Skyscrapers

JT Wunderlich PhD

http://www.evolo.us/wp-content/uploads/2010/07/twisting-tower-shanghai.jpg

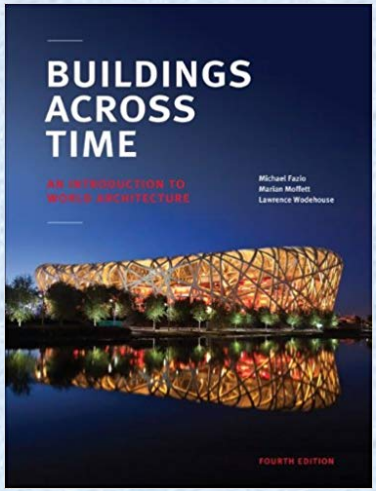
AGENDA

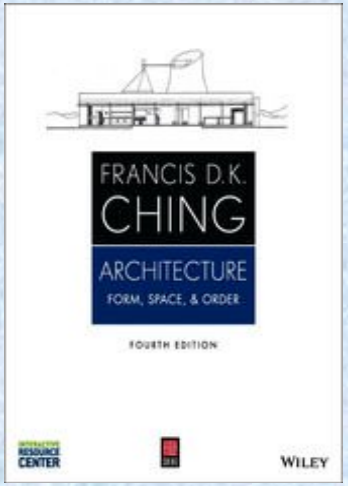
- Architecture Theory and Urban Design Throughout
- Engineering Innovations

Primary Sources

[1] Fazio, Michael and Moffett, Marian. ***Buildings Across Time.*** Lawrence Wodehouse, 4th Edition, McGraw Hill, 2013. (ART280 course text)

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





- Personal Architecture projects in Texas, California, and Pennsylvania
  - BS Architectural Engineering (U.Texas 84)
  - 1-1/2 years of Urban Design (UCSD 1986-87)
  - Education and experience for past 40 years applicable towards licensing as both a Professional Engineer and a Registered Architect
- Frequent international travel pictures of Architecture and Urban Design

A skyscraper is a Tower

During Feudal times (e.g. Europe or Japan), towers protected cities and castles, and demonstrated status of feudal Lords and Kings

Belgium 2014

Kasteel Beersel, Belgium

Kasteel Beersel, Belgium


Belgium 2014
Kasteel Beersel, Belgium

Selecting a castle to visit on 2014 Belgium/Italy/England trip

GASBEEK 10am to 6pm (last visit starts at 5pm), Tuesday to Sunday, April to October. 4 €. The big park surrounding the castle is open 8am to 8pm and admission is free. Daily => *(except a few Tuesdays and the first Saturday of the month) from 1st April to 30th September, from 10:00 am to 5:30 pm. Admission is 5 €.f*

No

From 10am to 12noon and 2pm to 6pm, **Tuesday to Sunday** from 1 March to 15 November

The castle is open from 1:00 pm to 6:00 pm everyday from 15 May to 30 September, and on weekends and holidays from 1 April to 14 May, or everyday from April to 15 October on demand for groups

The castle is open everyday, except Mondays which are not public holidays, from 10:00 am to 6:00 pm (last admission 5:30 pm). Entry to the castle is 4.96 € for adults, 3.72 € for senior (over 60), youth (12 to 18)

Rixensart Castle is only open on weekends and holidays from 2:00 pm to 6:00 pm, between 15 April to 31 October.

Entry cost 3.80 € for adults, 2.5 € for students and people between 13 and 18 and over 60 years old, 1.3 € for children between 6 and 13 years old and free under 6 and for disabled people. Guided tours take place every Sunday from April to October from 3:00 pm (6 €).

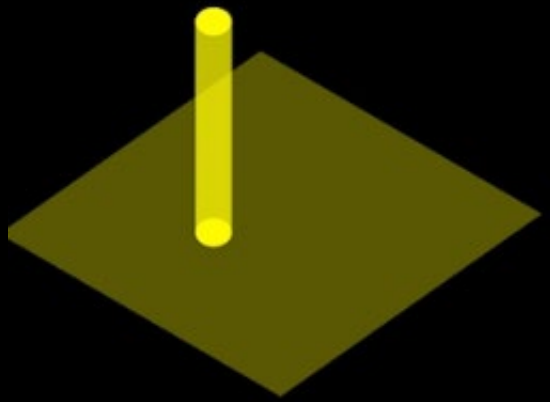
The castle is only open from 1st May to 28th September on Sundays and public holidays from 10:00 am to 6:00 pm (also Saturdays in July and August). Entry is 7 € for adults, and 2 € for children between 6 and 10 years old.

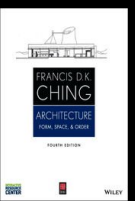
Kasteel Beersel, Belgium

DEFINING SPACE

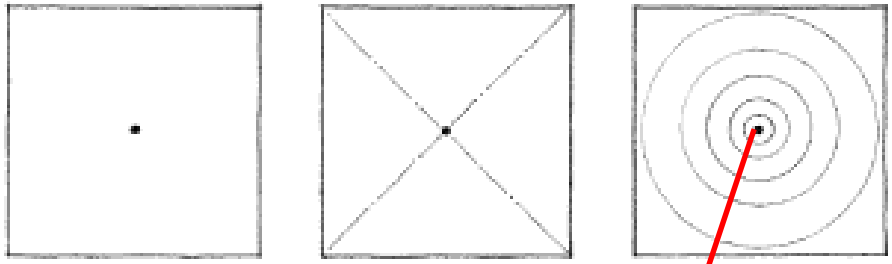
"A obelisk or tower establishes a point on the ground and makes it visible in space

… a column generates a field about itself and interacts with the space" [2]





"At the center of its environment, a point is stable and at rest, organizing surrounding elements about itself and dominating its field" [2]

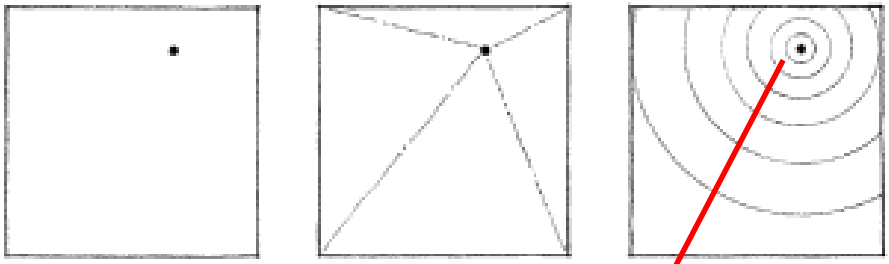


Rome, 2011

Piazza San Pietro, Vatican City, Rome


Rome 2011

*'When moved **off center**, it's field becomes more aggressive and begins to compete for visual supremacy. **Visual tension is created between the point and it's field"*** [2]



Campanile di San Marco in Piazza San Marco, Venice

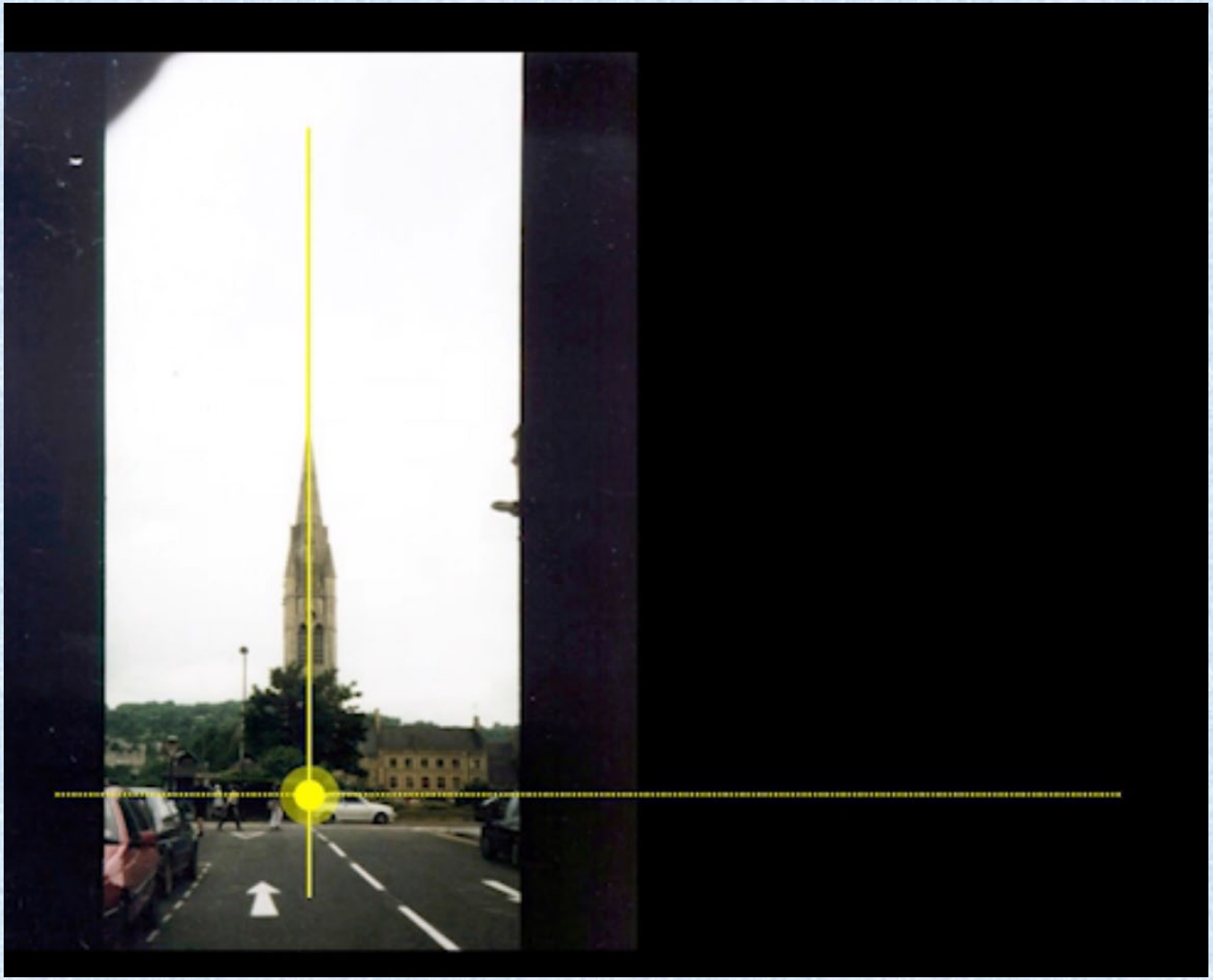
Venice 2008,2011,2014,2017

Venice 2008,2011,2014,2017


Venice 2008,2011,2014,2017

"A vertical line can express a state of equilibrium with gravity, and symbolize the human condition" [2]

“vertical equilibrium …the human condition” [2]



Venice 2008,2011,2014,2017

Prior to 1800's, most buildings not very tall, and mostly made of wood, or unreinforced masonry or concrete

UNREINFORCED CONCRETE

Concrete is a “concretion” of a mix of **AGGREGATE** (rocks) and a cementations binding material (**CEMENT**)

- Romans used it extensively from 300BC to 475AD

http://thumbs.media.smithsonianmag.com//filer/Roman-cement-

http://upload.wikimedia.org/wikipedia/commons/5/51/Rome-Pantheon-Interieur1.jpg

Early 1800's in the U.S.

First cast-iron frames and building fronts

(often painted to look like stone or other materials)

1865+ in the U.S.

