



ARCHITECTURE DESIGN THEORY

PART 6: PROPORTION & SCALE

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<http://users.etaown.edu/w/wunderjt/>





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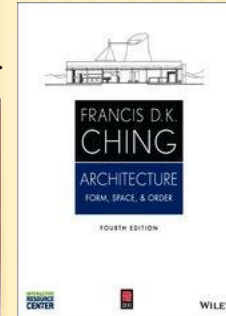
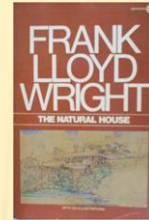


SOURCES

* Personal Architecture projects, frequent international travel, BS Architectural Engineering (U.Texas 84), plus 1-1/2 years of Urban Design (UCSD 1986-87)

COURSE TEXTBOOKS

- [1] Ching, Francis D.K. *Architecture: Form, Space, and Order*. 4 ed., Wiley, 2014.
- [2] Wright, Frank Lloyd. *The Natural House*. Bramhall House; 1954.

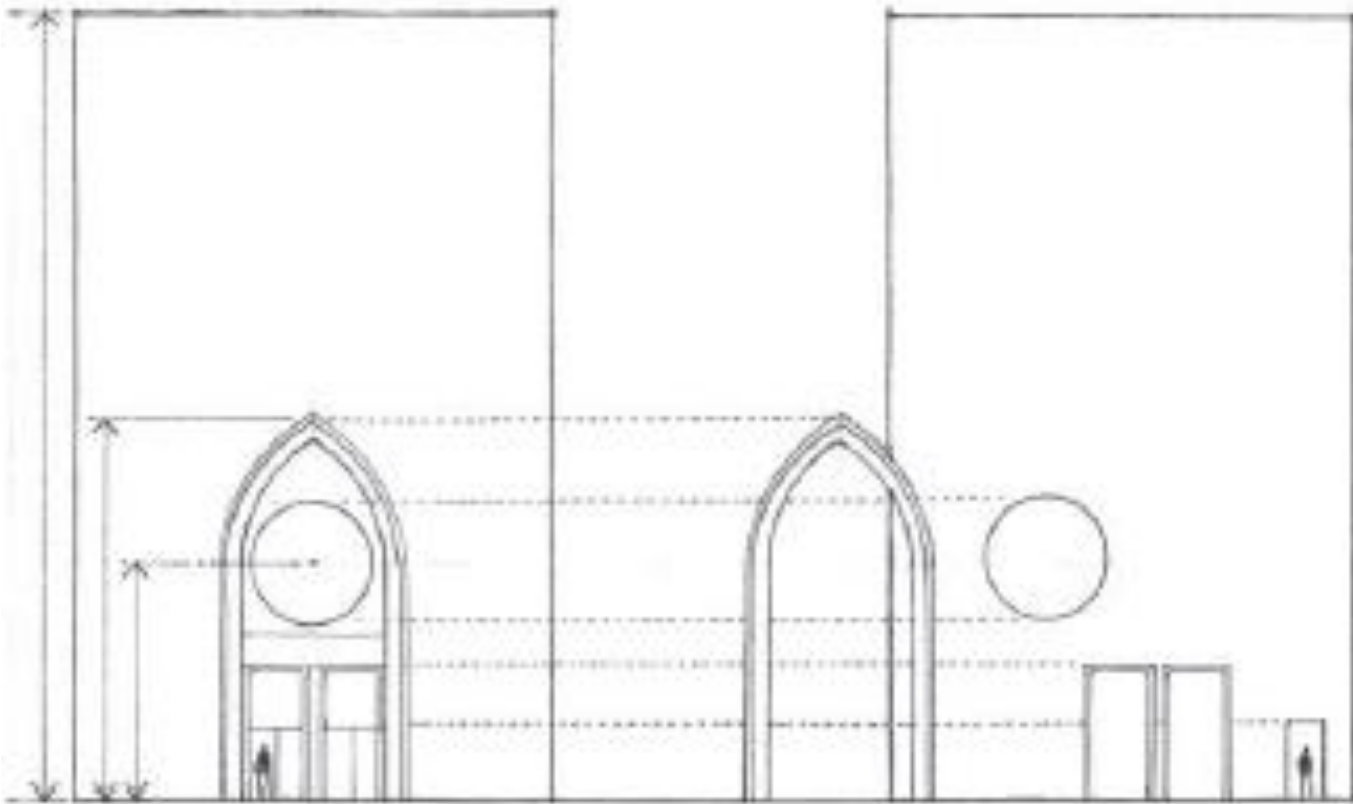


OTHER SOURCES

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- [4] Bacon, Edmond. *Design of Cities*. Thames & Hudson Ltd, 1978.
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<http://www.froebelgifts.com/history.htm>
- [8] *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>
- [9] 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>
- [10] Burns, Ken, and Novick, Lynn. *Frank Lloyd Wright: A Film by Ken Burns and Lynn Novick DVD*. PBS Home Video, August 28, 2001.
- [11] Wright, Frank Lloyd. *The Art and Craft of the Machine*, Vol. 8, No. 2 pp. 77-81, 83-85, 87-90, May, 1901.
<https://www.jstor.org/stable/pdf/25505640.pdf>
- [12] Wright, Frank Lloyd. *In the Cause of Architecture*. Architectural Record, vol. XXIII, March 1908.
- [13] Wright, Frank Lloyd. *In the Cause of Architecture; Second Paper*. Architectural Record, May 1914.



“SCALE is size compared to a reference“ [1]

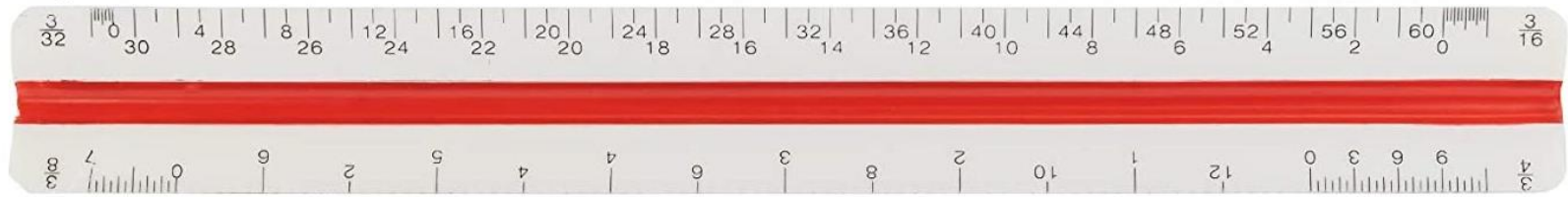


Mechanical scale: the size or proportion of something relative to an accepted standard of measurement.

Visual scale: the size or proportion an element appears to have relative to other elements of known or assumed size.

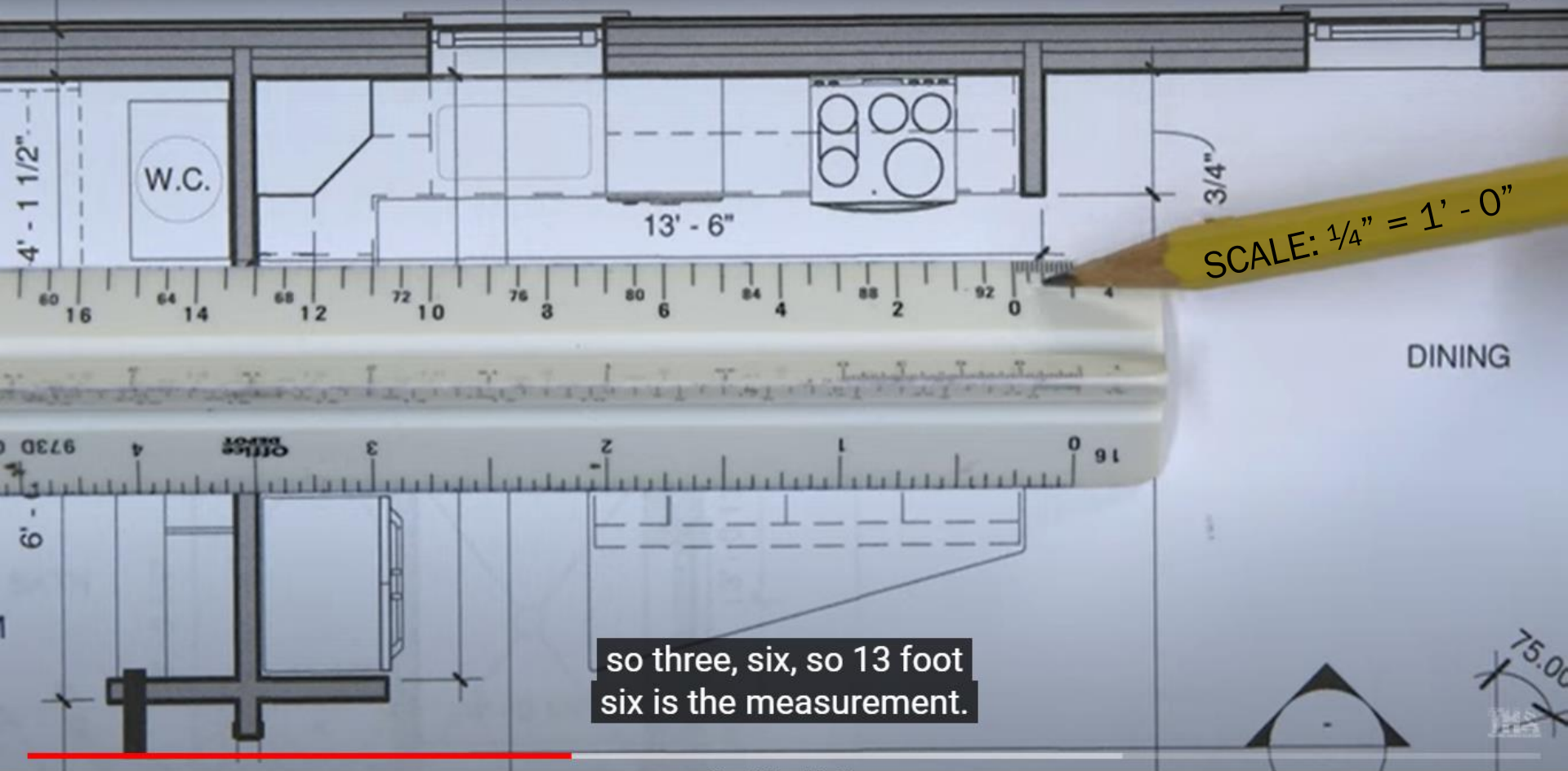


Architect Scale



[HTTPS://WWW.YOUTUBE.COM/WATCH?V=94FBIFHY5GM](https://www.youtube.com/watch?v=94FBIFHY5GM)

How to Read an Architectural Scale | Beginner



SCALE: $\frac{1}{4}'' = 1' - 0''$

so three, six, so 13 foot six is the measurement.



Architect Scale

Engineer Scale



FULL SCALE, WITH INCHES DIVIDED INTO SIXTEENTHS OF AN INCH (1:1)



$3/16" = 1'-0"$ SCALE (1:64)

$3/32" = 1'-0"$ SCALE (1:128)

$1" = 1'-0"$ SCALE (1:12)

$1/2" = 1'-0"$ SCALE (1:24)



$1/4" = 1'-0"$ SCALE (1:48)

$1/8" = 1'-0"$ SCALE (1:96)

$1-1/2" = 1'-0"$ SCALE (1:8)

$3" = 1'-0"$ SCALE (1:4)



$3/8" = 1'-0"$ SCALE (1:32)

$3/4" = 1'-0"$ SCALE (1:16)

$1" = 10'$ SCALE (1:10)



$1" = 20'$ SCALE (1:20)

$1" = 50'$ SCALE (1:50)



$1" = 30'$ SCALE (1:30)

$1" = 40'$ SCALE (1:40)



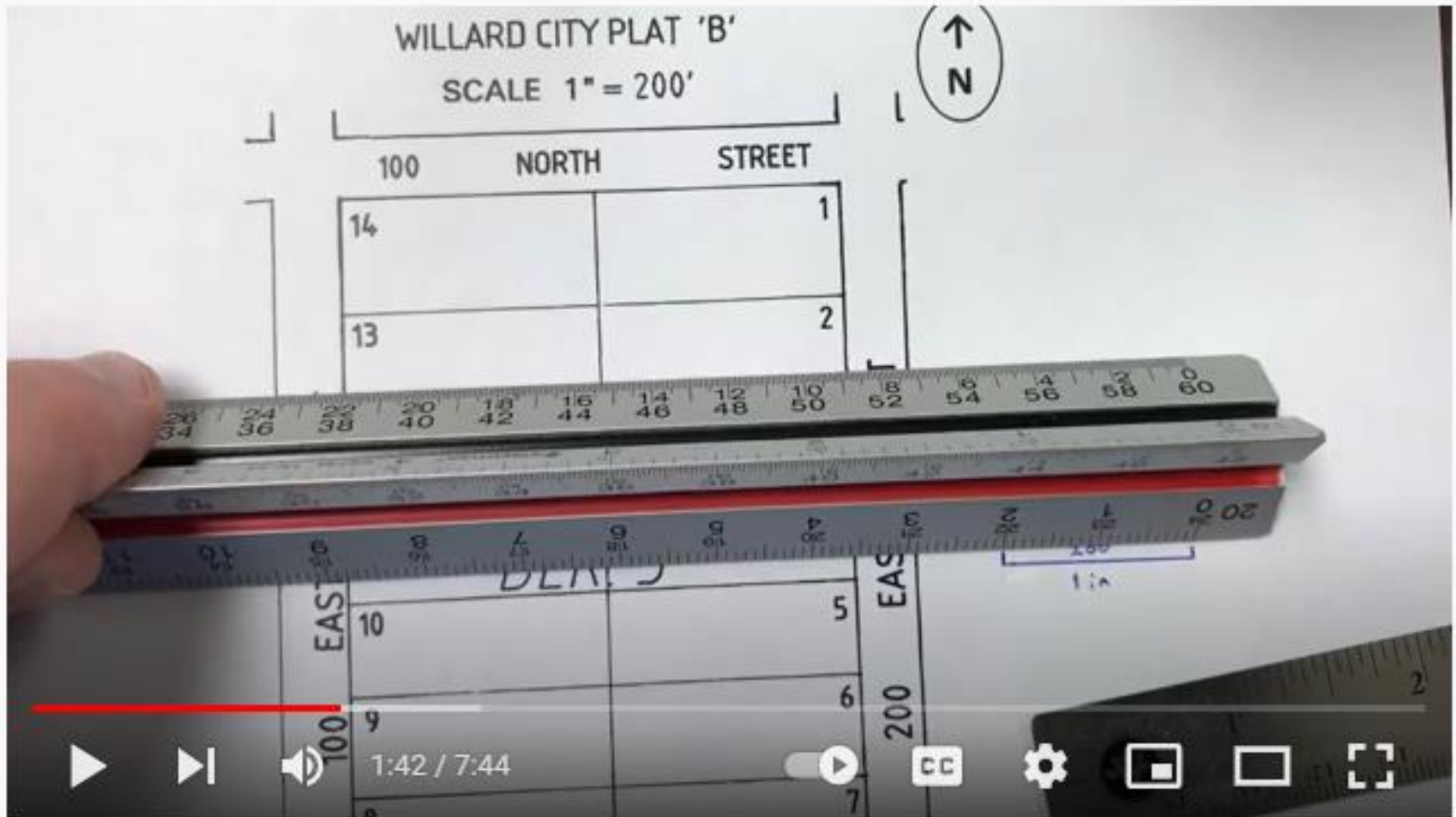
$1" = 60'$ SCALE (1:60)

Architect Scale

Engineer Scale

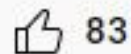


[HTTPS://WWW.YOUTUBE.COM/WATCH?V=U5PGWOC5IAG](https://www.youtube.com/watch?v=U5PGWOC5IAG)



Using an engineer scale

11,126 views • Sep 11, 2019



83



DISLIKE



SHARE



SAVE



“VISUAL SCALE refers not to actual dimensions, but to how small or large something appears in relation to its normal size, or to the size of other things“ [1]



*“We speak of **URBAN SCALE** when a project is in the context of a city*



*or **NEIGHBORHOOD SCALE** when a building is appropriate to its locale*



*or **STREET SCALE** for relative sizes of elements fronting a roadway“*
[1]



“At scale of a building, we perceive size of each element in relation to other parts, or to the whole“ [1]



“HUMAN SCALE is based on human body.

