Conference. (San Francisco: Western Region of the National Park Service, 1991), 4-2; T. Perbix and P. Burke, "Technics Topics: Teaming up for Seismic Retrofit," Progressive Architecture, 70 June 1989, 117-118.

restoration projects have dealt with issues of neglect or lack of a consistent maintenance program.

Here is the challenge: a balance must be struck between the value of Hanna House and the cost to incorporate effective safety and seismic strengthening fabric into the structure. This repair program must not only be cost efficient, but must also provide a high level of public safety. In addition the program must preserve the historic fabric and maintain the integrity of Wright's original design and structure.

CHAPTER 1

The Design and Construction History
of Hanna House

The construction project began for Paul and Jean Hanna when they first read the writings of Frank Lloyd Wright in the early 1930's and wrote to him inquiring about his designing a home for them. In their book, the Hannas revealed they were both educators in New York City when they learned of the work of Wright. Jean Hanna taught high school in the New York City school system and Paul Hanna lectured at Columbia University. Wright had been the Kahn lecturer at Princeton in 1930 speaking on "Machinery, Material and Men"; "Style in Industry"; "The Passing of the Cornice"; "The Cardboard House"; "The Tyranny of the Skyscraper" and "The City"⁹. While the Hannas did not actually attend Wright's lectures at Princeton, they described "sitting up all night reading and rereading" the lectures "aloud to each other"¹⁰. They were excited not only about the educational concepts Wright advocated in those lectures, but also that their educational beliefs were remarkably similar. Beginning with the initial reading of those lectures that night, the Hannas developed an enthusiastically unquestioning, although at times strained, life-long devotion and respect for the creativity of Wright. It was the Hannas' childhood remembrances that made Wright's philosophy and designs appealing.

⁹ Frank Lloyd Wright, "Being the Kahn Lectures for 1930," Modern Architecture (Princeton: Princeton Univ. Press, 1931).

¹⁰Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 15.

Both Paul and Jean Hanna were children of Minnesota ministers. Through their childhood, both moved frequently with their families as their fathers were appointed to new churches. As a consequence of their similar experiences in childhood, the Hannas felt strongly about making a more permanent home for their own family. After reading the Kahn Lectures, they wrote to Wright in Wisconsin, expressing their enthusiasm for his ideas. Wright invited them to visit his home and studio in Spring Green, Wisconsin on one of their future Minnesota family visits¹¹. In 1935, Stanford University offered Paul Hanna a permanent faculty position in the Education Department beginning the summer of 1935¹². While this country continued to feel the effects of the depression, the Hannas left New York City in June of 1935, on their drive to California¹³. They stopped in Spring Green, Wisconsin to renew their friendship with Wright and to initiate discussions on their California home¹⁴.

The traditional house of that period, reported by Sergeant, was two-story and designed in a square or rectangular plan constructed over an excavated basement. The basement housed the heating system and consequently raised the house above ground level¹⁵. Windows faced directly on the street. These houses were framed in wood with clapboard on the exterior and plaster on the interior walls.

¹¹ Ibid., 13.

¹² House Beautiful, 106.

¹³ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 16.

¹⁴ Ibid., 17.

¹⁵ John Sergeant, Frank Lloyd Wright's Usonian Houses, (New York: Watson-Guption Publications, 1976), 17.

Preliminary design discussions with the Hannas in 1935 coincided with Wright's rethinking of that traditional house design. Wright's design ideas for the Hannas continued to revolve around architectural design concepts which he first demonstrated in his Prairie Houses. His Prairie Houses were his first projects in which he broke out the confines of the box or rectangle plan with both interior space and exterior walls. Wright further opening up the floor plan by minimizing dividing walls between adjacent rooms.

In those designs with eliminated interior walls, by overlapping the corner spaces of adjacent rooms, he created spaces of ambiguous use. Using the living and dining rooms as an example, while the dining room continued to be an individual use space, the overlapping corners between the living and dining areas became ambiguous or open plan spaces. With Wright overlapping the corners of the box-shaped rooms, the rooms then evolved into open plan multiple-use areas. Wright did not apply the overlapping corner concept to the Prairie House kitchens. He left the kitchen at the back of the house in the more traditional location, still separate from the dining room.

The design concept of overlapped corners and ambiguous spaces moved to its extreme at Fallingwater (1934-37), where Wright abutted glass together at exterior wall corners creating the illusion of removing the corner all together. In addition to eliminating the traditional box plan, his Prairie House designs expressed his interest in an organic architecture.

Appearing to be one with nature and growing from the soil, his Prairie Houses were constructed with no basements. The Prairie House color palette tended toward warm natural colored plaster walls accented with natural wooden trim. Wright believed that houses should be constructed with natural, often on-the-site materials, express sympathy with nature and generate a sense of the family home as a shelter. Later these ideas evolved into revolutionary designs for living spaces that for no one specific reason, Wright called Usonian¹⁶. His Usonian concepts clarified further with his design for the 1936 Herbert Jacobs home in Westmorland, Wisconsin.

In the late 1930's Wright had entered his seventieth year. His career had taken a leap into the public eye with not only the Jacobs house in 1936, but with the completion of Fallingwater in 1934-37 for the Edgar J. Kauffman family in Bear Run, Pennsylvania. At this time also, Wright was involved in several other large projects: the Johnson Wax Company Administration Building of 1936-39 in Racine, Wisconsin; the Florida Southern College, Lakeland Master Plan 1938-41; Auldbrass, a 1939 private residence compound for Mr. and Mrs. C. Leigh Stevens in Yemassee, South Carolina and Taliesin West from 1934-37, a facility for his growing practice and apprentice group outside Scottsdale, Arizona.

In addition, Wright had spent 1934 and 1935 focusing and refining his designs for The Broadacre City project. At this

¹⁶ Meryle Secrest, Frank Lloyd Wright, (New York: HarperCollins Publishers, 1993) 448,449; Sergeant, Frank Lloyd Wright's Usonian Houses, 16.

time, his thoughts evolved to the belief that every man, woman and child deserved to own an acre of ground and was entitled to own his own home¹⁷. The Usonian houses reflected a combination of Wright's own published philosophy on architecture and also his Prairie House and Broadacre City Project designs¹⁸.

Many of the the design features that evolved into his Usonian plans were first expressed in the classically inspired 1893-94 William H. Winslow house in River Forest, Illinois. This was young Wright's first independent commission and tended toward simplicity both inside and outside. In contrast to the more traditional house plan of the day previously reported by Sergeant, the Winslow House was constructed on a cement slab with no basement. Without building on a basement, the structure was situated at ground level and then appeared rooted to the building site¹⁹. Other design features of the Winslow House include increased interior openness and extended vistas, a large central fireplace and inglenook, a broad horizontal sheltering roof protecting the windows from view and windows set at the roof line²⁰. One may speculate that this window location in the Prairie House design evolved into the clerestory windows seen in the Usonian houses.

Other more general design concepts evolved from the Prairie House to the Usonian designs. The more secluded entry

¹⁷ Frank Lloyd Wright, Frank Lloyd Wright Architect, ed. Terence Riley and Peter Reed (New York: The Museum of Modern Art, 1994), 45.

¹⁸ Frank Lloyd Wright, "Frank Lloyd Wright on Architecture. 1908: In the Cause of Architecture, I " Arch. Record March 1908, 31-45.

¹⁹ Robert C. Twombly, Frank Lloyd Wright. His Life and His Architecture (New York: John Wiley & Sons, 1979), 245.

²⁰ Ibid., 42, 46.

of the Prairie House became almost entirely hidden in the Usonian. The overlapping room spaces first seen in the Prairie House plan evolved into open multi-use rooms. Wright's advancement of a less formal way of living expanded into the Usonian plan with a combined living room and dining room. The kitchen was located conveniently to these combined spaces. The Prairie Houses established a close relationship with the outside through larger windows, French doors and expansive terraces. The Usonian houses took it a step further and became one with nature as the confining corners of the rooms disappeared into walls of glass. The porte-cochere of the Prairie House evolved into Wright's Usonian design feature, the car port.

Wright's Usonian houses stepped past the evolution from the Prairie Style and into their own in the following areas. They were constructed of inexpensive natural materials. Wright believed they become more affordable then for the average person. The houses were constructed on a cement pad laid over gravel. Water-circulating radiant heating pipes then were set in the gravel bed under the cement pad. This radiant heating system replaced the more traditional furnace so the Usonians had no need for a basement. There was no attic either; the roof and the interior ceiling were one.

The Usonian houses incorporated a precise geometric grid incised into the cement pad. The grid extended continuously and included all exterior cement terraces. This geometric grid then influenced all areas of the construction. All structural members were designed to fit that grid. Wright

believed with the accuracy of that grid, the construction materials could be precut and to some extent even prefabricated at another site. If not constructed off site, then the materials could be assembled on the cement pad and then laid up in place. This technique he believed could further reduce the cost of the building. The supporting central chimney was the next step in construction.

The brick chimney tower was built up after the pad was poured and accurately incised. Then as the tower was completed, the roof framing members could be attached to the tower and connected to the load-bearing prefabricated exterior walls installed along the floor grid lines²¹. Both exterior and interior walls were similarly assembled. Usually they were of three layers of wood sandwiched together. Over a layer of insulating material, horizontal boards were attached to flat-laid studs on both the exterior and interior walls. The Usonian construction methods were as innovative as the designs.

Wright designed the Usonian houses as small one-story detached dwellings for single families without servants. The houses were varied to suit both the clients and site. Plans were small and open, with individual efficient bedrooms to maximize any spaciousness a small house might have. Varieties in ceiling heights enhanced the illusion of spaciousness created by the open plan.

The open plan living space around the central hearth was designed to cultivate the family coming together as a unit, a

²¹ Sergeant, Frank Lloyd Wright's Usonian Houses, 19.

concept first demonstrated in Wright's Prairie House designs. The Usonian kitchen or laboratory, that Wright occasionally called it, was efficient and centrally located to the living and dining rooms encouraging interaction with the family and guests²².

These space-efficient houses were situated on building sites so they presented a closed and private facade to the street. The more traditional placement of front windows with a view of the street had been eliminated. Instead, for privacy from the street, clerestory windows were included in exterior walls. To admit natural light, Wright incorporated clerestory windows in both exterior and interior walls. Exposed natural wood, not plaster or wall paper was used. The use of natural materials on exterior and interior walls was intended to create an organic oneness with nature. The cool and secluded interior spaces were then enhanced by the beauty and scent of the natural wood. These natural colors of the wood and brick were reminiscent of the warm earth color schemes of the Prairie Houses.

The comfort of natural materials and the low overhanging horizontal roof line and eaves of the Usonian homes created the illusion of protection and privacy for the family. The eaves also protected the rooms from the heat of the summer sun eliminating the need for air conditioning yet trapped the sun's warmth in the winter months. The most consistently remembered aspect of the various Usonian plans is the exciting, seemingly unrestricted communication with nature and

²² Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 26.

the out of doors. Wright achieved that oneness with nature through the use of the open plan and his use of natural materials, earth colors and walls of glass. Wright's design ideas were revolutionary for his time as reported in the January 1963 House Beautiful issue on Hanna House.

In that issue of House Beautiful, Wright's philosophy was reported. He believed the 120-degree angles of the hexagon were more suited to human 'to and fro' movement²³. In 1937, Wright believed "a cross section of honeycomb has more fertility and flexibility where human movement is concerned than the square"²⁴. The second Hanna House design included the honeycomb or hexagon plan.

Wright submitted two design concepts to the Hannas. It was the second house design that embraced his forward thoughts and incorporated the hexagon shape as the basis for his design grid (Illustration 2). The first design plan submitted to the Hannas in late 1935, was for a two-story house. The Hannas reviewed their notes from their early summer, 1935 meeting with Wright. While the concept of a two-story house design had neither been accepted nor denied, the Hannas did find reference in their notes to their request of a "house nestling into the contours of the hill"²⁵. This request did not appear compatible with Wright's original design of a two-story house. Professor Hanna wrote back to Wright stating they were only interested in plans for a one-story house²⁶.

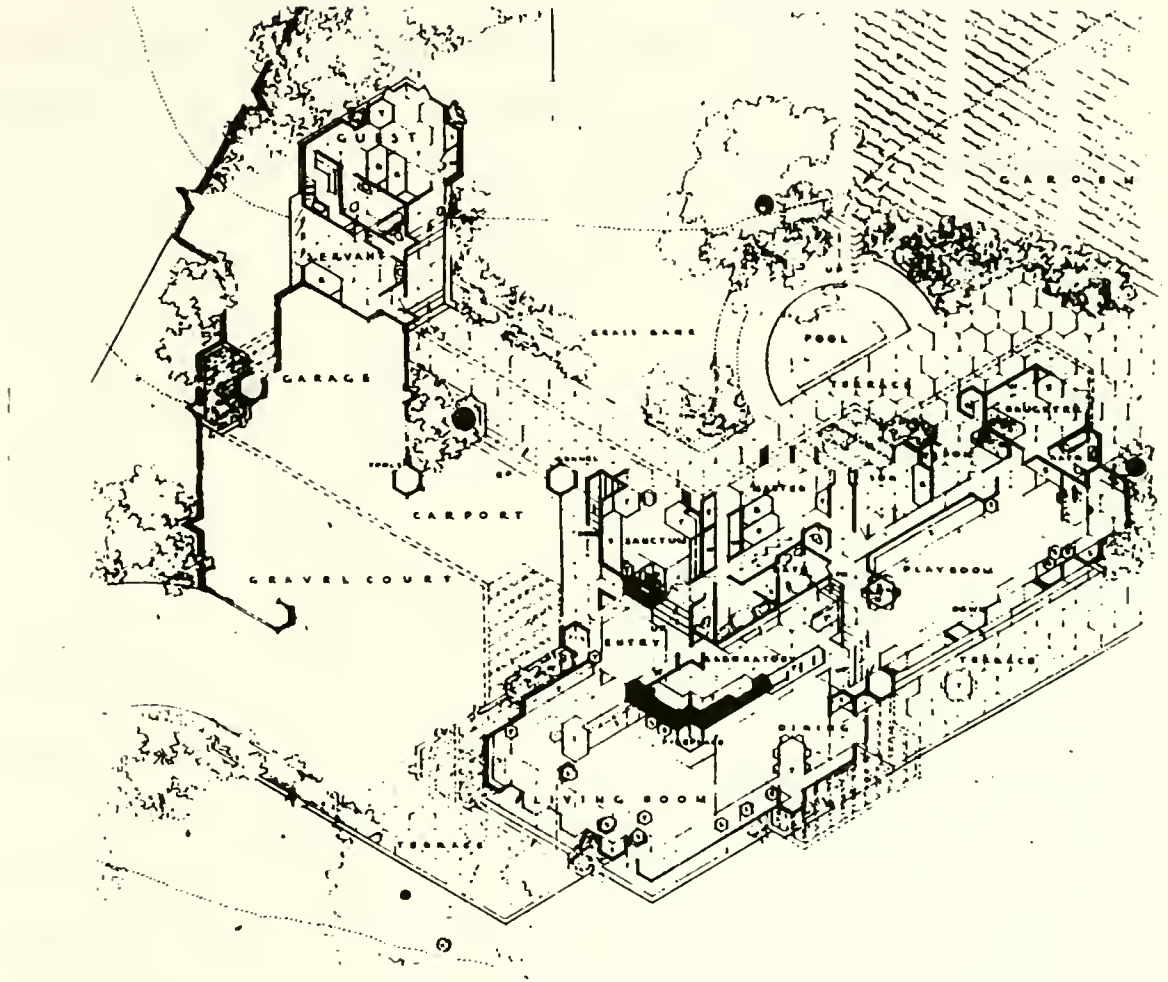
²³ House Beautiful, 71.

²⁴ Frank Lloyd Wright, The Architectural Forum, 68 January 1938, 68.

²⁵ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 18.

²⁶ Ibid., 18.

ILLUSTRATION 2

Plan of The Hanna House*

*Permission to copy from Paul R. Hanna & Jean S. Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report. Carbondale: Southern Illinois University Press, 1981 granted by the Frank Lloyd Wright Foundation, Scottsdale, AZ. © FLW FDN, Scottsdale, AZ.

In the meantime, Mr. and Mrs. Wright and their daughter Iovanna visited with the Hannas the last week of March, 1936. Wright was able to walk the available building sites with the Hannas so that when he sent the second design, it was a one-story plan and more appropriate for the available locations²⁷. Wright wrote, "I imagine [the enclosed sketches] will be something of a shock, but perhaps not..." He continued in his letter to describe the plan, the natural light illuminating the laboratory kitchen and bathrooms, the contrasting high and low ceilings in every room and the flow from the living room through the glass doors to the terrace outside. He added, "...spacious and spreads itself, it is not unduly extravagant, I think. It is so much more practical, I believe, than the conventional house"²⁸.

This second hexagonal-based design also was a shock for the Hannas. During his Palo Alto visit in March, Wright had talked about his hexagonal grid concept, but the Hannas' memories did not retrieve any details of these discussions²⁹.

At the same time the Hannas were discussing designs and floor plans with Wright, they were also negotiating with the property owner, Stanford University, to lease an available construction site. The first two sites were flat. The hill top lot that was finally selected was actually the third parcel made available to Professor and Mrs. Hanna. They had seen the hill site, 737 Coronado Avenue (to be renamed Frenchman's Road, at a later date), felt it was the ideal site

²⁷ Ibid., 19.

²⁸ Ibid., 20, 21.

²⁹ Ibid., 20.

for their new home and were persistent with the Provost's Office in requesting that particular lot³⁰. The University had originally intended to leave the entire area in open space, but acquiesced in the face of the Hannas' determination. The Hannas' third site influenced Wright's final plan.

On approximately, July 1, 1936, the Hannas were able to wire to Wright, "Today [the] University allotted us wonderful southern exposure hill top site"³¹. Wright creatively adjusted their house design then to suit this lot which included a falling away slope to the West.

Placement of the Hannas' home along the hill parcel of property is similar to the orientation of Taliesin in Spring Green, Wisconsin. Wright situated both Taliesin and the Hannas' house around and into the brow of their respective hills. The hexagonal grid plan of the Hannas' home accommodated the hill site location well; however, privacy from the street was sacrificed. Wright had to make adjustments here which were not entirely compatible with his Usonian thinking. The southwest house wall of French doors and full-length windows became open to public view from the street and driveway. This wonderful sunny location, however, included some problems.

