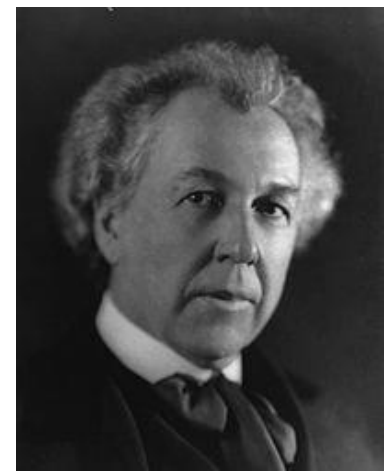


# THE LIFE AND WORK OF FRANK LLOYD WRIGHT



PART 6:  
Ages 63 (1930) to 78 (1945)  
In Wisconsin and Arizona



JT Wunderlich PhD

website: <http://users.etown.edu/w/wunderjt/> [Architecture Portfolio](#)

8/28/2018



## **PART 1: Frank Lloyd Wright Age 0-19 (1867-1886)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#)

*Context:* Post Civil War recession. Industrial Revolution. Farm life. Preacher/Musician-Father, Teacher-Mother. Mother's large influential Unitarian family of Welsh farmers. Nature. Parent's divorce.

*Architecture:* Froebel schooling (e.g., blocks). Barns/farm-houses ([PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#)). Organic Architecture roots.

## **PART 2: Frank Lloyd Wright Age 20-33 (1887-1900)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#).

*Context:* Rebuilding Chicago after the Great Fire. Wife Catherine and first five children.

*Architecture:* Architects Joseph Silsbee and Louis Sullivan. Oak Park. Home & Studio. "Organic Architecture" begins.

## **PART 3: Frank Lloyd Wright Age 34-41 (1901-1908)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#).

*Context:* First Japan trip ([PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#)). Arts & Crafts movements. Six children.

*Architecture:* Prairie Style. Oak Park & River Forest, Unity Temple, Robie House, Larkin Building.

## **PART 4: Frank Lloyd Wright Age 42-47 (1909-1914)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#)

*Context:* Runs off with Mistress. Lives in Italy ([Page](#) [MP4](#) [YouTube](#)). Builds Taliesin on family farmland. Mistress murdered.

*Architecture:* Wasmuth Portfolio published(Germany). Taliesin. Many operable windows for health & passive cooling. Sculptures.

## **PART 5: Frank Lloyd Wright Age 48-62 (1915-1929)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#)

*Context:* WWI, Roaring 20's. Short 2<sup>nd</sup> marriage. Lives 3 yrs in Japan, then California and Wisconsin. 3<sup>rd</sup> marriage (Olga).


*Architecture:* Tokyo Imperial Hotel. Textile Houses in California (with Mayan influences).

## **PART 6: Frank Lloyd Wright Age 63-78 (1930-1945)** [PDF](#) [PPTX-w/audio](#) [MP4](#) [YouTube](#) **THIS LECTURE**

*Context:* 1930's Great Depression. WWII. Taliesin Fellowship/school. Utopian-Ideals(communal-living) Winters in AZ.

*Architecture:* Broadacre City, Fallingwater, Johnson Wax Building, Taliesin-West, Hanna-Honecomb House, Usonian Homes.

## **PART 7: Frank Lloyd Wright Age 79-91 (1946-1958++)** [PDF](#) [MP4](#) [PPTX-w/audio](#) [YouTube](#)

*Context:* Post-WWII boom. Cold War. Communal living at Taliesin. FLW dies in 1959. Fellowship/school continued at Taliesin & Taliesin-West by Olga for 27 years -- and still exists today with some very recent changes. 

*Architecture:* Price Tower, Churches/Synagogue/Auditoriums. The Guggenheim. AZ homes, Modern materials.

Allan, Edward and Iana, Joseph. *Fundamentals of Building Construction: Materials and Methods*. Wiley; 7th edition (October 15, 2019).

American Institute of Architects. *AIA Guide to Chicago*. 2014.

Burns, Ken, and Novick, Lynn. *Frank Lloyd Wright: A Film by Ken Burns and Lynn Novick DVD*. PBS Home Video, August 28, 2001.

Bacon, Edmond. *Design of Cities*. Thames & Hudson Ltd, 1978.

Ching, Francis D.K. *Architecture: Form, Space, and Order*. 4 ed., Wiley, 2014.

Curtis, Stanley James. Friedrich Froebel; German educator. *Encyclopedia Britannica*, 2018. <https://www.britannica.com/biography/Friedrich-Froebel>

Fazio, M., Moffett, M., and Wodehouse, L. *Buildings Across Time: An introduction to world architecture*. 4<sup>th</sup> edition, McGraw-Hill, 2012.

Fici, Filipo. Frank Lloyd Wright in Florence and Fiosole. *Frank Lloyd Wright Quarterly*, Vol. 22 no.4, 2011.

*Find a grave; William Carey Wright*, 2018. <https://www.findagrave.com/memorial/55462361/william-carey-wright>

Frank Lloyd Wright Trust. *1905: Japan through the Lens of Frank Lloyd Wright*, 2017. <https://www.wrightsjapan1905.org/>

Frank Lloyd Wright Trust. *Unity Temple*, 2018. <https://flwright.org/researchexplore/unitytemple>

*Froebel; Brief History of the Kindergarten*. Froebel Gifts, 2013. <http://www.froebelgifts.com/history.htm>

*Ho-o-Den, An Illustrated Description of the Buildings Erected by the Japanese Government at the World's Columbian Exposition*. K. Ogawa publisher, Tokyo, 2018.

Hoffman, Anna. *Gustav Stickley: the American Arts & Crafts Movement*. Sept 16, 2010.

Huxtable, Ada Louise. *Frank Lloyd Wright*. New York Times, Oct. 31, 2004. <https://www.nytimes.com/2004/10/31/books/chapters/frank-lloyd-wright.html>

Kaufman, Clare. *The History of Higher Education in the United States*. WoroldWideLearn. 2018. <https://www.worldwidelearn.com/education-advisor/indepth/history-higher-education.php>

Kitagawa, Joseph Mitsuo. *On Understanding Japanese Religion*. Princeton University Press, 1987.

Lechner, Norbert. *Heating, cooling, lighting*. Wiley, 4<sup>th</sup> edition, October 13, 2014.

*LEED (Leadership in Energy and Environmental Design)*, The United States Green Building Council, 2018. <https://new.usgbc.org/leed>

Life of Olgivanna Lloyd Wright Reviewed by Architects and Artisans. *ORO Editions*. Sep 12, 2017. <https://www.oroeditions.com/2017/09/12/the-life-of-olgivanna-lloyd-wright-reviewed-by-architects-and-artisans/>

Lynch, Kevin. *The Image of The City*. MIT Press, 1960.

*PENN Rare Book and Manuscript: Frank Lloyd Wright's Paternal Family*. Penn Library. University of Pennsylvania, Feb. 20, 2014. <http://www.library.upenn.edu/rbm/featured/mscoll822.html>

Pearson, David. *The Breaking Wave: New Organic Architecture*. Stroud: Gaia, 2001.

Siry, Joseph M. *The Architecture of Earthquake Resistance*. *Journal of the Society of Architectural Historians*, Vol 67 (1): pp78–105, 2008.

Storrer, William Allin. *The Architecture of Frank Lloyd Wright, a Complete Catalog, 4<sup>th</sup> edition*. Chicago, University of Chicago Press, 2017.

Stevens, John L. *Incidence of travel in Yucatán*. Sastrugi Press, 2019.

Stevens, John L. *Incidence of travel in Central America, Chiapas, and Yucatán*. Dover Publications, 1969.

*Unity Chapel*, Unity Chapel Inc. 2018. <http://www.unitychapel.org/familyhistory/>

Vargas, A.P. and Schierle, G.G., The textile block system: seismic analysis and upgrading, *WIT Transactions on State of the Art in Science and Engineering*, Vol 62 WIT Press 2013.

Kim, Daeshick, and Back, Alan. *The Way to go: philosophy in martial arts practice*. Nanam Publishing House, 2000.

Wright, Frank Lloyd. *The Art and Craft of the Machine*, Vol. 8, No. 2 pp. 77-81, 83-85, 87-90, May, 1901. [tps://www.jstor.org/stable/pdf/25505640.pdf](https://www.jstor.org/stable/pdf/25505640.pdf)

Wright, Frank Lloyd. In the Cause of Architecture. *Architectural Record*, vol. XXIII, March 1908.

Wright, Frank Lloyd. *(1911 Wasmuth Portfolio) in Drawings and Plans of Frank Lloyd Wright: The Early Period (1893-1909)*. Dover Architecture 1983.

Wright, Frank Lloyd. *The Japanese Print, an Interpretation*. The Ralph Fletcher Seymour co., Chicago, 1912.

Wright, Frank Lloyd. In the Cause of Architecture; *Second Paper*. *Architectural Record*, May 1914.

Wright, Frank Lloyd. *The Natural House*. New York, Penguin Books, 1954.