*... We gauge a space whose **width** we can reach out and touch its walls*

*... We judge its **height** if we can reach up and touch the ceiling*

Once we can no longer do these things, we rely on visual clues to give us a sense of scale “ [1]



*“For these clues, we use elements whose dimensions are related to dimensions of our **PACE, REACH, or GRASP.**”*

... a table or chair, the risers and treads of a stairway, or the sill of a window, not only help us judge the size of a space but also give it a human scale” [1]

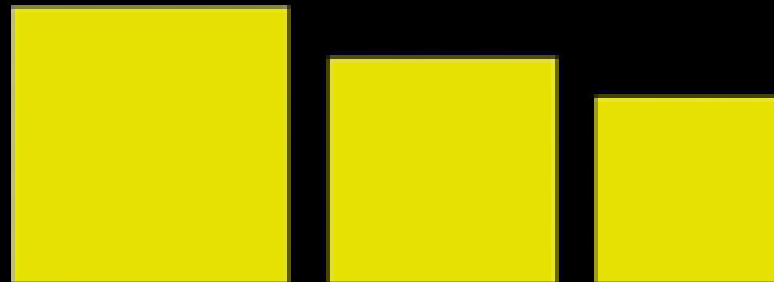


*“in a room that is intimate in scale, we **FEEL COMFORTABLE, IN -CONTROL, or IMPORTANT,***

*... a structure or urban space that is monumental in scale makes us **FEEL SMALL**” [1]*



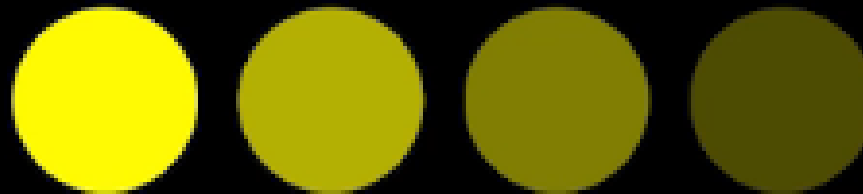
“PROPORTION is the harmonious relation (in Magnitude, Quantity, or Degree) of one part to another, or to the whole“ [1]



Magnitude



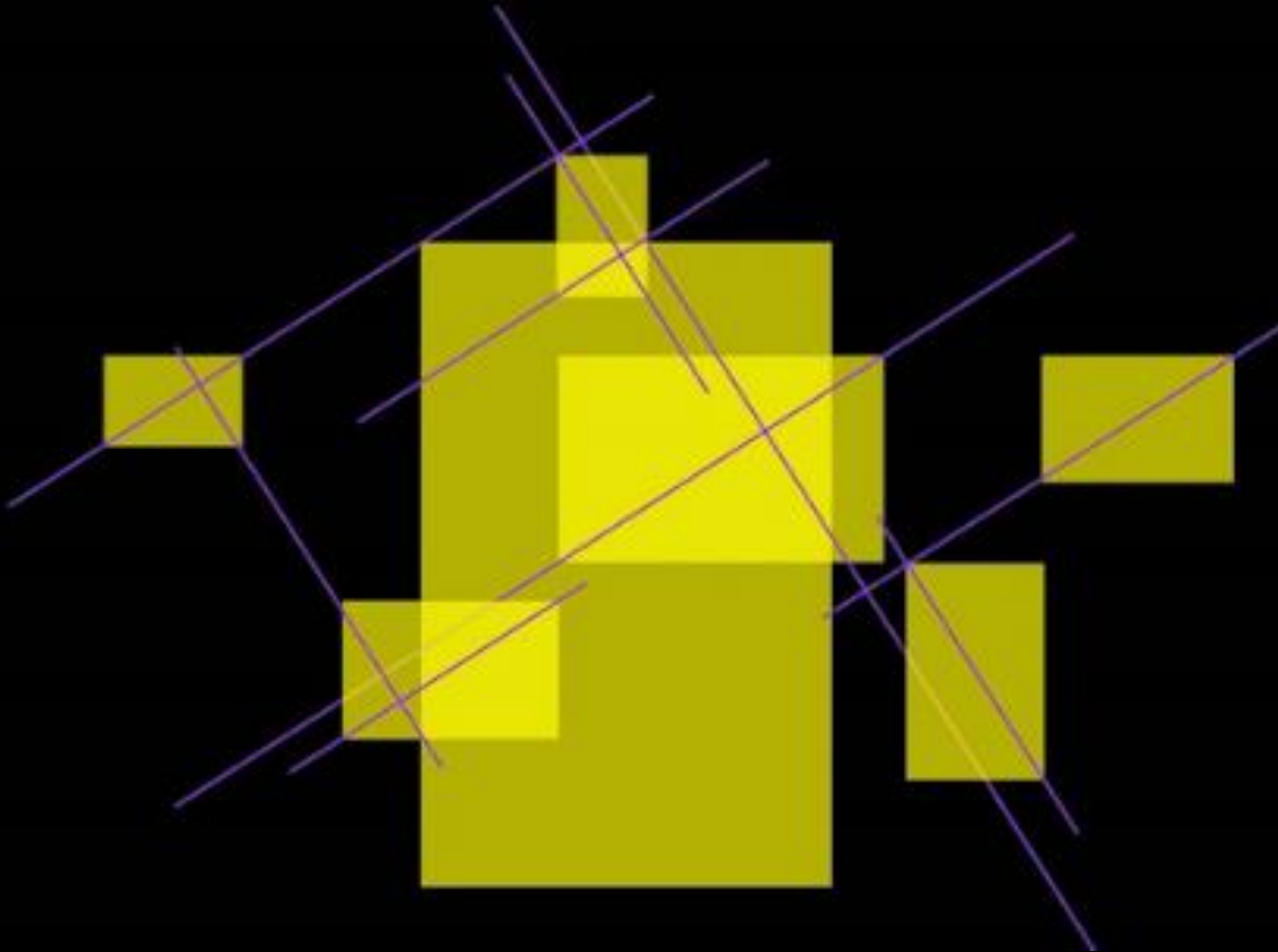
Quantity



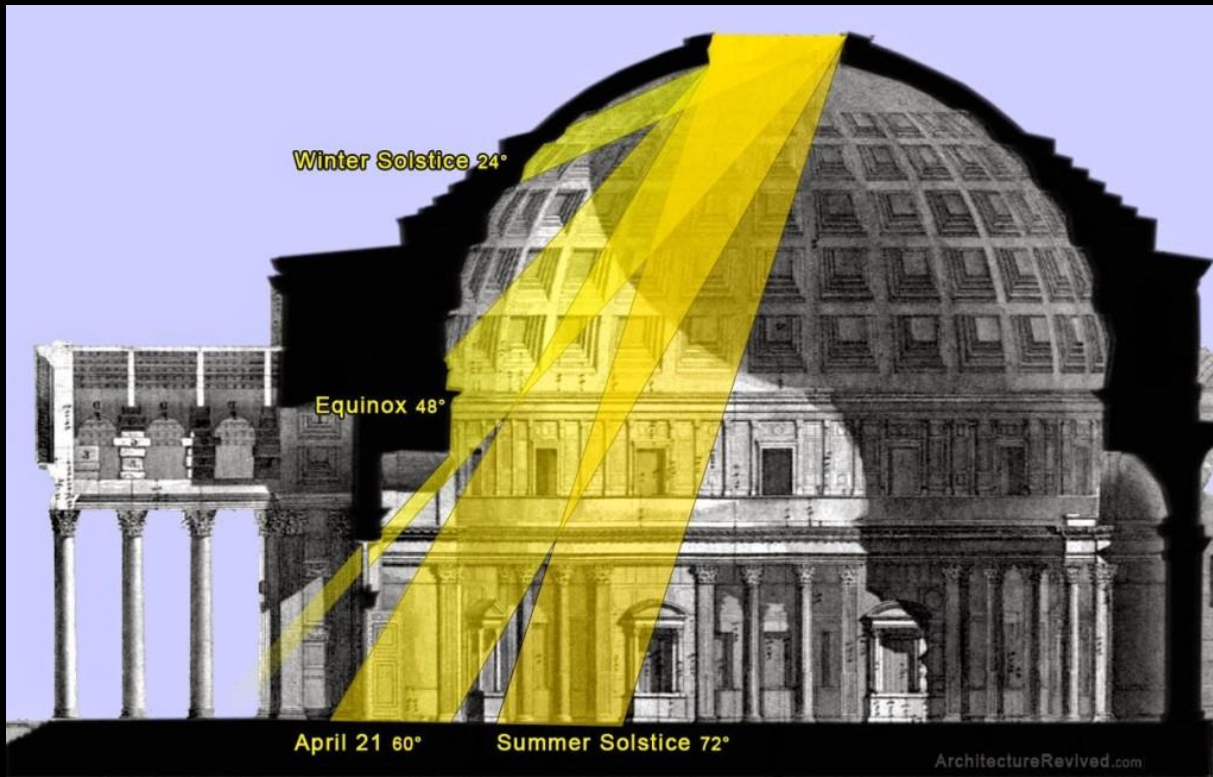
Degree



“REGULATING LINES, parallel or perpendicular, control the proportion and placement of elements“ [1]



REGULATING LINES – Pantheon in Rome



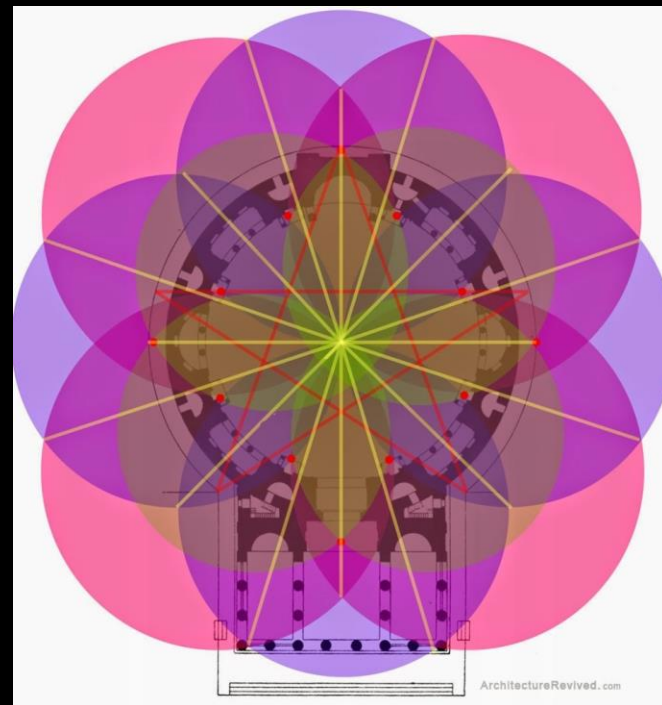
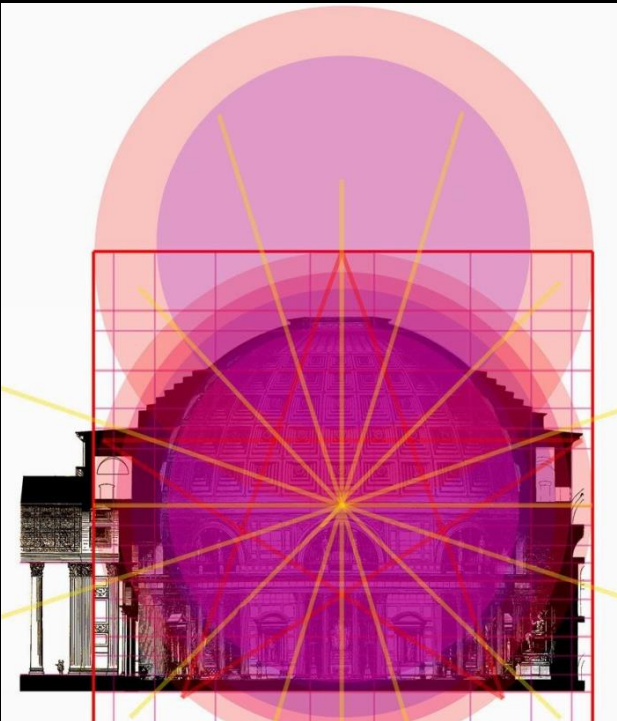
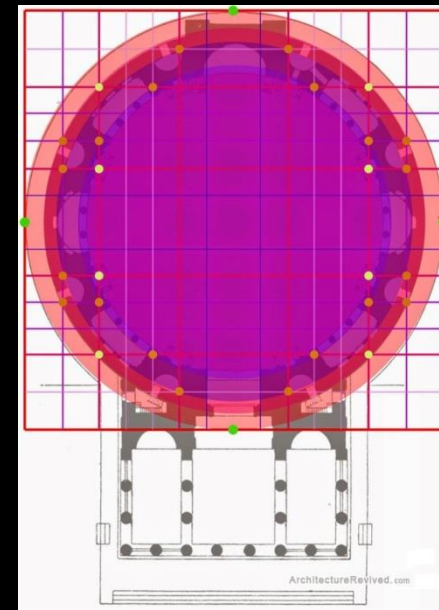
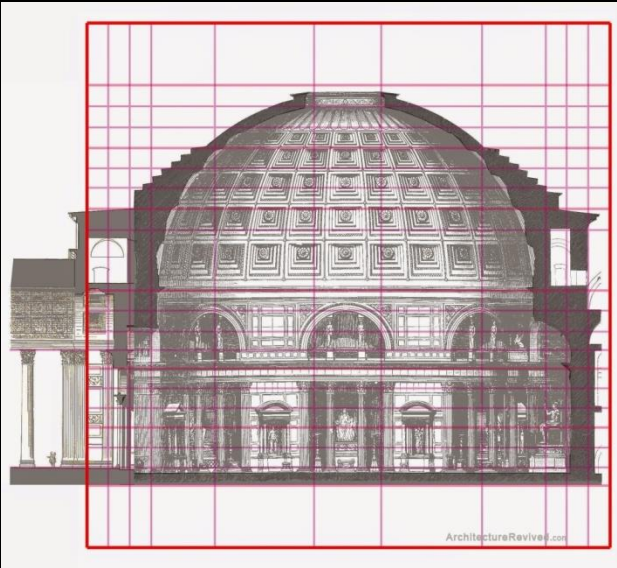
<http://www.architecturerevived.com/the-pantheon-romes-architecture-of-the-cosmos/>