Mrs. Hanna wrote to Wright on approximately July 1, 1936, about the activities of the previous owner and "The Romance of

³⁰ Ibid., 22.

³¹ Paul and Jean Hanna to F. L. Wright, 1 July 1936, Telegram, Stanford University Archives Special Collection 280, Carton 1, V. 2, Doc. #360084.

the Hill", at the location of their construction site³². She described the tunnels the earlier owner Peter Coutts had formed through a hill on his property which he called the Cypress Hill subdivision. These tunnels were excavated in order to connect his two artificial lakes with a nearby stream but were left incomplete and then abandoned. Senator and Mrs. Leland Stanford had purchased all Mr. Coutts property in the 1870's to augment their already sizable land holdings which subsequently became Stanford University³³. Mrs. Hanna indicated to Wright that the opening to one of the Coutts irrigation tunnels was at the foot of their hillside, just off Coronado Avenue.

There are two tunnels on the property, according to John Hanna, son of Professor and Mrs. Hanna³⁴. The entrances he said were between their driveway and Frenchman's Road. He recalled that one 4 x 6 foot tall tunnel through sandstone extended straight for about 200 feet to the southeast, then made a 90-degree turn to the left or northeast, with a return to the southeast for 50-60 feet into a dead end. The tunnel came to an end, John Hanna reported, approximately under the living room terrace. The second tunnel, located to the left of the first tunnel, was dug through "dirt"³⁵. It extended for only 50 feet and came to a dead end also under the

³² Jean Hanna to F. L. Wright, July 1, 1936 Letter, Stanford University Archives Special Collection 280, Carton 1, Vol. 2, Doc #360082 & 360083.

³³ Stanford University Archives Special Collection 280, Photo Album, Vol 1., pg. 3.

³⁴ John Hanna, Interview by author, Palo Alto, Calif., 29 March 1994.

³⁵ Ibid., 1994.

driveway. John Hanna said when he was a child, his father had the entrances bulldozed closed for safety reasons.

Through the years of living in the house, John Hanna did not remember seeing any "settling" cracks in the house structure, the cement floor or terraces which would indicate settled soil under the house foundation³⁶. The soils report indicated that much of the site is "underlain by moderate to high plasticity silty clay and sandy clay and loose to medium dense clay sand/fill. The fill is underlain by residual soils consisting of medium dense to very dense clay sands and low plasticity sandy clays and silty clays"³⁷. The U.S. Geological Survey indicates the soil includes poorly indurated non-marine conglomerate, sandstone, mud and stone. According to the U.S. Geological Survey map, the site of Hanna House is located along the Coast Range east of the San Andreas Fault³⁸.

Returning to the construction process, once the Hannas concluded discussions with Stanford University, agreed on this location and terms of their land lease, Professor and Mrs. Hannas' efforts turned to searching for a general contractor. They learned of building contractor Harold Turner from San Jose, California. Stanford University Professor Daniel Mendelowitz recommended Turner after he had done some work for him. The Hannas wrote to Wright, "It happens that Mr. Harold Turner, one of the two men we are considering, is going to be

³⁶ Ibid., 1994.

³⁷ J. V. Lowney & Assoc., Geotechnical Investigation for Hanna House Seismic Upgrade, Stanford, Calif., (Mt. View: J.V. Lowney & Assoc., 1990) exec summary #1.

³⁸ U.S. Department of the Interior, Geological Maps of Upper Cenozoic Deposits in Central California (U.S. Geological Survey: Reston, Va., 1993), map 1-1934.

in the middle west for the Christmas season"³⁹. The Hannas suggested that Wright invite Turner to stop at Taliesin for an interview.

After completion of the lease agreement with Stanford, the visit Turner had in Wisconsin with Wright, and with Wright's approval of Turner as general contractor, the building project proceeded. However, one Sunday afternoon, the Hannas were on their property laying out their house with stake and string according to Wright's plans, when they were interrupted by a hiker walking through. The man was Professor of Geology Bailey Willis, whom, they said looked disapproving at them. Professor Willis asked what they were doing and when the Hannas told him about their construction project, Professor Willis warned them that, "a minor earthquake fault runs right through this hill"⁴⁰.

When they recounted this conversation to Wright, he responded in a telegram, "I built the Imperial Hotel"⁴¹. Wright had spent six years in Tokyo, Japan from 1916 to 1923. He had studied the earthquake environment and the appropriate construction methods and materials as he designed and supervised construction of the Tokyo Imperial Hotel. It was not the Usonian design of Hanna House that caused the earthquake damage we see today.

Wright believed that in a Usonian design auxiliary or

³⁹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 33.

⁴⁰ Ibid., 31; Bailey Willis to Paul Hanna, Sept. 7, 1936 Letter, Stanford University Archives Special Collection 280, Carton 1, Vol. 2, Doc# 360090.

⁴¹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 31.

private rooms should be small to encourage simplicity⁴². This philosophy is reflected at Hanna House. The floor plan includes small bedrooms, a narrow connecting hall and small kitchen. These small spaces were also in keeping with Wright's six design principles describing organic architecture. He originally designed three small but open bedrooms for the Hannas' children with accordion walls to pull if the children wanted privacy. This idea did not please the Hannas. They insisted upon and acquired three small separate bedrooms for their children, two boys and a girl⁴³.

The hexagonal-grid house Wright designed anticipated a growing and changing family. As a consequence, the interior bedroom walls were not load-bearing so they could be rearranged at a later date when the children were no longer living at home. Though considered Usonian in design, The Hanna House of today nestled into the hillside does not incorporate several of the general Usonian features.

Usonian houses typically present a closed facade to the public street side. The Hanna House facade facing the street is the glazed southwest wall of the living room and play room. With a total of 4,825 square feet, Hanna House is a much larger plan than Wright's other Usonian houses. Despite the larger plan, Hanna House remains a single family dwelling.

Another Usonian feature, sub-floor hot water radiant heating, was not installed in the cement pad at Hanna House. The Hannas had never lived on the west coast so when Wright proposed embedding heating pipes in the cement pad, the Hannas

⁴² Wright, Frank Lloyd Wright Architect, 33.

⁴³ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 25.

believed, based on their east coast experiences, that a forced-air system would be more efficient and thus preferable. That heater was housed in a small basement room under the study and kitchen.

The copper roof originally installed at Hanna House was inconsistent with Wright's desire to create less expensive Usonian housing. While copper is a lighter weight and more flexible roofing material than other materials such as shingles or tar and gravel it also is more expensive. As a young academic couple, the final cost of their building project was a critical issue for the Hannas. Funding for housing was difficult to obtain during the depression. Federal Housing Authority (FHA) funds were lent for construction projects of more traditional designs. The FHA stated in regard to the Usonian designs, "the very uniqueness of the design put it beyond the scope of their approval"⁴⁴.

The Hanna's budgeted \$15,000 for their project; however, they soon realized their home was coming in well over budget. Even after dividing the project into two phases, the cost for completing the first phase came to \$36,000, an 150 percent cost increase over the original budget for the entire project. Even in the face of mounting construction expenses, the Hannas continued to be enthusiastic about the design and construction of their home. Their excitement and energy for the project radiate from the pages of their correspondence. Turner was an enthusiastic participant also. In a letter to the Hannas, Turner wrote "...I feel that it is

⁴⁴ Sergeant, Frank Lloyd Wright's Usonian Houses, 24.

more than a mere house or shelter. It expresses personality in every detail, and may I call it a possession for your soul as well as for physical well-being"⁴⁵. Finally, by the second week of January 1937, Turner came to the property to stake out the construction site. The Hannas' dream was underway at last.

Turner proceeded in laying out the site for the construction according to "The General Instructions to the Builder" provided by Wright. The instructions stated that the top soil was to be removed from the hillside construction site and stored on the lot to be used later in grading⁴⁶. Turner continued then with this foundation preparation. The Hannas add in their book that they had to first blast rock below the shallow layer of adobe for the basement furnace room and 4 x 4 foot connecting utilities tunnel⁴⁷. The utilities tunnel ran the entire length of the house under the bathrooms accommodating the heating ducts, electrical wires, water and sewage pipes.

Working drawing #37 in the Stanford University Archives and working drawing #3701-026 in the Getty Foundation Frank Lloyd Wright Archives, detail construction of a 12-inch wide perimeter wall foundation and an 8-inch wide foundation for a retaining wall⁴⁸ (Illustration 3). Notes on the blueprint held

⁴⁵ Harold P. Turner to Paul and Jean Hanna, Letter, November 29, 1936, Stanford University Archives Special Collection 280, Vol.2, Doc. #360110.

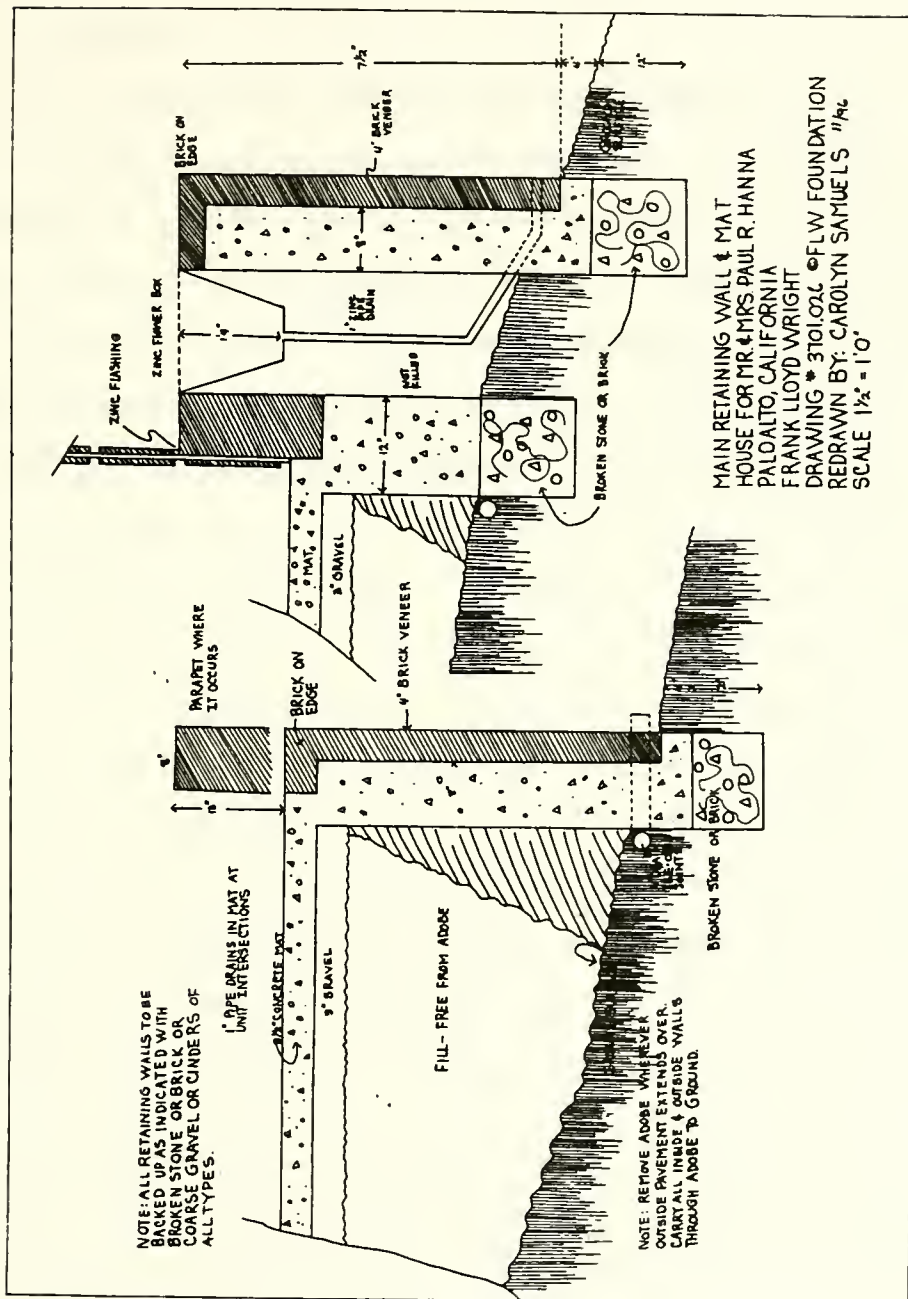
⁴⁶ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 34.

⁴⁷ Paul Hanna, n.d., Notes, Stanford University Archives Special Collection 280, Carton III, Vol. 23, Doc. #620031.

⁴⁸ Stanford University Archives Special Collection 280, Drawing #37; Getty Foundation Frank Lloyd Wright Archive, Drawing #3701-026.

ILLUSTRATION 3

Hanna House Foundation Drawing*



*The Hanna House drawing #3701.026 was redrawn with permission of the Frank Lloyd Wright Foundation. © 1996 FLW FDN, Scottsdale, AZ.

at Stanford indicate "Carry all inside and outside walls through adobe to ground". Wright also specified that the foundation for the living room fireplace should be constructed as the others and extend as the others, to "...solid ground"⁴⁹.

There are many construction photos in the Stanford University Archives organized and captioned by the Hannas. The photographs record reinforcing bar extending out of the perimeter house foundation, retaining wall foundations and the central chimney and tower⁵⁰. The 1938 Specification Documents for Building Materials & Construction do not specify reinforcing bar in foundation areas⁵¹. The construction schedule was plagued throughout by delayed construction and detail drawings.

Mr. Hanna wrote to Wright on January 10, 1939, "We wired you several days ago asking for cross sections on the foundation so that we can see just how you plan to have this laid. We need reinforcing steel instructions⁵². Hanna construction photos indicate the interior reinforced concrete foundation and a reinforced perimeter wall foundation were in place before the cement mat was poured⁵³. Construction of the cement foundation pad then followed.

⁴⁹ Stanford University Archives Special Collection 280, Drawing #41.

⁵⁰ Stanford University Archives Special Collection 280, Photos, Vol.1.

⁵¹ Pacific Coast Building Official's Conference, Specification Documents for Building Materials & Construction. (Los Angeles: Pacific Coast Building Officials, 1938).

⁵² Stanford University Archives Special Collection 280, Carton 1, Vol.3, Doc #370065.

⁵³ Stanford University Archives Special Collection 280, Photo Album Vol 1, 24,26,30,32 & 41.

Wright instructed the contractor to "...build the mat any way...."⁵⁴. Yet, Wright specified the cement mat installed in two layers. The top was to be 2-inches thick, laid over an unspecified under mat which in turn had been laid over 4 1/2-inches of gravel⁵⁵. Hanna photos and captions show that Turner strengthened the mat over Wright's specifications. Over the bottom layer of gravel, the contractor laid a 3-inch cement pad strengthened by a grid of reinforcing bars. A heavy wire mesh was placed on top of this bottom 3-inch mat before the top or final 3-inch mat was laid.

This reinforced final cement pad was poured as continuously as possible in one project, limited as it was by the single on site cement hand mixer⁵⁶. The 26-inch side hexagonal grid was then precisely incised in the top 3-inch thick pad. According to Wright, it was essential that the accurately measured hexagon grid extend from the interior floor to and including the exterior surrounding terraces. Following the top cement pad installation and curing, came the furnace placement.

The forced-air furnace was located in the small basement room under the kitchen. From that small room, the 4 x 4 foot utility tunnel ran the length of the house under the bathrooms. The bathtubs then were recessed into the top of this tunnel creating an illusion of more space in the small bathrooms.

⁵⁴ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 42.

⁵⁵ House Beautiful, 71.

⁵⁶ Stanford University Archives Special Collection 280, Photo Album, Carton 8, Vol.1, 19.

Once the utility tunnel, perimeter foundation, heater room and the cement pad were poured, construction began on the central living room brick fireplace and ventilation tower. The central chimney and ventilation tower are 21 and 1/2 feet tall from the floor and extend thirty-two brick courses above the roof line. Each brick is 2 5/8 inches tall by 8 1/4 inches long. One course of mortar is 5/8 inches wide. Added together then, a brick course and one mortar row is 3 1/4 inches wide. The chimney and ventilation tower extension at thirty-two brick courses lifts approximately 8 feet 8 inches above the roof line.

When the chimney and tower were completed, the framing members for the roof were attached to the brick chimney. The roof members then extended to the exterior wall hexagonal piers or columns (Illustration 4)⁵⁷. Steel fitch plates were laid across the tops of these piers⁵⁸. At the same time the roof members were extended to the support walls, the non-supporting walls were laid up and installed along the hexagonal grid lines. Those exterior wall grid lines were made of zinc weather stripping channels embedded in the cement pad⁵⁹.

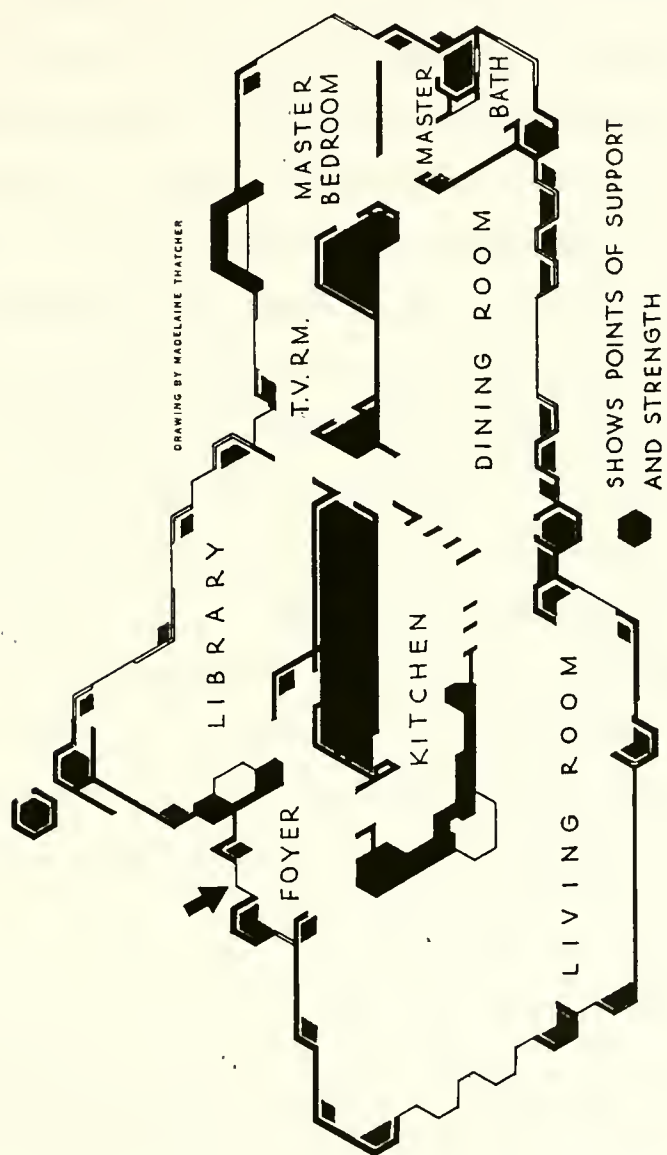
Both the interior and exterior walls were constructed in the innovative Usonian sandwich wall construction method described previously. At Hanna House, they were constructed as 2 3/4-inch sandwich walls. First insulating paper was placed over the 1-inch by 6-inch flat laid studs. Then both

⁵⁷ House Beautiful, 71.