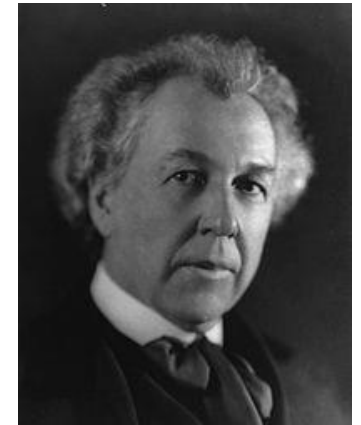
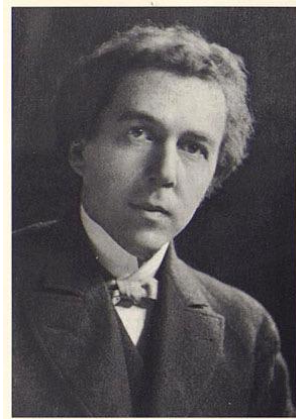
Wright, Frank Lloyd. *Testament*. New York, Bramhall House, 1957.

Zerbey, Nancy. New England Architecture | Guide to House Styles in New England. *New England Today Living*, May 9, 2018. <https://newengland.com/today/living/homes/new-england-architecture/>



○ First, a quick review of:

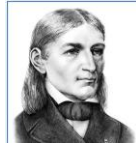
- PART 1 Ages 0 to 19
- PART 2 Ages 20 to 33
- PART 3 Ages 34 to 41
- PART 4 Ages 42 to 47
- PART 5 Ages 48 to 62



# FRANK LLOYD WRIGHT'S EARLIEST INFLUENCES

[FROEBEL 2013, PENN RARE BOOK 2014, HUXTABLE 2004, STORRER 2017, WRIGHT 1957, BURNS 2001]

- **FROEBEL** influenced by Taoism and Buddhism
  - Japanese Shinto rooted in Chinese Taoism
    - Shinto Gods in everything, especially **nature**
    - FLW would later love Japanese Art, Design, and Culture
- Mother's family were all **UNITARIANS**
  - Inspiration from all religions, love **nature**, God in everything



Friedrich Froebel  
1782-1852 Germany



Maria **Montessori**  
1913 in Italy



**FATHER**

Preacher, Lawyer, School Superintendent, Teacher, Musician  
B.A., M.A. Colgate University  
*"Artist, photographer, and designer of furniture, graphics, books, and buildings, his patronage of Chinese and Japanese art, his obsession with every aspect of his surroundings, his dedicated collecting of beautiful things, owed much to his father"* [Huxtable 2004]



**MOTHER**

Homeschool Teacher  
using Froebel System

Others in history homeschooled:  
Leonardo da Vinci, Monet, Mozart, Bach,  
Newton, Ben Franklin, Edison, Jefferson,  
Washington, Einstein, Teddy and  
Franklin-Delano Roosevelt, Churchill,  
John Muir, and the Wright brothers



Most of childhood in rural **WISCONSIN**

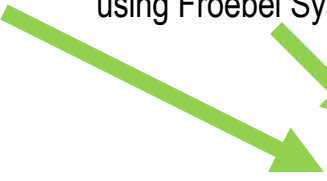
- Like Pennsylvania farmland



Frank Lloyd Wright 1867-1959



Future  
Designers

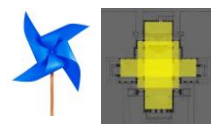


# ORGANIC ARCHITECTURE DESIGN PRINCIPLES

Frank  
Lloyd  
Wright

CONFORM TO SITE, sun, topography, environment

PINWHEELED PLANES -- CRUCIFORM



- PRAIRIE-SCHOOL , BROAD CENTRAL CHIMNEY, LONG CANTILEVERS (overhangs & balconies)

FOLDED PLANE like origami ...continuity...walls, ceilings, and floors become one

SIMPLE GEOMETRIES

HUMAN SCALE

OPEN FLOOR PLAN

- o DESTROY BOX, no Victorian box-type rooms, – FLOW between rooms, and inside/outside
- o Walls become screens, BANDS of WINDOWS, FRAME VIEWS – like ENGAWA
- o Use MATERIALS IN NATURAL STATE -- same on exterior and interior

FROEBEL  
BLOCKS



UNITARIAN  
MOTHER  
Teacher



Japanese Buddhism & Shintoism,  
with some roots in Chinese Philosophy

FORM and FUNCTION are one! Harmony, *not one following other, secondarily*

A UNIFIED WHOLE - inside and out - ORCHESTRATE SUN

BRING NATURE OUT OF MATERIALS, but Innovate (Textile Blocks, Modular "Ken" Design, etc.)

STRUCTURAL ART like in Nature (e.g., the veins in Leaves) - Interior space made exterior as architecture

SOFT WARM OPTIMISTIC COLOR TONES of earth, and autumn leaves

ASSIMILATE FIXTURES into structure, BUILT-IN FURNITURE ..... many plants & planters

ARCHITECTURE = MUSIC



© JT Wunderlich PhD

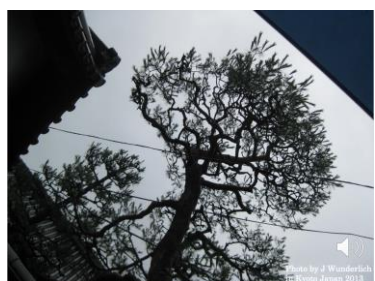
Arts & Crafts, Italy, JAPAN



MUSICIAN  
Preacher  
FATHER



ARCHITECT  
MENTOR  
Louis Sullivan



"Key" Japanese words  
by Mahua Bhattacharya,  
Professor of Japanese,  
for J Wunderlich's students

OMOIYARI – Considerate  
ON - Duty  
AMAE - Empathy  
WA - Group Harmony  
UCHI - Inner (or insider)  
KENSON - Modesty  
GIRI - Moral Obligation  
SOTO - Outside (or outsider)  
GAMAN - Persistence  
ENRYO - Restraint  
HAJI - Shame



NOTE: COMPRESSION & RELEASE is not Organic Design, but commonly used by FLW to cramp/hide entries so as to magnify destination Architecture

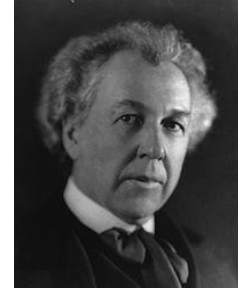
# 61 YEARS OLD (1928)

[Life of Olgivanna Lloyd Wright Reviewed, 2017 ]

## RECOVERS FROM **TRAUMA**; MARRIES **Olga** IN 1928 IN RANCHO SANTA FE, CA



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT

- **Olga** Ivanovna Milijanov Lazovich, born in Montenegro
- **Aristocratic** with Military General mother, and Supreme Court Justice father
- **Father went blind, so she read for him**; newspapers, legal documents, poetry and philosophy books
- Elementary school in Russia
- **At age 20, married a Russian architect.**
- **In Russia, followed mystic/philosopher Georgi Gurdjieff**
- Fled Russia with Gurdjieff during 1917 Russian Revolution, who established the **Institute for the Harmonious Development of Man** in France in 1922, to develop the “complete person”— **MIND, HEART, and BODY**
  - His curriculum was holistic and strict, incorporating dance, exercise, personal hardship, physical labor, and psychological discipline
  - She emerged as a **DANCER, MUSICIAN, EDUCATOR, and PHILOSOPHER**



# Recall: up to Age 62 (1929)



Musician Teacher  
Father



Mother



and her influential Rural  
Wisconsin Unitarian family



Wife Catherine & 6 children



His mistress murdered,  
and Taliesin burned to  
the ground in 1914



Marries Olga  
in 1928

A&E Professor  
Allan Conover



Architect  
Joseph Silsbee



Architect  
Louis Sullivan



- Late 1800's Industrial Revolution, Rebuilding Chicago after 1871 fire, 1893 Chicago Worlds Fair with Japanese Building, Visits pre-WWI Japan in 1906 and 1913, and lives in Italy 1909,10.
- From 1917 to 1922 (ages 50 to 55), lived three full years in Japan
- .... then lives in California. And short bad *"Rebound-Marriage"* ([Maude Miriam Noel](#))
- 1928 [Marries Olga](#), who will be his soulmate for the rest of his life (30 more years)

THEN:

- 1929 stock market crash starts the Great Depression





So now, at age 61:

- The Great Depression (1930's)
- Living with no money at beginning of Great Depression
- Taliesin Fellowship (Olga's idea)
  - Communal Living
  - Utopian Egalitarian Ideals
  - MIND, BODY, SPIRIT
- World War Two (1939-45)
  - U.S. fought Nazi Germany, Imperial Japan, and fascist Italy (Mussolini)
- Modernism (although he's different from the other Modern Architects)

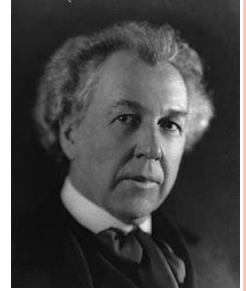


# 63-78 YEARS OLD (1930-1945)

[BURNS 2001]