Rome 2011

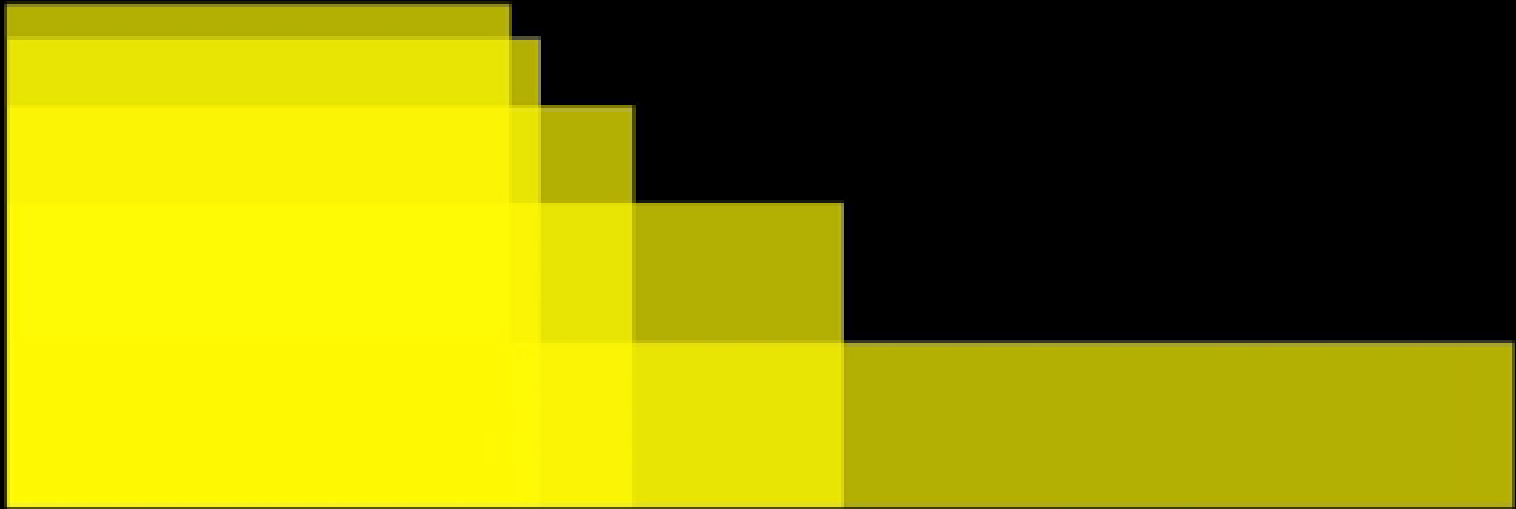


REGULATING LINES – Pantheon in Rome

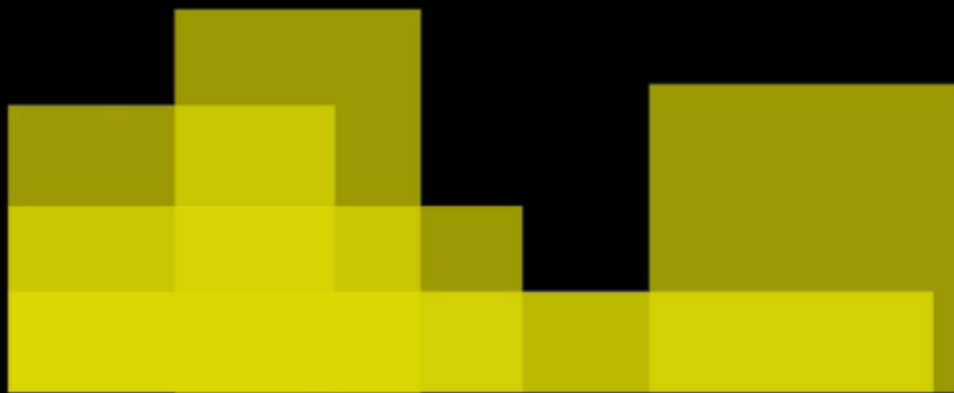


“A form can appear to be long, short, stubby, or squat, based on how we perceive its proportions

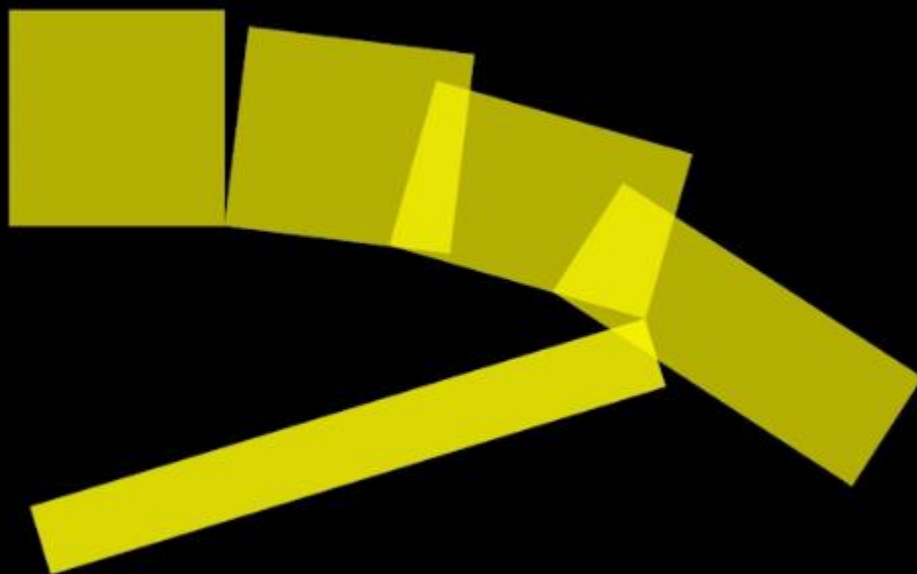
... a rectangle can appear square ... almost a square ... or very much unlike a square“ [1]



“While a composition of similarly proportioned elements may have a natural unity,

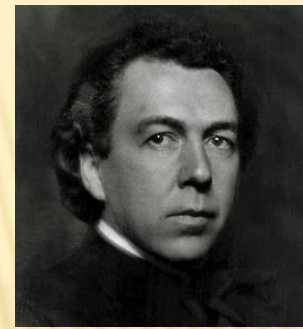


... a composition of dissimilar proportions can still be organized in a unified manner utilizing ordering principles such as datum or rhythm” [1]
(see [“PART 7 “PRINCIPLES”](#))



“The proportional emphasis of a composition can be primarily horizontal ...





Frank Lloyd Wright

Frank Lloyd Wright's "**PRAIRIE STYLE**" emphasized the **HORIZONTAL**

"I extended horizontal spacing without enlarging the building by cutting out all the room partitions that did not serve the kitchen or give needed privacy... Freedom of floor space and elimination of useless Heights ...Sense of repose in flat planes and quiet streamline effects"

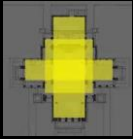
His **PRAIRIE STYLE** expands on his **ORGANIC ARCHITECTURE**

- + *"Planes close to earth identify with ground"*
 - + Complimenting wide open plains of the Midwest

His "**HORIZONTAL**" also emphasized by:

- + Low ceilings and **bands of windows**
- + Wall above window bands painted same color as ceiling
- + **Bands of interior horizontal trim** work
- + **Extended roof overhangs**, and long **cantilevered** balconies
- + Exterior facades of **horizontal Board and Batten** or **Roman Brick** (*thin*)
- + **Folded Plane** -- like origami ... "*Continuity*"...
 - *"walls, ceilings, and floors become one"*
- + **Pin-wheeled Planes**



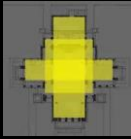


Frank Lloyd Wright

PRAIRIE STYLE

Willets House
Highland Park, IL





Frank Lloyd Wright

PRAIRIE STYLE



2019,20 LECTURE: 31 Frank Lloyd Wright sites, plus two FLW influenced family homes

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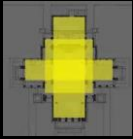
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Frank W Thomas
House
Oak Park, IL



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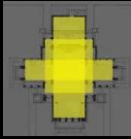
Frank Lloyd Wright

PRAIRIE STYLE



B. Harley Bradley
House
Kankakee, IL





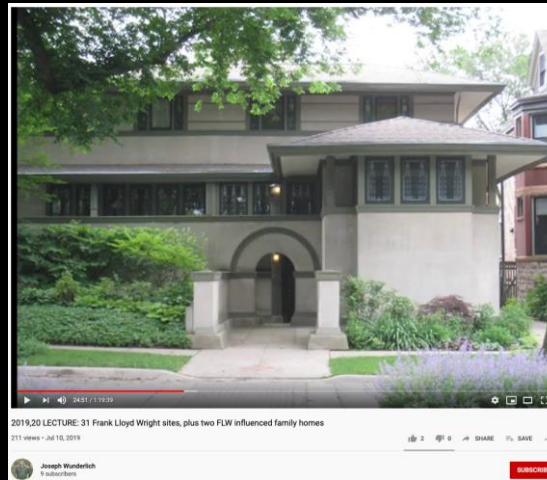
Frank Lloyd Wright

These three 1901 designs are each considered his first *mature* PRAIRIE- SCHOOL STYLE *by different scholars*

Willetts House
Highland Park, IL



Frank W Thomas House
Oak Park, IL



B. Harley Bradley House
Kankakee, IL

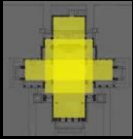


Even though FLW said that the Thomas house was the first of his prairie houses, he also said his earlier 1894 Winslow residence was a prairie style. The Thomas house is more of the mature established Prairie school style with all the accompanying features



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Frank Lloyd Wright

Prairie-school, three stories



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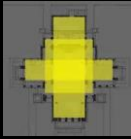
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Frank Lloyd Wright



Isabella Roberts
Residence
River Forest, IL

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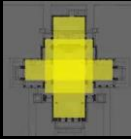
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Frank Lloyd Wright

PRAIRIE STYLE



Robie House
Chicago, IL

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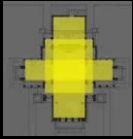
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PRAIRIE STYLE



Frank Lloyd Wright



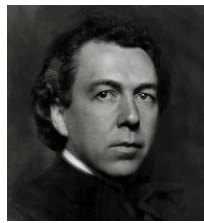
Robie House
Chicago, IL



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HORIZONTAL Board and Batten



Frank Lloyd Wright



S. 063 John A. Mosher Residence, Ohio 1902



Brick laid to look like HORIZONTAL Board and Batten



Frank Lloyd Wright



Arthur and Grace
Heurtley Residence
Oak Park, IL

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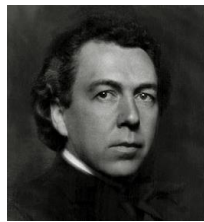


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Roman Brick (*thin*) – accentuates the **HORIZONTAL**



Frank Lloyd Wright



Darwin D. **Martin House**, Buffalo, NY



Roman brick used on a Wunderlich family residence (wife's father's home - "John Drozd") – for façade and chimney. Lemont IL, a suburb of Chicago in the 1950's.