Industrial revolution – mass production

Tall buildings a result of rising urban real estate values, and desire of businesses to remain in center of activity

William Le Baron Jenny

Home Insurance Building

Chicago 1883

Demolished 1931

1883 STEEL

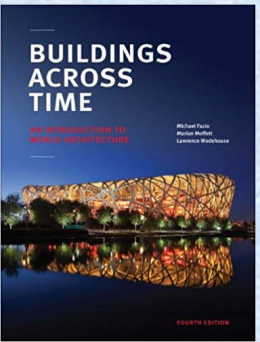
and an elevator

First *"Steel Skeleton"*

– but also much cast iron, and the first floor had masonry load-bearing walls [1]

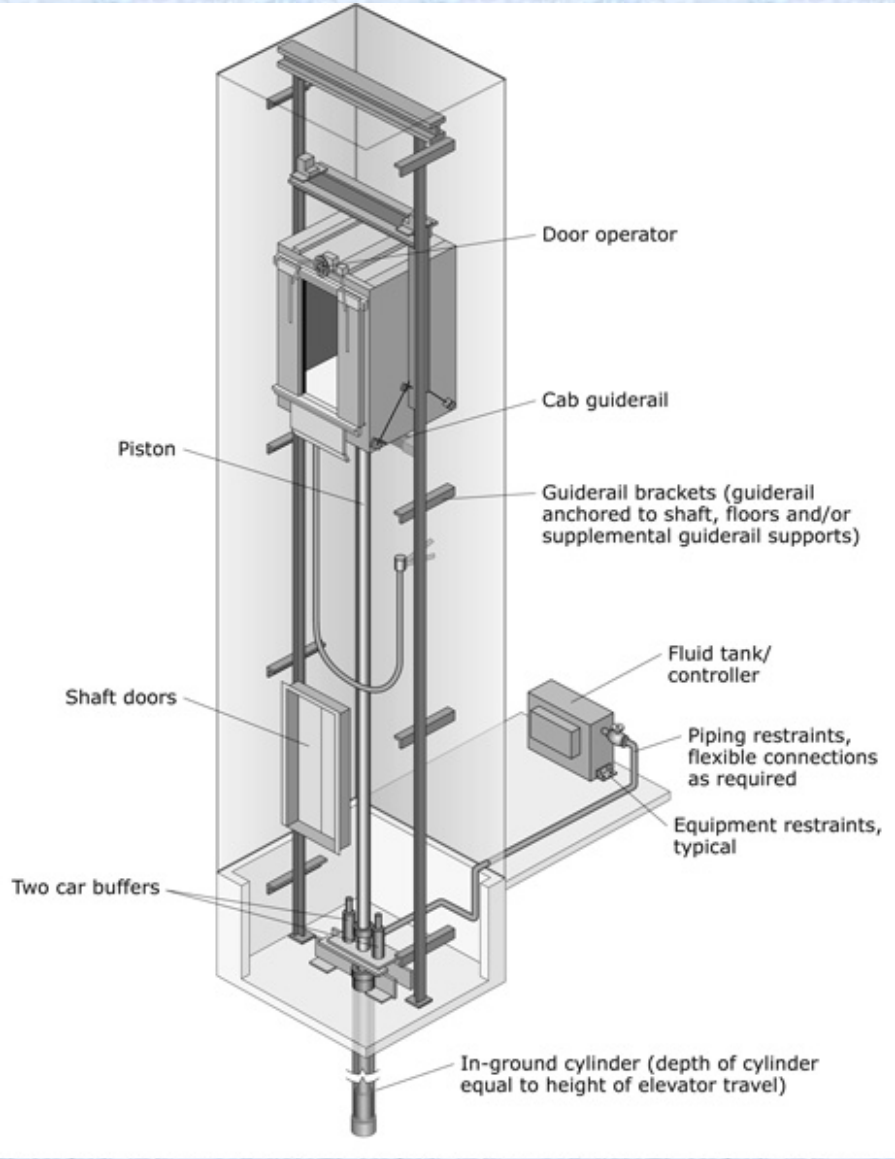
Also one of the first skyscrapers to use an elevator (hydraulic)

https://en.wikipedia.org/wiki/Home_Insurance_Building#/media/File:Home_Insurance_Building.JPG



ELEVATOR's Today

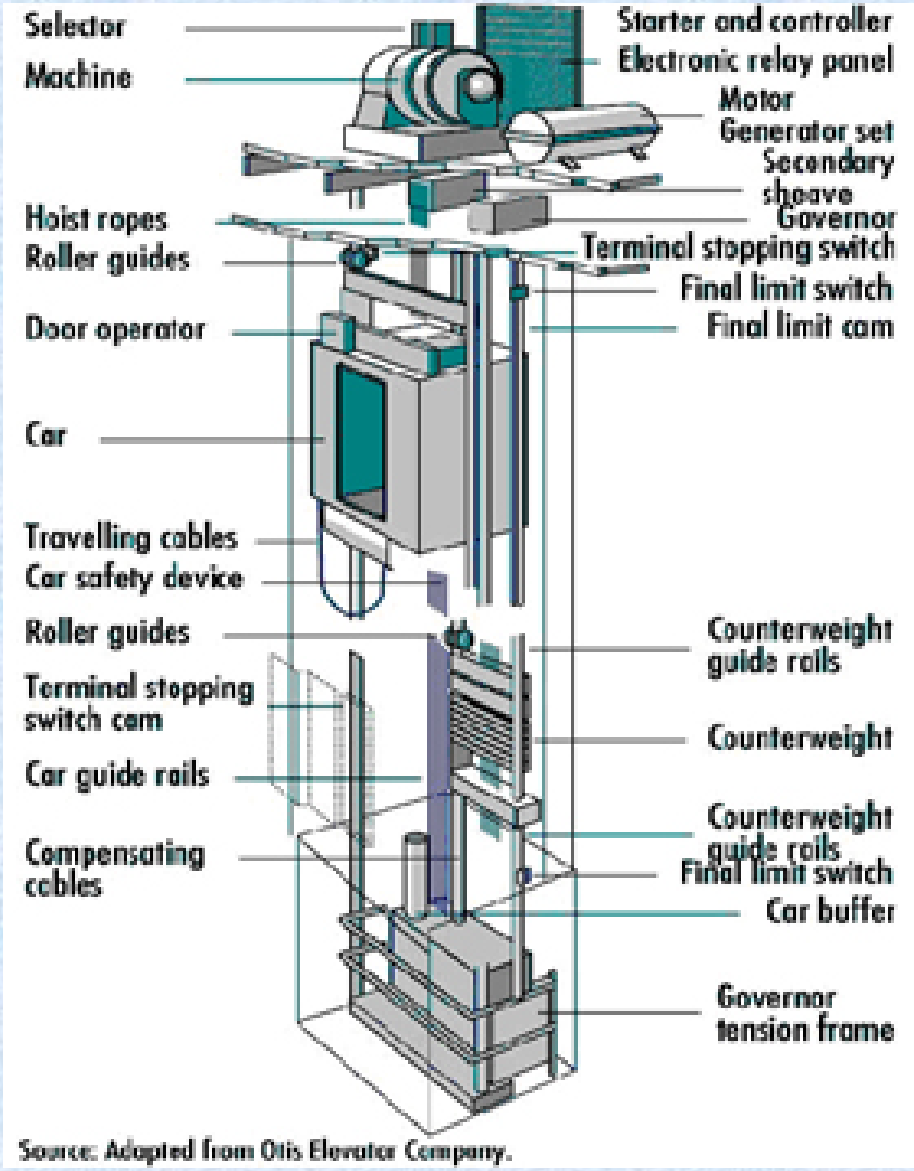
Hydraulic **elevators** for shorter buildings



http://www.fema.gov/sites/default/files/orig/plan/prevent/earthquake/fema74/images/chapter6_4_10/fig1_1.jpg

High-speed **elevators** for skyscrapers

-- use cables and electric motors

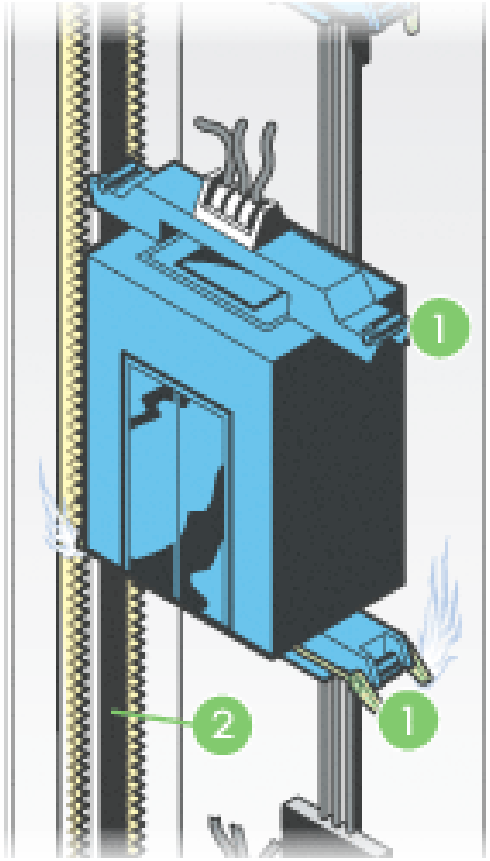


http://www.featurepics.com/FI/Thumb300/20070505/Highrise-Construction-306455.jpg

Elevator SAFETY-SYSTEMS allowed taller buildings

Braking system stops elevator from free-fall if cable snaps or melts

Also, **buffers** are at bottoms of shafts to dampen a falling elevator



1. If the cables snap, the elevator's **safeties** would kick in. **Safeties** are braking systems on the elevator.
2. Some safeties clamp the **steel rails** running up and down the elevator shaft, while others drive a wedge into the notches in the **rails**.