⁵⁸ Ibid., 71.

⁵⁹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 35-36.

ILLUSTRATION 4

Hanna House Roof Supports*

*Permission to photocopy Frank Lloyd Wright, House Beautiful, 98, granted by the Frank Lloyd Wright Foundation, Scottsdale, AZ, 1996. © FLW FDN, Scottsdale, AZ.

the interior and exterior 12-inch wide horizontal redwood boards were held in place by the battens. The battens were then attached with screws to the studs⁶⁰. The screws were installed so that the hatch marks were horizontal and parallel to each other. Plywood was not specified in the walls; however, Wright requested "plywood sheathing or ship-lap" installed in the ceiling⁶¹. "Nu-Wood" was installed in the interior ceiling and is simply a decorative non-structural 1/2-inch pressed cardboard insulating material⁶². As the construction progressed, the copper roof or "skin" was installed⁶³. Particularly because it was the first house on the San Francisco Peninsula designed by Wright, the construction attracted much local attention and publicity⁶⁴.

At a 1987 Hanna House reception, Professor Hanna remembered that in the 1930's there was "considerable opposition" to the unusual home. He recalled that people felt the "unorthodox house would depress the value of all houses and buildings on this campus"⁶⁵. However, clients and the general public found the Usonian houses extraordinarily

⁶⁰ House Beautiful, 71.

⁶¹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 36.

⁶² Hanna, Interview, 29 March 1994, Palo Alto, Calif.; Stanford University Archives Special Collection 280, Carton 1, Vol 3, Doc. # 370125.

⁶³ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 71.

⁶⁴ Hunter Hendee, "Dream Home Foundations Rise on Frenchman's Mystery Hill," Stanford Daily, 19 February 1937, Stanford University Archives Special Collection, Vol. 3, Doc #370122.

⁶⁵ Karen Bartholomew, "Reception Honors the Hanna House that Wright Built" Stanford University Campus Report, 18 November 1987.

innovative⁶⁶. The house was a dramatic departure from the more traditional house design and siting.

As completed, The house appears to be incorporated within the contours of the hill rather than perched on top. The long low horizontal roof line, which includes wide overhanging eaves, appear to repeat the shape of that hill. Then the central chimney and ventilation tower which extend above the low horizontal roof line recreate almost visually the top of that hill. To further create the illusion that the house is one with the hill, the house is constructed of natural materials stained and treated in naturally occurring colors. California Redwood was applied to all wall surfaces. Red brick with mortar stained to match was designated for the hearths, chimneys, ventilation tower and retaining walls. Also, the cement pad was stained to match the bricks and mortar. That combination of naturally stained redwood, rust red brick and the weathered copper of the original roof must have been a beautiful combination of natural textures and colors.

Today, one views Hanna House at the turn of the driveway from Frenchman's Road. The first view is the long and open southwest house wall. The visitor follows the steep drive as it curves up the hill and around to the northeast side of the house. The southwest living room and original play room wall include floor-to-ceiling glazed French doors and windows running the length of the wall. One does not have a clear view into the southerly-facing living room and play room from

⁶⁶ Twombly. Frank Lloyd Wright His Life and His Architecture, 260.

the driveway because the French doors and windows are placed along the 120-degree angles of the hexagonal Usonian plan. The angles of window glass obstruct the view to the inside and simply reflect back the outside surrounding trees and landscaping.

Once past the open windows and French doors of the southwest wall, the visitor arrives at the back, the more private side of the house, providing access to the carport, entry and covered connecting breezeway to the uphill guest wing. As one approaches the front door, while the Hanna House entry is not hidden entirely, it is well camouflaged. The tall and narrow two-door entry is placed along the angles of the hexagon. The doors are constructed of redwood and rectangle shaped windows to match and repeat the dimensions of the adjacent redwood board and batten walls. To further coordinate with the adjacent wall pattern, one-half inch raised redwood strips were added as accent door trim between each piece of door glass. The wooden trim also visually reproduces the adjacent wall batten patterns. Once through the entry, the redwood continues to the interior walls.

The interior entry hall is dark because of the redwood interior walls and the deep red brick of the chimney tower opposite the entry. Visitors are held visually in this tall entry space by the redwood walls on the left and a lowered soffit on the right. Two narrow kitchen doors blend entirely into the left wall except for one round peek hole in the right side kitchen door specified by Mrs. Hanna⁶⁷. To the right

⁶⁷ Paul Turner, Lecture, 14 March 1996, Stanford University, Palo Alto, California.

from the entry area, one must pass under the soffit to the drama of the living room. The surprise of natural light in the living room is in dramatic contrast to the cool darkness experienced while moving under the soffit between the entry and living room. Enhanced by the fragrance of natural wood, the adventure and joy of experiencing this dynamic hexagonal house begins.

The hexagonal-based plan of Hanna House is also an exciting space to enter. The large, open plan is both warm and secure while at the same time expansive and bold. One is drawn in to explore the structure by the light and diagonals created with the precise hexagonal grid incised on the rich brick red cement pad. Following the floor grid from the entry around the corner to the right, one enters the drama of the beautiful living room and much-photographed hearth.

The central living room chimney tower serves as a hinge point for the bedroom wing and living room. The hearth is lowered by two steps from the rest of the living room floor which consequently, appears to anchor this home to the hill site. Past the hearth, the eye is drawn through these spaces to the expanse of the southwest wall of full length windows and glazed French doors, then out of the enclosure to the beautiful view of the California Coast Mountains beyond. A complex variety of views is available from this interior space created by the wall of glazing set along the hexagonal plan.

While standing in that living room space with its dynamic floor plan, the visitor can also appreciate the complex interior ceiling. A pitched roof is the basic ceiling design,

but it is the variety of heights from 6 feet 7 inches to 16 feet 3 inches which enhance the drama of the room. The roof seems to be supported throughout the living room and play room in an effortless fashion on apparently paper-thin walls of redwood and glass. Walls of glass predominate yet one feels protected and secure. Wide overhanging roof eaves that stop barely six feet above the outside elevation hold the viewer inside. Still, the viewer is able to appreciate an unobstructed view of the exterior natural surroundings.

The Hannas and Wright were in agreement that a home was a secure and nurturing place for the family to gather and be drawn together. Wright didn't object at all when the Hannas chose to devote the beautiful, warm, southerly exposure space above the living room to a play room for the children. The play room, approximately the same size as the living room, is up four steps⁶⁸. At a later date this play room was converted to a dining room. The original dining area had been located in an alcove of the living room. With this play room conversion, a larger and more formal dining space was created. The kitchen then is conveniently located to the left after you climb the steps to the play room.

The long hall shaped kitchen is centrally located down four steps behind the living room chimney tower. That kitchen connects the space between the play room and the entry. Just inside the entry, the solid double doors with the round peek hole are at the opposite end of the kitchen from the play room. While some felt Mrs. Hanna's kitchen was a small,

⁶⁸ House Beautiful, 71.

narrow and inadequate working area, she always defended her kitchen as an efficient space⁶⁹. She also enjoyed an unobstructed view from her kitchen to the living room, play room and beyond to the Coast Mountains through several tall shuttered pass-through spaces. Those pass-through spaces also afforded easy communication with the open plan of the living room and play room. As completed in 1937, the Hannas and Wright created a successful compromise between an open Usonian house plan of multiple uses and private spaces for an individual family

Over the years, however, the color scheme and design for Hanna House have changed from Wright's original 1937 specifications. The original copper roof was replaced with a rust red tar and gravel roof between 1942 and 1952. Due to construction cost over rides, the original concept had been divided into two projects. The original plan also included a guest wing and work shop for Mr. Hanna. This guest wing and work shop was completed in 1950 thus finishing the entire project as Wright had originally designed. Then in 1956, to accommodate the increasing number of visitors to their home, Professor and Mrs. Hanna added a driveway and parking area below the house. In 1957 after the children had all left home, the Hannas added retaining walls below the house and remodeled the house interior. During this remodel, all of the original four bedrooms were transformed into a master bedroom suite, library and study area. A third hearth was added at this time to the master bedroom. In 1961, a garden room,

⁶⁹ Turner Lecture, 14 March 1996.

garden fountain, swimming pool and surrounding cement terrace areas were completed⁷⁰. This is the structural configuration we see today.

⁷⁰ U.S. Department of Interior, National Register of Historic Places Registration Form, submitted by Paul R. Hanna (National Park Service: Washington, D.C., 1977), Nov. 18; House Beautiful, 109.

CHAPTER 2

The Design and Construction History
of The Bazett House

Sydney and Louise Bazett, a young San Francisco couple, was attracted to the Hanna House construction site by the publicity surrounding the project. They met the Hannas and in the course of their visit, fell in love with the house design. At Jean Hanna's urging, they telephoned Wright at Taliesin West, then followed up with a telegram, dated April 9, 1939 requesting that Wright "do a home in Hillsborough for young couple"⁷¹. Wright agreed. The Hannas and Bazetts then shared their mutual enthusiasm by visiting back and forth between Palo Alto and Hillsborough at each other's construction sites. They discussed building orientation on the Bazetts' lot and watched the construction progress on the Hannas' lot⁷².

Surprisingly, the original owners of the first two San Francisco Peninsula Wright residences had much in common. Both couples were young, newly-married professionals with no children. These would be their first homes. Construction photos and correspondence in both the Getty Foundation Frank Lloyd Wright Archives and Stanford University Archives indicate both couples actively participated in the

⁷¹ Sydney and Louise Bazett to F. L. Wright, Telegram, 9 April, 1939, Getty Foundation Frank Lloyd Wright Archives, Bazett Project # 4002.

⁷² Sidney Bazett to F. L. Wright, Letters, 12 April 1939, 27 July 1939, Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002.

design phases and labored at their own sites during construction⁷³. There were other similarities.

After correspondence between the Bazetts and Wright and an initial plan from Wright that, as with the Hannas' experience, proved to be unsatisfactory, Wright sent them a second drawing based also on a hexagonal grid. He wrote, "I like it more than a little...a fresh design for living...outdoor bed space...wide shelter over curtained enclosure...shuttered...ideal for your climate" (Illustration 5)⁷⁴.

The Bazetts were anxious to start their project. They wrote to Wright, "The Hannas are almost as excited and thrilled about our home as we are. The house is perfect; just what we want; we are ever so grateful to you"⁷⁵.

The Bazetts owned their 1.1 acre lot at 101 Reservoir Road in Hillsborough, so when they hired their contractor, Mr. Oscar Cavanagh of San Mateo, they were underway with their construction by March, 1940⁷⁶. Their project started only a year after they had initiated correspondence with Wright. Wright sent one of his apprentices, Blaine Drake with his wife Hulda, to supervise the Bazett construction and make weekly written reports. Later, William Wesley Peters replaced

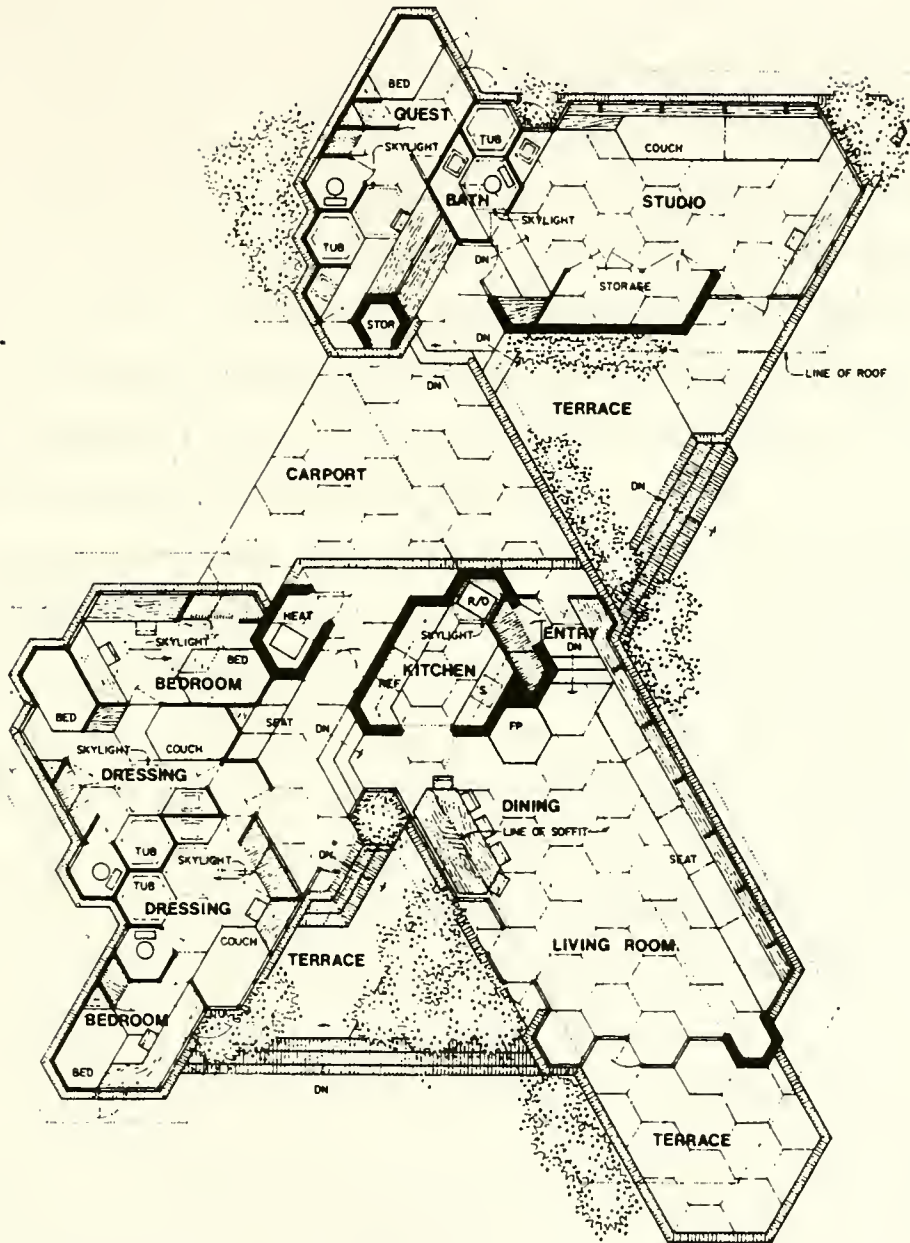
⁷³ Getty Foundation Frank Lloyd Wright Archives, Project #4002, photo. 038 1167.014; Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 1987.

⁷⁴ Frank Lloyd Wright to Sydney and Louise Bazett, Letter, 4 July 1939, Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002 .

⁷⁵ Sidney Bazett to Frank Lloyd Wright, Letter, 12 April 1939, Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002.

⁷⁶ San Mateo County Assessors Records, Redwood City, Calif., San Mateo County Assessors Office, Lot #9, Book 32, Vol #31, P.31.

ILLUSTRATION 5

Plan of The Bazett House*

*Permission to photocopy David Gebhard, Romanza: The California Architecture of Frank Lloyd Wright. San Francisco: Chronicle Books, c. 1988 granted by the Frank Lloyd Wright Foundation, Scottsdale, AZ, 1996. © FLW FDN, Scottsdale, AZ

Blaine Drake as Wright's job supervisor. The Bazetts told Wright they had \$7,000 set aside for their house construction, however when the job was completed in 1940, their project was over budget also at \$13,833⁷⁷.

While both couples were enthusiastic about their new homes, the Bazetts' stay in their house was not to be as long-lived as the Hannas'. Louise Bazett wrote to Wright in a letter dated August 8, 1940, with a 101 Reservoir Road return address. First she apologized for the delay in her letter because she said, "they were going through some hectic times". She then thanked the architect for their home "the house has been a Godsend. I don't like to think how unpleasant things could have been if we didn't have it to enjoy"⁷⁸.

Previous to the construction, Sidney Bazett had been Vice-President in charge of Securities Sales with the Bank of America in San Francisco. Sometime during the construction year, the couple lost a baby and Mr. Bazett took a new position with another San Francisco company⁷⁹. An invoice from A. H. Diltman dated April 9, 1942 to repair the copper pipes was sent to Mrs. S. Bazett, 101 Reservoir Road. That invoice suggests that the Bazetts were in their home at least through April, 1942⁸⁰. The current owners, Elizabeth and Louis Frank said they had purchased the house in

⁷⁷ Oscar L. Cavanaugh to Frank Lloyd Wright, Letter, 31 July, 1940, Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002.

⁷⁸ Louise Bazett to Frank Lloyd Wright, Letter, 8 August 1940, Getty Foundation, Frank Lloyd Wright Archives Bazett Project #4002.

⁷⁹ Blaine Drake to F. L. Wright, Letter, n.d., Getty Foundation Frank Lloyd Wright Archives, Bazett Project # 4002.

⁸⁰ Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002. Doc. #B086.

1945 from the Bazetts after the house had been rented for several years to the Joseph Eichler family⁸¹. After renting the Bazett house, Eichler went into real estate.