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT

- **The Great Depression (1930's)** resulted in less wealthy clients
- So in 1932, created **Taliesin Fellowship** (school) -- Olga's idea, somewhat of a socialist utopian architectural commune
- New socialist utopian ideals of equal distribution of land:
  - 1-acre suburban plot per person (1935 **Broadacre City**)
  - And later, after **WWII (1939-1945)**, small “affordable” homes (**Usonian Homes**)
- In 1937, the Fellowship expanded to **Taliesin West** in Arizona
- However noteworthy wealthy clients resulted in:
  - **Fallingwater** in 1935
  - The **Johnson Wax building** in 1936

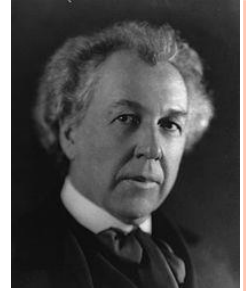


# 65 YEARS OLD (1932)

[BURNS 2001]



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT



- In 1932, created **Taliesin Fellowship** (school) -- Olga's idea, somewhat of a socialist utopian-ideal architectural commune

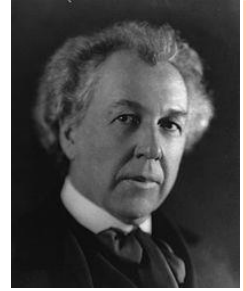


# 68 YEARS OLD (1935)

[BURNS 2001]



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT



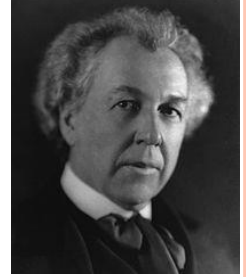
- 1-acre suburban plot per person (1935 Broadacre City)



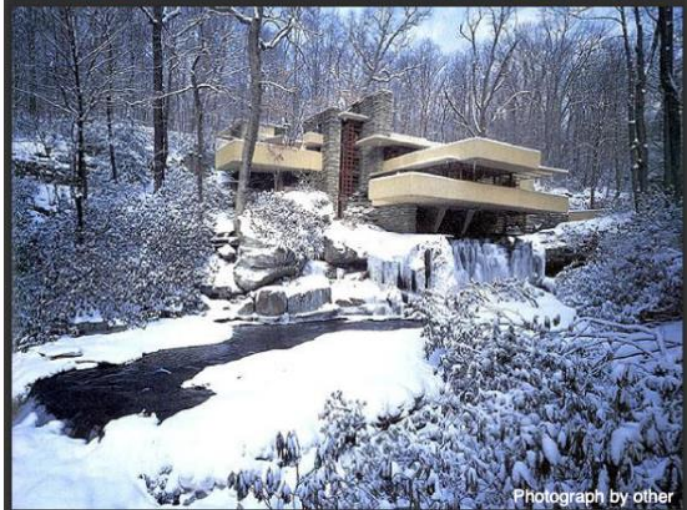
# 68 YEARS OLD (1935)

[STORRER 2017]

## S.230 Fallingwater, Mill Run, Pennsylvania, 1935



FRANK LLOYD  
WRIGHT



Images from  
Wunderlich's [2006](#)  
[Architecture Theory](#)  
[Lecture](#)

See more recent lectures  
in Wunderlich  
[Architecture Theory](#)  
Lecture Series



*2015 Etown Architecture field trip*

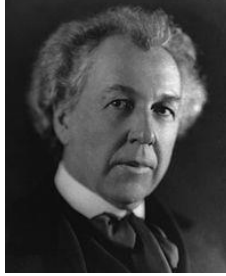


*Professor Kozimor  
works at Fallingwater*



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*

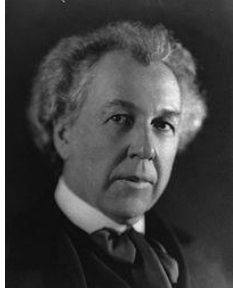


FRANK LLOYD  
WRIGHT



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



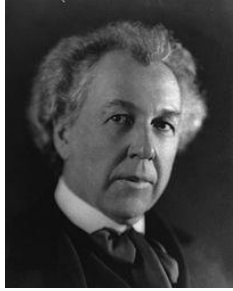
FRANK LLOYD  
WRIGHT





# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



FRANK LLOYD  
WRIGHT



**Joseph T Wunderlich PhD**

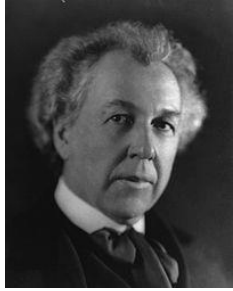
Co-Coordinator of Architecture Minors and Individualized Majors

Associate Professor, and Computer Engineering Program Coordinator



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



FRANK LLOYD  
WRIGHT

**Patricia L. Ricci PhD**

Co-Coordinator of Architecture Minors and Individualized Majors

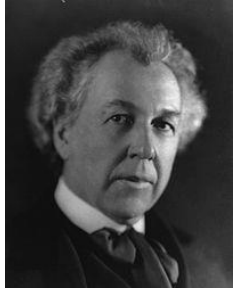
Director of Fine Arts

Associate Professor of Art History



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



FRANK LLOYD  
WRIGHT



**Milton D. Friedly MFA**  
Professor of Art

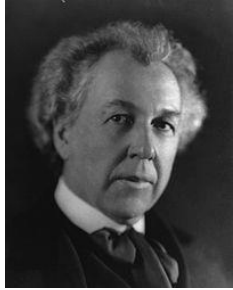


# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*

**Kristi L. Arnold**

Assistant Professor of Art

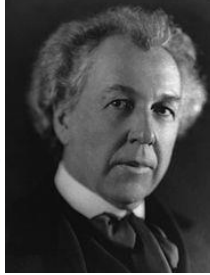


FRANK LLOYD  
WRIGHT



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



FRANK LLOYD  
WRIGHT



# 68 YEARS OLD (1935)

*2015 Etown Architecture field trip to Fallingwater*



FRANK LLOYD  
WRIGHT



The following slides are from  
Wunderlich Lectures on Masonry, Stone, and Concrete  
(specifically “PART 5 CONCRETE”),  
in his Materials and Methods course

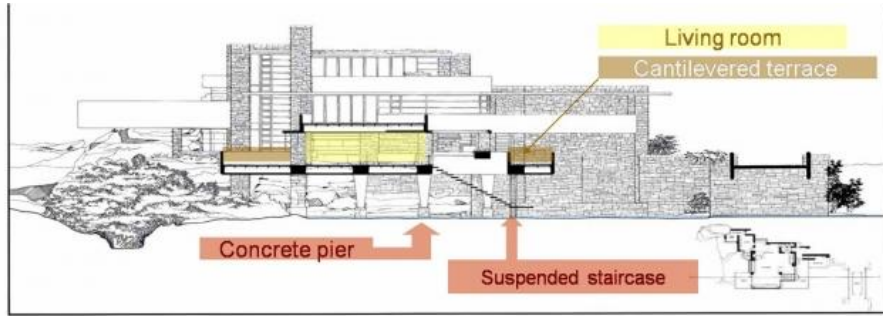
# MASONRY, STONE, & CONCRETE

## PART 5 CONCRETE

Joseph T Wunderlich PhD

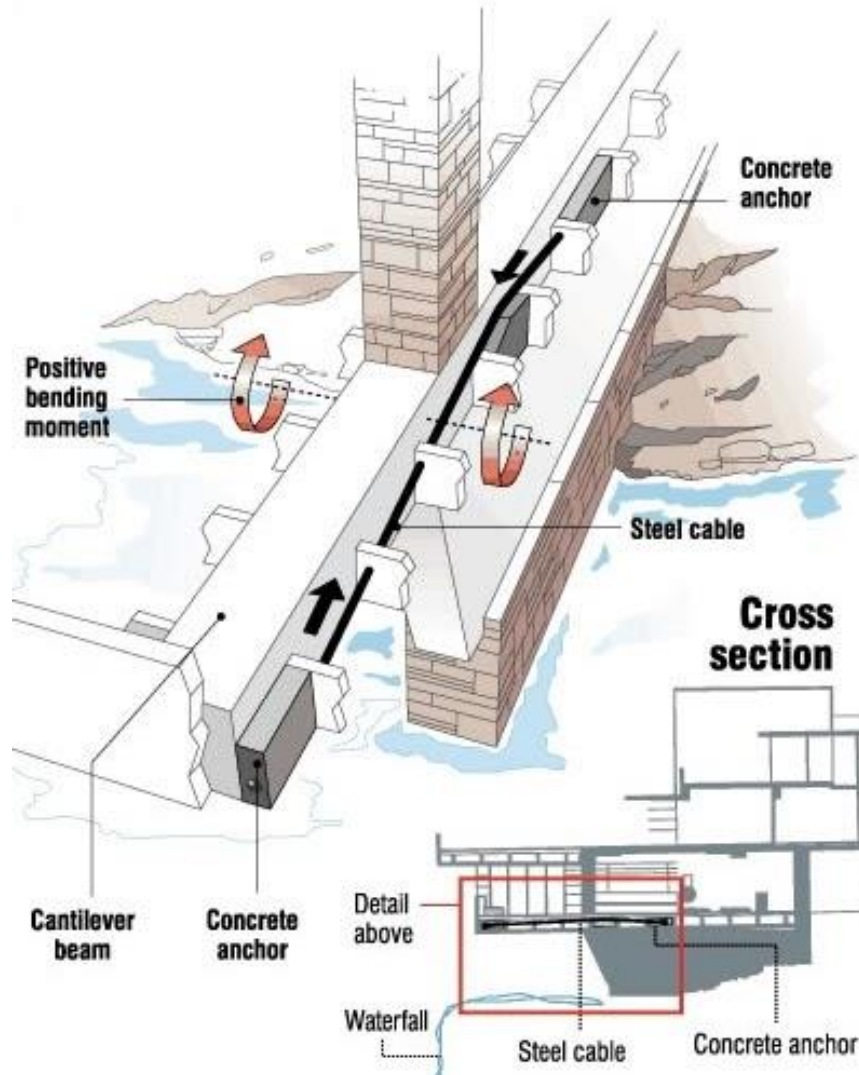


- ❑ **POST-TENSIONED CONCRETE**
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater





- ❑ POST-TENSIONED CONCRETE
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater



- ❑ POST-TENSIONED CONCRETE
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater



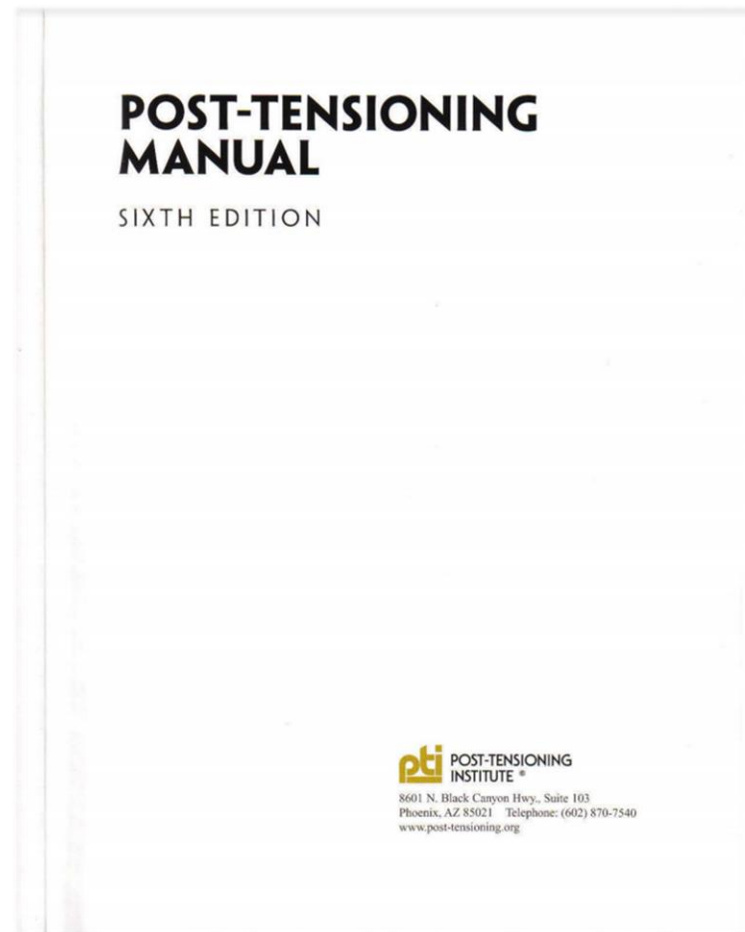
- ❑ POST-TENSIONED CONCRETE
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater



- ❑ POST-TENSIONED CONCRETE
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater



- ❑ POST-TENSIONED CONCRETE
- ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater
- ❑ Read page 57 and 58 of "**POST-TENSIONING MANUAL**" by Post Tensioning Institute



## ❑ POST-TENSIONED CONCRETE

### ❑ Repair of **DROOPING CANTILEVERS** in Frank Lloyd Wright's Fallingwater

#### 2.13.4 Fallingwater, PA

Painted into the picturesque southwestern Pennsylvania landscape is a national treasure that is also one of Frank Lloyd Wright's most famous architectural home designs; Fig. 2.89. Unfortunately, the famous structure, Fallingwater, was at risk of failure. The challenges date back to the original construction in 1937. The concrete beams that support the hung-in-space living room, its two adjoining terraces, and the master bedroom terrace above were under-designed. The beams sagged during construction and continued to creep every year. By 1994 they were an alarming 4 to 7 inches out of level. Given the great amount of concern to public safety, the owner chose to install temporary shoring beneath the main level terrace until a permanent strengthening scheme could be designed.

The primary requirements for the permanent repair system were strength and aesthetics. The system would need to be strong enough to halt vertical creep while being invisible to visitors. After careful review, the design team selected external post-tensioning to retrofit the structure. Since post-tensioning was an active system, in addition to the

increasing the capacity it offered a means of reducing the current deflections. Post-tensioning was also attractive from an aesthetic viewpoint because it could be hidden in the floor cavity between the girders and be virtually invisible to the public.

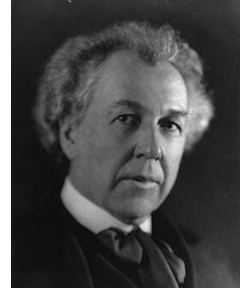
Thirteen-strand tendons were placed on each side of two of the girders. One 10-strand tendon was placed on the western side of the third girder. Eight 0.6-inch single-strand tendons were slated for the east-west direction. Reinforced concrete blocks doweled into the sides of the existing girders were used to anchor and profile the post-tensioning tendons. Small openings were cut into the existing south parapet wall to gain access for multi-strand tendons for stressing. Dead-end anchors were placed at the north end of the girders.

Stressing operations were carefully staged and sequenced. The four single-strand tendons were stressed in the east-west direction and then the four multi-strand tendons were stressed in the north-south direction. Stage stressing was beneficial because it allowed engineers to visually inspect the structure and monitor strains and deflections periodically. The single-strand tendons were tensioned to jacking forces of approximately 43 kips each. The 10-strand and 13-strand tendons were post-tensioned to jacking forces of 300 kips and 390 kips respectively. The multi-strand tendons were grouted with a high quality, low-bleed cementitious grout mixture.

All of the renovation work on the project was completed in a 10-week period during the winter months when the building normally closes to the public. No time was lost for visitor services. The client was thrilled with the entire process. The final result exceeded everyone's expectations and is a testament to its success. The renovation process did not have any architectural impact on the project. The team proudly claims that the house looks exactly the same after the renovation as it did before the work started.



# 69-72 YEARS OLD (1936-39)



FRANK LLOYD  
WRIGHT



S.237 Johnson Wax Building, 1936

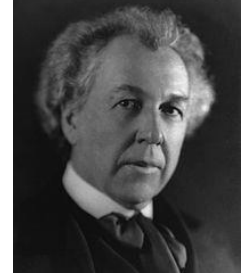
VIDEO: <https://www.youtube.com/watch?v=z1MXuBAxcdM>