http://static.ddmcdn.com/gif/runaway-elevator-2.gif

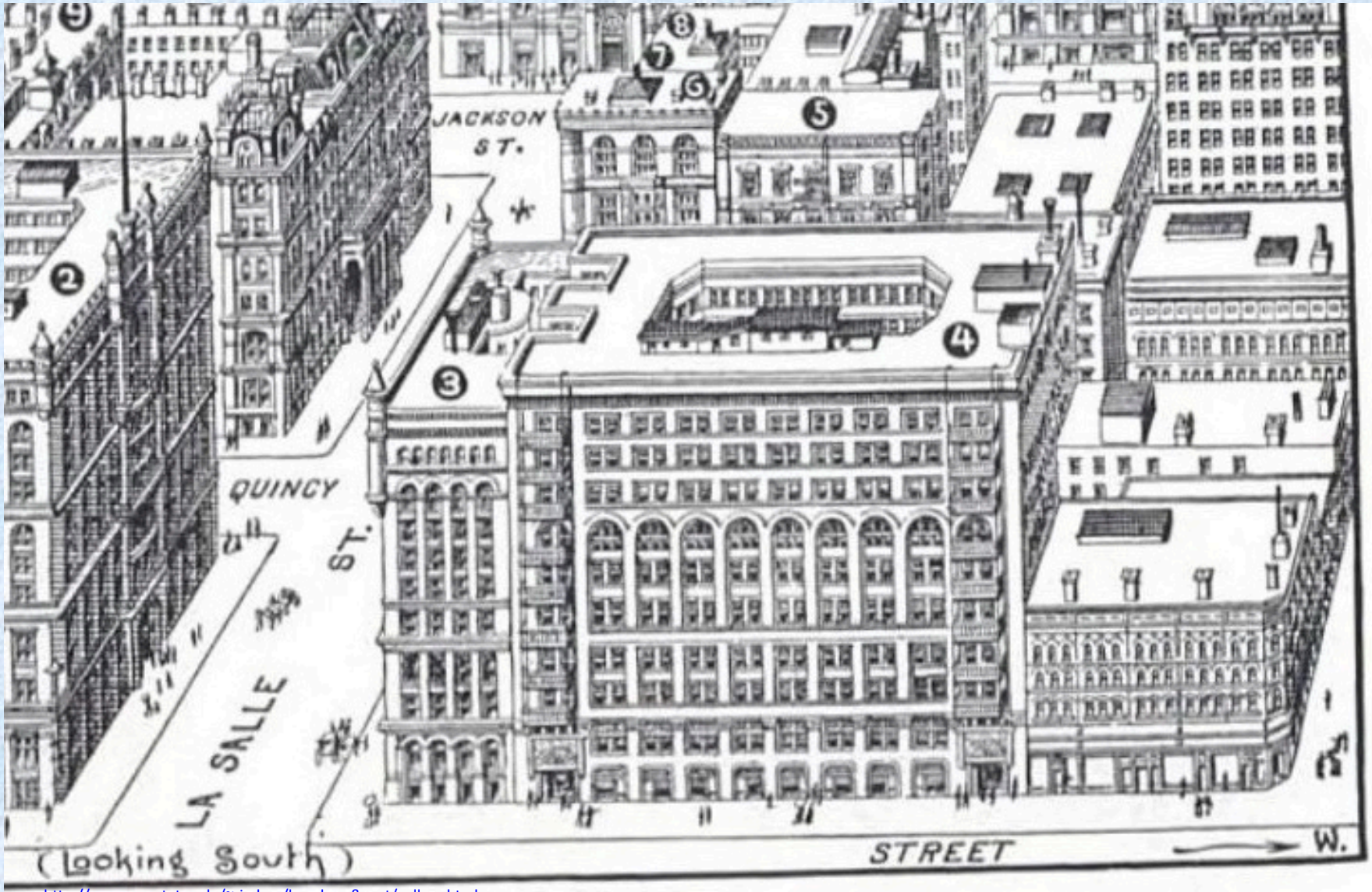
Burnham and Root

Rand McNally Building

Chicago 1889

Demolished 1911

First to use Structural Steel for entire frame [1]



http://www.appstate.edu/~riedme/burnham&root/gallery.html

Cast IRON

*"an alloy of iron, carbon, and silicon that is cast in a mold and is hard, **brittle**, **nonmalleable**"*

Wrought IRON

"a form of iron that is tough, malleable, and relatively soft, contains usually less than 0.1 percent carbon, and carries 1 or 2 percent of slag mechanically mixed with it"

STEEL

*"commercial iron that contains **carbon** as an essential alloying constituent, and is distinguished from cast iron by its **malleability** – less brittle (more "ductile")*

SOURCE: http://www.merriam-webster.com/dictionary/

From http://image.slidesharecdn.com/structural-steel-8768/95/structural-steel-6-728.jpg?cb=1173466999

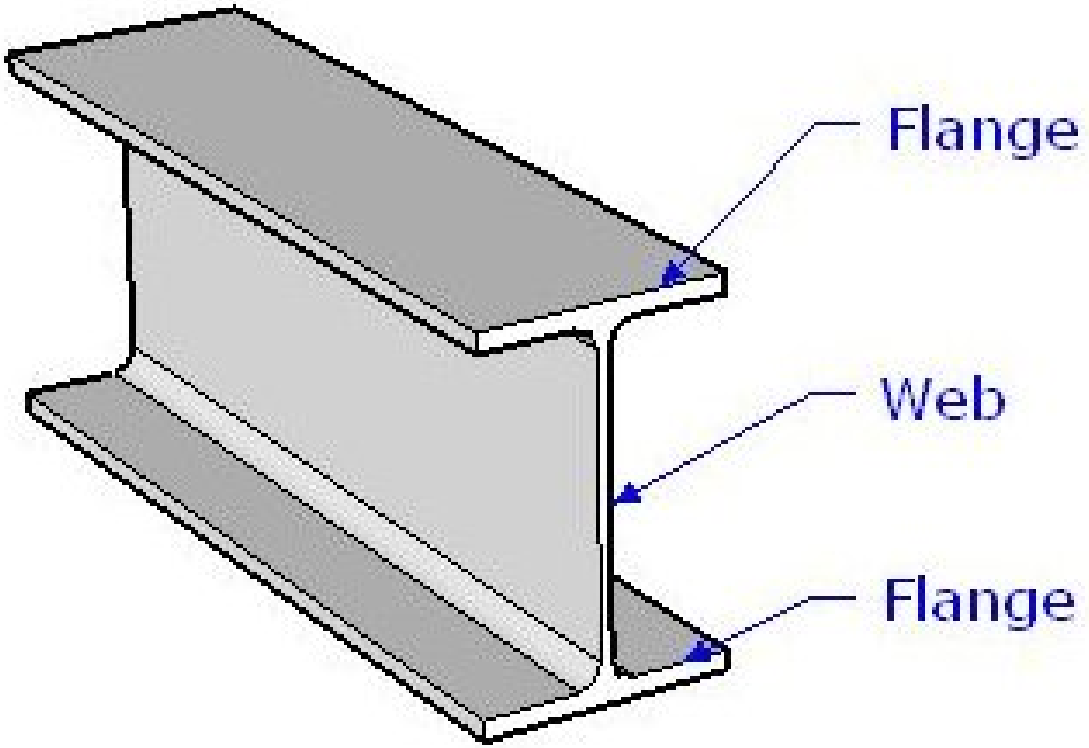
Comparison between Cast Iron, Wrought Iron & Steel

	Cast Iron	Wrought iron	Steel
Rusting	Does not rust easily	Rusts more than Cast Iron	Rusts easily
Malleability&Ductility	Brittle & cannot be welded or rolled into sheets	Tough, malleable, ductile & moderately elastic	Tough, malleable & Ductile
Reaction to sudden shock	Does not absorb shocks	Cannot stand heavy shocks	Absorbs shocks
Forging & Welding	Brittle and cannot be welded or rolled into sheets	Easily forged or welded	Rapidly forged or welded

"Wide-Flange" steel beam or column
(sometimes called an "I beam")
helped allow taller buildings

Great:

- Flexural Strength
- Compression Strength
- Shear Strength
- Tensile Strength

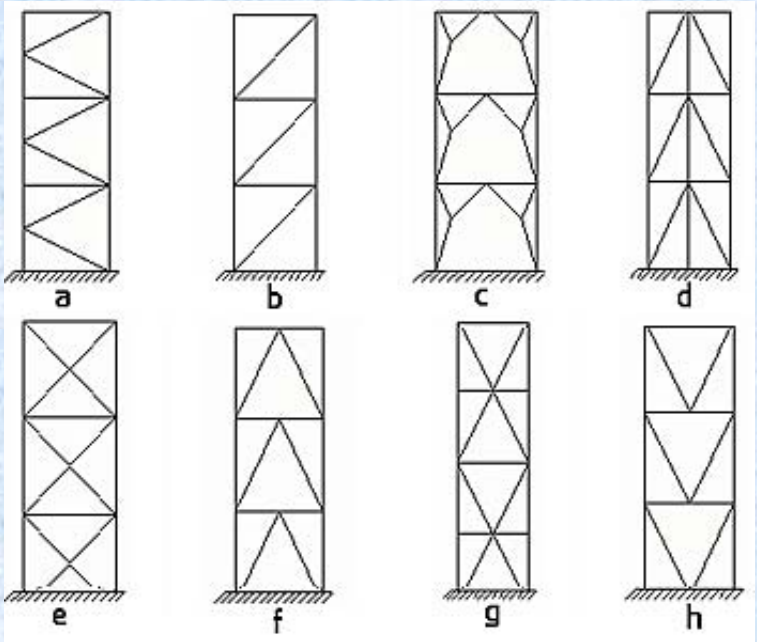


http://www.architectionary.com/uploads/WideFlangeSection/wshape.jpg

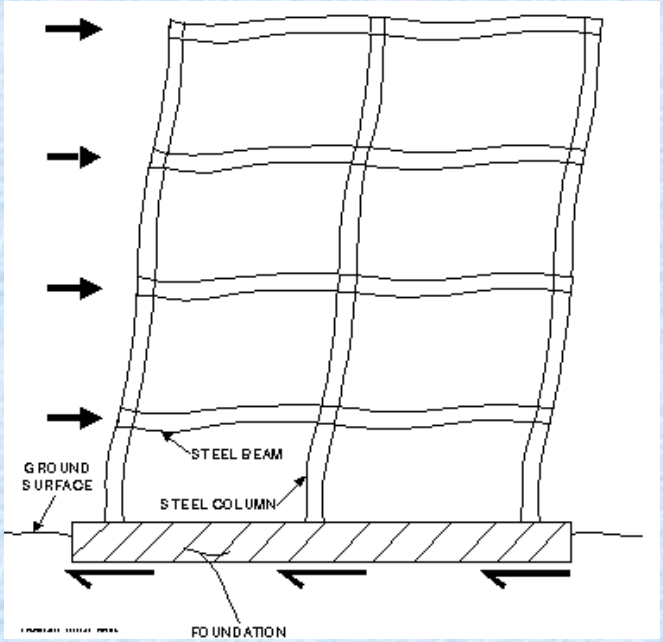
STEEL FRAME STRUCTURES

- Can melt, so fire safety coatings developed *(in Chicago after great fire of 1874)*
- Can handle large LATERAL LOADS
  - wind
  - seismic (earthquake) forces
    - in one of two ways:

"**BRACED-FRAME**" Diagonal braces OR "**MOMENT CONNECTION**"



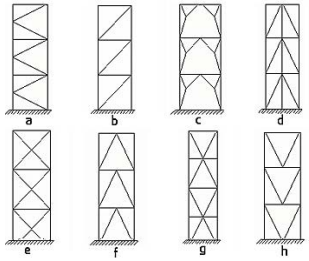
http://www.graitec.com/en/images/products/ad_bracings_01.jpg

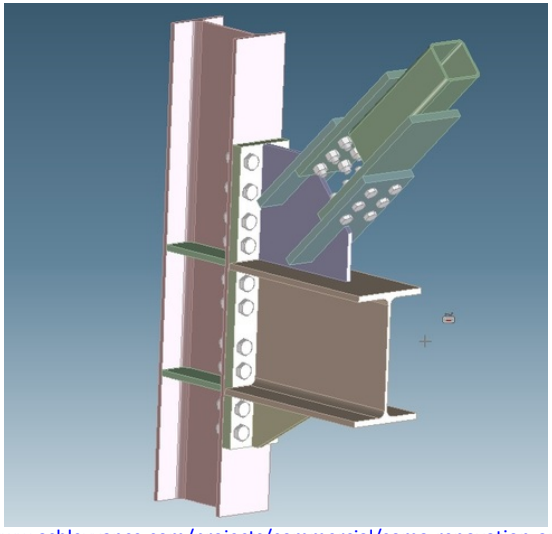


http://www.graitec.com/en/images/products/ad_bracings_01.jpg

BRACED-FRAME

- Cheaper

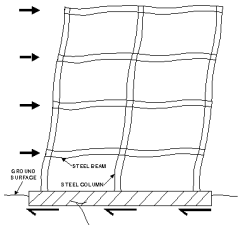


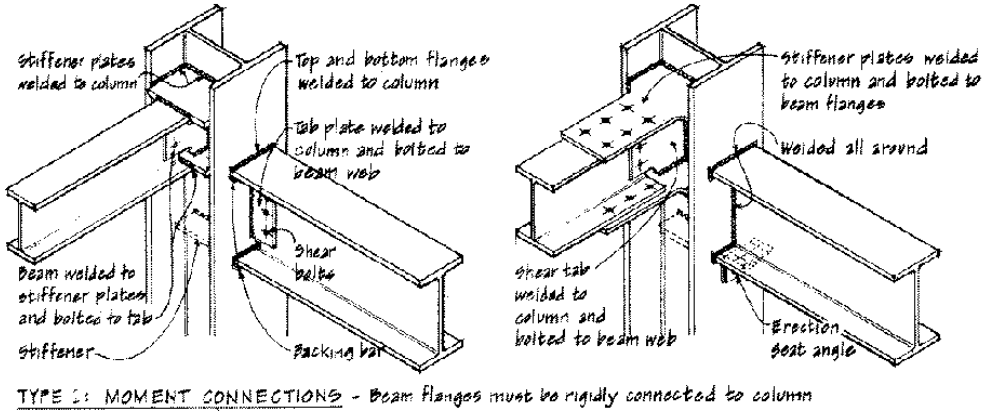


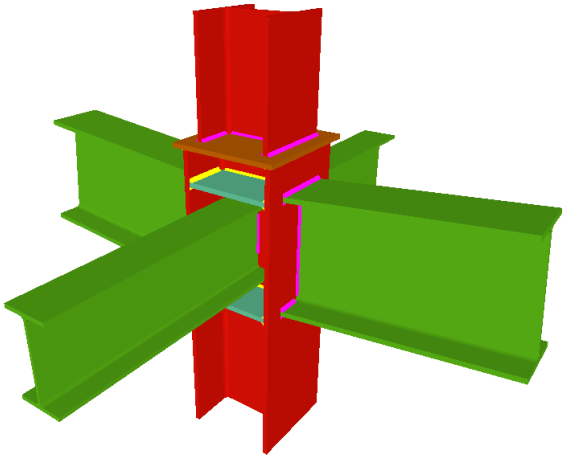
MOMENT CONNECTION

("MOMENT" = "TORQUE")