See more in Wunderlich [Vlog Lecture](#) on [YouTube Channel](#)

2019,20 LECTURE: 31 Frank Lloyd Wright sites, plus two FLW influenced family homes

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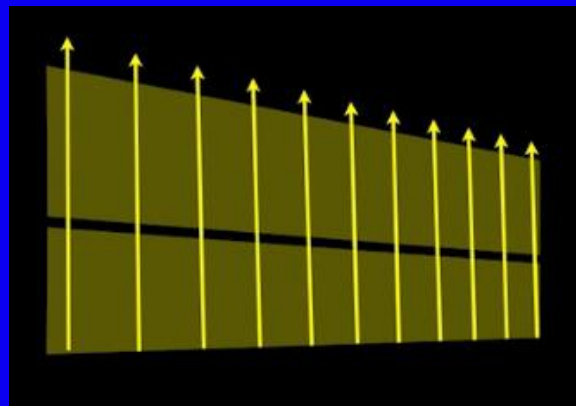
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ANALYTICS EDIT VIDEO



proportional emphasis of a composition can be primarily VERTICAL



proportional emphasis of a composition can be primarily VERTICAL

Lived here for three years in the 1980's

Austin Texas skyline



<https://www.pinterest.com/pin/186195165819905265/>



proportional emphasis of a composition can be primarily VERTICAL

Lived here for three years in the 1980's

San Diego California skyline



proportional emphasis of a composition can be primarily VERTICAL

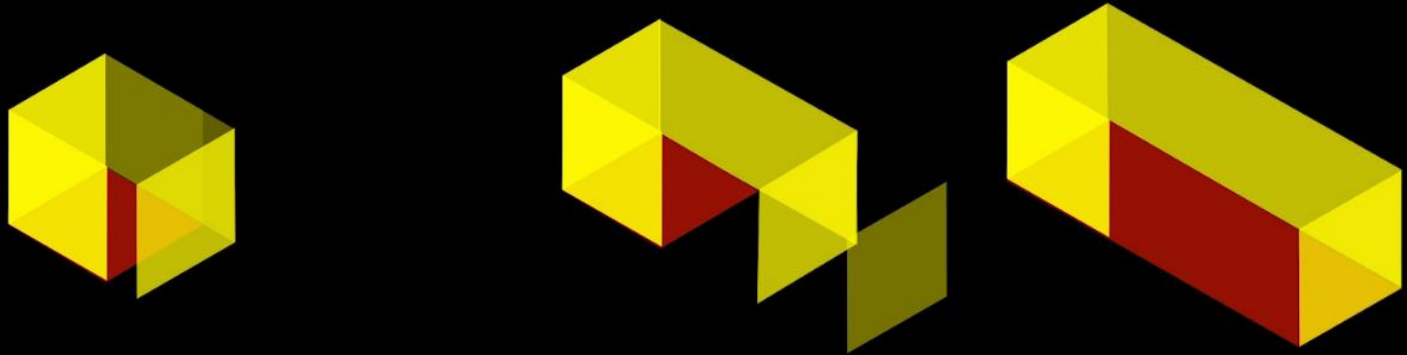
Lived here for two years in the 1980's

San Francisco California skyline

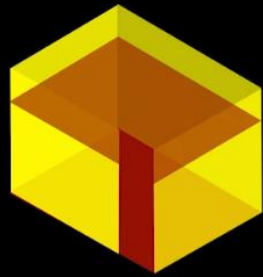


“proportional constraints on form by materials or structure, control proportion of forms and spaces

... To make a room square or oblong



... intimate or lofty in scale,



... or imposing, with higher-than-normal facade“ [1]



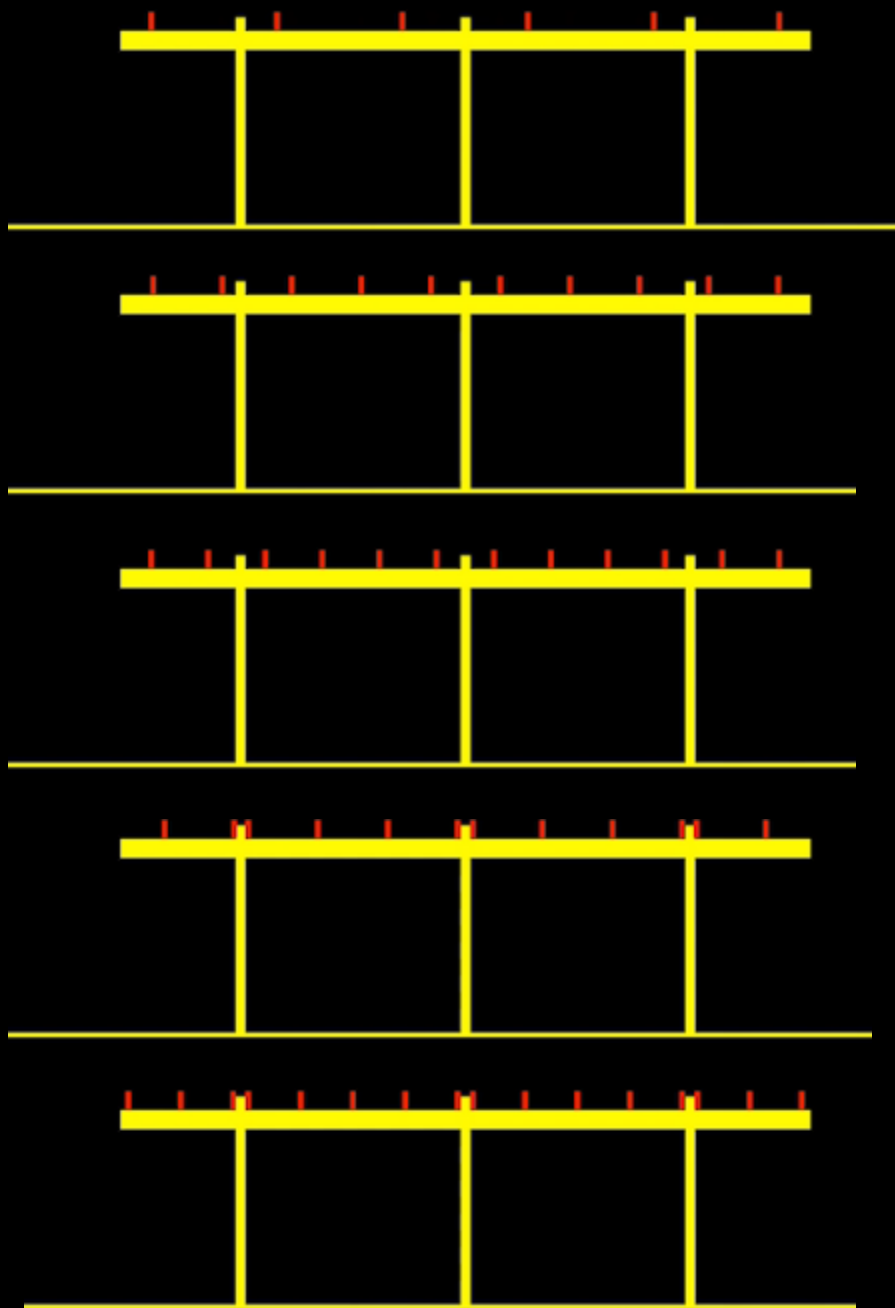
“ Is there a point at which the overhead plane becomes visually too much for its supporting visual mass?”



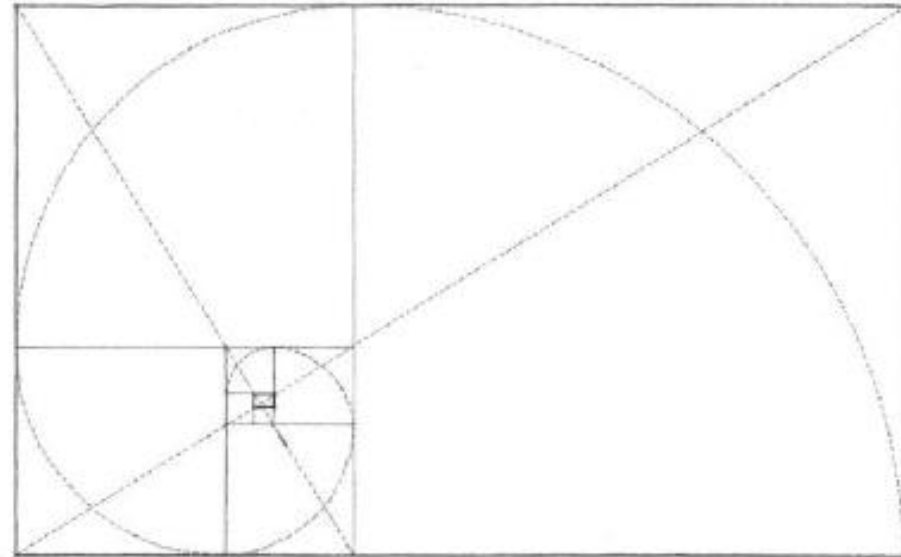
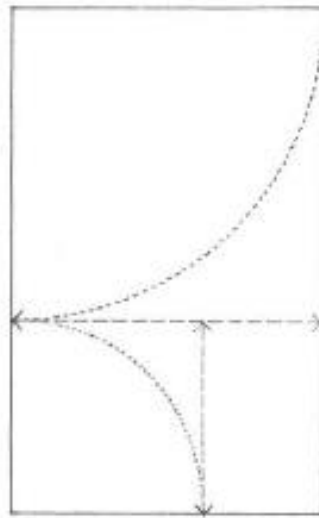
Or a point at which the supporting visual structure becomes too light to support the overhead plane?” [1]



“At what point does this array of trellising appear to be properly spaced?” [1]



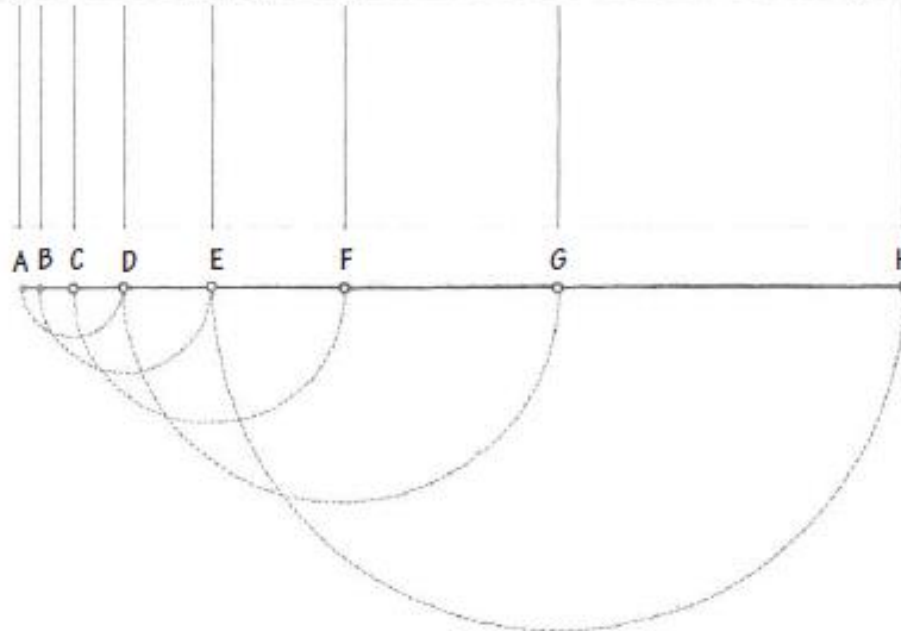
PROPORTION– The Golden Section/ Golden Ratio



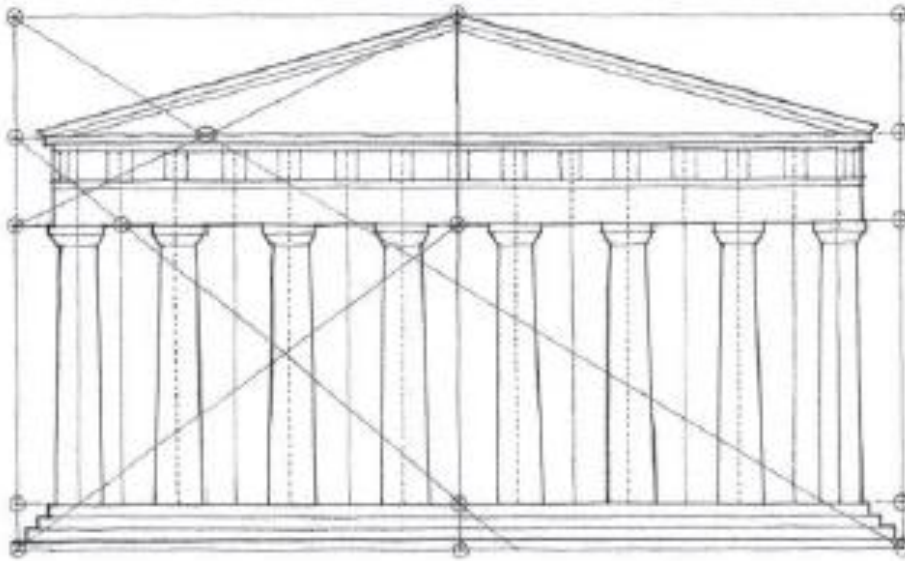
$$\frac{AB}{BC} = \frac{BC}{CD} = \frac{CD}{DE} \dots = \theta$$

$$AB + BC = CD$$
$$BC + CD = DE$$

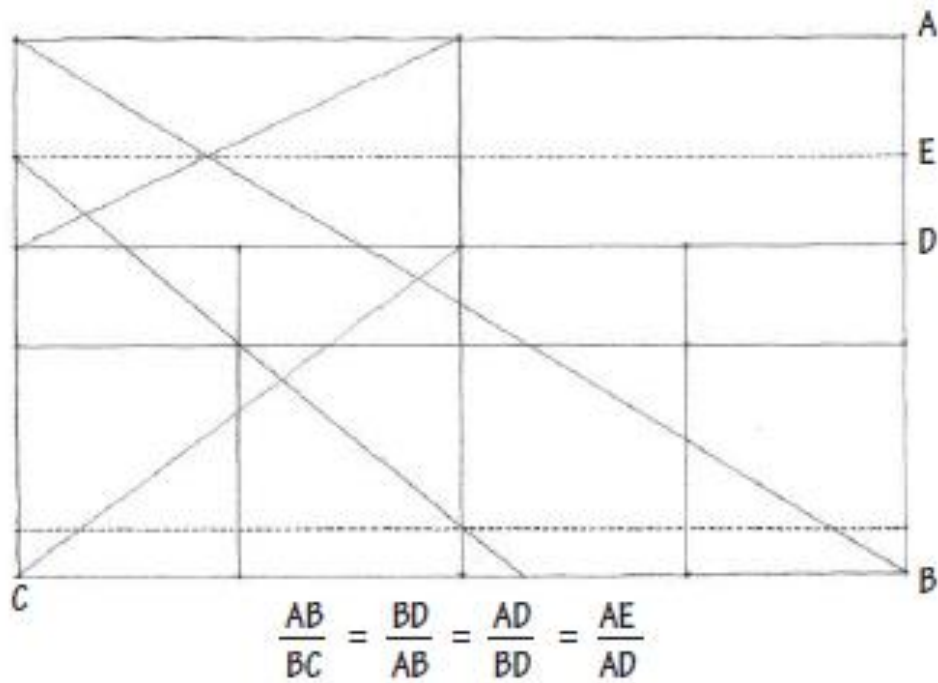
etc.