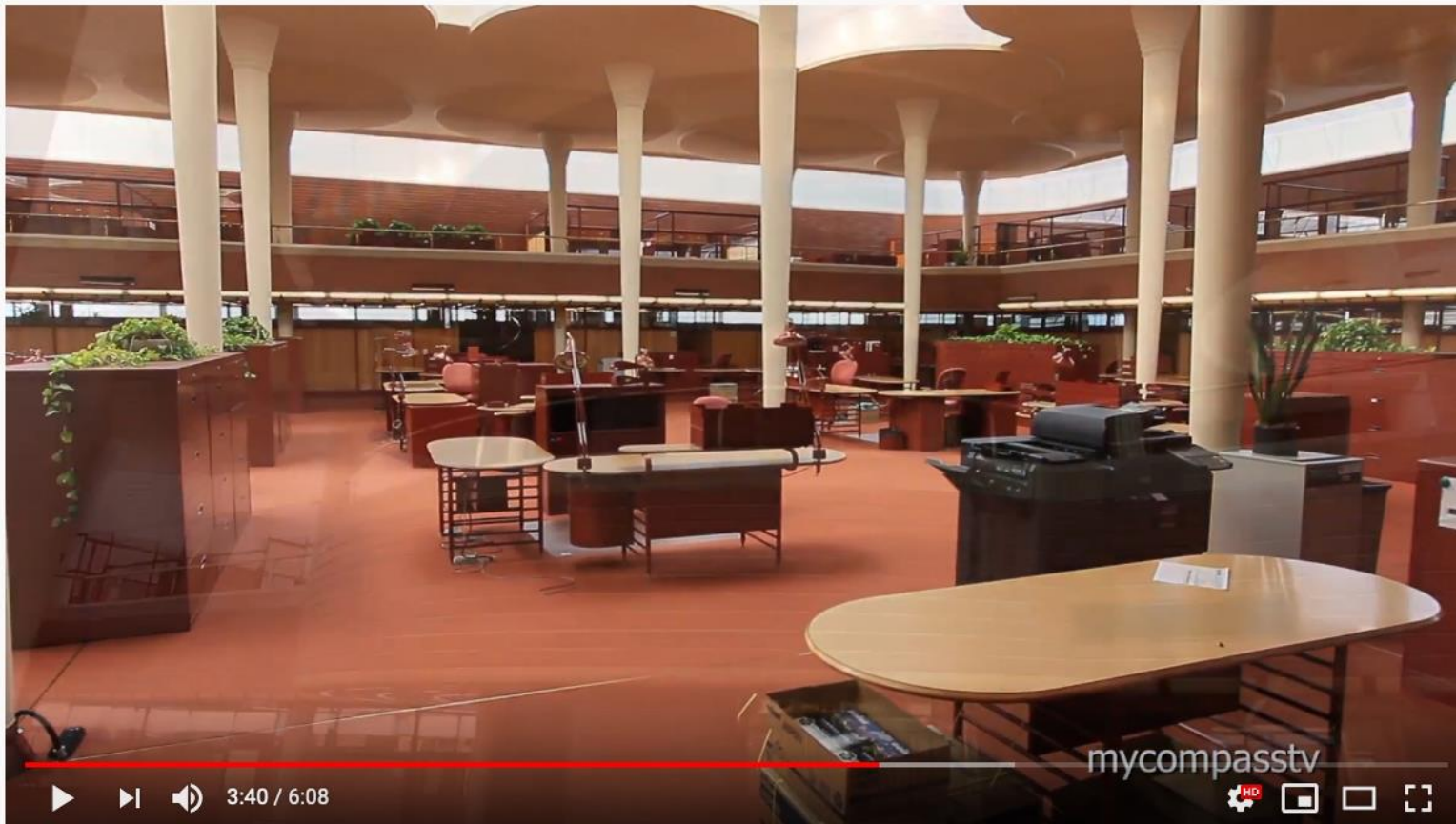
# 69-72 YEARS OLD (1936-39)

Johnson Wax Building

Watch VIDEO: <https://www.youtube.com/watch?v=z1MXuBAxcdM>



FRANK LLOYD  
WRIGHT



#FLW150

Johnson Wax Building - Frank Lloyd Wright

9,949 views • Apr 19, 2018

👍 102    💬 1    ➦ SHARE    📌 SAVE    ⋮





# 69-72 YEARS OLD (1936-39)

## Johnson Wax Building



FRANK LLOYD  
WRIGHT

He's often been criticized for the engineering involved with his architecture,

However:

- 1) As shown with the Japanese Imperial Hotel that was one of only a few buildings standing after the 1923 earthquake thanks to his seismic structural engineering concepts learned from the 1906 San Francisco earthquake →
- 2) He loaded a mockup of these Johnson Wax building columns with twice the design load just to prove to his detractors that this revolutionary idea of Lillypad-like columns could hold up this building

### ARCHITECTS' SPECIFICATIONS.

#### ENGINEERING PRINCIPLES TO BE APPLIED IN CONSTRUCTION OF

#### IMPERIAL HOTEL, TOKIO, JAPAN.

CONDITIONS:	Soft ground; Earthquake tremors; High winds; Great humidity; Downpours; No frost.
MATERIALS:	No fabricated Steel; Reinforced Concrete; Commercial round rods only; Structure faced with Masonry material throughout; Foundation - Cushion; Soil reinforced to depth sufficient to take loads safely by casting into it's texture small needles of Concrete - 2'-0" on centers - to the required number or to the economic limit.
SUPPORTS:	Intermediate, - exaggerated; horizontal bond; Concrete faced with other material; hollow wherever practicable.
WALLS:	Exaggerated (less than piers); battered and cast solid, layer upon layer, within thin shells of facing material, with horizontal bond - facing thus becoming part of wall; Walls to be divided vertically into sections not over 40 feet; No piers or walls to be "puddled".
LATERALS:	Slabs wherever possible continuous from side to side of building with continuous reinforcement; All slabs and beams homogeneous as far as possible; Steel reinforcement sub-divided into smallest units possible; No single rod permitted to stand where two or more could take it's place; The more numerous the strands, the more homogeneous the mass of steel and concrete; No slabs to be "puddled"; Where continuous homogeneous construction is used, the factor of safety in the materials and formulae is sufficient to care for exigencies of live load; In floors assume a low live load; In figuring beams - one half the amount; In footings one tenth; Wherever possible construction is to be balanced over beams, reducing clear spans, employing the continuous beam and cantilever principle. Always the structural form shall give the ground-work for the finished surfaces unless otherwise required for ducts or for acoustics. Continuous flat slabs to be given preference to beam and slab construction wherever economically reasonable. Two way reinforcing to be used whenever conditions do not render it uneconomic absurdity. Horizontal slabs and beams are to continue through the walls they encounter and to the back of the facing.

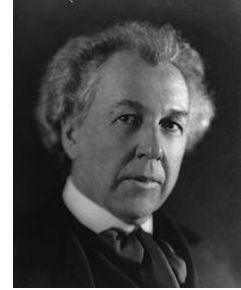
Figure 9 "Architects Specifications. Engineering Principles to Be Applied in Construction of Imperial Hotel, Tokio, Japan"



# Johnson Wax Building (1938) – Building Ahead of Its Time

Posted on **May 18, 2018** | By **Hugh Morrison** | **No comments**

69-72 YEARS OLD  
(1936-39)



FRANK LLOYD  
WRIGHT

## 1930s State of The Art Dendiform Columns Tested

This post reviews briefly testing to destruction of a tapering reinforced concrete column, conceived in 'organic style' like a flower stem with **calyx**.



The image to the left shows the vast open plan offices for the Johnson Wax company headquarters in **Racine Wisconsin** which was completed in 1938.

The dimensions of the columns were as follows: height 21ft (6.5m), base 9in (225mm) diameter, head 21in (533mm) diameter – hollow, opening out to a concrete dish at the top (*calyx*) 18.5ft diameter (5.7m). the columns supported glass skylights on a grid

approximating to 7m (actual dimension not known).

The two engineers who made calculations for the columns were **Mendel Glickman** and **Wesley Peters**, the son in law of Frank Lloyd Wright.

Their design was not believed to be sufficient according to the state engineers, who stated that the base of the columns should be at least 30in (762mm).

It would not take a lot of imagination, looking at the columns in the image to the left, to see the effect of tripling the column diameter – they would look stupendously large. Intuitively, looking at the proportions of the columns and the fact that they are not carrying a large load – lightweight roofing and their own self weight – the stems look proportionally correct.

To prove to the authorities that the columns were strong enough a column was tested to twice its design load – 24tons (24,000 lbs; 11,000kg;110kN). Frank Lloyd Wright stood next to the column at the design weight of 12 tonnes and tapped the shaft with his walking stick.

The column was loaded further 60 tonnes (5 times design load), when cracks appeared, but it still withstood the loading, only collapsing after a crane pulled away one of the timber props.

He loaded a mockup of these Johnson Wax building columns with twice the design load just to prove to his detractors that this revolutionary idea of Lillypad-like columns could hold up this building

**SOURCE:** <http://struartapp.com/johnson-wax-building-1938-building-ahead-of-its-time/>

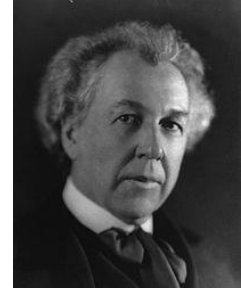


# Structural Appraisal

*Might the design be judged conservative by modern standards?*

*Can the maximum 60 tonne load be justified by our old friend, the Euler buckling equation?*

69-72 YEARS OLD  
(1936-39)



FRANK LLOYD  
WRIGHT



The testing was carried out using sand bags and sand to load up the columns.

## Restraints

The image to the left shows the test column. It was supported by leaning shores

which were braced in plane.

By appearance the shores provided partial restraint to the top of the column, but for the purpose of this blog it will be assumed that they are well held in position.

## Eccentricity

There is bound to be some eccentricity of loading. This is assumed to be 150mm or circa 30% of the top diameter.

## Design Check

If the initial 2x design load is considered to be the ultimate load to limit state design, then a simple chart for circular columns can be used. In this example the UK design standard chart BS8110 is shown below.

He loaded a mockup of these Johnson Wax building columns with twice the design load just to prove to his detractors that this revolutionary idea of Lillypad-like columns could hold up this building

**SOURCE:** <http://struartapp.com/johnson-wax-building-1938-building-ahead-of-its-time/>



## Calculation Check to BS8110

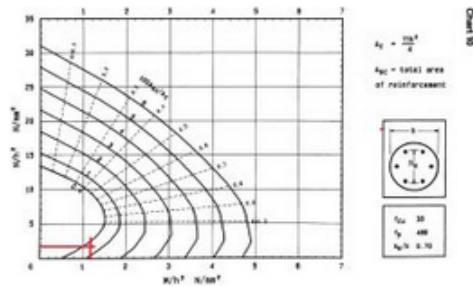
A calculation was carried out based on a design ultimate load of 110kN, with moment of 16.5kNm from the 150mm eccentricity and an average assumed column diameter of 250mm....