- Unobstructed views
- Simpler interiors







http://www.ashleyvance.com/projects/commercial/soma-renovation-and-seismic-upgrade

http://www.stlsi.com/images/DSC01209.JPG

https://d2t1xqejof9utc.cloudfront.net/screenshots/pics/a97c97f0e72c8856c002117a53f2bb1b/medium.jpg

http://www.graitec.com/en/images/products/ad_bracings_01.jpg

http://programas.cype.es/imagen/nuevoMetal3D/union_I_soldada_49.gif

http://buildipedia.com/images/masterformat/Channels/On_Site/Technical_Lessons_Learned/

STEEL

BRACED-FRAME

http://jiano.typepad.com/photos/uncategorized/brb_02.jpg

MOMENT CONNECTION

http://www.featurepics.com/FI/Thumb300/20070505/Highrise-Construction-306455.jpg

Louis Sullivan, The Father of Skyscrapers

Architect Louis Sullivan

1856-1924

Auditorium Building
Chicago, 1889, Adler and Sullivan

Architect Louis Sullivan

Dankmar Adler and **Louis Sullivan**
Wainwright Building
St. Louis 1890

Frank Lloyd Wright

(a protégée of Louis Sullivan) called this building:

"the very first human expression of a tall steel office-building as Architecture"

Building has a base, a middle section, and a top -- like a classical column [1]

http://en.wikipedia.org/wiki/Wainwright_Building

https://mohistory.org/collections/item/resource:140756

Union Trust Company Building,
St Louis, 1893, Adler and Sullivan

Architect Louis Sullivan

https://theplacesihavebeen.com/atlas-obscura/1554/guaranty-building

The Guaranty Building (now the Prudential Building)
Buffalo, New York, 1895, Adler and Sullivan

Architect Louis Sullivan

At age 21, Frank Lloyd Wright approached the most famous architect in Chicago, **Louis Sullivan**

*"I was accepted by Mr. Sullivan and went to work for **Adler and Sullivan**, then the only moderns in architecture, and with whom, for that reason, I wanted to work."*

Frank Lloyd Wright

Architect Louis Sullivan

- Frank Lloyd Wright quickly rose to chief draftsman in charge of 49 others
- Referred to Louis Sullivan as **Liebermeister** (“Dear Master”)
- Given a five year contract, and asked Louis Sullivan for personal loan against contract to build a house

Frank Lloyd Wright and wife Catherine who he met at age 21 when she was 17

Architect Louis Sullivan

- **Neither Architect liked Neoclassicism** (Greek or Roman)
  - Both annoyed by "White City" built for 1893 Worlds Fair in Chicago
  - Frank Lloyd Wright quoted French poet Victor Hugo:

    "The setting Sun all mistook for Dawn""

- **Both Architects in search of an entirely new American Architecture**

Frank Lloyd Wright

"White City" built for 1893 Worlds Fair in Chicago

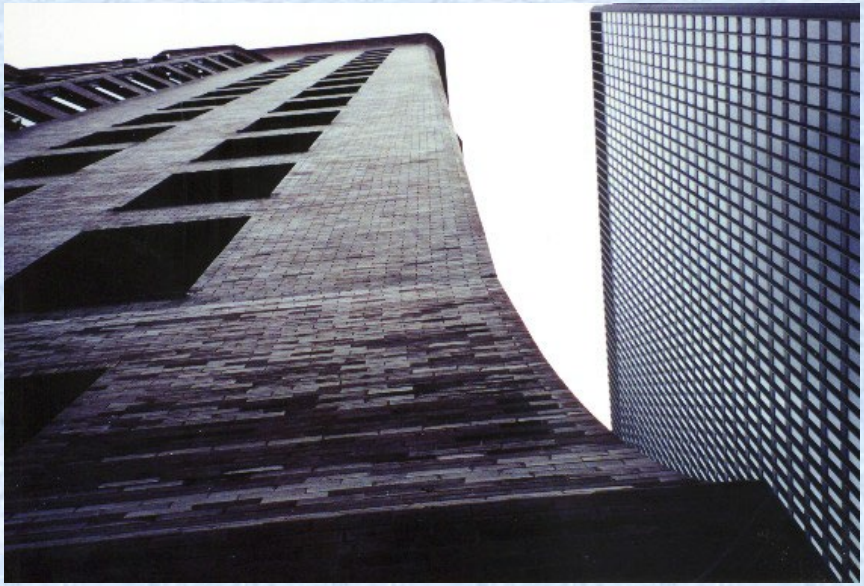
Architect Louis Sullivan

Daniel H. Burnham & John Welborn Root

Monadnock Building
Chicago 1891

One of the last exterior load-bearing-masonry skyscrapers

- Walls very thick, to carry load



Also an internal iron frame for lateral bracing of exterior walls [1]

http://www.american-architecture.info/USA/CHICAGO/CHIC-LS/018-reliance1a.gif

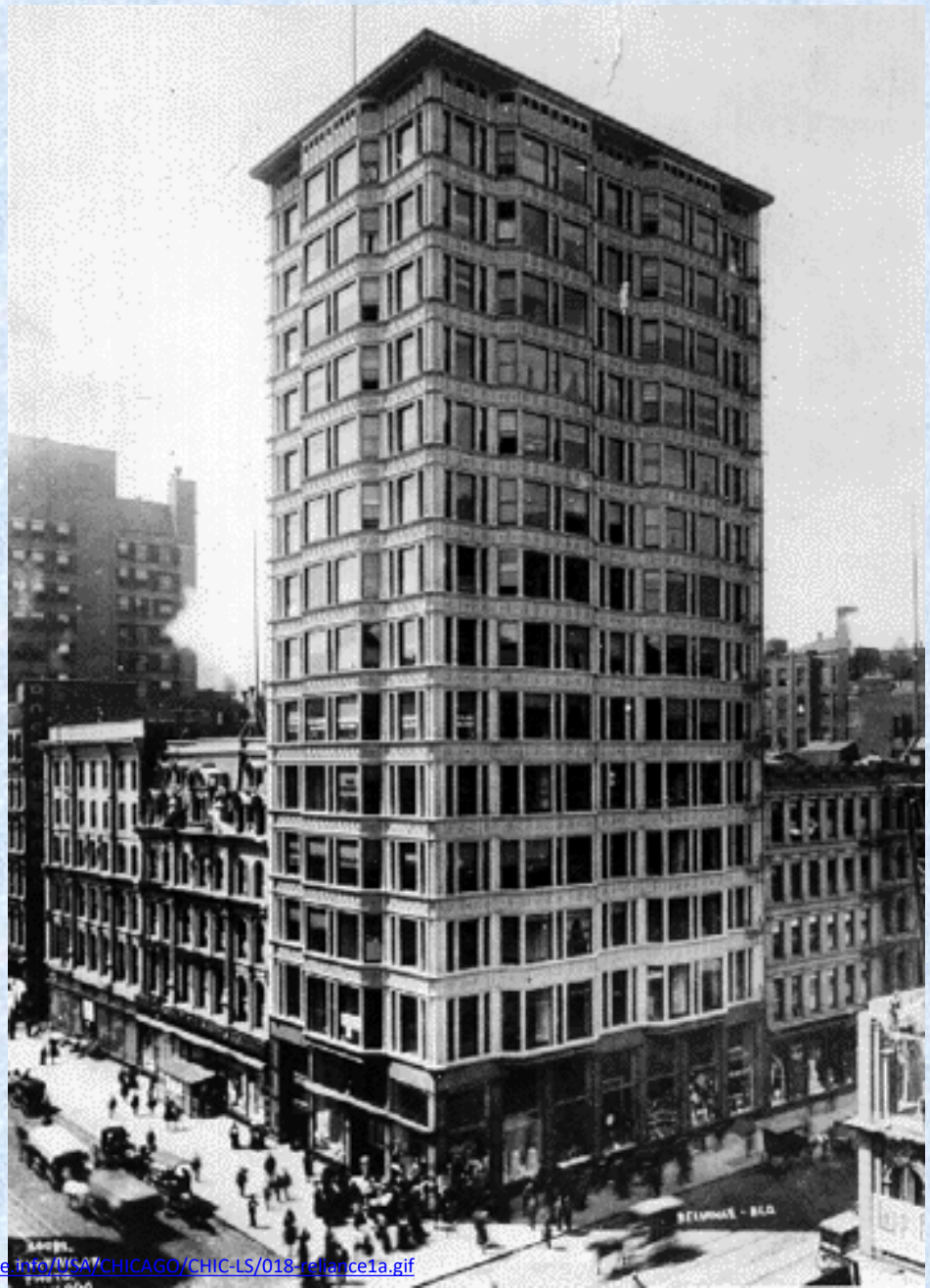
John Root and Charles Atwood

Reliance Building
Chicago 1895

1895 CURTAIN WALL

External skin of terracotta and glass clipped onto internal steel skeleton [1]

Precursor to glass curtain walls of 1960's and 70's



http://www.american-architecture.info/USA/CHICAGO/CHIC-LS/018-reliance1a.gif

Glass CURTAIN WALL common in modern commercial buildings

Recent **CURTAIN WALL**

http://img.archiexpo.com/images_ae/photo-g/stainless-steel-fixing-systems-suspended-curtain-wall-55078-1714337.jpg

Recent **CURTAIN WALL**

http://www.extal.com/userfiles/products/msg/Msg_02.jpg

Typical Modern Commercial Construction Floor Plan

Recent **CURTAIN WALL**

Structural Load carried by **core** and **columns**

Glass **CURTAIN WALL** doesn't carry load

This allows a **SHELL** to be built, followed by **TENANT IMPROVEMENTS** in interior

Tenants given a fixed $ per square foot, and they use a different architect (a "**SPACE PLANNER**")

http://www.expresstowers.in/images/floor_plan1_1.jpg

JT Wunderlich 1984,85 Project Manager / Designer

"West Lake Oaks" (13 buildings),

Doerring Development, Austin TX

- Architecture , Engineering, and management of 60 contracts and several employees