Eichler became a prominent San Francisco Peninsula real estate developer over the next 20 years. He became known for building affordable, practical housing with a unique architectural character and plan. Eichler was the first real estate developer who, with an architect, designed low-cost housing here on the San Francisco Peninsula⁸². The character of his original houses is reminiscent of the Bazett plan.

The Bazett House is situated on a hillside similar to the Hanna House. However, unlike the Hanna House construction site, the Bazett House is located on an old established road bed. Mr. Frank indicated there was no earthquake damage in 1989 because the house "is on rock"⁸³. The U. S. Geological Survey fault and soils map of this area indicates the Bazett house is located along the Coast Mountain Range east of the San Andreas Fault. The soils at this site are sedimentary with crystalline and volcanic rock⁸⁴.

On-site construction photos in the Getty Foundation Frank Lloyd Wright Archives show form boards in place for pouring the cement perimeter foundation⁸⁵. On the elevation

⁸¹ Louis Frank, Telephone Interview by author, 29 September, 1993, Hillsborough, Calif.

⁸² Jerry Ditto and Lanning Stern. Design for Living. Eichler Homes, (Chronicle Books: San Francisco), 1995.

⁸³ Louis Frank, Telephone Interview by author, 29 September, 1993, Hillsborough, Calif.

⁸⁴ U. S. Department of the Interior, Geological Maps of Upper Cenozoic Deposits in Central California, 1993, map 1-1943.

⁸⁵ Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002, photo 4002.009.

drawings from Wright's office, notes indicate that "all foundations to be a minimum of 2 feet below grade"⁸⁶. Another photo in the Getty Foundation Frank Lloyd Wright Archives shows reinforcing bar incorporated in the north living room wall⁸⁷.

The Bazett House construction phases then proceeded in the same sequence as documented at Hanna House. The reinforced perimeter foundation was poured, then the gravel laid down in anticipation of the cement pad. At The Bazett House, radiant heating pipes were installed in the gravel before the cement pad was poured. Next, the living room brick chimney tower would have been constructed after the cement pad had been scored in the hexagonal shape. As completed, the central chimney is low and extends only two rows of bricks above the peak of the roof⁸⁸. Following construction of the chimney tower, the exterior walls were installed. As the exterior walls were secured, the copper roof was installed, supported then by the chimney tower and the exterior walls.

Additional specifications from Wright indicated that the core for both the exterior and interior walls, was to be vertical common board or 13/16 inch plywood sandwiched with layers of exterior and interior horizontal redwood boards and

⁸⁶ Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002, photos 4002.101 and 4002.006.

⁸⁷ Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002, photo 4002.012.

⁸⁸ Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002, photo 4002.042.

battens. Ceilings were to be of plywood or other synthetic material⁸⁹.

One can see the Bazett House design concept was heavily influenced by Hanna House although the Bazett House is quite small by comparison with only 1,480 square feet. As constructed, the Bazett House is situated also at the brow of a hill. The visitor approaches this three-bedroom, two-bath house also on a steep, uphill driveway and arrives at the home with the private northwest bedroom wing on the right and guest wing to the left. These two wing structures are connected by a covered carport. The continuous exterior cement terrace surrounding the house is approximately one-third the size of the interior plan. The hexagonal grid also defines the Bazett floor plan and because of the angles of the hexagon, the Bazett House bedroom wing and living room wing were constructed at 60 degree angles. These two wings wrap around and protect the garden viewed from the living room. As with Hanna House, Wright specified using native building materials stained in naturally occurring colors to encourage a close proximity with the out of doors.

California Redwood has been used on the exterior and interior walls. The central chimney and hearth are constructed of red brick with mortar stained to match. In addition, the hexagon-incised cement floor pad is also stained a deep red to match the brick. The low horizontal copper roof line and deep eaves protect the interior from view, creating privacy for both the bedroom and living room exterior walls.

⁸⁹ Frank Lloyd Wright, Instructions to the Builder, September, 1939, Getty Foundation Frank Lloyd Wright Archives, Bazett Project #4002.

The exterior walls are solid with only narrow clerestory windows tucked under at the deep roof eaves. Those windows are covered with irregularly cut-out panels of wood which create a frieze effect under the eaves and limit the natural light to the interior rooms. Light is further limited to the northwest bedroom wing by the covered carport. The entry, secluded and difficult to find is located in the back of the covered carport along the dark northwest exterior house wall.

Through the small and narrow entry, one steps past the hearth on the right and down steps into the long, narrow, rectangularly-shaped living room wing. The view is to the garden through the long interior wall of windows and French doors. Though not as long as the wall at Hanna House, this wall of French doors and windows set on the angles of the hexagon, is reminiscent of the Hanna House play room wall. A built-in sofa extends along the length of the left living room wall with attached book shelves above. Above the book shelves, narrow clerestory windows are again tucked under the roof eaves.

Compared to the long, open living room, the bedrooms and bathrooms are quite small and efficient spaces. The kitchen is also a small area tucked behind the living room chimney. The size and height of these rooms contrast dramatically with the height of the living room.

The Franks then purchased this efficient and dramatic home from the Bazetts in 1945 and have resided there continuously⁹⁰. The Franks, as the Hannas, have not only been

⁹⁰ Elizabeth and Louis Frank, Interview by author, Hillsborough, California, 5 October 1993.

conscientious homeowners but they also have been respectful in nurturing their home's original Wright design and philosophy. Mr. Frank reported that when they needed to replace the original roof, they replaced it again with copper⁹¹. In some literature, the Franks' home is called the Bazett-Frank House possibly reflecting their fifty-two year dedication to Wright's design and philosophy.

⁹¹ Ibid.

CHAPTER 3

The San Francisco Bay Area Earthquake Environment

On Tuesday, October 17, 1989 at 5:04 p.m., an earthquake originated on the San Francisco Peninsula approximately eleven miles beneath the earth's surface. The earthquake, with a Richter magnitude of 7.1, erupted on a section of the San Andreas Fault in the Santa Cruz Mountains of Northern California, ninety miles south of San Francisco (Illustration 6). The epicenter, or origin of the earthquake, was near the town of Watsonville, approximately ten miles northeast of the city of Santa Cruz and forty-five miles south of San Jose. The earthquake was felt over an area approximately 400,000 square miles from Los Angeles to the Oregon-California boarder and east into western Nevada. This earthquake released an amount of energy equal to about thirty million tons of high explosives, which is nearly ten times the total of all bombs used in World War II⁹². According to the U.S. Geological Survey sources in Menlo Park, California, the southern-most sixty-mile section of the San Andreas Fault was ruptured. The last time this section broke loose with such intensity created the San Francisco Earthquake and Fire of 1906⁹³.

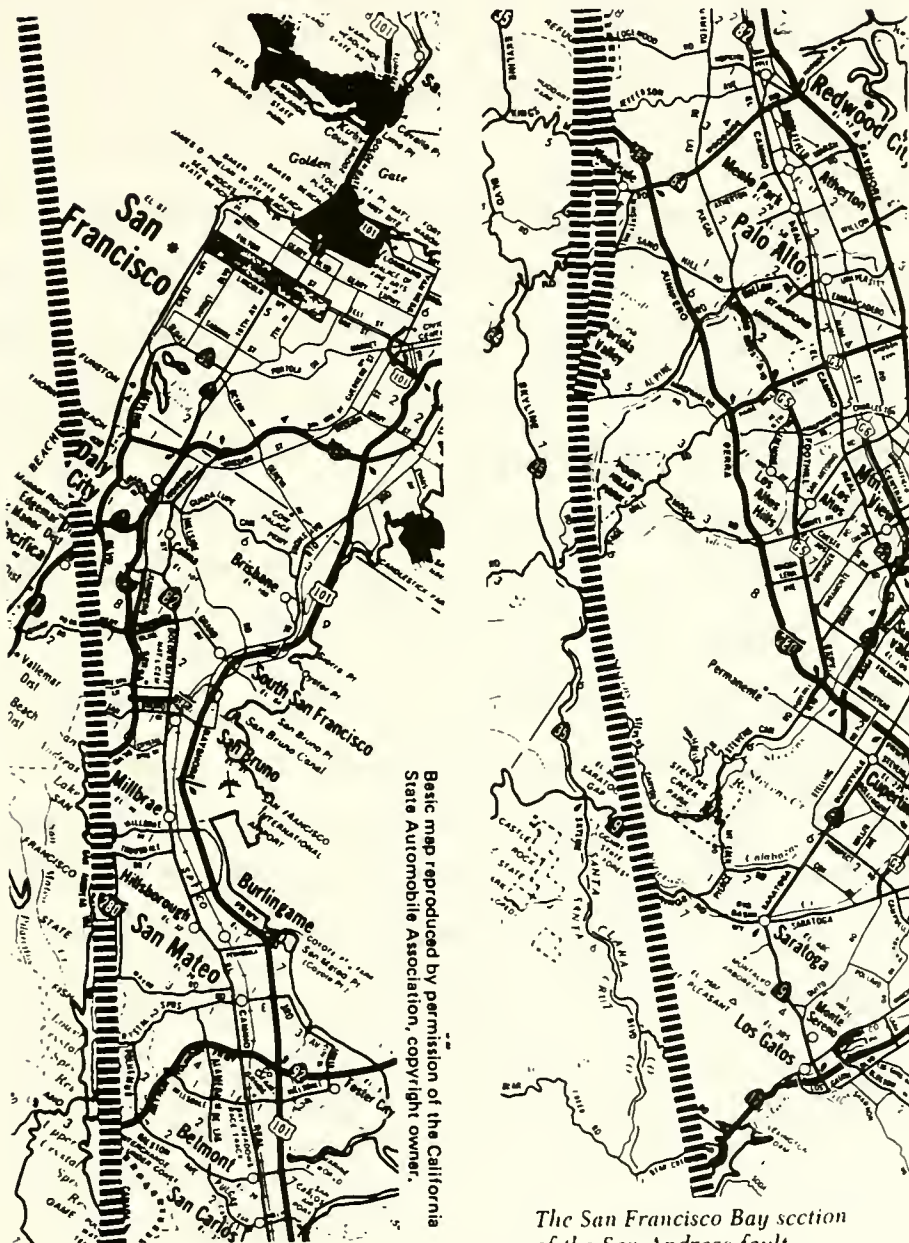
Eighty-three years later, the 1989 Loma Prieta Earthquake struck at the peak hour of the San Francisco Peninsula evening

⁹² Henry J. Lagorio, Earthquakes-An Architect's Guide to Nonstructural Seismic Hazards, (New York: John Wiley & Sons., Inc. 1990), 269.

⁹³ George Plafker and John P. Galloway, ed. Lessons Learned from the Loma Prieta, California, Earthquake of October 17, 1989, U.S. Geological Survey Circular 1045 (Washington: U.S. Government Printing Office, 1989), 1.

ILLUSTRATION 6

Location of the San Andreas Fault in the
San Francisco Bay Area*



Basic map reproduced by permission of the California State Automobile Association, copyright owner.

The San Francisco Bay section of the San Andreas fault.

*Map reproduced from: Peter Yanev, Peace of Mind in Earthquake Country, 252.

commute. Fortunately though, by 5 p.m. over 60,000 spectators were waiting at Candlestick Park for the beginning of the third game of the World Series between the Oakland Athletics and the San Francisco Giants. Because of the rivalry between these two Northern California baseball teams, this World Series had drawn a particularly large audience. That day also, a large number of fans had left work early to watch or listen to the game elsewhere.

Most importantly, those 60,000 people were not jammed in the usual San Francisco and Oakland commute traffic on the surrounding freeways and bridges. Lagorio reported that although the area of damage was large, the built environment generally performed well⁹⁴. The damage extended over a seven-county area from Monterey and San Benito counties in the South Bay to San Francisco and Alameda counties in the North Bay. This is the region which includes the San Andreas Fault.

The San Andreas Fault line is formed along the meeting edge of the oceanic Pacific and the Continental North American tectonic plates. As a result of the pressure that accumulates and discharges in earthquakes along the San Andreas Fault, California is classified as a Region 4 on the Seismic Risk Map from the 1988 Uniform Building Code⁹⁵. This designation indicates that California is located in an area of the most severe earthquake magnitude, intensity, probable recurrence and frequency.

Seismological research introduced in 1967 indicated that

⁹⁴ Lagorio, Earthquakes-An Architect's Guide to Nonstructural Seismic Hazards, 272.

⁹⁵ Ibid., 22.

the earth's crust originally had been a single mass of one huge supercontinent without any ocean basins⁹⁶. Perhaps about 200 million years ago, the earth's crust gradually broke apart and drifted into twenty extremely thick tectonic segments or plates. These plates now move across the molten mantle of the earth forming our planet's shifting crust of ocean floors and continental land masses. Along the coast of California, a section of the meeting edge of the Pacific Plate moves in a northeast direction past the Continental North American Plate. Their frictional movement past one another in this lateral direction creates an average surface displacement of from 1.5 to 2.5 inches a year along the San Andreas Fault.

That surface displacement or tectonic plate movement over the millions of years has created a diverse assortment of soils deposited along fault lines such as the San Andreas Fault. Potential earthquake vibration then radiates from its epicenter and emerges along a fault line from this variety of abutting soils. The lateral earthquake vibrations then are distorted as they emerge from the various soils.

Buildings by their very design are able to withstand heavy vertical loads. It is the lateral shaking earthquake vibrations emerging from and distorted by the various soils that cause the greatest building damage. The lateral earthquake vibrations emerge from the fault into the building foundation then travel vertically up through the structure walls to the roof. The lateral and vertical earthquake movements then return to the foundation and ground along that

⁹⁶ Ibid, 6.

same path through the walls of the structure. Vibrations are changed as they travel through the various materials within a building. Consequently, depending on the strength, speed and duration of the earthquake vibrations and the variety in building materials, a structure is snapped back and forth in a diverse and erratic fashion.

Earthquake turbulence inevitably focuses on any weak or stressed structural connection or materials. Once those structural components and connections of a building begin to fail, the behavior of the building changes drastically. It was the central chimney and tower that failed at Hanna House during the 1989 earthquake.

When the central chimney and tower failed, the damage was grave and resulted in serious consequences for Hanna House. The chimney tower was unable to continue flexing with the vibrations and at the same time provide the main support for the tar and gravel roof. The weight of the roof then settled on the lightweight wooden exterior walls preventing them from flexing with the earthquake vibrations and returning to their natural positions. The roof settled about 1 inch out of alignment, holding the walls out of alignment in the process. Then interior door openings, windows and walls were distorted also. As the chimney and tower failed, floor line bricks were crushed. Also, the cement floor surrounding the chimney and tower cracked and broke. In addition, the cement living room floor pad separated and has shifted in elevation reflecting the soil movement under the house during the earthquake. The

library fireplace constructed in 1957 cracked along the mortar.

In addition to the damage inside, there was extensive damage outside to the terrace and retaining walls. The cement floor pad which continued outside the living room and play room creating the living room, play room and master bedroom exterior terrace cracked and shifted in elevation. The perimeter terrace retaining walls exhibited a variety of damage. The north-side retaining walls bowed while the top of the northern-most part of the retaining wall collapsed. Some terrace retaining walls rotated and separated from the brick facing while in some places along the living room retaining wall, the brick facing simply cracked. In other locations along the living room and dining room retaining walls, the brick facing actually separated and fell away from the supporting cement terrace walls⁹⁷. The stability of individual buildings in this environment is different in each earthquake.

The same earthquake depending on variables of distance, intensity and surrounding soil approaches each building uniquely and is affected or diverted in addition by each building's own variables. The magnitude and duration of the Loma Prieta Earthquake produced different levels of damage for Wright's two similar Peninsula designs, Hanna House and the Bazett House. Structures even of similar design respond individually in the same earthquake. Construction materials

⁹⁷ Architectural Resources Group. Hanna House. Recommendations for Seismic Repair and Conservation of Historic Features, Final Report (San Francisco: Architectural Resources Group, 1991), 17-18.

of varying densities react uniquely in an earthquake creating a variety of stresses within an individual structure⁹⁸.

Buildings fail during earthquakes because they are often constructed of a combination of stiff and flexible building materials. These are the consequences of the earthquake climate found here on the San Francisco Peninsula.

The relationship between earthquakes and plate tectonics is a relatively new research area. Little is understood about why the earth's crust originally broke into the many tectonic plates and what causes their movement today. Currently, it is believed that the plate movement creates earthquakes as the plates move past or beneath one another along the fault lines or plate boundaries. Ninety percent of all earthquakes do occur along plate boundaries. Deep-seated and extremely serious earthquakes are less likely to occur where plates slide past each other in a lateral movement, as along the San Andreas Fault. Plate movement is unpredictable, however.

If the Pacific Ocean and Continental Plates could creep by each other smoothly in a gradual, lateral and barely discernible manner, Californians generally, would have little with which to be concerned. In reality however, earthquakes are created from the accumulated strain along a fault line between two abutting plates which then breaks apart forcefully causing soil slippage. The fault movement in the San Francisco Peninsula is further complicated because the San Andreas Fault is not a single break in the earth's surface.

⁹⁸ Lagorio, Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards, 37, 53.

Instead, the San Francisco Peninsula is included in a wide zone made up of several additional, roughly-parallel fault lines including the Hayward, Calaveras and Sargent Earthquake Faults. The San Andreas Fault zone includes not only these most recent and active faults, but also a network of older inactive earthquake movement and surface displacements. With the accumulated movement along these fault lines, assorted soil and shattered rock sections have been deposited along the fault lines from previous earthquake motion. This soil variety is what creates the random vibration patterns that occur with new earthquakes. The new fault lines and the older, less-active faults are further linked.

Old earthquake fault lines can include partially-healed ruptures. Potentially, these ruptures can also break loose again with a new earthquake⁹⁹. During an earthquake along the San Andreas Fault, older or inactive ruptures can possibly not only break loose again, but also move in different directions from the current vibrations of the larger and newer fault. A reactionary process may occur when new earthquake motions loosen older and assorted formations of unstable rock along an inactive earthquake fault. The disruption of the older fault then can further intensify the current earthquake occurring along the newer fault. In addition, a current earthquake can also influence other new fault lines located in the same proximity.