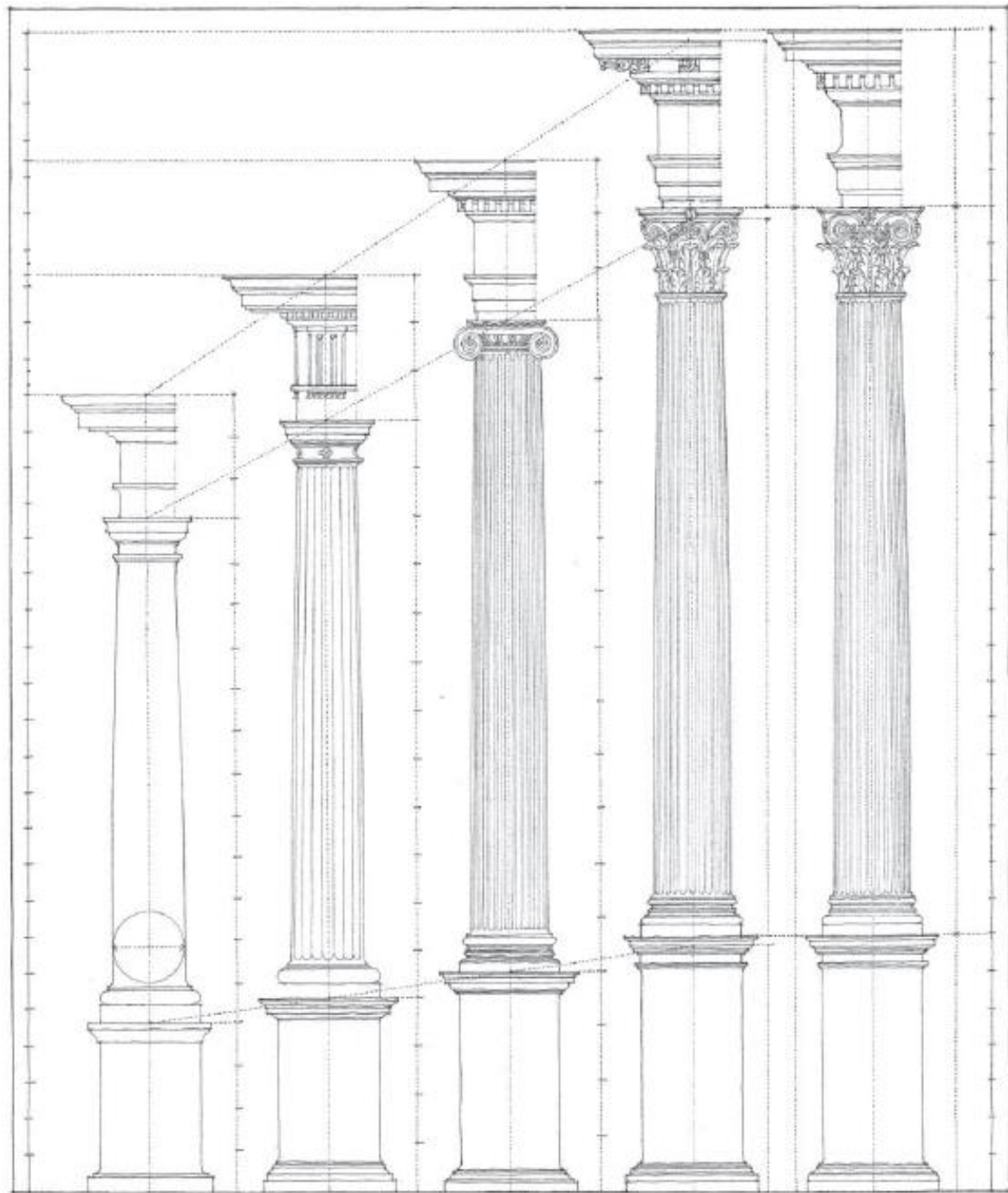
PROPORTION- The Golden Section/ Golden Ratio



The Parthenon, Athens, 447–432 B.C., Ictinus and Callicrates



CLASSICAL ORDERS



Tuscan

Doric

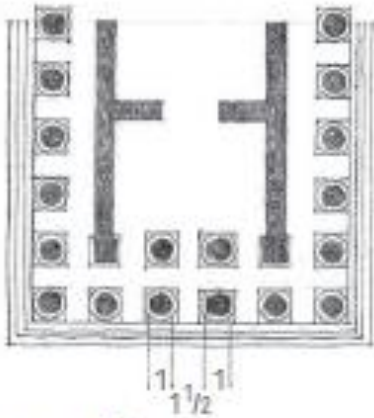
Ionic

Corinthian

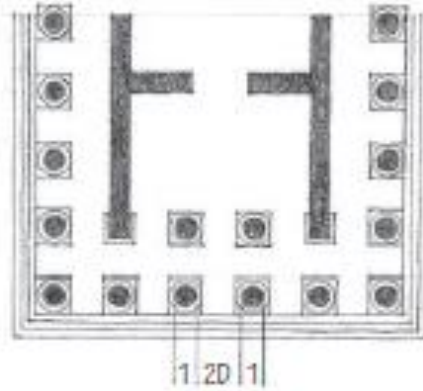
Composite



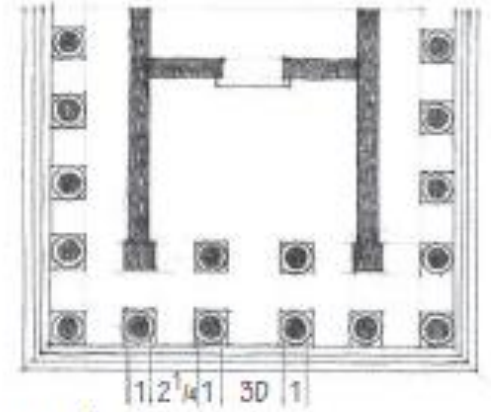
CLASSICAL ORDERS



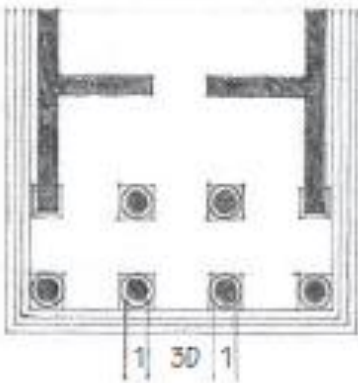
Pycnostyle



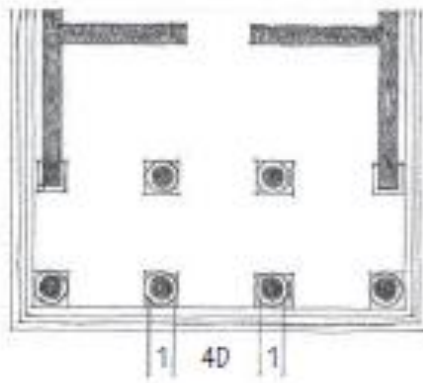
Systyle



Eustyle



Diastyle



Araeostyle

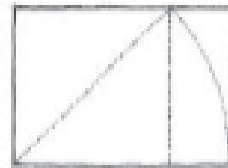
Classification of Temples according to their **intercolumniation**



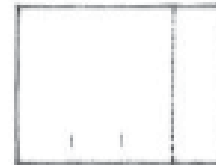
RENAISSANCE THEORY

Seven Ideal Plan Shapes for Rooms.

Andrea Palladio (1508–1580) was probably the most influential architect of the Italian Renaissance. In *The Four Books on Architecture*, first published in Venice in 1570, he followed in the footsteps of his predecessors, Alberti and Serlio, and proposed these seven “most beautiful and proportionable manners of rooms.”



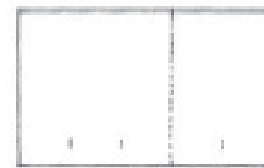
$1:\sqrt{2}$



3:4



2:3



3:5



1:2



RENAISSANCE THEORY

Determining the Heights of Rooms.

Palladio also proposed several methods for determining the height of a room so that it would be in proper proportion to the room's width and length. The height of rooms with flat ceilings would be equal to their width. The height of square rooms with vaulted ceilings would be one-third greater than their width. For other rooms, Palladio used Pythagoras' theory of means to determine their heights. Accordingly, there were three types of means: arithmetic, geometric, and harmonic.

Arithmetic:

$$\frac{c-b}{b-a} = \frac{c}{a} \text{ (e.g., 1, 2, 3... or 6, 9, 12)}$$

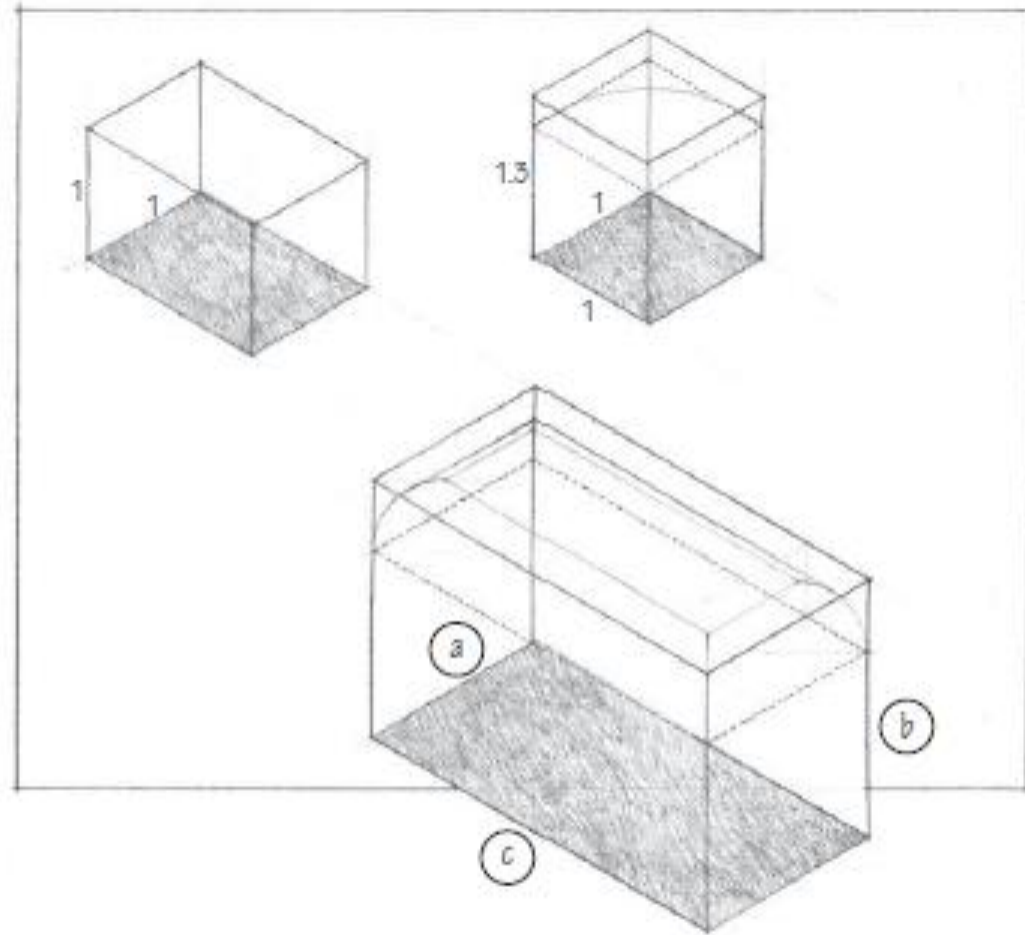
Geometric:

$$\frac{c-b}{b-a} = \frac{c}{b} \text{ (e.g., 1, 2, 4... or 4, 6, 9)}$$

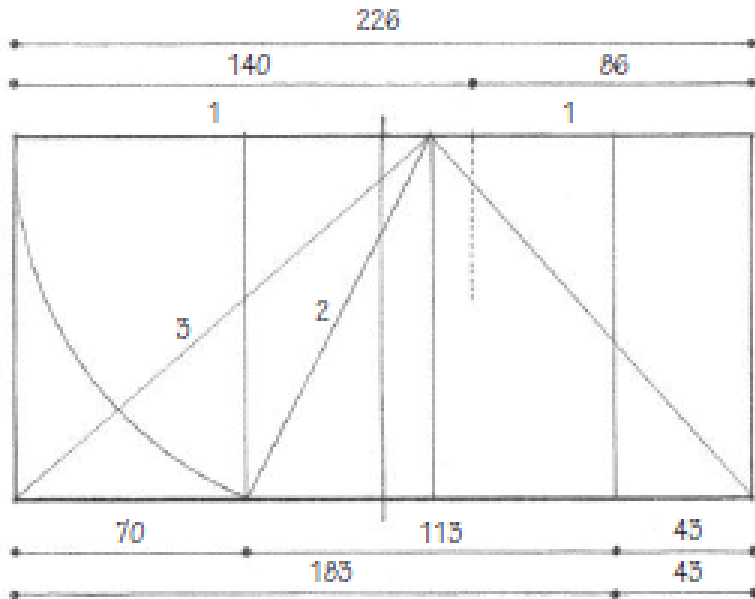
Harmonic:

$$\frac{c-b}{b-a} = \frac{c}{a} \text{ (e.g., 2, 3, 6... or 6, 8, 12)}$$

In each case, the height of a room is equal to the mean (b) between the two extremes of the width (a) and length (c) of the room.