See calculation link below....

### column calculation

Using the parameters on the chart below, it is clear that the column is not designed anywhere near its practical limits, with only minimum reinforcement needed to comply with a modern code. The main vertical reinforcement may be shown to be approximately 0.4% of the column area (assuming an average diameter of 250mm or 1ft). This is a minimum amount generally used in contemporary design.

Note that the column is sensitive to the eccentric bending moment in this example.



### Slenderness

Is the column slender?

The ratio of width to height is 6400/250 approximately...26.

BS8110 gives a limiting ratio of height between restraints to minimum width approaching 60.

The column is not particularly slender, although visually it appears so.

### Failure? Using Euler....

Failure of the test column is envisaged as a buckling of the section.

To test this Euler critical load is readily found as the column is slender.....With reference to the book page 78, aside....

$$P_{cr} \text{ (Critical buckling load)} = \pi^2 EI / L_e^2$$

where  $I = \pi d^4 / 64$  and  $L_e = 6.4m$  and  $E$  short term concrete = 20E3mPa (N/mm<sup>2</sup>)

Calculate  $I = 3.142 \times 250^4 / 64 = 192E6 \text{ mm}^4$  (19177 cm<sup>4</sup>)

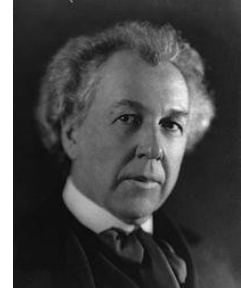
Therefore....

$$P_{cr} = 3.142^2 \times 20E3 \times 192E6 / 6400^2 = 925,515N$$

(92,000kg; 202,000lb; 101 tons)

Answer – critical buckling load is 101 tons which is 40% greater than the final test load of 60 tonnes.

# 69-72 YEARS OLD (1936-39)



FRANK LLOYD  
WRIGHT

He loaded a mockup of these Johnson Wax building columns with twice the design load just to prove to his detractors that this revolutionary idea of Lillypad-like columns could hold up this building

SOURCE: <http://struartapp.com/johnson-wax-building-1938-building-ahead-of-its-time/>



## Conclusion

The column was designed well within its capabilities, assuming a reasonably strong concrete, well compacted with nominal reinforcement mesh. When the props were removed the loose material (sand bags and sand) might have very quickly increased any eccentric loading into a progressive collapse. The column was vulnerable to an increase in moment (see above) and the second order effect of shifting load and lack of restraint.

Frank Lloyd Wright included many other ground breaking features in the design - Perspex tubes to provide a dappled light effect, underfloor heating, cavity filled external bricks - with insulating cork and concrete.

A very informative [youtube video](#) lasting about 30 minutes gives a fascinating history to the building.

## WATCH THIS:

[https://www.youtube.com/watch?v=lqQCLm7k\\_mo](https://www.youtube.com/watch?v=lqQCLm7k_mo)

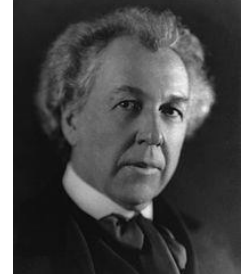


Frank Lloyd Wright - Johnson Wax Administrative Building | 07/23

114,952 views · Jun 25, 2011

👍 954 🗨️ 15 ➦ SHARE ↗️ SAVE ...

69-72 YEARS OLD  
(1936-39)



FRANK LLOYD  
WRIGHT

He loaded one of these columns with twice the design load to prove to his detractors that this revolutionary idea of Lillypad-like columns could hold up



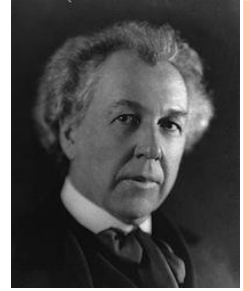
## SOURCE:

<http://struartaapp.com/johnson-wax-building-1938-building-ahead-of-its-time/>

# 70 YEARS OLD (1937)



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT



Taliesin West, 1937, Scottsdale AZ





Taliesin West, Phoenix Arizona, 1937 Frank Lloyd Wright







Taliesin West, Phoenix Arizona, 1937 Frank Lloyd Wright







A man with long grey hair and a beard, wearing a red jacket and blue jeans, stands on the left side of the group. He has a lanyard around his neck and is looking towards the center.

A woman with her hair in a bun, wearing a colorful patterned top and a bright green crossbody bag, stands in the center of the group. She is looking towards the man in the red jacket.

A man wearing a dark blue jacket and a grey cap stands with his back to the camera, looking towards the building.

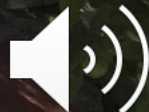
A man in a blue sweater and blue jeans stands on the right side of the group, looking towards the building.

A man wearing a white jacket, a grey cap, and dark pants stands on the far right, looking towards the building.

A small table with several colorful balls (green, blue, red) on it, located in the center of the patio.

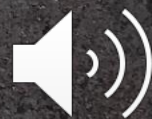
A planter box containing dry, brown grass, situated in the center of the patio.







Small red rectangular object with illegible text or markings.

















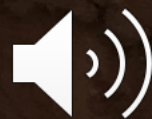


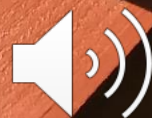
















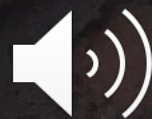
















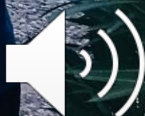






Taliesin West, Phoenix Arizona, 1937 Frank Lloyd W

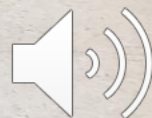






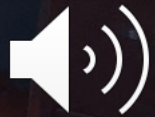


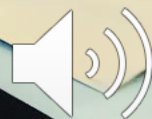


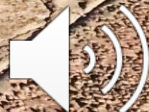














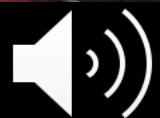


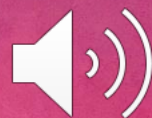






Watch:





Because they new I was an architecture professor, and because they knew my son was looking into graduate schools for architecture, they gave us a private tour of more of the Frank Lloyd Wright school.

Including their performance space, their library/study-room, and where they build their own dwellings in the Desert.





















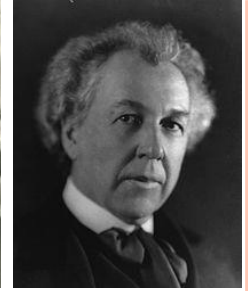
# 70 YEARS OLD (STARTING IN 1937)

[STORRER 2017]

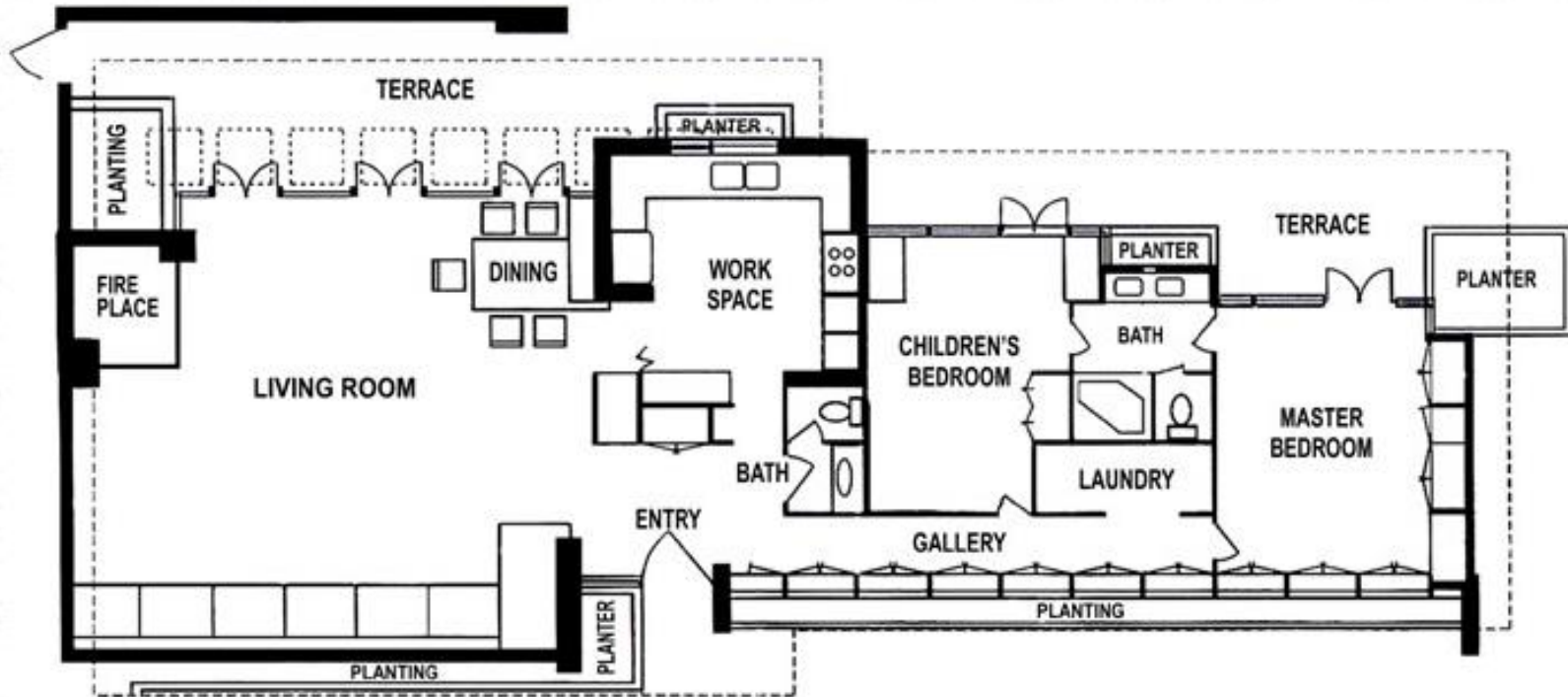
## ○ Small “affordable” homes (Usonian Homes)