Two IBM360 Computer Centers

JT Wunderlich 1984,85

Recent **CURTAIN WALL**

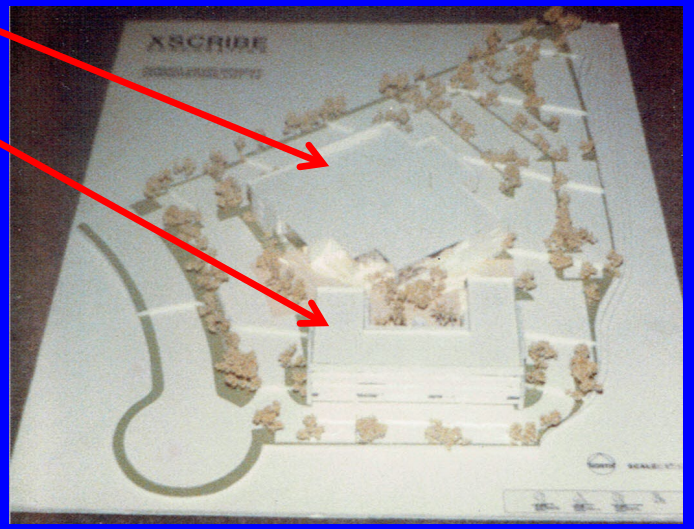
Austin TX

- 2018 Photo

JT Wunderlich 1985,86
Director of Projects / Designer
JDC Development, La Jolla, CA

66,000sf hi-tech office
and light manufacturing
44,00sf office building

Recent CURTAIN WALL
and Reinforced Concrete



JT Wunderlich 1985,86
La Jolla, CA

Recent CURTAIN WALL
and Reinforced Concrete

- Led Design Team, Modified forms, Selected materials & landscaping
- Project nominated for Award

Louis Sullivan

Pirie Scott Department Store
Chicago 1899

Balance of vertical and horizontal elements

Has "**Chicago Windows**" with large fixed panes between operable windows [1]

http://blogs.artinfo.com/objectlessons/2012/07/27/louis-sullivans-carson-pirie-scott-co-building-reopens-as-a-target-and-why-chicagoans-should-be-smiling/

Daniel Burnham and Frederick Dinkelberg

Flatiron Building
New York 1902

One of the first very tall buildings

http://www.nyc-architecture.com/GRP/GRP24A.jpg

Elzner & Anderson

Ingalls Building
Cincinnati 1903

1903 REINFORCED CONCRETE

A COMPOSITE MATERIAL of:

1. **Concrete**
   (High Compression strength)
2. **Steel Reinforcing-Bars (“Re-Bar”)**
   (High tensile strength)

First Reinforced Concrete Skyscraper

https://www.loopnet.com/listing/656-4th-st-cincinnati-oh/12158500/

Today's REINFORCED CONCRETE

REINFORCED Concrete in more recent times

"**SLIP FORMS**" allows taller buildings

http://www.wiport-land.com/images/xSlip1.jpg

http://www.structuremag.org/images/0407-f1-1.jpg

Wunderlich family project included reinforced concrete to strengthens foundation

Today's REINFORCED CONCRETE

Cass Gilbert

Woolworth Building

New York 1913

http://www.cassgilbertsociety.org/images/works/NYC-woolworth-bldg2.jpg

Art Deco

Architectural Style

William Van Alan

Chrysler Building
New York 1930

Art Deco

Architectural Style

http://www.central-nyc.com/wp-content/uploads/2013/04/chrysler-building-296507.jpeg

William F. Lamb, Gregory Johnson

Empire State Building
New York 1931

Art Deco

Architectural Style

The Word's tallest building for 40 years [1]

1933 Movie clip:
https://www.youtube.com/watch?v=CuRQH_hLcTw

BAHAUS SCHOOL

Germany 1919 to 1933

Founder: Architect Walter Gropius

"Modern" Architecture

The Bauhaus combined art, architecture, graphic design, interior design, industrial design, and typography. This school had influence on the Modern Architecture movement to come – in Chicago

Modern

Architectural Style

- Simplicity
- Minimalistic
- No ornament
- **Harmony between function and Design**

Closed due to pressure from Nazi's claiming it was a center of communist intellectualism

https://en.wikipedia.org/wiki/Bauhaus

Le Corbusier

Unité d'Habitation

Marseille, France 1945

http://thepositive.com/sounds-and-lights-animates-the-machine-for-living/

Modern

Architectural Style

Le Corbusier

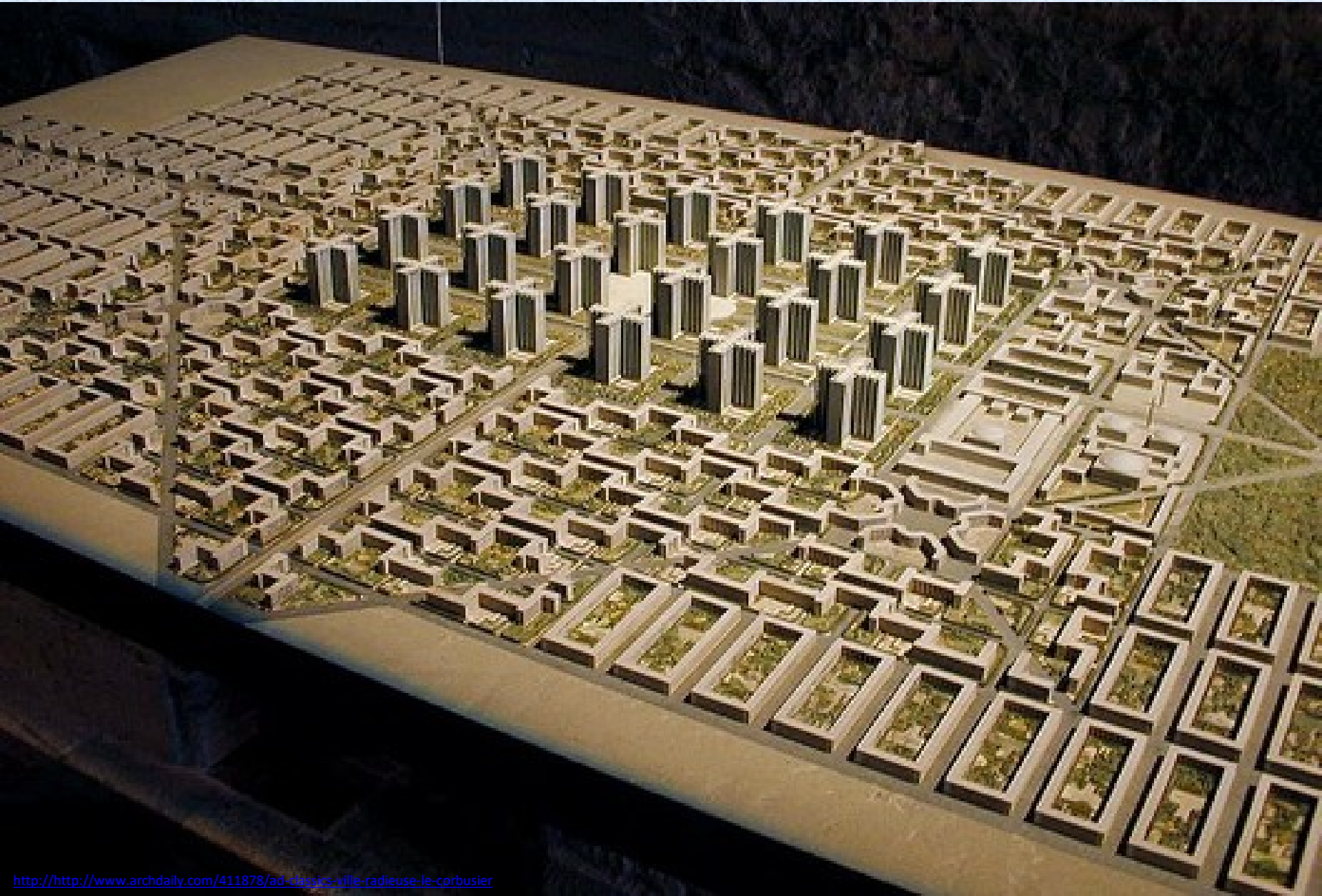
Villa Savoye

Poissy, France 1931

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

Le Corbusier - *a planned city concept:*

Modern
Architectural Style



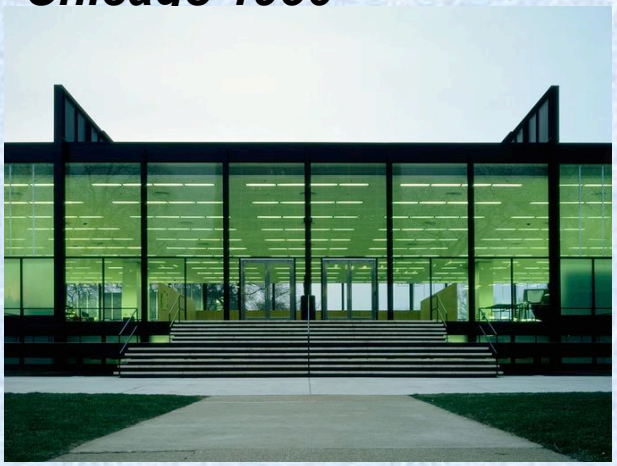
http://http://www.archdaily.com/411878/ad-classics-ville-radieuse-le-corbusier

Modern
Architectural Style

Ludwig Mies van der Rohe
(a Bauhaus Architect from Germany)
Seagram Building
New York 1958

http://www.curbed.com/maps/mies-van-der-rohe-important-works
http://conservapedia.com/images/a/a6/Seagram_Building.jpg
http://conservapedia.com/images/a/a6/Seagram_Building.jpg

Ludwig Mies van der Rohe
S.R. Crown Hall
Chicago 1956



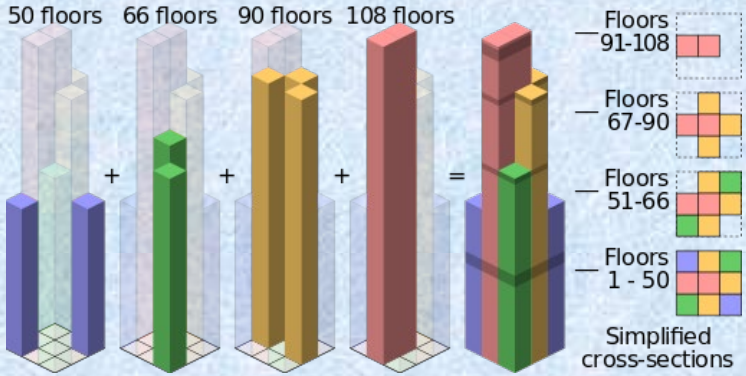
Ludwig Mies van der Rohe
Farnsworth House
Plano, IL 1951

Fazlur Rahman Khan, Bruce Graham

Sears Tower ("Willis Tower")
Chicago 1973

Modern
Architectural Style

The Word's tallest building for 25 years after it surpassed the Empire State Building [1]



Source: http://en.wikipedia.org/wiki/Willis_Tower

Phillip Johnson
IDS Center
Minneapolis 1968

Phillip Johnson was first a **Modern** Architect

Phillip Johnson
Glass House
Canaan, CT 1949

Modern
Architectural Style

http://assets.bizjournals.com/twincities/pdm-edition/IDS-center*304.jpg?v=1

Phillip Johnson

AT&T Building, now Sony Tower

New York 1984

Postmodern
Architectural Style

POSTMODERN Architectural style - references elements prior to the Modernist movement -- in contrast to the simplicity of Modern movement [1]

At it's top, a pediment. **Postmodern** reminiscent of a grandfather clock, or a tall 18th century chest-of drawers

http://www.achievement.org/achiever/joh0/large/joh0-050.jpg

Phillip Johnson

AT&T Building, now Sony Tower

New York 1984

Postmodern

Architectural Style

At it's base, **Postmodern** reminiscent of Italian renaissance architecture

http://www.constructionphotography.com/ImageThumbs/A084-00022_Sony_Plaza_tower_Manhattan_New_York_City.jpg