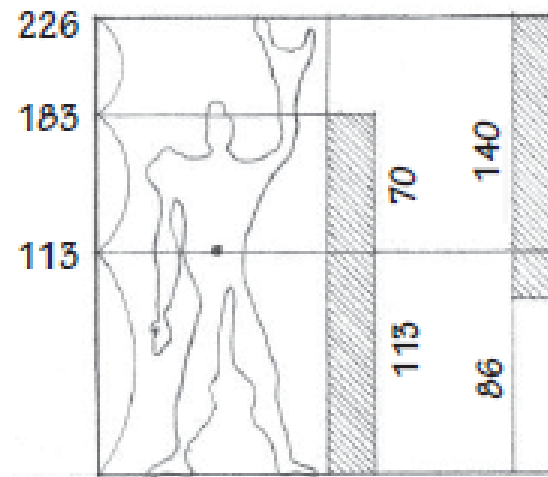
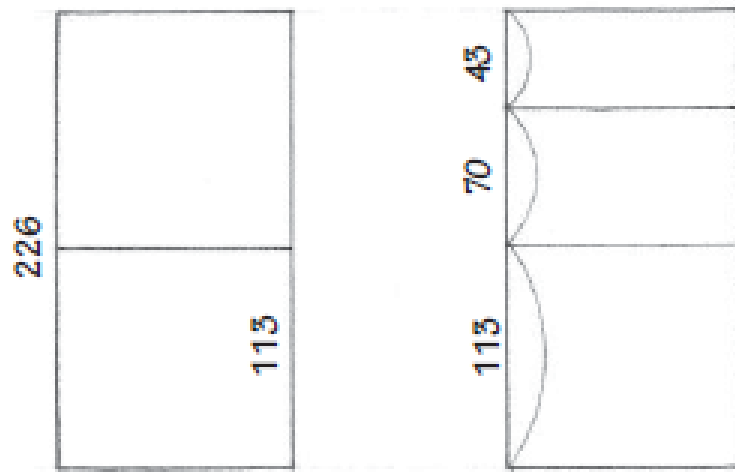


“MODULOR” – by Le Corbusier

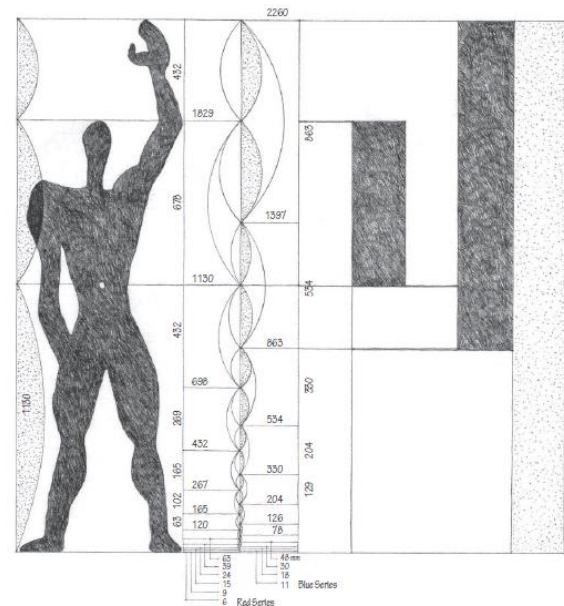
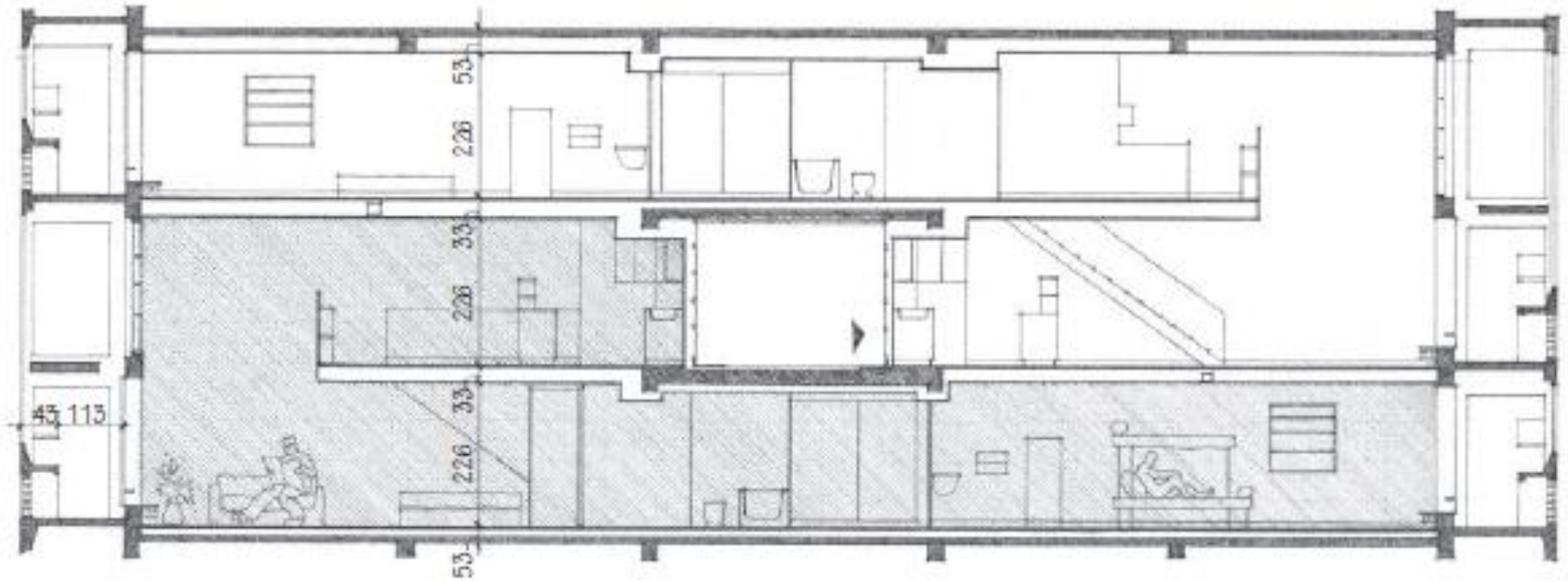


Le Corbusier developed his proportioning system, the Modulor, to order “the dimensions of that which contains and that which is contained.” He saw the measuring tools of the Greeks, Egyptians, and other high civilizations as being “infinitely rich and subtle because they formed part of the mathematics of the human body, gracious, elegant, and firm, the source of that harmony which moves us, beauty.” He therefore based his measuring tool, the Modulor, on both mathematics (the aesthetic dimensions of the Golden Section and the Fibonacci Series), and the proportions of the human body (functional dimensions).

Le Corbusier began his study in 1942, and published *The Modulor: A Harmonious Measure to the Human Scale Universally Applicable to Architecture and Mechanics* in 1948. A second volume, *Modulor II*, was published in 1954.



“MODULOR” – by Le Corbusier



Le Corbusier

***Unité d'Habitation
Marseille, France 1945***



<http://thepositive.com/sounds-and-lights-animate-the-machine-for-living/>

Le Corbusier

***Villa Savoye
Poissy, France 1931***



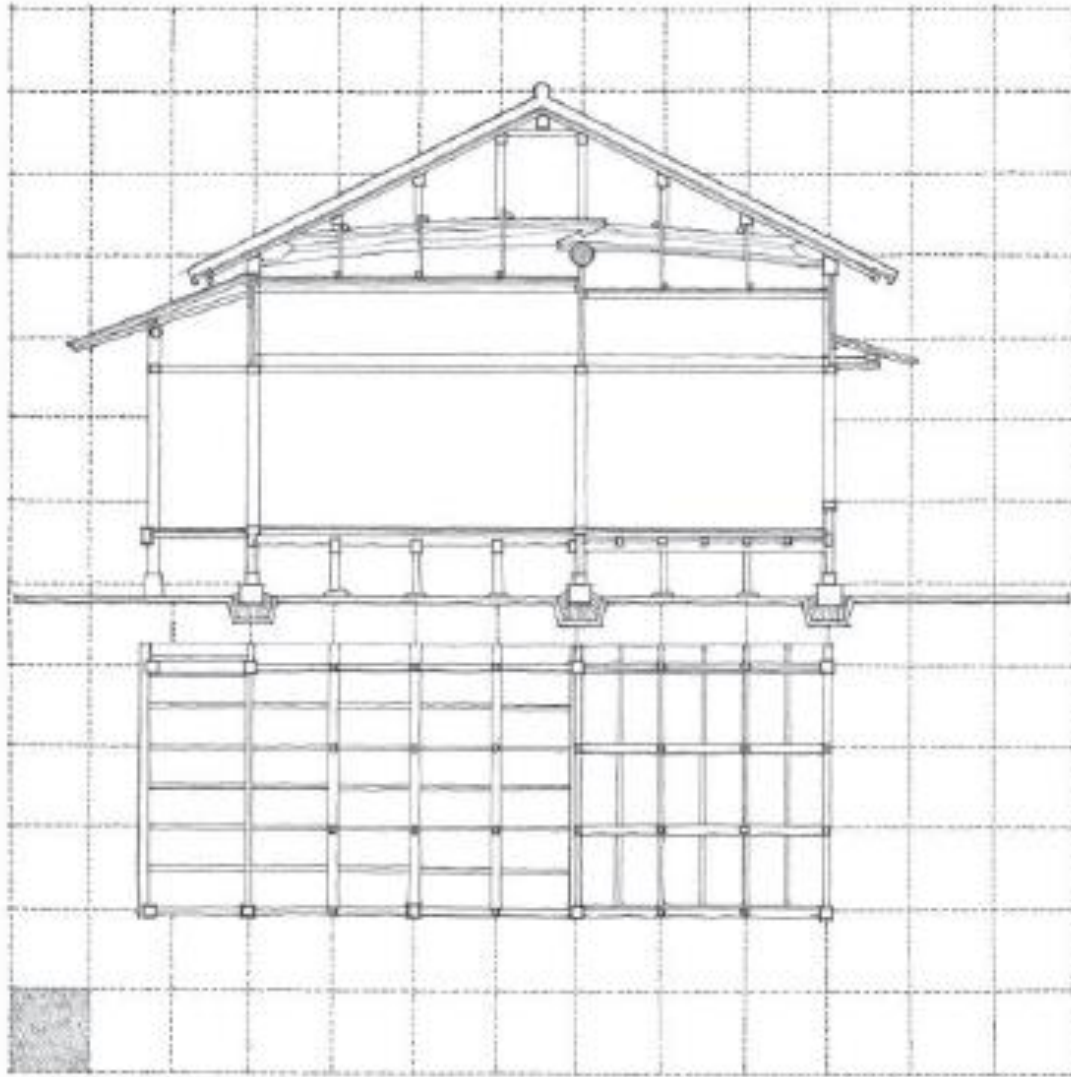
http://www.fondationlecorbusier.fr/CorbuCache/410x480_2049_791.jpg



Le Corbusier - a planned city concept:



“KEN” – in Japan



Traditional Japanese House

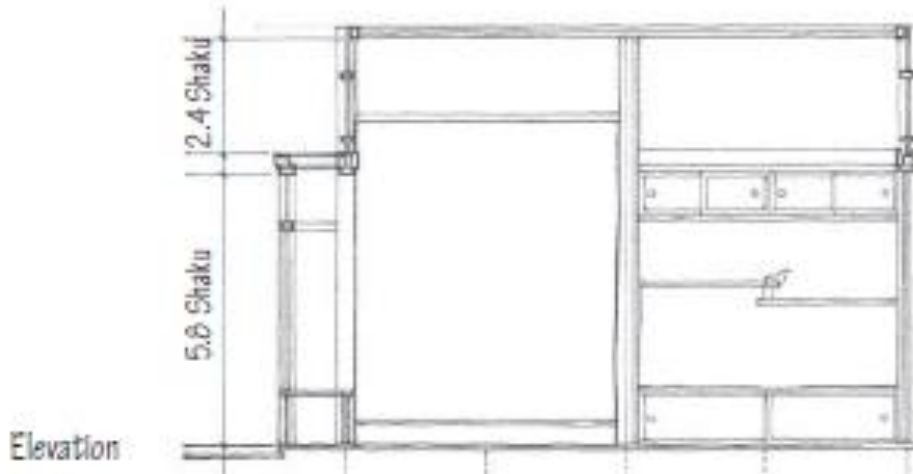
The traditional Japanese unit of measure, the shaku, was originally imported from China. It is almost equivalent to the English foot and divisible into decimal units. Another unit of measure, the ken, was introduced in the latter half of Japan's Middle Ages. Although it was originally used simply to designate the interval between two columns and varied in size, the ken was soon standardized for residential architecture. Unlike the module of the Classical Orders, which was based on the diameter of a column and varied with the size of a building, the ken became an absolute measurement.

The ken, however, was not only a measurement for the construction of buildings. It evolved into an aesthetic module that ordered the structure, materials, and space of Japanese architecture.



“KEN” – in Japan

Traditional Japanese House



Elevation

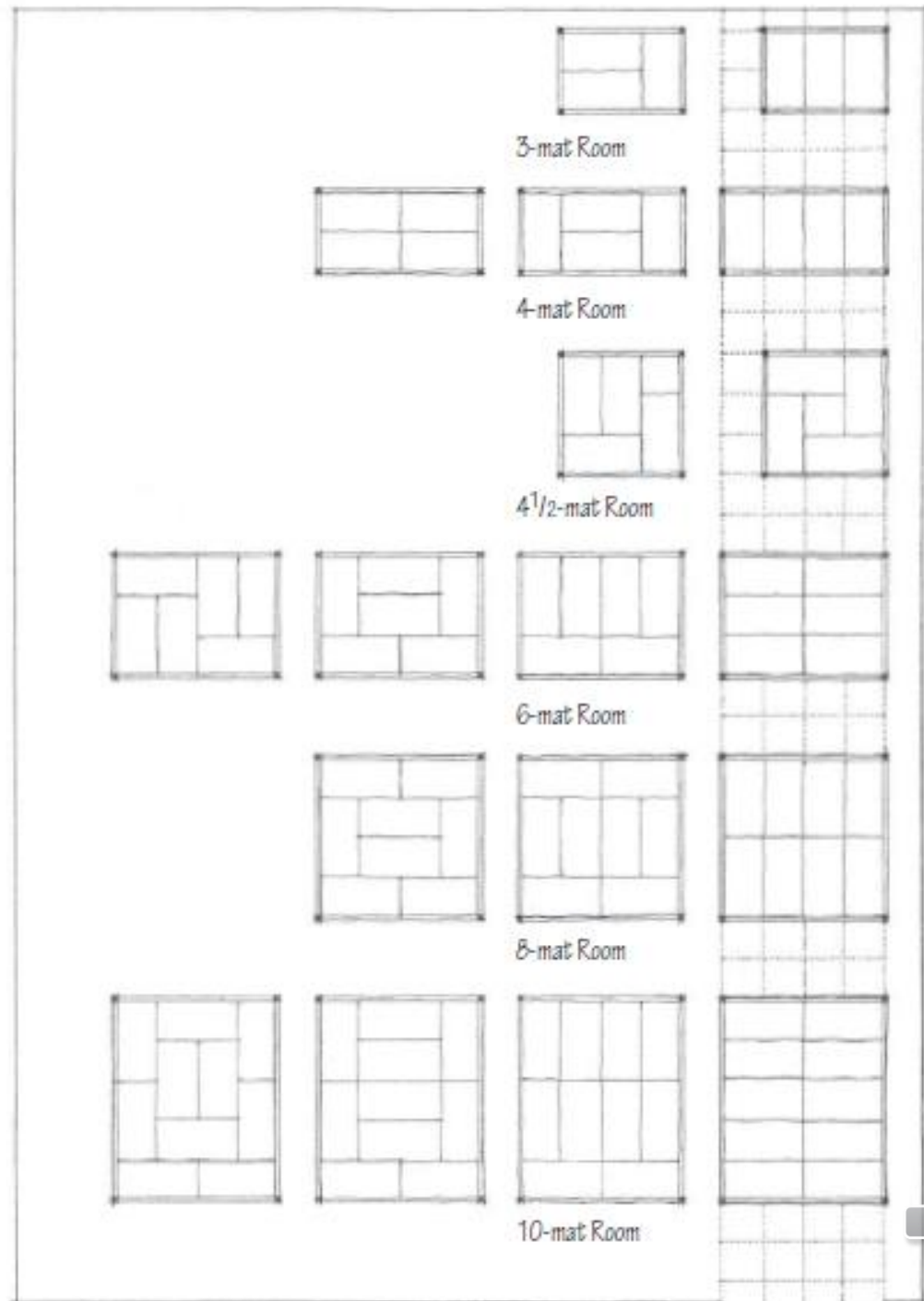
The **tokonoma** (picture recess) is a shallow, slightly raised alcove for the display of a kakemono or flower arrangement. As the spiritual center of a traditional Japanese house, the tokonoma is located in its most formal room.