OLGIVANNA  
WRIGHT



FRANK LLOYD  
WRIGHT



*The Usonian Exhibition House floor plan created approximately 1,700 square feet of living space.*





# Usonian Houses (from Wikipedia)

[Lowell and Agnes Walter House](#) 1950, [Quasqueton, Iowa](#)

[Kraus House](#) 1950, [Kirkwood, Missouri](#)

[Kenneth and Phyllis Laurent House](#) 1951, [Rockford, Illinois](#)

[Nathan Rubin House](#) 1951, [Canton, Ohio](#)

[Muirhead Farmhouse](#) 1951, [Hampshire, Illinois](#)

[Zimmerman House](#) 1951, [Manchester, New Hampshire](#)

[John D. Haynes House](#) 1952, [Fort Wayne, Indiana](#)

[Frank S. Sander House](#) 1952, [Stamford, Connecticut](#)

## **[Kentuck Knob](#) 1953,**

### **[Stewart Township, Fayette County, Pennsylvania](#)**

[John and Syd Dobkins House](#) 1953, [Canton, Ohio](#)

[Bachman Wilson House](#), [Millstone, New Jersey](#) 1954

[Ellis Feiman House](#) 1954, [Canton, Ohio](#)

[John E. Christian House "Samara"](#) 1954, [West Lafayette, Indiana](#)

[J. Willis Hughes house "Fountainhead"](#), 1954, [Jackson, MS](#)

[William L. Thaxton Jr. House](#) 1955, [Houston, TX](#)

[Louis Penfield House](#) 1955, [Willoughby Hills, Ohio](#)

[Cedric G. and Patricia Neils Boulter House](#) 1956, [Cincinnati, Ohio](#)

[Dudley Spencer House](#) 1956, [Wilmington, Delaware](#)

[Donald C. Duncan House](#) 1957, [Donegal, Pennsylvania](#) (dismantled and relocated from its original location in [Lisle, Illinois](#))

[Evelyn and Conrad Gordon House](#) 1957, [Wilsonville, Oregon](#) (later moved to [Silverton, Oregon](#))

[Lovness House and Cottage](#) 1957, [Stillwater, Minnesota](#)

[Robert H. Sunday House](#) 1957, [Marshalltown, Iowa](#)

[John Gillin Residence](#) 1958, [Dallas, Texas](#)

[Paul J. and Ida Trier House](#) 1958, [Johnston, Iowa](#)

[Herbert and Katherine Jacobs First House](#), "Jacobs I," 1937, [Madison, Wisconsin](#)

[Paul and Jean Hanna House](#), "Honeycomb House," 1937, [Palo Alto, California](#)

[Bernard Schwartz House](#) 1939, [Two Rivers, Wisconsin](#)

[George Sturges House](#) 1939, [Los Angeles, California](#)

[John and Ruth Pew House](#) 1939, [Shorewood Hills, Wisconsin](#)

[Hause House](#) 1939, [Lansing, Michigan](#)

[Bazett-Frank House](#) 1940 [Hillsborough, California](#)

[Goetsch-Winckler House](#) 1940, [Okemos, Michigan](#)

[Rosenbaum House](#) 1940, [Florence, Alabama](#)

[Clarence Sondern House](#) 1940, [Kansas City, Missouri](#)

[Pope-Leighey House](#) 1941, [Alexandria, Virginia](#)

[Stuart Richardson House](#) 1941 (built 1951) [Glen Ridge, New Jersey](#)

[Alvin and Inez Miller residence](#) 1946, [Charles City, Iowa](#)

[Erling P. Brauner House](#) 1948, [Okemos, Michigan](#)

[Usonia Homes](#), [Pleasantville, New York](#)

[Sol Friedman House](#) 1949

[Edward Serlin House](#) 1951

[Roland Reisley House](#) 1951

[Melvyn Maxwell and Sara Stein Smith House](#) 1949, [Bloomfield Hills, Michigan](#)

[Robert and Rae Levin House](#) 1949, [Kalamazoo, Michigan](#)

[Weltzheimer/Johnson House](#) 1949, [Oberlin, Ohio](#)

[Donald Schaberg House](#) 1950, [Okemos, Michigan](#)

[J.A. Sweeton Residence](#) 1950, [Cherry Hill, New Jersey](#)



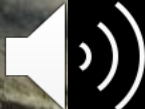
*2015 Etown Architecture field trip to Fallingwater,  
And we also visited nearby Kentuck Knob that he designed much later (1956 at age 89)*



*2015 Etown Architecture field trip to Fallingwater,  
And we also visited nearby Kentuck Knob that he designed much later (1956 at age 89)*



*2015 Etown Architecture field trip to Fallingwater,  
And we also visited nearby Kentuck Knob that he designed much later (1956 at age 89)*



*2015 Etown Architecture field trip to Fallingwater,  
And we also visited nearby **Kentuck Knob** that he designed much later (1956 at age 89)*



70 YEARS OLD (1937)

*HEXAGONAL*



FRANK LLOYD  
WRIGHT



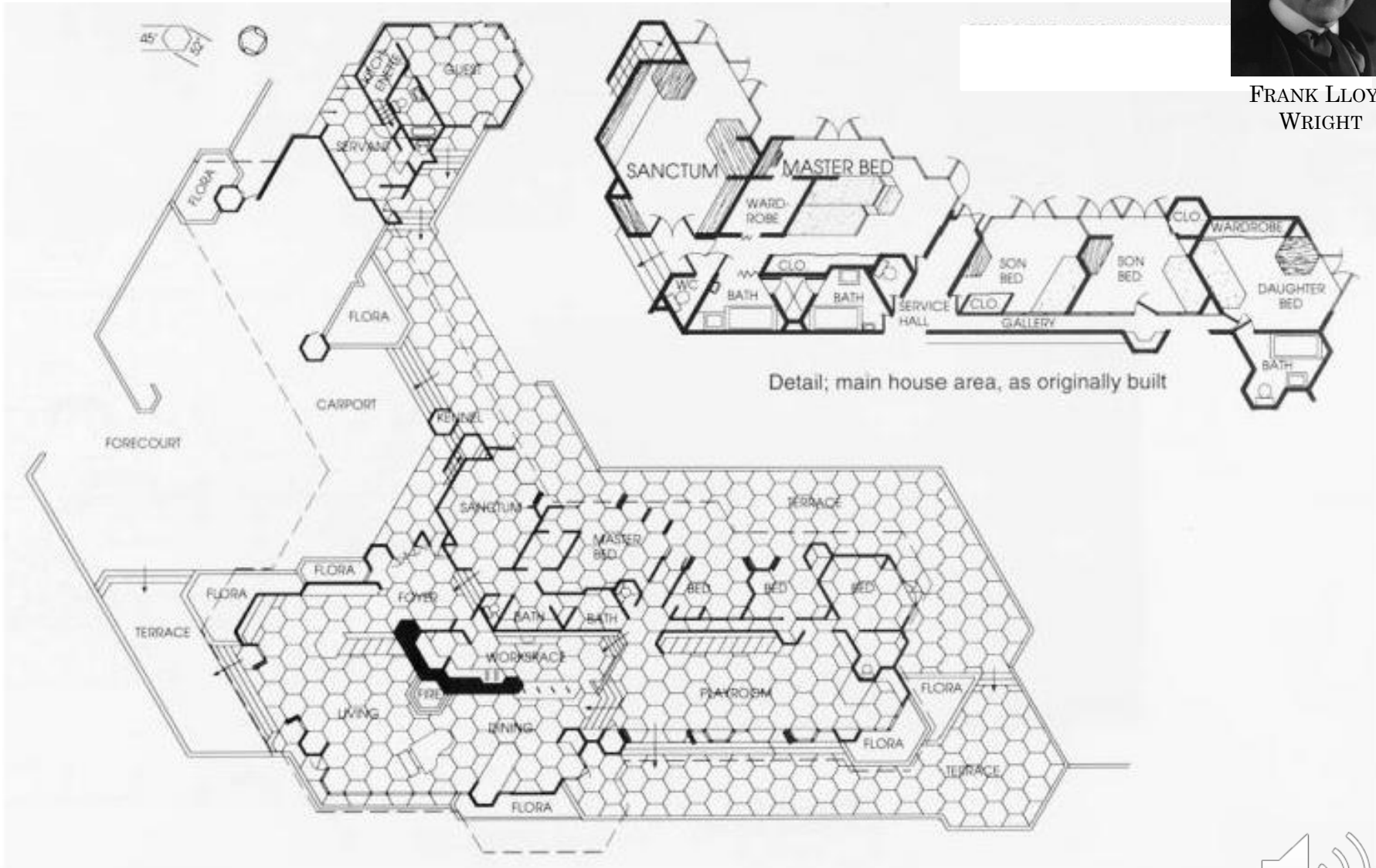
**Hanna-Honeycomb House, Stanford California, 1937**