St. Peters Basilica in Rome 2011

Phillip Johnson

Sony Tower

New York 1984

Postmodern reminiscent of Italian renaissance architecture

Postmodern

Architectural Style

http://upload.wikimedia.org/wikipedia/commons/1/1f/Sony_Building_by_Matthew_Bisanz.jpg

Vatican Museum in Rome 2011

César Pelli

Petronas Towers

Kuala Lumpur, Malaysia 1996

Postmodern

Architectural Style

http://www.orangesmile.com/extreme/en/highest-buildings/petronas-towers.htm

C.Y. Lee & Partners

Taipei 101

Taipei, Taiwan 2004

Postmodern

Architectural Style

http://www.lonelyplanet.com/taiwan/taipei/sights/architecture/taipei-101

Rem Koolhaas, Ole Scheeren

CCTV Headquarters

Beijing, China 2008

Deconstructive

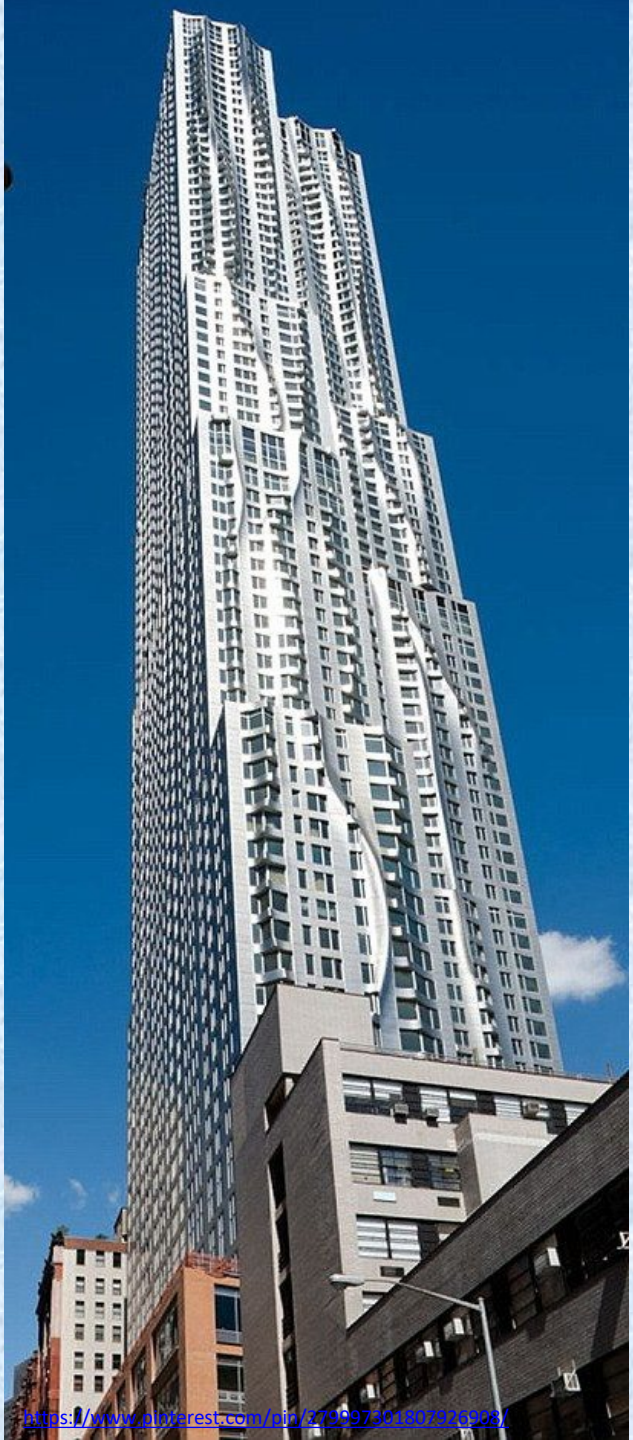
Architectural Style

http://www.skyscrapercity.com/showthread.php?t=178084

Frank Gehry

Spruce St. Tower

New York 2011



https://www.pinterest.com/pin/379997301807226928/

Deconstructive

Architectural Style

https://www.flickr.com/photos/bostoncitywalk/6657472251

“Deconstructive” Architectural Style

From

https://en.wikipedia.org/wiki/Deconstructivism

Gallery [edit]

Jewish Museum, Berlin, Germany

Alpine Deconstructivism in Kitzbühel, Austria, by Christine & Horst Lechner

Günter Domenig' s "Steinhaus" at Lake Ossiach, Austria

Vitra Design Museum by Frank Gehry, Weil am Rhein, Germany

Dancing House by Vlado Milunić and Frank Gehry, Prague, Czech Republic

City of Capitals in Moscow IBC, Russia

UFA-Palast in Dresden, Dresden, Germany, by Coop Himmelb(l)au

Walt Disney Concert Hall by Frank Gehry, Los Angeles, California

The Guggenheim Museum Bilbao by Frank Gehry, in Bilbao, Spain

Paseo de Gracia Station, Barcelona (1991) by Daniel Navas, Neus Solé. Arch.

The Gymnasium by Josef Kiszka and Barbara Potysz, in Orlová, Czech Republic

Hotel Porta Fira (left) in Barcelona, Spain, by Toyo Ito

The McCormick Tribune Campus Center at Chicago's IIT Campus by Rem Koolhaas, completed 2003

Puente de la Mujer, Argentina by Santiago Calatrava

New synagogue in Mainz by Manuel Herz

Adrian Smith, Marshall Strabala,
George J. Efstathiou, William F. Baker

Burj Khalifa
Dubai, United Arab Emirates 2014

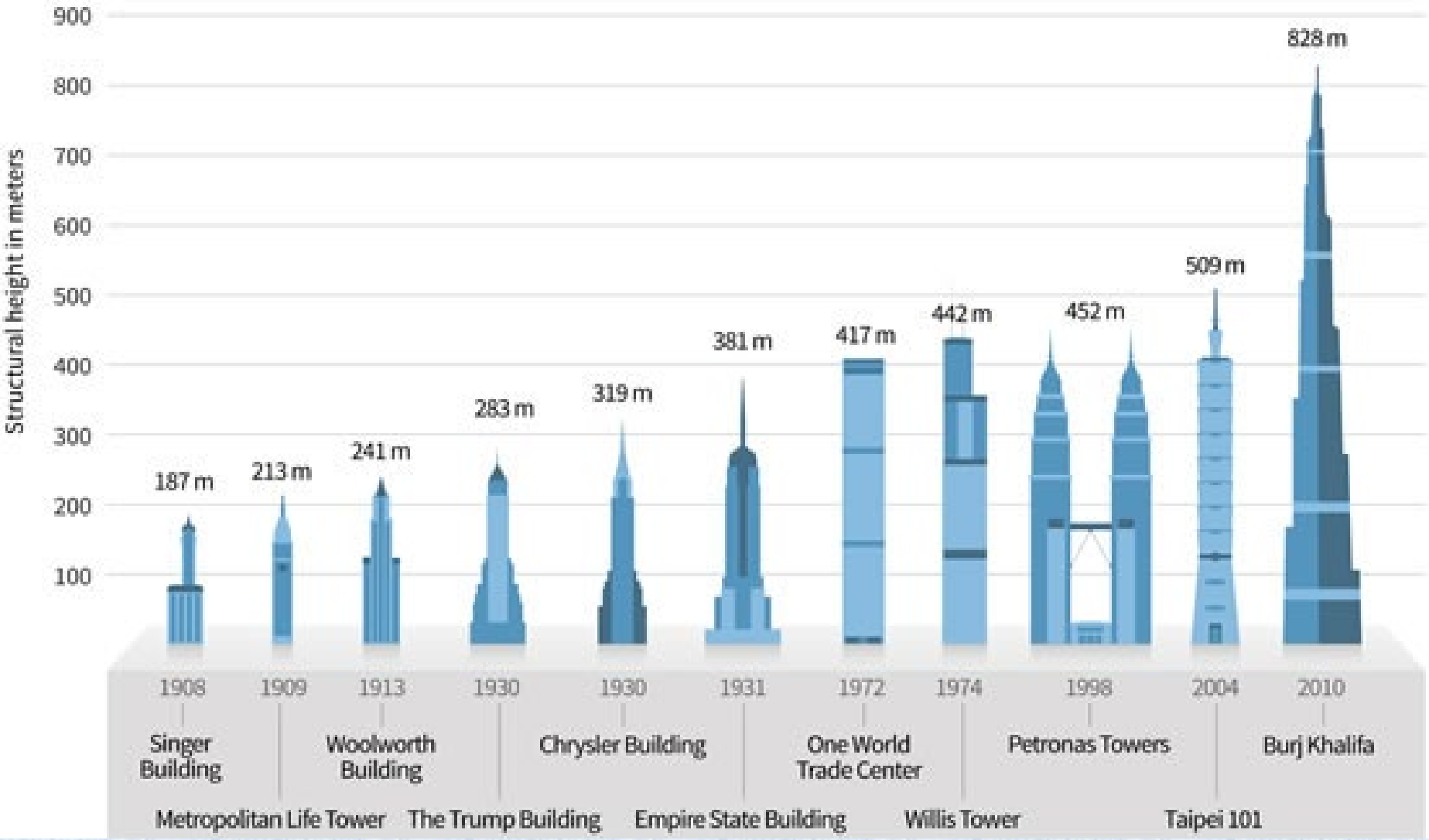
Neo-Futuristic
Architectural Style

World's
Tallest Building

http://en.wikipedia.org/wiki/File:Burj_dubai_aerial_closeup.jpg

Burj Khalifa

Neo-Futuristic
Architectural Style

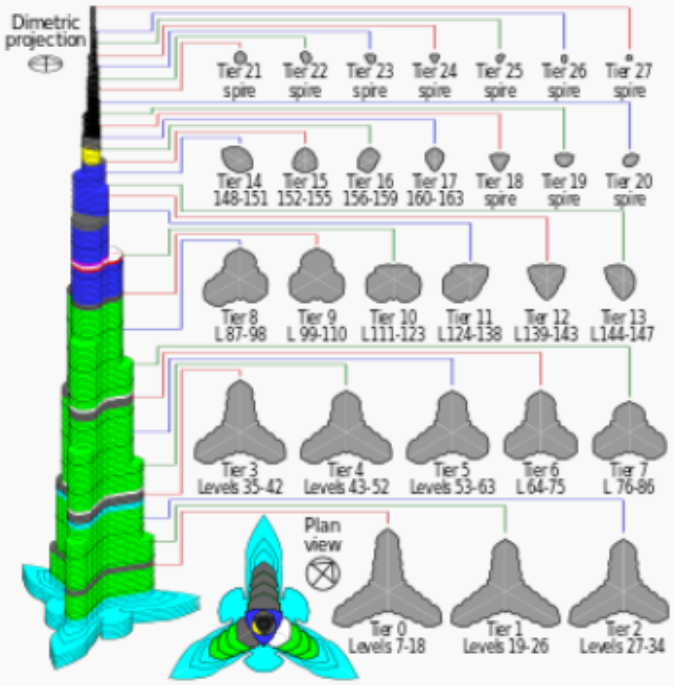


http://highrisefacilities.com/wp-content/uploads/2013/12/Skyscraper-History-Chart.jpg