When an earthquake occurs along the San Andreas Fault,

⁹⁹ Robert Iacopi, Earthquake Country, A Sunset Book. (Menlo Park: Lane Publishing Co., 1980), 16.

additional movement and serious damage is also possible among any of the other newer parallel faults. Any of those new faults can then also release pressure, initiate earth vibrations and in return, influence activity along the San Andreas Fault. Slippage along a new fault can also influence possible earth movement along previously presumed inactive or "locked" fault traces in older, weakened rock. When plates remain "locked" for a period of time, pressure gradually builds up, erupts in all directions and produces an earthquake. The vibrations can be intense or mild depending on the accumulation of pressure released. The 1906 and 1989 California earthquakes were caused by violent adjustments of a temporarily "locked" fault¹⁰⁰. Movement along the plates then is unpredictable.

Regions along the fault line closest to the epicenter where the most dramatic shift of the two plates occurs are not necessarily those with the most damage. Sometimes the farther a building may be from one fault zone, the closer it can be to any of the other old or new parallel fault lines on the San Francisco Peninsula. Consequently, proximity to the epicenter does not necessarily indicate the area of most severe building damage.

Two scales were developed as research tools to measure earthquake damage and movement so that the world's diverse earthquake environment could be classified. The severity of earthquakes is measured on the Richter Magnitude Scale and the Modified Mercalli Intensity Scale (MMI). First published in

¹⁰⁰ Yanev, Peace of Mind in Earthquake Country, 27.

1935, The Richter Scale measures the quantity of energy released during any given earthquake. The Modified Mercalli Intensity Scale developed in 1931 measures the effects of the earthquake.

The Richter Scale is a logarithmic scale with each whole number representing approximately 31.5 times that of the next lower number. The Richter Scale has no fixed maximum; however, the largest world earthquakes rank at the 8.8 and 8.9 level. Here are a few examples. An earthquake registering 1 on the Richter Scale is so mild, it is only observed by instruments; however, a 4.5 magnitude earthquake can be felt up to 20 miles from its epicenter. Earthquakes measuring over 7 are classified as major earthquakes and characterized by conspicuous ground ruptures. The Loma Prieta earthquake indicated 7.1 on the Richter Scale and the 1906 San Francisco Earthquake was assigned the Richter Scale measurement of 8.3. For comparison, the 1923 Tokyo Earthquake earned a measurement of 8.2, the Great Alaska Earthquake in 1964 topped the scale at 8.6, the 1985 Mexico City earthquake recorded an 8.1 measurement and the 1994 Northridge, California earthquake measured 6.8 on the Richter Scale.

While the Richter Scale indicates the amount of energy released during an earthquake, the 1931 Modified Mercalli Index (MMI) measures the effects of an earthquake. The MMI scale uses Roman numerals I to XII to indicate the intensity of ground vibrations, the severity of earthquake damage and the effects on the public. People could probably not even perceive an I earthquake on the MMI scale. An earthquake with

an intensity of VII on the MMI scale, at the same time registering 4.5 on the Richter Scale, would be frightening to those experiencing the trembler. People would find it difficult to stand and trees and bushes would shake moderately. Damage would be negligible in well-designed buildings and slight to moderate in well-built buildings.

The Loma Prieta Earthquake was classified as a IX level earthquake on the MMI scale. The population within the earthquake area experienced panic. After the Loma Prieta Earthquake, damage was considerable in masonry structures built especially to withstand earthquakes and great in other masonry buildings. Some wood-frame buildings built especially to withstand earthquakes, were thrown out of plumb, while others shifted entirely off their foundations¹⁰¹. The built environment including building structures, bridges and highways is indeed at continuing risk in California.

Given the location of the Pacific Ocean and Continental Plates creating the San Andreas Fault along the West Coast, earthquakes have become a part of California's accepted heritage. As urban growth continues in California the devastating potential of earthquake damage escalates, exposing buildings located within fault zones to the highest possible earthquake risk.

During an earthquake, damage to the built environment is inevitable. Building structures are exposed to ground ruptures, surface displacements and severe ground vibrations.

¹⁰¹ George Plafker and John P. Galloway, ed., Lessons Learned from the Loma Prieta, California Earthquake of October 17, 1989. U.S. Geological Survey Circular 1045 (Washington: U.S. Government Printing Office, 1989), 19.

Most structural damage during an earthquake is directly related to the intensity of the ground vibrations. While the potential for earthquakes remains in California, there have been significant advances in technology, building design, construction methods and materials which reduce structural damage. In addition, more sophisticated research techniques have been developed to map and better understand the hazardous areas of the earthquake region. These advances and developments combine to reduce losses in newly constructed structures. Unfortunately, historic buildings are still at risk.

Historic buildings constructed in earthquake areas are extremely vulnerable to damage because they were constructed of dated building techniques and superseded building codes. Building codes can only assure that structures are constructed to the maximum knowledge of strength and lateral bracing for the year in which the house was built. The first specific ordinances governing earthquake-resistant building design appeared in the 1934 Uniform Building Code (UBC)¹⁰². Consequently, 1934 is an important year when studying construction methods and assessing the seismic damage of an historic structure. Today, uniform building codes are assisted by local city planning and zoning ordinances which prevent building development in the most hazardous earthquake areas.

¹⁰² Pacific Coast Building Officials' Conference, Uniform Building Code (Los Angeles: Pacific Coast Building Officials' Conference, 1934).

CHAPTER 4

Ordinances and Policies Governing Hanna House

In a codicil to their will dated February 7, 1967, Professor and Mrs. Hanna granted to the Stanford University Board of Trustees the gift of Hanna House, their real property at 737 Frenchman's Road, Palo Alto, California. The terms of the Hannas' will over the years increased the house ownership percentages for Stanford University. Then in their February 21, 1974 letter to Stanford University, they wrote "...this will bring Stanford's interest up to 100% of the whole [Hanna House] without any reservations." In compliance with their will, Professor and Mrs. Hanna generously gave ownership of their home of thirty-eight years to Stanford University, a private not-for-profit organization. The value of the real property gift to the University in 1974 was \$254,119¹⁰³. This dollar amount reflected the value of Hanna House only. It did not include the value of the land.

Under no circumstances can Stanford University land be sold by the University Board of Trustees. The founding grant establishing Stanford University specified that the original land given to the University by Senator and Mrs. Stanford must remain intact. Over the years, to encourage talented academic people, Stanford University set aside sections of campus land for faculty housing. The University then leased lots for construction. In 1936, Stanford University leased the

¹⁰³ Stanford University Archives Special Collection 280, Carton 5, Vol. 35, Doc. #740017, 740018.

1.42 acre lot to the Hannas for an annual ground rent of \$100¹⁰⁴. With the gift of Hanna House to Stanford University in 1974, the land was returned to the supervisory responsibility of the University Board of Trustees.

In addition to maintaining the site, the Stanford University Board of Trustees became responsible also for planning and implementing all conservation and repair work on Hanna House. The University Board was charged with assuring that the work was carried out within the framework of the goals, objectives and standards of Stanford University. Stanford University is not located within Palo Alto City limits so campus construction or repairs are not regulated by that City's building code. Stanford falls under the jurisdiction of the Santa Clara County Building Department and the Uniform Building Code (UBC). Earthquake repair to Hanna House recommended by the University Board of Trustees then must be in compliance with the Santa Clara County Building Codes.

Upon receipt of Hanna House, the University Board of Trustees appointed a nine-member Hanna House Board of Governors which reported directly to the Board of Trustees and the President of Stanford University. The Board of Governors, consisting of University faculty, staff and Stanford University Art Department volunteer docents, has the responsibility of evaluating and reviewing any changes in the use and care of the house and site.

At the local level, the Stanford Board of Trustees

¹⁰⁴ Stanford University Special Collection 280, Carton 1, Vol. 3, Doc. #370073.

administers Hanna House policy. At the national level, because Hanna House is on The National Register of Historic Places, Hanna House is subject to the terms of that program as administered by the National Park Service. Hanna House is an important national resource and has received considerable national recognition.

Because Hanna House is not only listed on The National Register of Historic Places but also was designated by the National Park Service as a National Landmark, Hanna House is subject then to the terms of the National Register and The National Landmark Program. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program "to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources"¹⁰⁵. While listing properties in the National Register often adds a non-monetary value to the local community, "listing in The National Register, however, does not interfere with a private property owner's right to alter, manage or dispose of property"¹⁰⁶.

National Landmarks constitute about 2,000 of the more than 50,000 entries on the National Register so Hanna House is one of a select group of historic structures. The purpose of the National Landmarks Program is to identify and designate specific National Historic Landmarks and to encourage the long range preservation of nationally significant properties. In addition, the National Landmarks Program focuses attention on

¹⁰⁵ Secretary of the Interior, The National Register of Historic Places (Washington, D.C.: U.S. Government Printing Office, 1993).

¹⁰⁶ Ibid.

properties of exceptional value to the nation as a whole rather than to a particular state or locality¹⁰⁷. Nomination recommendations to National Historic Landmark status originate with the National Park Service.

In order to locate significant properties for National Landmark status, the National Park Service conducts theme studies. Then the National Park Service makes recommendations to an advisory board which in turn makes recommendations to the Secretary of the Interior. The Secretary of the Interior nominates the structure for designation as a National Landmark Property after receiving approval from the owner. Consequently, periodic visits are made to the Landmark structure by the State Historic Preservation Officer. In the event that Hanna House falls into disrepair, the National Park Service has recourse to require conformity and repair. This recourse is through the California State Historic Preservation Office review and inspection process of State structures listed as National Historic Landmarks¹⁰⁸. Thus, while privately owned, Hanna House can fall under the jurisdiction of the National Park Service and the U.S. Department of the Interior. Hanna House received further national honor.

The American Institute of Architects (AIA) Award in 1960 recognized Hanna House as one of seventeen buildings by Wright "to be retained as an example of his contribution to

¹⁰⁷ Secretary of the Interior, Proceedings of the National Historic Landmarks Program. (Washington, D.C.: U.S. Government Printing Office, 1990) 294-302.

¹⁰⁸ Ibid.

American culture." This award, however, does not include restrictions or conditions¹⁰⁹.

When Professor and Mrs. Hanna originally gave their home to Stanford University, they hoped that an endowment would be established for a distinguished visiting professorship¹¹⁰. The visiting scholar and family would occupy the house and hold small seminars or research gatherings to allow continuing academic exposure for Hanna House. In the absence of funding for a visiting professor program, and in the interim period between when the Hannas moved out in October, 1975, and the Loma Prieta Earthquake in October, 1989, the Provost of the University and his family moved into Hanna House. Through the meetings, receptions and small seminars conducted by the Provost at Hanna House, the home was exposed to a broader range of the University community. This appeared to be a satisfactory compromise between the Hannas' wishes for their house to continue with greater public exposure through a visiting professor program and the lack of funding available to initiate the program.

Hanna House has enjoyed considerable public exposure. Professor and Mrs. Hanna have been generous in sharing their home. Over the years, they have graciously welcomed Stanford University students in addition to both national and international visitors. Included on the list of visitors were professional groups as well as individuals who arrived often spontaneously and unannounced at their front door requesting a walk through their private home, which coincidentally happened

¹⁰⁹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 123.

¹¹⁰ Ibid., 125.

to be the public design of Frank Lloyd Wright. From the quantities of correspondence in the Stanford University Archives, it appears that the Hannas turned very few visitors away. After they moved and before the 1989 earthquake, the Stanford University Board of Trustees continued the tradition of their gracious hospitality. Since 1974, Stanford Art Department docents have led public bimonthly tours of Hanna House. However, following the 1989 earthquake, Hanna House was evacuated by the Provost and is now closed to the public.

According to various reports, Stanford University Campus incurred \$120 to \$200 million damage with the Loma Prieta earthquake¹¹¹. Damage was found in more than two hundred-forty Stanford University campus buildings. The damage completely closed down twenty-three structures¹¹². Hanna House is included as one of eight historic structures of those two hundred-forty damaged Stanford University buildings.

In order for the University to become a functioning academic institution as quickly as possible after the earthquake, Stanford gave the academic and dormitory buildings top repair priority. After the damage to Hanna House was assessed, the central chimney tower was immediately stabilized. Hanna House was left then as the University focused on returning the academic community to normalcy. The University's performance goal established after the 1989 earthquake addressed the issue of earthquake damaged

¹¹¹ Don Kozok, "Quake Damage Bill Still Unpaid," Palo Alto Weekly 20 October 1993, 9; Colin Norman, "Bad Vibes at Stanford," Science 4929, 1998, 438; Robert Buderl, "Stanford in Squabble over Relief Funds," Nature 342, Nov, 1989, 23; Bill Workman "Stanford Hopeful on Quake Repairs," San Francisco Chronicle, August 12, 1993, A17.

¹¹² Kozok, Palo Alto Weekly, 9.

buildings. That goal instructs that all earthquake damaged Stanford University structures are to be repaired and seismically strengthened to a level so that they will protect building occupants while at the same time resist any earthquakes measuring to the 7 to 7.5 level on the Richter Scale¹¹³.

After the earthquake, as a private not-for-profit organization, Stanford University qualified for reconstruction funds from The Federal Emergency Management Agency (FEMA). FEMA was confronted with some unique situations because Stanford's campus consists of large number of older academic and student resident buildings. Stanford staff reported, "I don't think they've ever seen claims like we have submitted for \$10 to \$11 million on some buildings"¹¹⁴.

Negotiations with FEMA were further complicated because FEMA assistance was limited to the repair, rehabilitation, replacement or stabilization of not-for-profit facilities (or public buildings). FEMA would not pay for consultant services or church repairs¹¹⁵. In addition, FEMA would only consider those expenses not already covered by insurance. The Stanford Board of Trustees had determined in years past that paying enormous premiums for earthquake insurance did not serve their

¹¹³ Architectural Resources Group, Hanna House: Recommendations for Seismic Repair and Conservation of Historic Features. Final Report, 3.

¹¹⁴ Curt Williams, "Quantities of Quake Quandaries," Stanford Observer, January/February 1990, 13.

¹¹⁵ California Preservation Foundation. History at Risk, Loma Prieta: Seismic Safety & Historic Buildings, (Oakland: California Preservation Foundation, 1990), 34.

primary responsibility¹¹⁶. They felt their responsibility was to invest in the process of education not in costly annual earthquake insurance premiums. FEMA assistance appeared to place the University's earthquake damaged historic structures in jeopardy of even survival.

During the first thirty days after any emergency, FEMA legislation takes precedence over other Federal, State and local laws¹¹⁷. It was this thirty-day suspension after the Loma Prieta earthquake that caused such anguish among preservationists and historians across the country. In the interests of public safety, historic buildings deemed hazardous to the public were demolished by owners with no questions asked because FEMA reimbursed owners for the demolitions if they were conducted within those first thirty days after the earthquake. Local governmental review processes which evaluated the historic importance of structures were abolished for that period of time.

As a result of that FEMA stipulation, many important California structures damaged in the Loma Prieta earthquake were completely lost. The Cominos Hotel was demolished. Built in 1874 in Salinas, California, the hotel had as recently as June, 1989 been saved from demolition by a court order obtained by the Monterey County Historical Society. The Cooper House, constructed in Santa Cruz, California in 1894, the centerpiece of the Pacific Garden Mall, a National

¹¹⁶ Patti Plummer, Interview with author, April, 1994, Stanford University Provost's Office, Minutes of University Board of Trustees meetings are closed for twenty years.

¹¹⁷ California Preservation Foundation, History at Risk, Loma Prieta: Seismic Safety & Historic Buildings, 6.

Register District, was demolished because of the damage it incurred in the Loma Prieta Earthquake. Also, San Francisco lost the beaux-arts style Marine Building in the City's financial district as a result of the FEMA thirty day ruling¹¹⁸.

If owners did not choose to demolish their earthquake damaged buildings during those thirty days, the repairs were governed by the prevailing codes of the California State Historical Building Code and the current UBC. Repair of earthquake damaged buildings was not required to comply necessarily with State or National fire and safety requirements. If there were no local preservation rehabilitation regulations, the prevailing guidelines for repair of historic buildings was the Secretary of the Interior's Standards for the Rehabilitation of Historic Structures¹¹⁹. Because Stanford University is not located within the Palo Alto City limits, the University repairs are not required to comply with that City's local Preservation Ordinance. Hanna House will be repaired to comply with the Secretary of the Interior's Standards for the Rehabilitation of Historic Structures and will fall under the umbrella of the California State Historical Building Code.

The purpose of the California State Historic Building Code is to provide alternative building regulations and standards for the rehabilitation, restoration or relocation of designated historic building structures. These standards and

¹¹⁸ "Natures Wrecking Ball," Preservation News, December 1989.

¹¹⁹ California Preservation Foundation. History at Risk. Loma Prieta: Seismic Safety & Historic Buildings, 18.

regulations were designed to facilitate the restoration of an historic structure in the event of a natural disaster. The regulations preserve the original architectural elements and features while at the same time provide reasonable safety to the occupants. Before the repair work can be started, a survey and evaluation are made by an architect or structural engineer who is knowledgeable in earthquake resistant design. The survey and evaluation then are reviewed by a State Historic Building Safety Board member within the State Architect's Office. The advantage of the California State Historic Building Code is that broad judgment can be used regarding strength and performance of materials not necessarily recognized by prevailing building code requirements¹²⁰.

There are additional requirements to be met when a private not-for-profit organization such as Stanford University applies to FEMA repair funds for historic buildings. The National Historic Preservation Act of 1966, Section 106, requires that all Federal agencies consider the effects of their activities on historic properties listed on or eligible for the National Register of Historic Places. While the Advisory Council on Historic Preservation, an independent Federal agency, administers the review process, the State Office of Historic Preservation has the role of reviewing the proposed work to ensure that Federal funds will not be used to diminish the architectural, historic, or cultural integrity of the historic structure. Unresolved

¹²⁰ State of California. Title 24 Building Standards, Part 8, Sec. 505. (Sacramento: State of California, 1979, revised June, 1990), 8-19.

issues between the property owner and FEMA would be reviewed by the Advisory Council for Historic Preservation. The process is usually completed with a formal agreement among all parties¹²¹.