70 YEARS OLD (1937)

HEXAGONAL



FRANK LLOYD WRIGHT



Detail; main house area, as originally built



**Hanna-Honeycomb House, Stanford California, 1937**

# OCTAGONAL

Offices

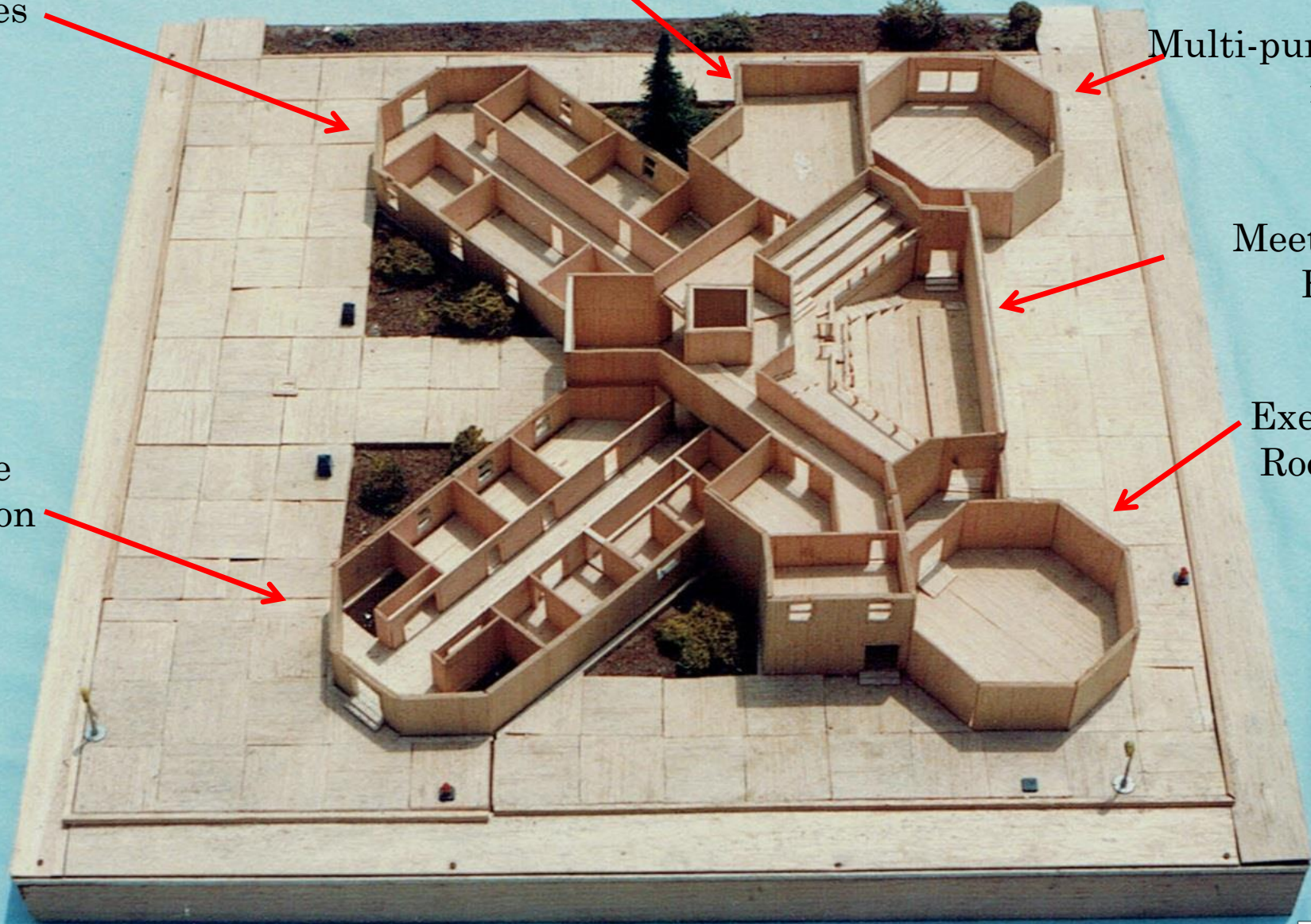
Mayor's Office

Multi-purpose room

Meeting Hall

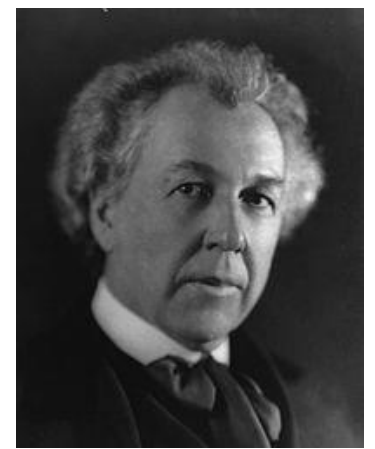
Exercise Room

Police Station





# 78 YEARS OLD (1945)



FRANK LLOYD WRIGHT

## World War II ends in 1945

- Nazi Germany defeated with a mass invasion by allied troops
- Imperial Japan defeated by dropping of two atomic bombs
- Taliesin Fellowship (Olga's idea) continues



NOTE: JT Wunderlich's Father (JH Wunderlich II) served two years in the United States Army fighting the Japanese in World War II in the South Pacific, then served in the Texas air national guard and almost went to the Korean War (a Proxy Civil-War over communism). He died in 2008.

Here's a website made I for him:

[http://users.etown.edu/w/wunderjt/DADhome\\_page.html](http://users.etown.edu/w/wunderjt/DADhome_page.html)





JH Wunderlich (II)

WWII stories, and more, here:

[http://users.etown.edu/w/wunderjt/DADhome\\_pageSTORIES.html](http://users.etown.edu/w/wunderjt/DADhome_pageSTORIES.html)

#### 1930's -- THE GREAT DEPRESSION

- "Parents lose large savings when banks close"
- "My **father** (Joseph Wunderlich I) works a four-day week to help others stay employed"

#### 1940's -- WORLD WAR II

- "A teenager preparing for war"
- "**Father** refuses my enlisting as an Airforce officer at age 17"
- "Drafted into the Army on my 18th birthday"
- "One poor American soldier left in the Pacific Ocean"
- "One poor hungry Japanese soldier"
- "Still have ringing in my ear from exploding mortar that broke my watch"
- "Missionary work with the **Headhunters of Borneo**"
- "The mayor of Mandoai has a tuxedo and top-hat, but no pants"
- "Saved by penicillin in a Philippine jungle"
- "Fishing with a hand grenade"
- "Sharing a joke with 100 Japanese prisoners"
- "Great structures that take years to build can sadly be destroyed in seconds"
- "The unparalleled waste of war"

#### 1940's -- TEXAS

- "Becoming an Engineer at the University of Houston"
- "Surviving a Houston hurricane in a college trailer"
- "Flashbacks of war while finding screens for our college trailer"
- "Founding a chapter of the Neumann Club at the University of Houston"
- "The Texas Air National Guard"
- "Seismic blasting in West Texas to find water"

#### 1950's

- "Leaving Texas to be with my **father** after my mother dies"
- "Seriously considering Seminary"
- "I begin my 25 year career in Aerospace"

#### 1960's

- "My **wife** gives birth to four children in less than three years"
- "Helping the US win the space race"
- "Convincing Pentagon Generals that fiber optic glass wires don't break"
- "**Father** dies in 1968"

#### 1970's

- "Turning down aerospace job in Pasadena to instead keep raising four children in PA"
- "I end my 25 year career in Aerospace"
- "Teaching tough teens at a vocational/Technical high-school"
- "Helping my maverick teenage son(s) through the 1970's"

#### 1980's

- "Teaching calculus and physics in an all-female private school"
- "Teaching physics at Villanova University"
- "My son **Joseph III** marries **Karla** in 1988"

#### 1990's

- "My grandson **Joseph Wunderlich IV** is born in 1997"

#### 2000's

- "My granddaughter **Anna** is born in 2002"