Burj Khalifa

Neo-Futuristic
Architectural Style

Floors	Use
160 and above	Mechanical
156–159	Communication and broadcast
155	Mechanical
139–154	Corporate suites
136–138	Mechanical
125–135	Corporate suites
124	*At the Top* observatory
123	Sky lobby
122	*At.mosphere* restaurant
111–121	Corporate suites
109–110	Mechanical
77–108	Residential
76	Sky lobby
73–75	Mechanical
44–72	Residential
43	Sky lobby
40–42	Mechanical
38–39	Armani Hotel suites
19–37	Residential
17–18	Mechanical
9–16	Armani Residences
1–8	Armani Hotel
Ground	Armani Hotel
Concourse	Armani Hotel
B1–B2	Parking, mechanical



Dimetric projection with floors colour-coded by function[84]

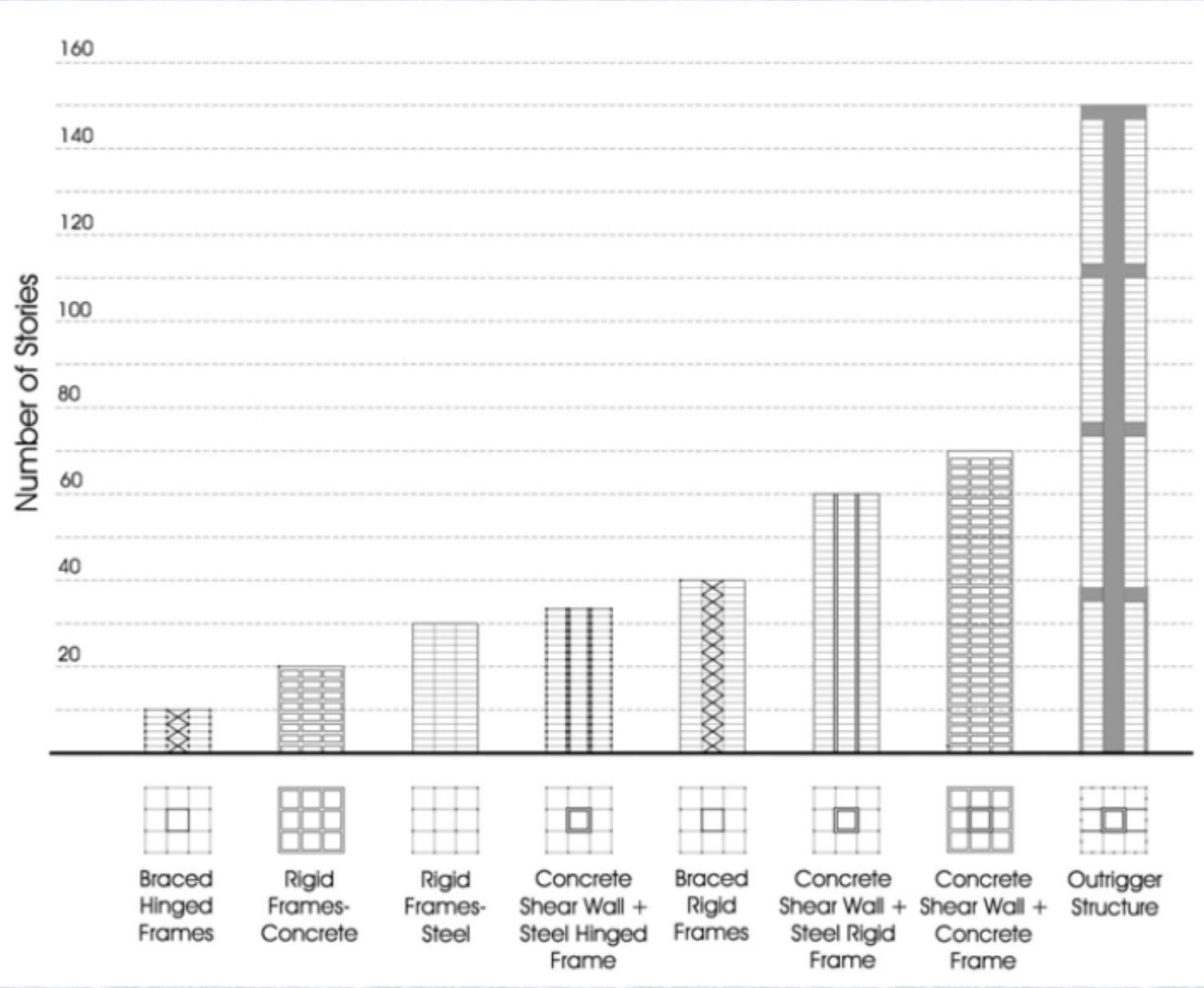
http://upload.wikimedia.org/wikipedia/commons/thumb/0/06/Burj_Khalifa_floors.svg/512px-Burj_Khalifa_floors.svg.png

Video:

http://www.skymetweather.com/content/earth-and-nature/must-watch-natures-lightning-show-over-burj-khalifa/

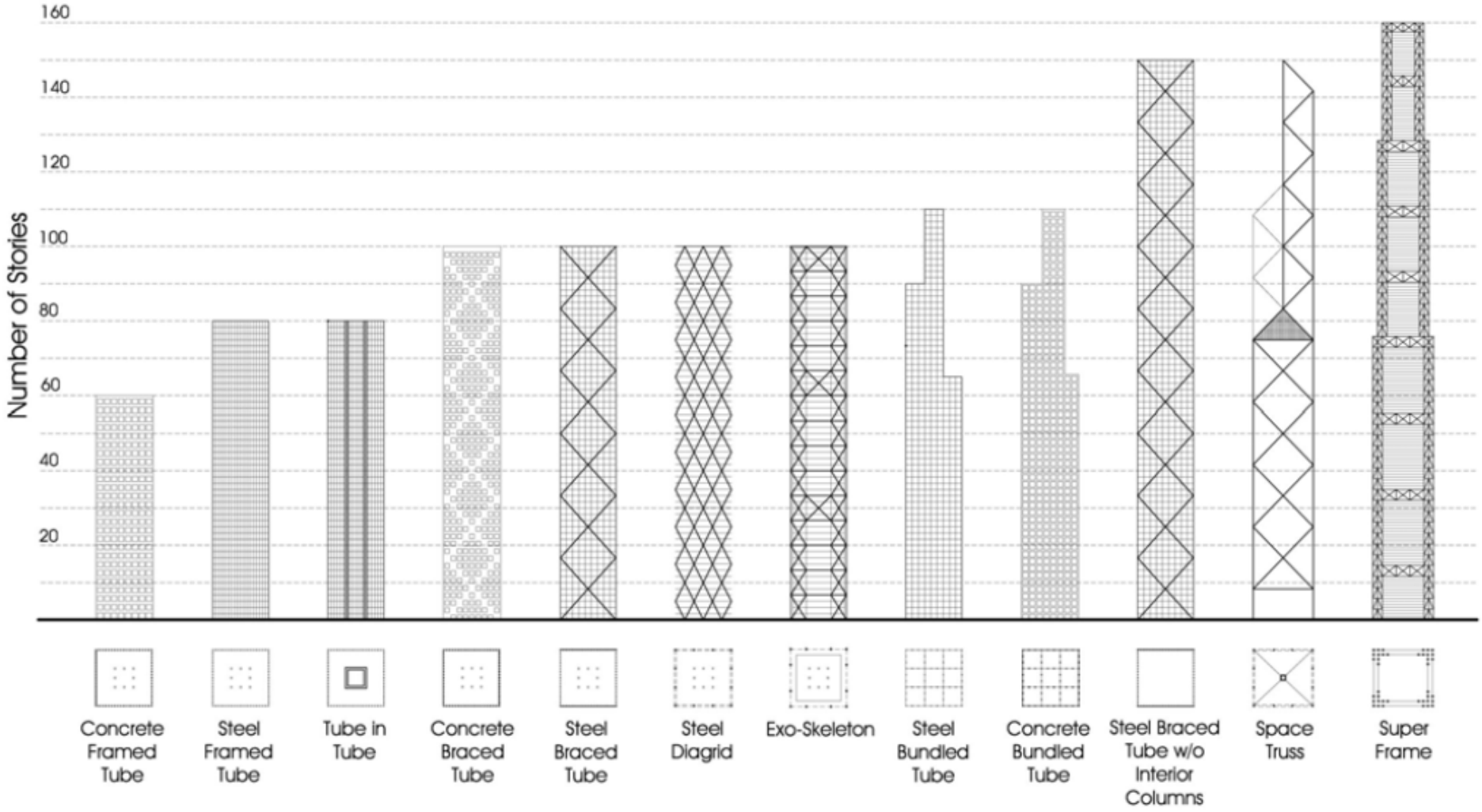
http://upload.wikimedia.org/wikipedia/commons/thumb/0/06/Burj_Khalifa_floors.svg/512px-Burj_Khalifa_floors.svg.png

INTERIOR STRUCTURES and corresponding building heights



http://sydney.edu.au/architecture/documents/publications/ASR/Structural%20Developments%20in%20Tall%20Buildings.pdf

EXTERIOR STRUCTURES and corresponding building heights



http://sydney.edu.au/architecture/documents/publications/ASR/Structural%20Developments%20in%20Tall%20Buildings.pdf

Norman Foster

The Gherkin

London, 2004

Neo-Futuristic

Architectural Style

http://www.luxuryestate.com/blog/wp-content/uploads/2014/09/copertina3-720x408.jpg

Neo-Futuristic Architectural Style

From https://en.wikipedia.org/wiki/Neo-futurism

TWA Terminal in New York City by Eero Saarinen, 1962

Dulles International Airport in Chantilly by Eero Saarinen, 1963

Gorkovskaya Metro in St. Petersburg, Soviet Union, 1963

The Tour de Montréal in Montreal by Roger Taillibert, 1987

Kunsthaus Graz in Graz by Peter Cook and Colin Fournier, 2003

The Pavilions of Futuroscope in Poitiers by Denis Laming, 1984

London City Hall in London by Norman Foster, 2002

The British Library of Political and Economic Science in London by Norman Foster, 2000

The futuristic interior roof of Hong Kong International Airport in Hong Kong by Norman Foster, 1998

The new Wembley Stadium in London by Norman Foster, 2007

L'Oceanogràfic in the *City of Arts and Sciences* in Valencia by Félix Candela, 2003

L'Àgora in the *City of Arts and Sciences* in Valencia by Santiago Calatrava, 2009

El Palau de les Arts Reina Sofía in the *City of Arts and Sciences* in Valencia by Santiago Calatrava, 2005

The Turning Torso in Malmö by Santiago Calatrava, 2005

L'Hemisfèric in the *City of Arts and Sciences* in Valencia by Santiago Calatrava, 1998