Some unforeseen complications surfaced with FEMA assistance for those historic buildings damaged during the 1989 California Earthquake. While The Secretary of Interior's Standards for the Rehabilitation of Historic Structures required appropriate repairs to historic structures, at the same time, FEMA's reimbursement policy paid only for costs necessary to return buildings to an operable condition¹²².

This FEMA policy discouraged faithful restoration of important historical structures. It was found that FEMA funds could not be used to replace high quality original materials in historic buildings. If in-kind restoration was found to be more expensive, FEMA's interpretation was that it was not responsible for those additional costs¹²³.

On the other hand, if a city ordinance required adherence to a more recent building code, or that materials must be replaced in-kind, FEMA did agree that the local requirement would prevail, but they wouldn't pay for the more expensive in-kind restoration. For example, full restoration of a marble cornice, marble mantle or crown molding using original materials would not be funded by FEMA if fiberglass or plastic replicas were available and less expensive.

¹²¹ California Preservation Foundation. History at Risk. Loma Prieta: Seismic Safety & Historic Buildings. 20.

¹²² Ibid., 34.

¹²³ Ibid., 35.

So while FEMA determined that project owners must restore their historic structures to The Secretary of Interior's Standards, FEMA appeared also to discourage the accurate restoration of damaged historic property. This is in direct conflict with The Secretary of the Interior's Standards for the Rehabilitation of Historic Structures which requires Federal agencies to exercise great care with historic properties.

Financial support from FEMA is essential to repair structures in the event of a disaster. The restrictions though, limit eligibility for the funds. These regulations do not have the best interests for historically significant buildings yet a property owner can be burdened with tremendous expense without FEMA assistance. In the case of Hanna House, FEMA funds can be only used to repair, stabilize and rehabilitate the building structure and retaining walls. If in-kind materials are necessary, such as brick or redwood to match the original building materials, FEMA money can not be used to manufacture the construction materials if less expensive materials are already available.

CHAPTER 5

Conclusions

The San Francisco Peninsula is routinely subjected to earthquake tremors varying from barely discernible to the 7.1 Loma Prieta Earthquake in 1989. For a variety of reasons, the stability of individual buildings is different in each earthquake. The Hanna and Bazett houses are of similar design. One house survived the 1989 earthquake with no structural damage while the other stands structurally weakened and vacant now as a result of that same 1989 earthquake. The houses, containing similar design features, were originally built of the same construction materials and located just thirty miles from each other in the same earthquake environment. A comparison of these two structures reveal important differences which are helpful in designing a seismic strengthening and repair program for Hanna House.

Both the Hanna and Bazett houses are located approximately forty miles from the Watsonville, California epicenter of the 1989 earthquake. Based on the similar distance from the epicenter, the severity of the vibrations felt during the fifteen-second earthquake would have been approximately the same for both houses. Both houses are situated along the same eastern slope of the Pacific Coast Mountains and east of the San Andreas Earthquake Fault. In addition, the Hanna and Bazett Houses are of a similar Usonian design created by Frank Lloyd Wright.

Wright's designs were quite unconventional for 1937 and

1940. Both Hanna House and the Bazett House are of innovative designs with an irregular plan based on the hexagon. Wright then in addition, designed the two house plans to flow in an organic or irregular fashion rather than conform to rigid and symmetrical axes. A symmetrical plan on both axes is the most stable in an earthquake environment because an individual building must be able to oppose earthquake motion from any wall or facade¹²⁴. Because earthquake ground waves can arrive at a site from any direction, research has shown that structures of irregular plans are not as stable during an earthquake as those with regular plans¹²⁵. Wright's innovative designs also tended to push the new machine age construction materials such as steel and cement to their tensile limits. As a consequence over the years, his Usonian plan homes have garnered reputations for structural faults and poor quality workmanship.

Historians and architects alike have not always been generous in their reviews of the Usonian houses. The Museum of Modern Art Catalog, Frank Lloyd Wright Architect, claimed that "Frank Lloyd Wright repeatedly pushed materials to the extreme limits of tolerance to the verge of failure and beyond"¹²⁶. Hildebrand reported in his book on the Usonian houses that "questions of craftsmanship, maintenance and durability loom large in the case of the Usonians"¹²⁷. Again

¹²⁴ Lagorio, Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards, 47, 48.

¹²⁵ Ibid., 47.

¹²⁶ Frank Lloyd Wright, Architect, 8.

¹²⁷ Hildebrand, The Wright Space. Pattern and Meaning in Frank Lloyd Wright's Houses, 135.

in the Museum of Modern Art Catalog, Mrs. Richard Lloyd Jones, the wife of Wright's cousin, when asked about the problems caused by her own leaky roof said "This is what happens when you leave a work of art out in the rain"¹²⁸. John Eifler in his article on restoring the Usonian Jacobs House indicated that it was "revolutionary in plan but structurally flawed"¹²⁹.

Wright's experiments with innovative non-traditional house designs in which he incorporated some untested construction techniques and pushed building materials to their limit of strength can be partially responsibility for those perceptions; however, the research for this paper indicates those were not the circumstances for the Hanna and Bazett Houses. Construction design did not cause the earthquake damage at Hanna House. While Wright may have pushed building materials to their limits at the Hanna and Bazett Houses, he did so with a strong engineering background. Wright's engineering education began in Wisconsin before he moved to Chicago to study architecture.

As a young man in Chicago, he worked as a draftsman in the office of Dankmar Adler (1844-1900) and Louis Sullivan (1856-1929). Sullivan had worked for William Le Baron Jenney (1832-1907) when he had first arrived in Chicago and Jenney had been active during the rebuilding of Chicago after the 1871 fire. Chicago is located on alluvial soil. Jenney was considered a pioneer in the technology of designing

¹²⁸ Frank Lloyd Wright, Architect, 9.

¹²⁹ John Eifler, "Restoring the Jacobs House," Fine Homebuilding April/May 1993, 78-82.

foundations necessary to support the tall steel frame buildings constructed in the unstable alluvial soil¹³⁰.

As a draftsman, Wright then worked with both Adler and Sullivan on the large, multi-use structure, the Chicago Auditorium Building, 1886-90. Adler was the master technician of his day adapting Frederick Baumann's Chicago foundation system to the Auditorium Building. While working in Adler's office, it was Paul F. P. Mueller who further modified the Chicago Auditorium foundation to create a set of "floating" foundations to carry the weight of the structure¹³¹. From his experiences in this office, Wright then brought a strong engineering grounding to his developing architectural career.

Following his work in the Adler and Sullivan Chicago firm, Wright's career led him to Japan. In 1916, he was awarded the commission to design the new Tokyo Imperial Hotel. The challenge was to construct a large, new, modern hotel on a layer of jelly-like unstable soil in an ongoing active earthquake environment. Prior to this commission, Wright's career had focused on designs for private residences. This public hotel project was similar to the challenges he had been exposed to during the design of the Chicago Auditorium Building.

Mueller, from the Adler and Sullivan days, worked on Wright's Imperial Hotel and designed anti-seismic foundation

¹³⁰ Marcus Whiffen & Frederick Koeper. American Architecture 1607-1976. London: Routledge & Kegan Paul Ltd., 1981, 246; Frank Lloyd Wright, Architect, 126.

¹³¹ Frank Lloyd Wright, Architect, 59.

footings¹³². Completed in 1923, the Tokyo Imperial Hotel survived the September 1, 1923, 8.2 Richter Scale earthquake and fire. This was an enormous disaster claiming the lives of thousands of people. The Hotel was demolished after World War II only because it had fallen into disrepair, not because of damage it sustained in the 1923 earthquake.

While reflecting on the construction of the Imperial Hotel, Wright perceived one problem. The problem he saw was how to make a flexible structure rather than what he called a "foolish rigid one". He felt that heavy massive masonry would be destroyed with the ground wave movement. Also, he believed "the heavier the masonry, the greater the wreck"¹³³. Further, he recalled that a building design needed flexibility and resiliency in order to ride the earth waves of an earthquake and return to normal at the end of the vibrations¹³⁴.

Wright believed that because the earth waves of an earthquake were deep, a foundation needed to be shallow to ride with the wave motion. He thought a short foundation coupled with a lightweight and flexible structure above would survive an earthquake in better condition than a heavy rigid one¹³⁵. Current research indicates that flexible building materials have a greater capacity of absorbing more cycles of ground motion before failure¹³⁶. Thus buildings need to be designed either with boundless flexibility in order to endure

¹³² Ibid., 59.

¹³³ Frank Lloyd Wright, An American Architecture, 199.

¹³⁴ Frank Lloyd Wright, Writings and Buildings, ed. Edgar Kaufmann and Ben Raeburn (New York: Meridian Penguin Books, 1960), 149.

¹³⁵ Ibid., 200.

¹³⁶ Yanev, Peace of Mind in Earthquake Country, 137.

earthquake motion or an unlimited capability for stiffness in the more traditional fashion.

In designing the Tokyo Imperial Hotel, Wright was also concerned with using the more traditional heavy roof tiles. "Roof tiles have murdered countless thousands of Japanese in upheavals, so a light hand-worked copper roof was planned for the hotel"¹³⁷. Wright must have been satisfied with the effect of the lightweight and flexible copper sheet roofing material because he specified it again on the 1938-42 Auldbrass Plantation in Yemassee, South Carolina, in addition to the Hanna and Bazett Houses. Later, in 1945-51, he also used copper roofing material on the Unitarian Church in Madison, Wisconsin.

While commissioned to design the new Imperial Hotel, Wright spent six years primarily in Japan developing a foundation and hotel structure he believed would be earthquake safe. Reflecting on the design process for the Imperial Hotel, Wright recalled that "I spent six years studying earthquake conditions"¹³⁸. Wright immersed himself in earthquake resistant technology and construction techniques which also eventually affected the design for the Hannas' home and the Bazett residence.

An assumption can be made that from Wright's work in Tokyo, an understanding of the strengths of flexible and lightweight building materials remained with him to influence designs for his later residences. Wright's experience in Japan and his interest in constructing for the active

¹³⁷ Wright, Writings and Buildings, 151.

¹³⁸ Ibid., 149.

earthquake environment of the Tokyo area also influenced his decision to create a home in the Usonian design for the Hannas. The Tokyo Imperial Hotel had been completed in 1923 so that the progression of timing would allow Wright's thoughts to develop in this manner. Another influence on his two San Francisco Peninsula designs was the Prairie Style plan.

The Prairie Style houses show a progression of designs which also affected his Usonian houses. As reported in Chapter 1, Wright broke out of the traditional square- or box-shaped house plan early in his Prairie House designs. With the Bazett and Hanna plans, Wright continued refining the design process he started with the Prairie Style houses. His ideas of overlapped room spaces to create ambiguous use spaces advanced further in the Usonian houses where he entirely opened up the public spaces. Both the Usonian living room and dining room spaces then became ambiguous or multi-use areas. The original Prairie House plans evolved into the open and irregular plans seen at the Hanna and Bazett houses.

When the Hannas then approached Wright in 1935 to create their California home, the Imperial Hotel project was behind him and he was refining his designs for the Broadacre City Project. His Usonian philosophy evolved. The influences included the Broadacre City Project, coupled with Wright's experiences in the Tokyo earthquake environment and the evolution of the Prairie House Plan. These concepts all combined to influence the Hanna House concept and plan. The

design would be a natural choice for the earthquake-prone San Francisco Peninsula.

As reported in Chapter 1, he first drew a two-story home for the Hannas¹³⁹. Why did Wright change his concept from a two-story plan to the Usonian structure we see today? Possibly his visit to the Hannas' three available Stanford University campus building sites in March of 1936 influenced his choice. With that visit, Wright must have realized the San Francisco Peninsula was as active an earthquake region as Tokyo. He then applied concepts and construction methods learned on the Tokyo Imperial Hotel. His second proposal to the Hannas incorporated a lighter weight, one-story, flexible, wood construction which is a more appropriate design and materials choice for the Peninsula.

This second design for the one-story Hanna House reduced construction weight by utilizing flexible and lightweight materials. Both the Hanna and Bazett houses are one-story, wooden structures, designed on the 60- and 120-degree angles of the hexagonal grid. Structural resiliency is incorporated through walls folding along those lines of the hexagon¹⁴⁰. Further, by using thin, wood-framed interior and exterior walls in the sandwich design, the need for the more traditional and heavier lath and plaster wall was eliminated. There are no attics in the two houses which further reduced weight in the framing and roof. With a one-story structure, which reduced the total vertical weight, Wright then created

¹³⁹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 19.

¹⁴⁰ L. Cornelia Brierly to Professor and Mrs. Hanna, Letter, n.d., Stanford University Archives Special Collection 280, Doc. # 370089.

dynamic interiors through the hexagon grid plan, dramatic changes in interior ceiling heights and steps to separate living spaces. Wright developed working drawings for this second design.

Wright's knowledge of earthquake movement and engineering skills are further demonstrated in his working drawings for Hanna House. With the Hanna construction, Wright conformed to the prevailing UBC and Turner then enhanced the foundation strength over what Wright had specified in the "Instructions to the Contractor"¹⁴¹. The many Hanna construction photos demonstrate Turner's workmanship and job site supervision (see Chapter 1). These photographs show reinforcing bar extending from the house perimeter foundation, foundations for retaining walls, the living room chimney tower and adjoining kitchen wall. However, the applicable building codes that Turner followed were ambiguous for the construction period.

The Specification Documents for Building Materials & Construction, 1938 did not require reinforcing bar in foundation areas¹⁴². A change to reinforced foundations had not yet been incorporated in the Specification Documents. Yet the UBC for 1937 published in April of that year specified "all exterior walls shall be supported on continuous masonry or reinforced concrete walls or footings"¹⁴³. Hanna House construction started in January, 1937. It seems likely that Turner would start construction with the still applicable 1935

¹⁴¹ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 35.

¹⁴² Pacific Coast Building Officials, Specification Documents for Building Materials & Construction, 1938.

¹⁴³ Pacific Coast Building Officials, Uniform Building Code, 1937, 90.

UBC and complete Hanna House relying on that same code. The 1935 UBC was unavailable for this thesis research. The only copy of the 1935 UBC in the California State Legal Library System has been reported missing and presumed lost. However, the Hannas' construction photos record and document the foundation development.

Given the ambiguous building standards for 1937, the photographs demonstrate that Turner chose to construct the foundation, retaining walls and central chimney tower to a greater strength by incorporating reinforcing bars. A letter was found in the Getty Foundation Archives from Blaine Drake who was at the time supervising construction at the Bazett House. Drake indicated to Wright that the Hanna House floor foundation wall at the lower terrace corner (southwest corner) "is good"¹⁴⁴. The construction photographs demonstrate that the Hanna House foundations were well designed and constructed for 1937 and the prevailing building codes.

Turner constructed the foundations to conform with the yet to be published 1937 UBC and possibly to a higher standard than was required by the prevailing 1935 UBC. With no Santa Clara County, San Mateo County or even Palo Alto City building inspections required until 1947, a less ethical contractor might have chosen to construct the 1937 foundation in a less-expensive and time-consuming manner¹⁴⁵. The Hanna photographs illustrate that Turner had experience and knowledge to increase the foundation strength over the 1938 Specification

¹⁴⁴ Drake to Wright, Letter, n.d., Getty Foundation, Frank Lloyd Wright Archives, Bazett Project #4002.

¹⁴⁵ Jim Devine, Interview by author, 6 February 1994, Santa Clara County Building and Inspection Department, San Jose, California.

Documents for Building Materials and Construction

requirements. Turner's good workmanship is evidenced in these high standards.

The relationship between Wright and Turner continued after the Hannas' home was completed. Harold Turner, over the course of the next six years, went on to build a number of houses with Wright including the 1938 Rehbuhn House of Great Neck, Long Island¹⁴⁶. While a skeptic might argue that each was simply looking to their next paycheck, Turner's six-year career with Wright indicated a level of trust between the two men and a mutual confidence in each other's skills and talent. Hanna House however, did not remain as constructed by Wright and Turner.

Over the years, larger additions and more extensive repairs have been made to Hanna House. Each addition or remodel has added more weight and variables to the building site. The Hanna House design became less flexible with each remodel and in the event of an earthquake became more susceptible to damage. It is this weight of the subsequent additions made to the original lightweight and flexible building over the years that created the stress and failures we see today at Hanna House. Professor and Mrs. Hanna supervised those additions to assure they agreed with Wright's Usonian philosophy.

Following his Usonian design philosophy, Wright required that in order to make the hexagonal grid precise and continuous, the exterior terraces were poured and incised at

¹⁴⁶ Sergeant, Frank Lloyd Wright's Usonian Houses, 118.

the same time as the interior pad. The later additions of cement terraces including the swimming pool and surrounding deck then all connected to the original 1937 terrace. When one stands at Hanna House today, it is difficult to determine where the subsequent terraces were integrated with the original work. One must refer to the Hanna photographs in the Stanford Archives in order to verify where the terraces were enlarged. In addition to the weight of the building materials associated with the swimming pool, the weight of the water contained in the pool is considerable. An average backyard swimming pool of 15 feet wide by 35 feet long and an average of 6 feet deep holds 197,000 pounds of water¹⁴⁷. These additional structures and connected terraces have all increased the weight of the original project¹⁴⁸.

Also, the replacement tar and gravel roof affected the weight load on the wooden exterior load-bearing walls. Correspondence or invoices were not found in the Stanford University Archives to accurately date the replacement of the copper roof with tar and gravel. In 1937 however, at the completion of construction, there is much correspondence in the Archives between Wright and the Hannas about the original copper roof design, cost and specifications¹⁴⁹. Then in 1942, the Archives include photographs documenting the inspection of the "failed" copper roof¹⁵⁰.

¹⁴⁷ $15 \times 35 \times 6 = 3150$ cubic feet. Water weighs 62.4 lbs. per cubic foot = 197,000 lbs. water.

¹⁴⁸ Hanna, Frank Lloyd Wright's Hanna House. The Clients' Report, 143, 144.

¹⁴⁹ Stanford University Special Collection 280, Vol. 3, #370063.

¹⁵⁰ Stanford University Special Collection 280, Photo V. III, pg. 52..