Partial Plan



“KEN” – in Japan

Two methods of designing with the ken modular grid developed that affected its dimension. In the Inakama method, the ken grid of 6 shaku determined the center-to-center spacing of columns. Therefore, the standard tatami floor mat (3 x 6 shaku or 0.5 x 1 ken) varied slightly to allow for the thickness of the columns.



“KEN” – in Japan

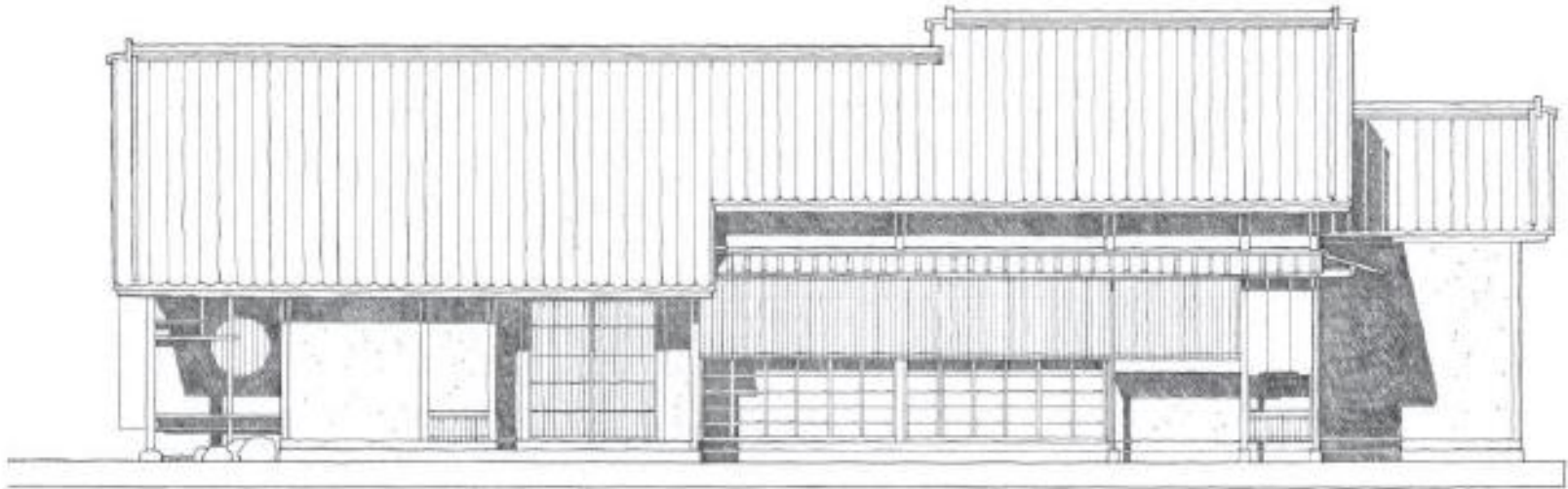


In a typical Japanese residence, the ken grid orders the structure as well as the additive, space-to-space sequence of rooms. The relatively small size of the module allows the rectangular spaces to be freely arranged in linear, staggered, or clustered patterns.



“KEN” – in Japan

Elevations of a Traditional Japanese Residence



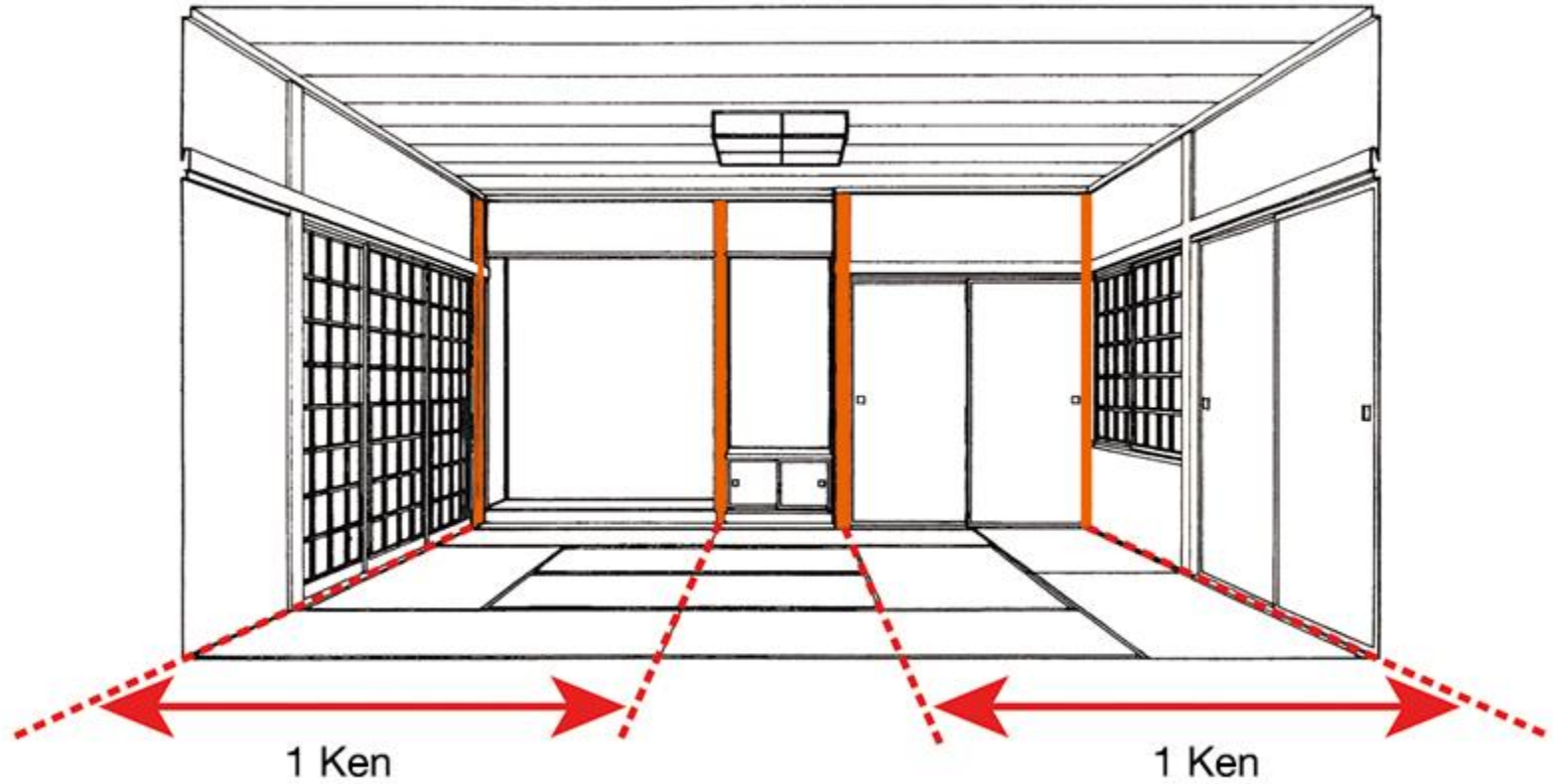
North Elevation



East Elevation



“KEN” – in Japan



<https://art-design-glossary.musabi.ac.jp/ken/>



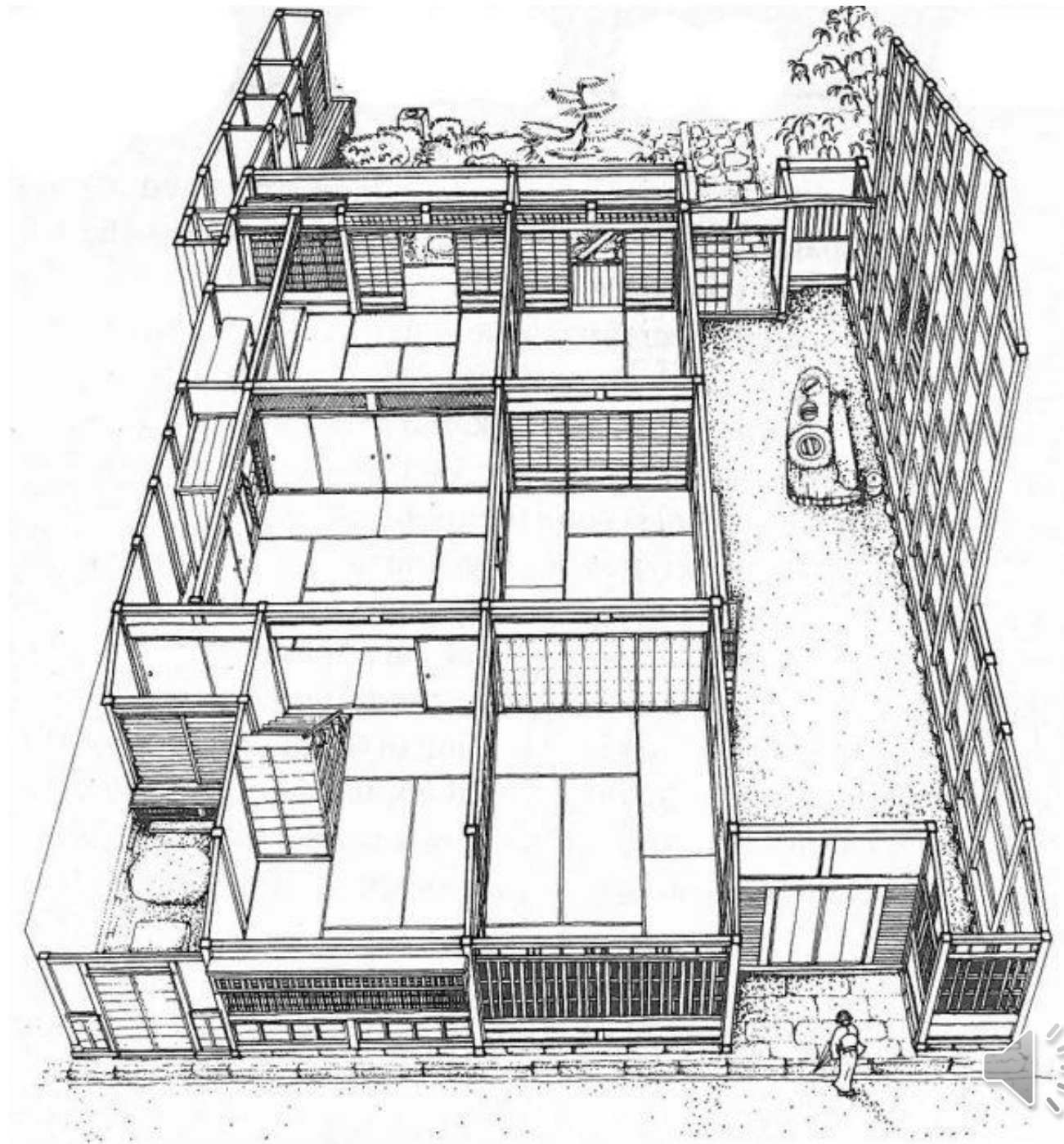
“KEN” – in Japan

<http://inpark22.blogspot.com/2012/02/ken>



<http://inpark22.blogspot.com/2012/02/ken.html>

“KEN” – in Japan



<https://www.kyotojournal.org/culture-arts/maplace-space-void/>

“Modularity” in Frank Lloyd Wright’s textile houses

Ennis House in Los Angeles

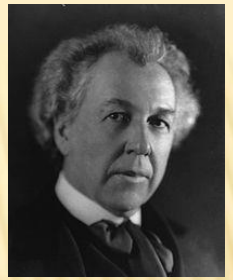


“Modularity” in Frank Lloyd Wright’s textile houses

Ennis House in Los Angeles



AGE 56 (1923)



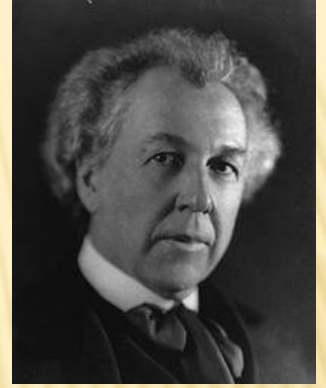
FRANK LLOYD WRIGHT

- × STILL Recovering from shock & **Trauma** of Mistress's 1914 murder?!
- × Creates more Mayan Pre-Columbian type Architecture in California
 - + TEXTILE HOUSES
 - × Tomblike and reminiscent of Mayan burial rituals (and human sacrifice)
 - * He's arguably still feeling the trauma of the murder of his mistress



56 YEARS OLD (1923)

Textile Houses



FRANK LLOYD WRIGHT

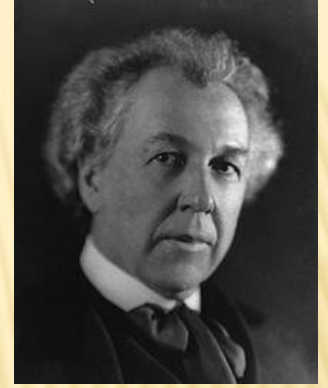


MILLIARD HOUSE IN LOS ANGELES, 1923



56 YEARS OLD (1923)

Textile Houses



FRANK LLOYD WRIGHT

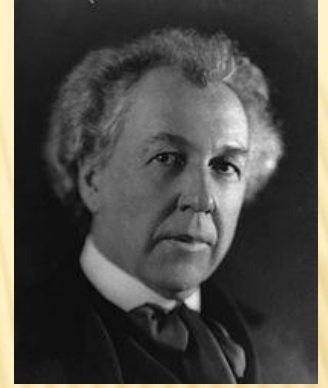


JOHN STORRER HOUSE IN LOS ANGELES, 1923

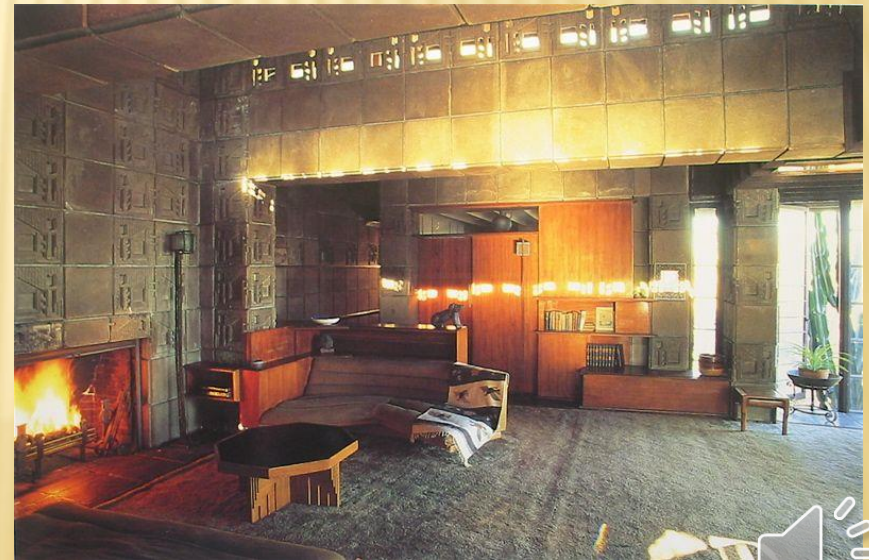


56 YEARS OLD (1923)

Textile Houses



FRANK LLOYD WRIGHT

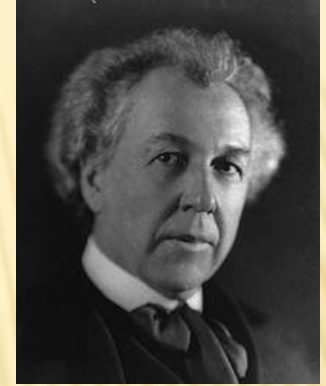


SAMUEL FREEMAN HOUSE IN LOS ANGELES, 1923



56 YEARS OLD (1923)

MODULARITY “Structured ART”