Copper is a lighter-weight material and more flexible than a tar and gravel roof. According to the 1938 Specification Documents for Building Materials & Construction, copper sheeting roofing material weighed 1.51 pounds per square foot and tar and gravel weighed 6.0 pounds per square foot¹⁵¹. When multiplied by 4,825, the square feet included in the Hanna House plan (excluding the eaves), the copper roofing material would have weighed 7,237.5 pounds while the tar and gravel weighed 28,950 pounds. The additional weight on the exterior walls reduced their flexibility in the event of an earthquake which in turn reduced their ability to return naturally to their original position.

These improvements and additions have increased the total weight of the original 1937 construction project. Lagorio reported "that building damage occurs when any component of a structure is loaded beyond its capacity to resist an applied force of any given magnitude"¹⁵². Also, the less rigid elements tend to pass the seismic loads on to the more rigid building elements whether they are designed to resist the loads or not. When this happens a concentration of stresses focuses on those more rigid structural elements causing their failure¹⁵³. The rigid central chimney tower failed at Hanna House in the 1989 Loma Prieta Earthquake. There were no failures at the Bazett House.

¹⁵¹ Pacific Coast Building Officials' Conference, Specification Documents for Building Materials & Construction. (Los Angeles: Pacific Coast Building Officials, 1939), 279.

¹⁵² Lagorio, Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards, 37.

¹⁵³ Ibid., 53.

The contrast with the Bazett House provided interesting data and reinforce the findings that it was the additional weight of the remodels that created the environment for the extensive earthquake damage at Hanna House. The characteristics of the Bazett House make it appear more stable than the Hanna House in this earthquake environment.

A major reason the Bazett structure incurred little earthquake damage in 1989 is that through the years it has remained essentially the same plan as devised by Wright. The cement terrace around the Bazett House has never been enlarged over the original design. The Franks reported the guest wing was enlarged only slightly when they converted it to their own master bedroom.

The Franks constructed a swimming pool and surrounding pool deck on their property, however; the pool and accompanying deck are located across the driveway from the house. The swimming pool project is not continuous or attached in any way with the existing house or original cement terrace. In addition, when it became necessary to replace their roof, the Franks chose copper again. They selected the lighter weight and more flexible characteristics of the original copper roof without succumbing to a more traditional tar and gravel roof. The heavier tar and gravel material would have been less expensive to install and also required less maintenance¹⁵⁴. There are also interesting comparisons in site conditions and foundation construction between the two houses.

¹⁵⁴ Rick King, Izmerian Roofing Co., Interview by author, San Mateo, California, 21 February 1997..

The Bazett House was situated on the property at an abandoned road bed. The Getty Foundation Archives contained nothing to indicate subterranean tunnels at the Bazett House site. In addition, the Bazett House photographs at the Getty Foundation Archives do not indicate the preparative process of grading and filling that we saw at the Hanna House construction site. The Bazett House is located on more stable sedimentary rock while the soil at the Hanna House construction site is of poorly indurated non-marine conglomerate sandstone, mud and stone¹⁵⁵. Radiant heating pipes were embedded in the gravel as specified by Wright at the Bazett House so there was no need for an underground furnace room or utility tunnel found within the Hanna House foundation.

Further comparing the two house plans, one of the major differences is Hanna House at 4,825 square feet is a larger and inherently heavier structure than the Bazett House plan of 1,480 square feet. The continuous exterior cement terraces at Hanna House are approximately equal in size to the interior square foot measurement while the exterior terraces at the Bazett House are approximately only one-third the size of the plan¹⁵⁶. Adding more weight to Hanna House is the central chimney and tower.

The Hanna House central chimney and tower is larger, taller and more massive. The central living room chimney

¹⁵⁵ U.S. Department of the Interior. Geological Maps of Upper Cenozoic Deposits in Central California, map 1-1943; Lowney & Assoc., Geotechnical Investigation for Hanna House Seismic Upgrade, Stanford, Calif., 26.

¹⁵⁶ Hildebrand, The Wright Space. Pattern and Meaning in Frank Lloyd Wright's Houses, 149.

tower at Hanna House is a total of 21 1/2 feet tall from the living room floor line and extends 8 feet 8 inches above the roof line¹⁵⁷. The Bazett House central chimney and tower extend only three brick courses above the roof line¹⁵⁸. No elevation drawings of the Bazett House were found to compare with elevations for the Hanna House living room chimney and tower. With visual comparisons, one can see the Hanna House tower is taller and larger indicating more weight extending above the roof line than the single central chimney tower at the Bazett House.

As Wright created the design for Hanna House, the central brick chimney and tower were intended to provide the primary support for the roof joists. The joists were supported at strategic reinforced locations along the wooden exterior walls. When the weight of the roof was increased with the tar and gravel material, the chimney tower was loaded past it's ability to absorb the earthquake vibrations from both the wooden support walls and the foundation. This created the failure of the central chimney mass during the 1989 earthquake. Lagorio reported that the "integrity of a building itself depends on the capacity of the foundation to support any above loads placed on it by the superstructure"¹⁵⁹.

According to Yanev, a carefully designed and constructed modern wood frame building is the most desirable small

¹⁵⁷ Stanford Special Collection 280, drawing #41; Photo Vol. 1, pg. 11.

¹⁵⁸ Gebhard, Romanza. The California Architecture of Frank Lloyd Wright, 42.

¹⁵⁹ Lagorio, Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards., 60.

property because it is lightweight and flexible¹⁶⁰. Also, certain building materials perform better than others under the stress of earthquake motion. Generally wood and steel are preferred construction materials in earthquake-prone regions because these materials are flexible and relatively lightweight. Wright believed that building designs needed flexibility and resilience in order to ride the earth waves of an earthquake and return to normal at the end of the vibrations¹⁶¹.

With each project improvement or addition over the years, more weight was added to Wright's original construction so that Hanna House, designed to be lightweight and flexible, could not support the additional accumulated weight and at the same time resist the vibrations it sustained in those fifteen seconds during the 7.1 Richter Scale 1989 Loma Prieta Earthquake. If left as originally constructed, leaving the weight, or vertical load as was originally designed, Hanna House would endure with less damage in the earthquake climate of the San Francisco Peninsula.

¹⁶⁰ Yanev, Peace of Mind in Earthquake Country, 135, 137.

¹⁶¹ Frank Lloyd Wright, Writings and Buildings, 149.

CHAPTER 6

Recommendations

Turning now to my recommendations, the design challenge of installing a seismic strengthening program at Hanna House is complex. Hanna House is located in the most severe earthquake environment of the United States. This historic structure is already located in close proximity to the active San Andreas Earthquake Fault stands seriously damaged as a result of the 1989 Loma Prieta Earthquake. The repair program designed for Hanna House needs to meet the Stanford University performance goal for public safety while at the same time retain as much historic fabric in the building as possible. Also, the repair materials and treatments must be reversible in anticipation of future knowledge and improvements in seismic research and treatments. Earthquake damage to historically significant buildings adds a new parameter to the field of Historic Preservation.

Traditionally, Historic Preservation has addressed the concerns for repairing structural and decorative damage of historic buildings caused by neglectful maintenance. Concerns of minimal intervention, reversibility of repairs and preservation of historic fabric have been the important issues. However, with Hanna House, or for that matter any historic structure located in an active earthquake area, the first concern is one of seismic strength providing public safety within the structure during any possible future

earthquakes. A balance between history and safety must be found through a combination of strategies¹⁶².

The following are my recommendations to be initiated now in anticipation of the eventual program adopted by Stanford University to restore Hanna House.

First: The cement terraces added after 1950 should be separated from the original terraces. This procedure will reduce the connected weight moving dynamically with Hanna House in any future earthquake. Reducing the amount of connected weight will make the already severely weakened structure less susceptible to possible future earthquake damage pending completion of the restoration design.

Second: Hanna House and it's site must be carefully and completely documented before the restoration process is initiated. Existing records must be examined to ensure that this current documentation augments but does not duplicate what is already located in the Stanford University Archives. The documentation should include drawings locating the two Coutts irrigation tunnels on the site. Also, scale drawings depicting the current Hanna House need to be prepared. The interior and exterior of the house should be photographed completely. Those photographs then would be carefully labeled and dated. All newspaper and journal articles in addition to the correspondence pertaining to the damage and restoration of Hanna House need to be organized. Written reports, cost estimates and actual repair costs would be recorded also. All

¹⁶² M.J. Crosbie. "Quakeproofing Landmarks: Protecting Historic Buildings from Earthquakes without Destroying Original Features," Architecture 81 November 1992, 119.

of this information should be cataloged in the Stanford University Archives Special Collection 280 with copies of the drawings and records sent to the Frank Lloyd Wright Fellowship Library at Taliesin West, Scottsdale, Arizona.

Third: It is necessary to locate and chart the reported old or locked earthquake fault line on the Hanna property. It is important to establish regularly monitored fault creep markers on that earthquake fault to establish the longest possible record of any movement. Any creeping movement along this line indicates an active earthquake fault. It is essential that the creep markers are installed even before the restoration of Hanna House begins in order to initiate that history of any possible earthquake activity. Whether or not movement is found along that fault line will influence the scope of the seismic strengthening plan for Hanna House.

Fourth: The date to which Hanna House will be returned must be established. This date should be determined first before the various restoration programs and seismic treatments are even considered because that date influences both the extent of the restoration project and the total project budget. In 1994, Stanford University officials estimated that it will take \$2 million to restore Hanna House¹⁶³. With a restoration date established, this figure then can be verified or adjusted.

Research for this thesis indicates Hanna House should be returned to 1950 which is the year the Hannas completed

¹⁶³ Karen Bartholomew. "Stanford, FEMA Agree on Sharing Quake Repair Tab." Stanford University Campus Report. 26 March 1994, 1; Mary Madison. "Quake-Damaged Hanna House Gets Face-Lift." San Francisco Chronicle. 8 March 1996.

construction on the guest wing. This will restore Hanna House to the design as originally conceived by Wright in 1937. It is also the date before the subsequent remodels and additions.

During a restoration, there are always questions of whether to leave or remove additions or modifications to historic structures. Properties change over time. Sometimes those changes have acquired historic significance in their own right. Sometimes also, the modifications may or may not be sympathetic with the design of the original structure. In any case, the public grows used to them.

The question with Hanna House is not one of appearances or whether a modification is sympathetic with the entire project. The question concerns what construction or additions may, because of weight, have impaired Wright's original flexible design and its ability to survive in the earthquake environment on the San Francisco Peninsula. This is why the 1950 restoration date was chosen, after the guest wing was completed, yet before the various additions were made to the project.

These previous four recommendations may be conducted at the same time Stanford University establishes a budget for the seismic retrofit and restoration program and develops a fund raising program for the additional necessary funds. The following is my recommendation for a seismic strengthening program:

Fifth: This research recommends removing Hanna House from its site in order to undertake the most complete, careful and safety conscious restoration. This is an extreme measure,

and possibly the most costly method of restoration; however, this measure is proposed because of the uncertainty created by the Coutts irrigation tunnels. The possibility of even a section of the Coutts tunnels collapsing beneath the house would be devastating. The advantage of documenting, dismantling and removing Hanna House from the site is that the original building materials would be safe from any damage while the tunnels were being inspected and reinforced. The entrances to the Coutts tunnels could be located and opened. Their exact path in relation to the location of Hanna House would be determined and recorded. Also, it would be possible to determine and clearly assess any failure of the fill section under the living room and living room terrace. If the University decides to leave Hanna House on site during the exploration of the subterranean tunnels and the foundation restructuring, the restoration project is further complicated.

If the building structure is left on site, the space in which personnel have to maneuver heavy excavation equipment is restricted. The house itself is not only subject to further failure, as the building site is excavated and explored but also the structure is exposed to further possible damage by that equipment.

If repairing Hanna House were simply a matter of strengthening the foundation, then Hanna House could be supported while the new foundation work were completed. As previously reported, the central chimney tower failed in the 1989 earthquake which resulted in damage to the entire structure. Because the damage is not localized in the

structure but is extensive throughout the entire house, it makes poor economic sense to maintain the structure in place while conducting exploratory excavations then seismic repair work to the foundation.. When one looks at the totality and pervasiveness of the earthquake damage to Hanna House and how each structural problem affects and is inter-related with other damage to the house, removing Hanna House from its site does not seem such a radical idea. There is a precedent also.

A similar removal and restoration program was implemented for another Wright design, the Pope-Leighey House¹⁶⁴. Constructed originally in 1940 in Falls Church, Virginia, the 1,200 square foot Pope-Leighey House was moved in 1961 because Mrs. Leighey's home was condemned by the Commonwealth of Virginia Department of Highways to make way for construction of Interstate 66. The house was donated by Mrs. Leighey to the National Trust and subsequently moved to the site of the National Trust property, Woodlawn Plantation in Fairfax County, Virginia.

The entire Pope-Leighey House process of dismantling and moving the house was filmed. Taliesin sent the original plans to help with the procedure. Dismantling Hanna House would be a more complex project than was the Pope-Leighey House because Hanna House is larger at 4,825 square feet compared to the Pope-Leighey House of only 1,200 square feet.

At the Hanna House construction site, after the irrigation tunnels are made secure, and the fill area inspected, then the perimeter foundation would be rebuilt to

¹⁶⁴ Helen D. Bullock, ed. Pope-Leighey House. (Washington, D.C.: National Trust for Historic Preservation, 1969).

current building codes. The damaged retaining walls, the chimneys, the ventilation tower, the subterranean furnace room and utilities tunnel could then be rebuilt also with the benefit of current seismic engineering technology to conform to the current UBC over the newly constructed perimeter foundations. This procedure creates the most secure site for Hanna House. The house would be reinstalled over the reinforced foundation members and returned to the 1937 flexible concept originally designed by Wright.

The flexibility that Wright originally incorporated into this structure through the hexagonal floor plan, wooden construction members, wooden sandwich walls and the copper roof would be allowed to respond on their own in the event of another severe earthquake. A new copper roof should be constructed to Wright's design specifications which are illustrated in drawing #81 held at the Stanford University Archives¹⁶⁵. The master bedroom chimney constructed in the 1957 remodel ideally should not be rebuilt.

As the structure is rebuilt over a modern foundation, new plywood shear walls and bracing should be added where possible inside the sandwich walls. The Stanford University Archives indicate that in 1957, plywood was installed in some walls creating shear walls. Plywood adds lightweight strength with some flexibility. When it is not possible to install the plywood, cross bracing should be installed in the walls. The cross bracing would at least slow down the motion of the building during an earthquake¹⁶⁶. The diaphragm action of the

¹⁶⁵ Stanford University Archives Special Collection 280, drawing #81.

¹⁶⁶ Arnold, All Shook Up, 116.

roof will be improved if plywood is installed first before the copper sheathing is applied¹⁶⁷. Arnold reports that when a building is firmly attached to the ground, it tends to resonate with the ground vibration of an earthquake. The earthquake forces increase greatly at higher floors or at the roof line¹⁶⁸.

Hanna House then should be constructed to include the guest wing as it appeared in 1950. The structures added to Hanna House after 1950 when the guest wing project was completed need to be removed and not rebuilt in the restoration. Consequently, Hanna House would not be hindered by the weight of the subsequent cement terrace additions, the garden room, fountain, swimming pool, tar and gravel roof, the lower driveway, parking area and connecting stair.

Removing these connected structures from the hillside will reduce the amount of accumulated weight which moves dynamically with Hanna House during an earthquake and as a result will reduce earthquake damage. The lighter the building mass, the less resulting dynamic and damaging force is created during an earthquake¹⁶⁹. In this case, in the event of another earthquake, the reduced construction weight would allow Hanna House to float with the earth movement. This is the building action Wright had originally intended.

In summary, Hanna House, though situated in an active earthquake environment, incorporated good quality materials

¹⁶⁷ J. S. Russell, "On Shaky Ground," Architectural Record 179 June 1991.

¹⁶⁸ Arnold, All Shook Up, 113.

¹⁶⁹ Lagorio, Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards, 84.

and was constructed in a conscientious fashion to the prevailing 1937 UBC. Wright and Turner turned to the best available 1937 knowledge and technology. An article appearing in the August, 1937 "Architect & Engineer" reported on "a Frank Lloyd Wright house at Palo Alto, California designed to resist earthquakes." Further, the author of the article reported that even though the Hannas' house was constructed in the center of the San Andreas earthquake fault, still it was constructed to "withstand the most severe disturbance"¹⁷⁰. This article demonstrates that earthquake resistance was certainly a concern in 1937. Wright did not ignore that concern, but worked with the knowledge and technology available at the time.

Compared to our knowledge today of course, less was understood in 1937 of seismic strengthening construction methods and stress tolerance levels of building materials. Knowledge of earthquake construction has changed vastly over the past twenty years so that we are quite sophisticated in our technology today.

Returning to the construction site, the Coutts tunnels, the subterranean heater room, utility tunnel and the cut and fill of the foundation pad under the living room were significant issues contributing to the structural earthquake damage. How much each of these issues participated in the damage can not be documented but as an aggregate, they share responsibility for the considerable earthquake damage seen today at Hanna House. The issue of questionable foundation

¹⁷⁰ Architect & Engineer, Aug. 1937, 3.

stability was compounded with the remodels to Hanna House which enlarged the project and increased the total weight carried by the foundation supported over the Coutts irrigation tunnels.

As a result of the research conducted for this thesis, an effective restoration and strengthening plan has been devised for Hanna House which acknowledges Wright's original flexible design concept. These recommendations did not include imposing a rigid or stiff retrofit program on a building that Wright designed to float. A rigid program will work at cross purposes with the flexibility Wright originally incorporated into this house. Stiffening an old structure can make it more susceptible to seismic forces. The stiffer a structure becomes, the shorter its vibration period and the more the earthquake vibrations are magnified¹⁷¹.

Instead, a program has been recommended which would reduce the accumulated weight of subsequent additions made to Hanna House over the years, stabilize the subterranean Coutts tunnels, rebuild the foundations to current UBC and further reinforce the interior with flexible lightweight wood support members.

¹⁷¹ Crosbie. "Quakeproofing Landmarks: Protecting Historic Buildings without Destroying Original Features," 119.

BIBLIOGRAPHY

- AIA Journal Editors. "Hexagonal-Module Wright House is Placed on National Register." AIA Journal (May 1979) :68.
- Alofsin, Anthony, ed. Frank Lloyd Wright: An Index to the Taliesin Correspondence. New York: Garland Pub, 1988.
- Architectural Resources Group. Hanna House. Recommendations for Seismic Repair and Conservation of Historic Features. San Francisco: Architectural Resources Group, February, 1991.
- Arnold, C. "All Shook Up." Architecture 79 (My 1990): 113-116.
- Bartholomew, Karen. "Reception Honors the Hanna House that Wright Built." Stanford University Campus Report, 18 November 1987.
- Berke, Philip R. and Timothy Beatley. Planning for Earthquakes. Baltimore: The Johns Hopkins University Press, 1992.
- Breiholz, David C. "Nondestructive System of Reinforcing Existing Walls." Architecture 77 (Mr. 1988): 158.
- Bullock, Helen D., ed. Pope-Leighey House. Washington, D.C.: National Trust for Historic Preservation, 1969.
- Buderi, Robert. "Stanford in Squabble Over Relief Funds." Nature 342 (Nov.1989): 23.
- California Preservation Foundation. History at Risk. Loma Prieta: Seismic Safety & Historic Buildings. Oakland: California Preservation Foundation, 1990.
- Crosbie, M.J. "Quakeproofing Landmarks: Protecting Historic Buildings from Earthquakes without Destroying Original Features." Architecture 81 (N 1992): 119-23.
- Devine, Jim. Interview by Carolyn Samuels, 6 February 1994, Santa Clara County Building and Inspection Department, San Jose, California.
- Ditto, Jerry and Stern, Lanning. Design for Living. Eichler Homes. San Francisco: Chronicle Books, 1995.
- Eifler, John. "Restoring the Jacobs House." Fine Homebuilding (April/May, 1993): 78-82.

Elsesser, Eric. Repair of Five Historic Buildings Damaged by the Loma Prieta Earthquake. The Seismic Retrofit of Historic Buildings Conference. San Francisco: Western Region of the National Park Service, 1991.

Frank, Louis. Interview by Carolyn Samuels, 29 September 1993, Hillsborough, Ca., Telephone Conversation.

Frank, Louis and Frank, Elizabeth. Interview by Carolyn Samuels, 5 October 1993, Hillsborough, Ca.

Gebhard, David. Romanza: The California Architecture of Frank Lloyd Wright. San Francisco: Chronicle Books, c.1988.

Getty Foundation. Frank Lloyd Wright Archives, Bazett Project # 4002. Santa Monica, Ca.

_____. Frank Lloyd Wright Archives, Hanna Project #3701. Santa Monica, Ca.

Gill, B. "Frank Lloyd Wright's Auldbrass: A Film Producer Restores the Architect's Forgotten Plantation Complex in South Carolina." Architectural Digest, 50(D 1993): 126-37.

Gousha Travel Publications. Map. San Francisco Peninsula. San Jose: H.M. Gousha, 1989.

Hanna, John. Interview by Carolyn Samuels, 29 March 1994, Palo Alto, Ca.

Hanna, Paul R. National Register of Historic Places Registration Form, 18 November 1977. Washington, D.C.: U.S. Department of the Interior, National Park Service, 1977.

Hanna, Paul R. and Jean S. Frank Lloyd Wright's Hanna House. The Clients' Report. Carbondale: Southern Illinois University Press, 1981.

Hart, Gary C. Defining and Quantifying An Adequate Level of Safety for Historic Buildings. The Seismic Retrofit of Historic Buildings Conference. San Francisco: Western Region of the National Park Service, 1991.

Hildebrand, Grant. The Wright Space. Pattern and Meaning in Frank Lloyd Wright's Houses. Seattle: University of Washington Press, 1991.

- Hitchcock, Henry Russell. In the Nature of Materials 1887-1941; Frank Lloyd Wright. NY: Duell, Sloane & Pearce, 1942.
- Hendee, Hunter. "Dream Home Foundations Rise on Frenchman's Mystery Hill." Stanford Daily 19 (February 1937).
- International Conference of Building Officials. Uniform Code for Building Conservation. Whittier, Ca.: International Conference of Building Officials, 1987.
- Iacopi, Robert. Earthquake Country. A Sunset Book. Menlo Park: Lane Publishing Co., 1980.
- J. V. Lowney & Associates. Geotechnical Investigation for Hanna House Seismic Upgrade, Stanford, California. Mt. View: J.V. Lowney & Associates, Sept. 1990.
- Jacobs, Herbert Austin. Building with Frank Lloyd Wright. SF: Chronicle Books, c. 1978.
- Joncas, Richard. "Pedagogy and 'Reflex': Frank Lloyd Wright's Hanna House Revisited." Journal of the Society of Art Historians 52 (September 1993): 307-322.
- Kaufmann, Edgar and Ben Raeburn, eds. Frank Lloyd Wright: Writings and Buildings. Cleveland: World Publishing Co., c.1960.
- Kaufmann, Edgar, ed. An American Architecture Frank Lloyd Wright. New York: Horizon Press, 1955.
- Kazok, Don. "Quake Damage Bill Still Unpaid." Palo Alto Weekly 20 October 1993, 9.
- King, Rick. Interview by Carolyn Samuels 21 February 1997, San Mateo, Ca., Telephone Conversation.
- Lagorio, Henry J. Earthquakes. An Architect's Guide to Nonstructural Seismic Hazards. New York: John Wiley & Sons, Inc., 1990.
- Look, David W., ed. The Seismic Retrofit Conference Workbook. San Francisco: Western Region of the National Park Service, 1991.
- National Park Service. Landmark Status Report prepared by Carolyn Pitts, 9 February 1989. San Francisco: Western Region of the National Park Service, Historic Division.
- Norman C. "Bad Vibes at Stanford." Science, 4929 (1989): 438.

Preservation News. "Natures Wrecking Ball," Preservation News (December 1989).

Norris, Robert M. and Robert W. Webb. Geology of California. New York: John Wiley & Sons, Inc., 1990.

Pacific Coast Building Officials' Conference. Specification Documents for Building Materials & Construction. Los Angeles: Pacific Coast Building Officials, 1938.

. Uniform Building Code Los Angeles: Pacific Coast Building Officials' Conference, 1934.

. Uniform Building Code. Los Angeles: Pacific Coast Building Officials Conference, April, 1937.

. Uniform Building Code. Los Angeles: Pacific Coast Building Officials Conference, 1939.

Perbix, T. and Burke, P. "Technics Topics: Teaming up for Seismic Retrofit." Progressive Architecture 70 (Je 1989): 117-118.

Pfeiffer, Bruce Brooks. Letters to Clients. Fresno, Ca.: Calif. State Univ. Press, c.1986.

Plafker, George and John P. Galloway, eds. Lessons Learned from the Loma Prieta, California, Earthquake of October 17, 1989. U.S. Geological Survey Circular 1045. Washington, D.C.: U.S. Government Printing Office, 1989

Riley, Terence and Reed, Peter, eds. Frank Lloyd Wright Architect. New York: The Museum of Modern Art, 1994.

Russell, J.S. "On Shaky Ground." Architectural Record 179 (Je 1991): 104-15.

San Mateo County. "Assessors Records." Book 32, Vol #31, p. 31, Lot #9, Redwood City: Office of County Assessor.

Santa Clara County. "Assessors Records." Book 142, p.11, Lot #134, San Jose: Office of County Assessor.

Scully, Vincent. Frank Lloyd Wright. New York: George Braziller, 1960.

Secretary of the Interior. Proceedings of the National Historic Landmarks Program, part 65. Washington, D.C.: U.S. Government Printing Office, 1990.

- Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings. Washington, D.C.: U.S. Government Printing Office, 1990.
- The National Register of Historic Places. Washington, D.C.: U.S. Government Printing Office, 1993.
- Secrest, Meryle. Frank Lloyd Wright. New York: HarperCollins Publishers, 1993.
- Sergeant, John. Frank Lloyd Wright's Usonian Houses. New York: Watson-Guptill Publications, c.1976, 1984.
- Solomon, N. M. "Preservation Resource: The National Parks Service Offers Advice in Restoring Historic Structures." Architecture 80(N 1991): 125-7.
- Smith, K. "Frank Lloyd Wright: A Primer on Architectural Principle: The Wright Space Pattern and Meaning in Frank Lloyd Wright's Houses." J. Soc. Archit. Hist. 51(S1992): 320-2.
- Stanford University. Historic Preservation Manual for Project Managers. Stanford University: Planning Office, June, 1993.
- Stanford University Special Collection #280, Hanna-Honeycomb House, Unpublished Correspondence and Photographs. 1935-1978, Stanford, Ca.
- State of California. Title 24 Building Standards, Part 8. Sacramento: State of California, 1875, revised June, 1990.
- Storrer, William A. The Frank Lloyd Wright Companion. Chicago: U. of Chicago Press, 1993.
- Sweeney, Robert Lawrence. Frank Lloyd Wright An Annotated Bibliography. Los Angeles: Hennessey & Ingalls, 1978.
- Twombly, Robert C. Frank Lloyd Wright His Life and His Architecture. New York: John Wiley and Sons, 1979.
- U.S. Geological Survey. Geological Maps of Upper Cenozoic Deposits in Central California. Washington, D.C.: U.S. Governmental Printing Office, 1993.

- _____. Lessons Learned from the Loma Prieta, California, Earthquake of October 17, 1989. U.S. Geological Survey Circular 1045. Washington: U.S. Governmental Printing Office, 1989.
- _____. Probabilities of Large Earthquakes in the San Francisco Bay Region, California. U.S. Geological Survey Circular 1053. Washington: U.S. Government Printing Office, 1990.
- Williams, Curt. "Quantities of Quake Quandaries." Stanford Observer (January/February 1990), 13.
- Woodbridge, S. "Quake Damage to Historic Buildings." Progressive Architecture 71(January 1990): 29-30.
- Workman, Bill. "Stanford Hopeful on Quake Repairs." San Francisco Chronicle (August 12, 1993): A17.
- Wright, Frank Lloyd. "A Great Frank Lloyd Wright House." House Beautiful 105, n.1(January 1993): 54-113.
- _____. An Autobiography. New York: Horizon Press, c.1977.
- _____. "Frank Lloyd Wright Designs a Honeycomb House." Architectural Record (July, 1938): 59-74.
- _____. "Frank Lloyd Wright on Architecture. 1908: In the Cause of Architecture, I." Arch. Record March 1908.
- _____. "Models New Type of City for Self-Contained Group." The New York Times 27 March 1935, 16.
- _____. Modern Architecture. Being the Kahn Lectures for 1930. Princeton: Princeton University Press, 1930.
- _____. The Architectural Forum 68 (January 1938).
- Wyllie, Loring A., Jr. The Balance Between Historic Preservation and Seismic Safety - Can We Achieve It? The Seismic Retrofit of Historic Buildings Conference. San Francisco: Western Region of the National Park Service, 1991.
- Yanev, Peter. Peace of Mind in Earthquake Country. San Francisco: Chronicle Books, 1974.

INDEX

- Adler, Dankmar, 74
 American Institute of Architects, 5
Architect and Engineer, 97
 Architectural Resources Group, 53, 66
 Arnold, C., 96
 Auldbrass (Yemassee, S.C.) *see also Stevens*
 Bartholomew, Karen, 6
 Baumann, Frederick, 75
 Bazett, Sydney and Louise: 1, construction, 43,44;
 correspondence with FLW 39,42;
 Bazett House (Hillsborough, CA):1,5; clerestory windows, 46;
 copper roof, 45,47; entry, 46; FLW fellow B. Drake, 40;
 FLW fellow William Wesley Peters, 40; hexagonal grid, 45;
 Oscar Cavanaugh, 40; plan, 40,45; site, 43,45
 "Box" construction, 10
 Broadacre City,12
 Buderer, Robert, 65
 Bullock, Helen D., 94
 Calavaras earthquake fault, 55
 California Preservation Foundation 66,67,68,70
 California Redwood, 32,45
 California State Historic Preservation Office, 63
 Cavanaugh, Oscar, 40
 Chicago, Illinois fire, 74
 Clerestory windows, 16
 Cooper House (Santa Cruz, California), 67
 Copper roof, 25, 37, 45, 47, 83, 84
 Coutts, Peter, 21, *see also Cypress Hill Subdivision*
 Crosbie, M.J., 90, 98
 Devine, Jim, 81
 Ditto, Jerry, 43
 Drake, Blaine, 40
 Earthquakes: creation of, 50,51; fault on Hanna lot, 23;
 measurement of,56,57,58; San Francisco Peninsula
 climate, 48, 54
 Eaves, 16
 Eichler, Joseph, 43
 Eifler, John, 74
 Elsesser, Eric, 7
 Epicenter (Watsonville, California), 56
 Fallingwater (Bear Run, Pennsylvania), 11,12
 Federal Emergency Management Agency (FEMA), 5, 66,67,70,71
 Federal Housing Authority (FHA), 25
 Florida Southern College (Lakeland, Florida), 12
 Frank, Elizabeth and Louis, 42,46
Frank Lloyd Wright Hanna House. The Clients' Report,
 3,5,9,10,16,17,19,23,26,29,30,32,40,64,79,80,83
 French doors, 33,34,46
 geometric grid, 14, 15, 40,45

Great Alaska Earthquake, 57
 Hanna House: 1; annual ground rent, 61; budget, 25; challenge for historic preservation, 7; construction 17, 22, 26, 28-30; earthquake damage 5, 52, 53, 82, 83, 84, 86; earthquake fault 23; entry, 34; forced air heat 24, 29, 30; Harold Turner, 22, 25, 26; hexagonal grid 24; kitchen (laboratory), 16, 36; lease with Stanford University, 19; location on San Francisco Peninsula, 1; opposition to construction, 32; plan, 24; remodels, 37, 82; repair costs, 91; soils 22; use of natural materials, 33; visiting professor program, 64;
 Hanna John, 21
 Hanna, Paul and Jean: 1, 3; design phase, 17, 18; initial introduction to FLW, 9; met Bazetts, 39; philosophy, 9, 10, 36; Stanford University appointment 10; will, 60
 Hart, Gary C., 6
 Hayward earthquake fault, 55
 Hexagon construction, 3, 17, 19, 20, 24, 35
 Hildebrand, Grant, 73, 87
House Beautiful, 4, 17, 29, 30, 32, 36
 Iacopi, Robert, 55
 Imperial Hotel, Tokyo, 23
 Jacobs House (Madison, Wisconsin), 12
 Jenny, William LeBaron, 74
 Johnson Wax Building, Administration Building (Racine, Wisconsin) 12
 Jones, Mrs. Richard Lloyd, 74
 Kahn lectures, 9, 10
 King, Rich, 85
 Kozok, Don, 65
 Lagorio, Henry J., 54, 50
 Lakeland (Florida Southern College), 12
 Loma Prieta earthquake, 1, 48, 57, 58, 64
 Lowney, J.V. and Assoc., 22, 86
 Madison, Mary, 6
 Marine Building (San Francisco, California), 68
 Mueller, Paul F.P., 75
 Mexico City earthquake, 57
 Modified Mercalli Intensity Scale (MMI), 57, 58
 Northridge, California earthquake, 57
 Open plan, 15
 Organic architecture, 11
 Peters, William Wesley, 40
 Plafker, George, 48, 58
 Plummer, Patti, 67
 Pope-Leighey House (Falls Church, Virginia), 94
 Prairie Houses: design, 11-14
 Radiant heat pipes, 14
 Rehuhn House (Great Neck, Long Island), 82
 Richter Magnitude Scale, 56-57
 Russell, J.S., 96
 San Andreas Fault, 48, 55, 56, 58

San Francisco Earthquake and Fire, 48, 57
 Sandwich walls, 15, 30, 32
 Sargent fault, 55
 Scottsdale, Arizona (Taliesin West), 12
 Secrest, Meryle, 12
 Secretary of the Interior Standards for Rehabilitation of
 Historic Structures, 68, 70, 71
 Sergeant, John, 10,12,15,25,82
Specification Documents for Building Materials and
 Construction, 28, 80, 84
 Spring Green, Wisconsin (Taliesin East), 10,20
 Stanford, Senator and Mrs. Leland, 21
 Stanford University: Board of Governors, 61; Board of
 Trustees, 60, 61; campus earthquake damage 5, 65, 66;
 gift of Hanna House, 60; lease negotiation with Hannas,
 19
 Stevens, Leigh, 12 *see Auldbrass*
 Sullivan, Louis, 74
 Taliesin West (Scottsdale, Arizona),12, 94
 Tokyo earthquake, 57, 76
 Tokyo Imperial Hotel, 75, 77
 Turner, Harold, 22, 25, 80, 81, 82
 Turner, Paul 34, 37
 Twombly, Robert C., 13,33
Uniform Building Code, 59, 61, 80
 Unitarian Church (Madison, Wisconsin), 77
Universal Building Code, 1934, 59
 U.S. Department of the Interior: National Landmark, 5, 62, 63;
 National Parks Division, 62,63; National Register, 5, 38,
 62
 U.S. Geological Survey, 22, 43, 48, 86
 Usonian houses: characteristics, 13, 14, 15, 16, 24
 Watsonville, California, 48, *see also epicenter*
 Whiffen, Marcus, 75
 Willis, Bailey, 23
 Workman, Bill, 65
 Wright, Frank Lloyd: Broadacre philosophy, 13; earthquake
 technology, 77; hexagon philosophy, 17; home as a
 nurturing place, 36; instructions to builder, 45; Kahn
 lectures, 9; on Tokyo Hotel, 76; Prairie design, 13;
 Usonian philosophy, 13,24; visit to Palo Alto, 19
 Yamassee, S.C., 12, *see also Auldbrass*
 Wyllie, Loring, 6
 Yanev, Peter, 56, 76, 88

Anne & Jerome Fisher
FINE ARTS LIBRARY
University of Pennsylvania

Please return this book as soon as you have finished with it. It must be returned by the latest date stamped below.

~~RECEIVED
MAR 28 2006
FINE ARTS LIBRARY~~

~~RECEIVED
AUG 1 2008
FINE ARTS LIBRARY~~

FINE ARTS LIBRARY
UNIVERSITY OF PENNSYLVANIA
AUG 1 1997

3 1198 04975 3747



N/1198/04975/3747X

3 1198 04975 3747



N/1198/04975/3747X