FRANK LLOYD WRIGHT

- ✘ His “Textiles” in his Textile houses

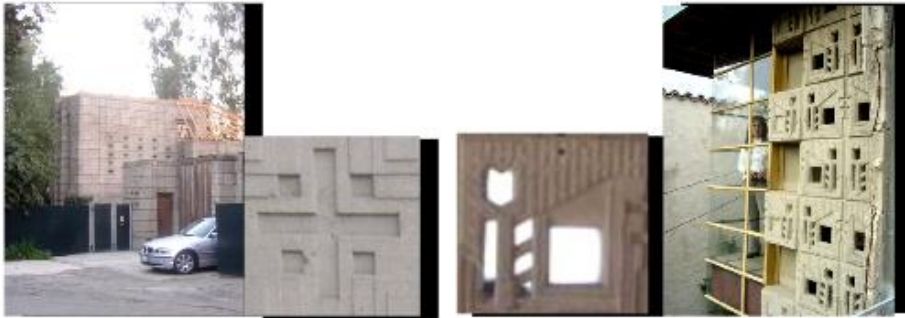


Figure 1: Millard House/block detail, Pasadena, CA. Freeman House/block detail, Hollywood, CA. Photos Angela Paola Vargas, 2004.

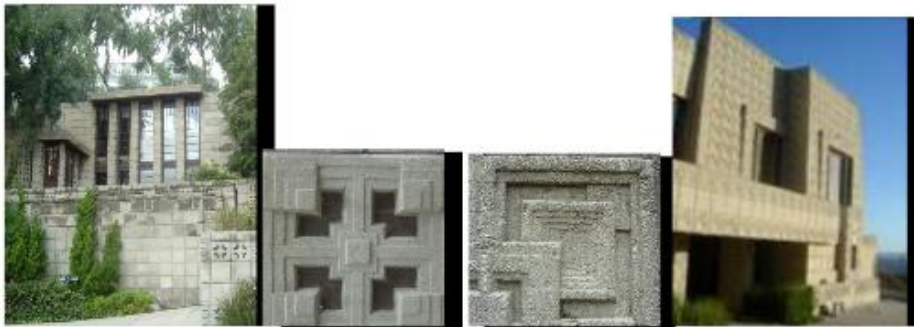


Figure 2: Storer House/block detail, Hollywood, CA. Ennis-Brown House/block detail, Hollywood, CA. Photos Angela Paola Vargas, 2004.

Cast concrete shapes, in **unit sizes**, with Mayan patterns, and woven together with steel reinforcing bars (Rebar)

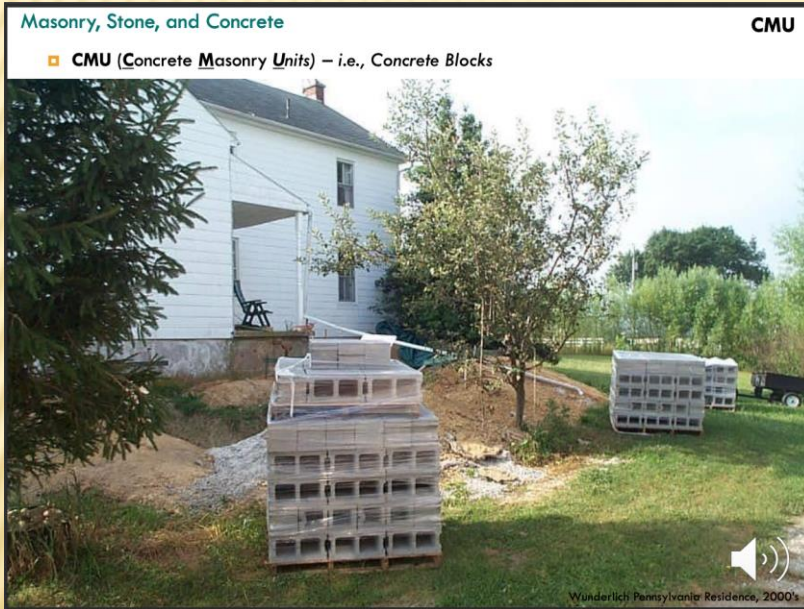
From

[The textile block system: seismic analysis and upgrading](#), A.P. Vargas & G. G. Schierle, USC School of Architecture, Los Angeles, CA, USA, *WIT Transactions on State of the Art in Science and Engineering*, Vol 62, 2013 WIT Press.

MODULARITY

“Structured ART”

- His **TEXTILE BLOCKS** are like present day Concrete Masonry Units (CMU) referred to in layman’s terms as concrete blocks

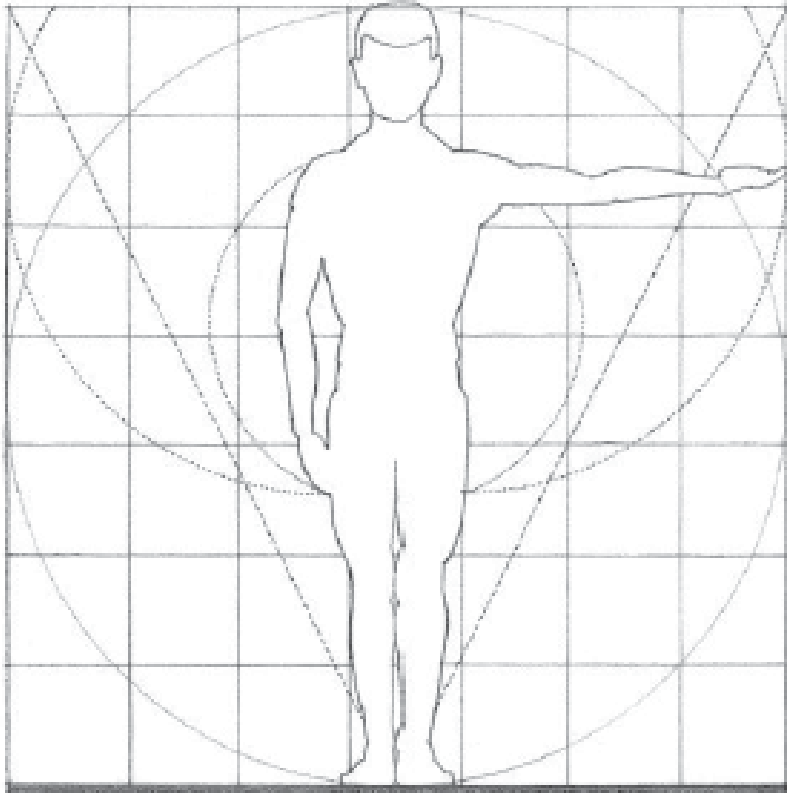


From Wunderlich
Lecture on CMU in
Materials & Methods
course

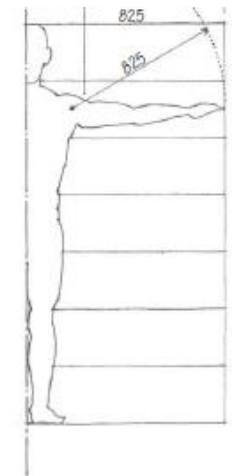
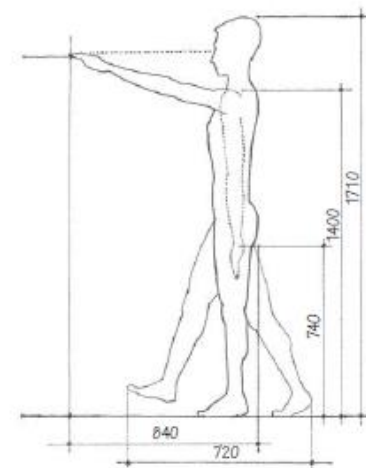
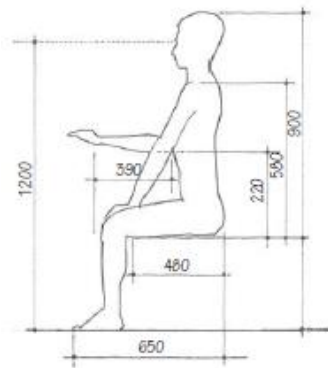
([PDF](#)) ([PPTX-w/audio](#))



ANTHROPOMETRY

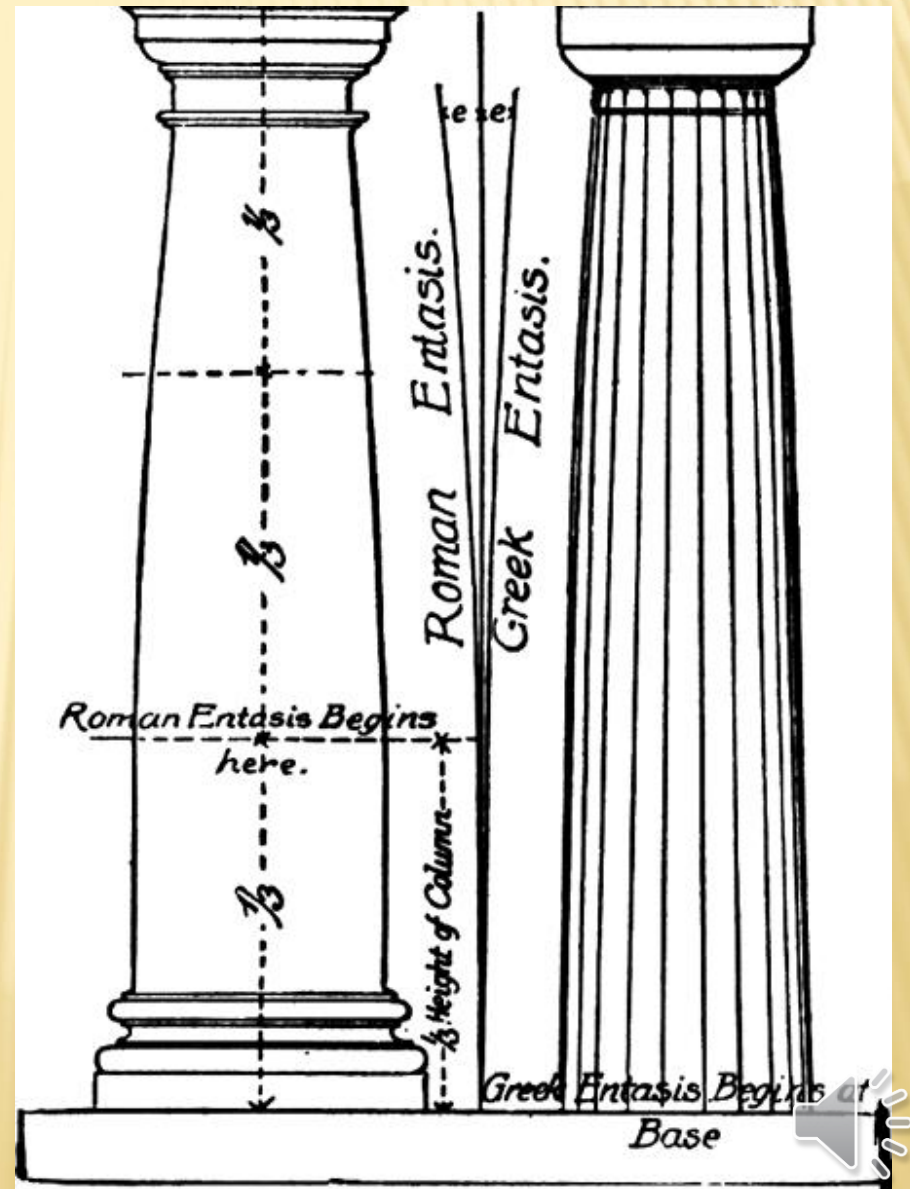


Anthropometry refers to the measurement of the size and proportions of the human body. While the architects of the Renaissance saw the proportions of the human figure as a reaffirmation that certain mathematical ratios reflected the harmony of their universe, anthropometric proportioning methods seek not abstract or symbolic ratios, but functional ones. They are predicated on the theory that forms and spaces in architecture are either containers or extensions of the human body and should therefore be determined by its dimensions.



ANTHROPOMORPHISM

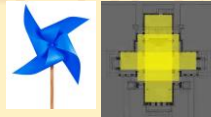
- ✗ Animate the inanimate
 - + Equate columns with humans
 - ✗ “Entasis” in columns is a slight curvature to resemble hips



ORGANIC ARCHITECTURE DESIGN PRINCIPLES

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

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

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

Arts & Crafts, Italy, JAPAN

Frank Lloyd Wright

Japanese Buddhism & Shintoism, with some roots in Chinese Philosophy

FROEBEL BLOCKS



UNITARIAN MOTHER Teacher



© JT Wunderlich PhD



MUSICIAN Preacher FATHER



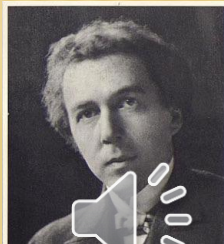
ARCHITECT MENTOR Louis Sullivan



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

More on ORGANIC ARCHITECTURE DESIGN PRINCIPLES:

Wunderlich Lecture Series on *“The Life and Work of Frank Lloyd Wright”* ©



Frank Lloyd Wright

1867-1958



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