Auditorio de Tenerife in Santa Cruz de Tenerife by Santiago Calatrava, 2003

Iceberg Palace in Sochi by Andrey Bokov, 2012

Heydar Aliyev Cultural Center in Baku by Zaha Hadid, 2012

London Aquatics Centre in Stratford by Zaha Hadid, 2011

Hungerburgbahn top station in Hungerburg by Zaha Hadid, 2007

Jockey Club Innovation Tower in Hong Kong by Zaha Hadid, 2013

The Alamillo Bridge in Seville by Santiago Calatrava, 1992

Canadian Museum for Human Rights in Winnipeg by Antoine Predock, 2014

The One World Trade Center in New York City by David Childs, 2014

The Margaret Hunt Hill Bridge in Dallas by Santiago Calatrava, 2012

Museum of Tomorrow in Rio de Janeiro by Santiago Calatrava, 2015

The World Trade Center Hub in New York City by Santiago Calatrava, 2016

Liège-Guillemins railway station in Liège, Belgium, 2009

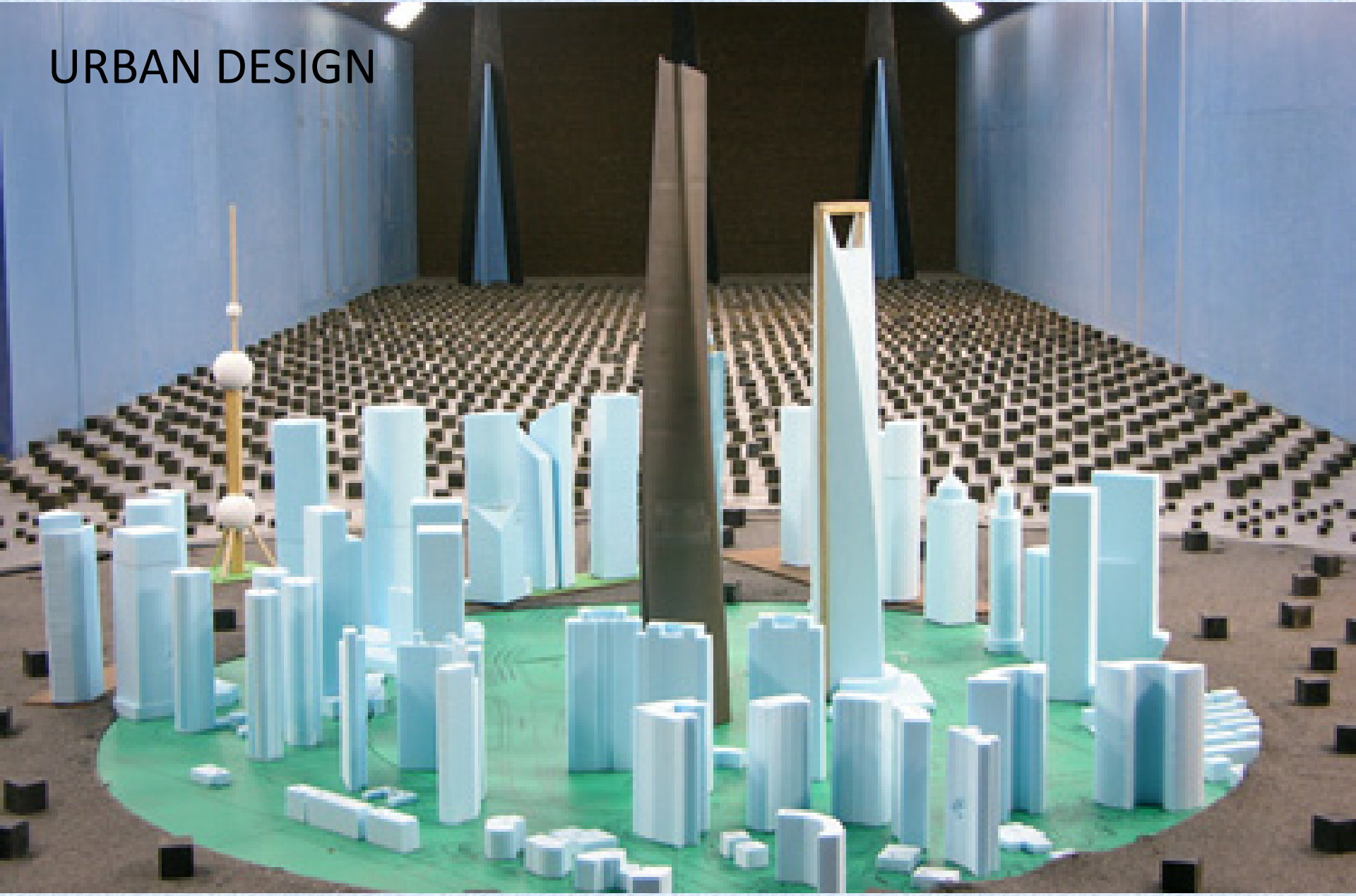
Signaturen in Tønsberg, 2019

Marshall Strabala, Jun Xia

Shanghai Tower
Shanghai, China 2015

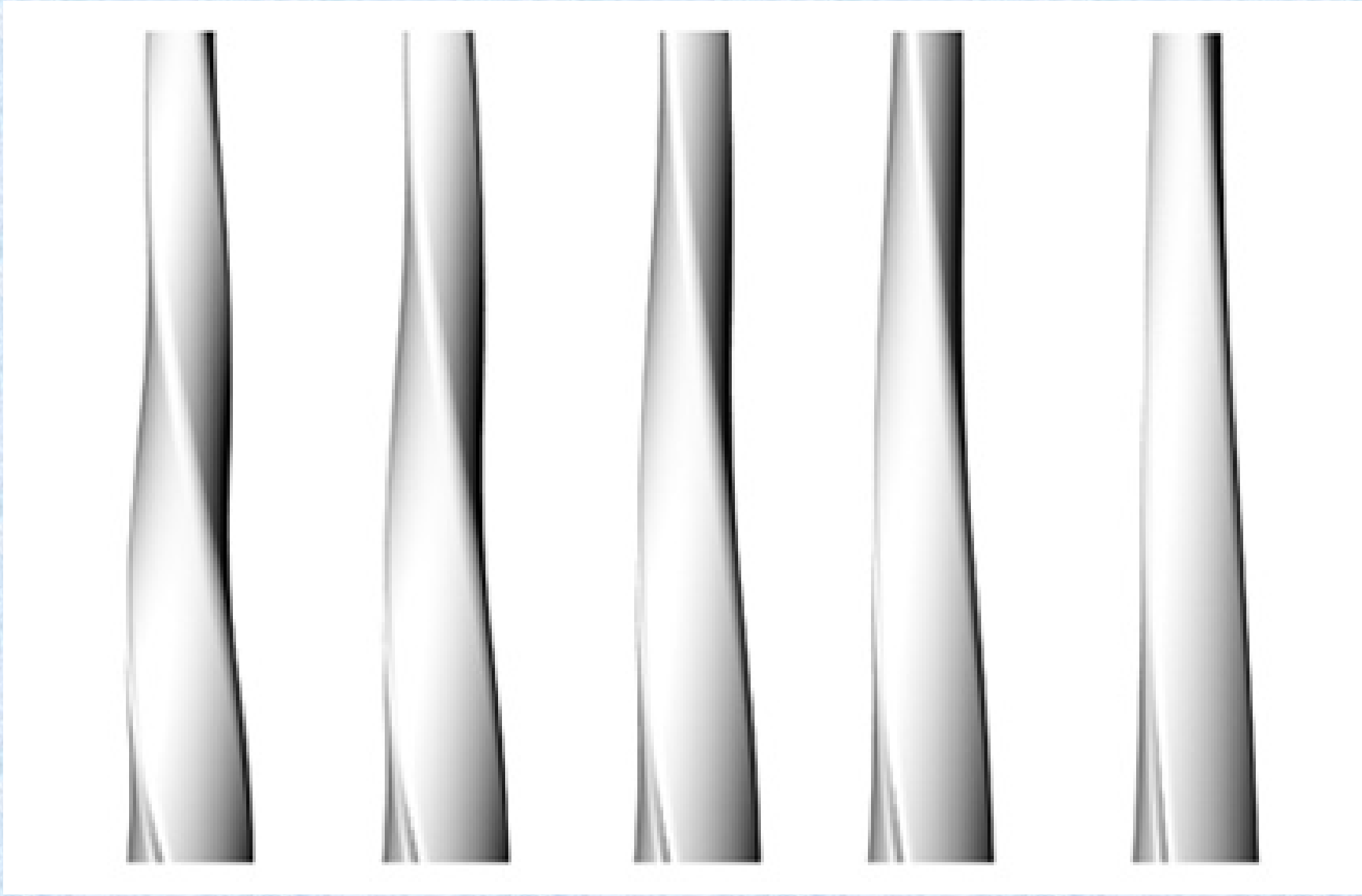
Artist's rendition

Sustainable Design



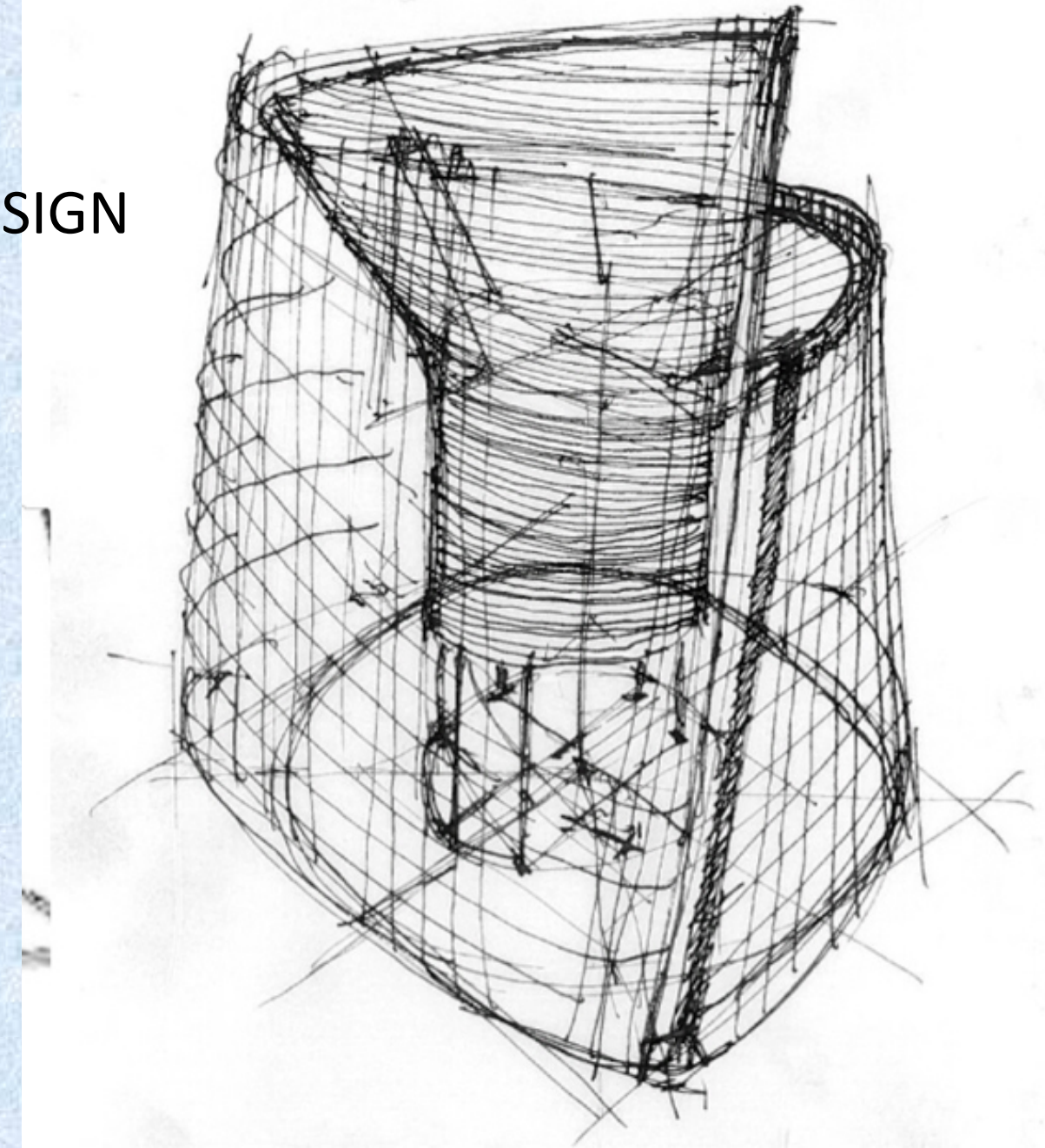
http://images.autodesk.com/flashassets/thegallery/galleries/shanghai_tower/1.analysis/images/Shanghai_Tower_Analysis_2.jpg

CONCEPTUAL DESIGN



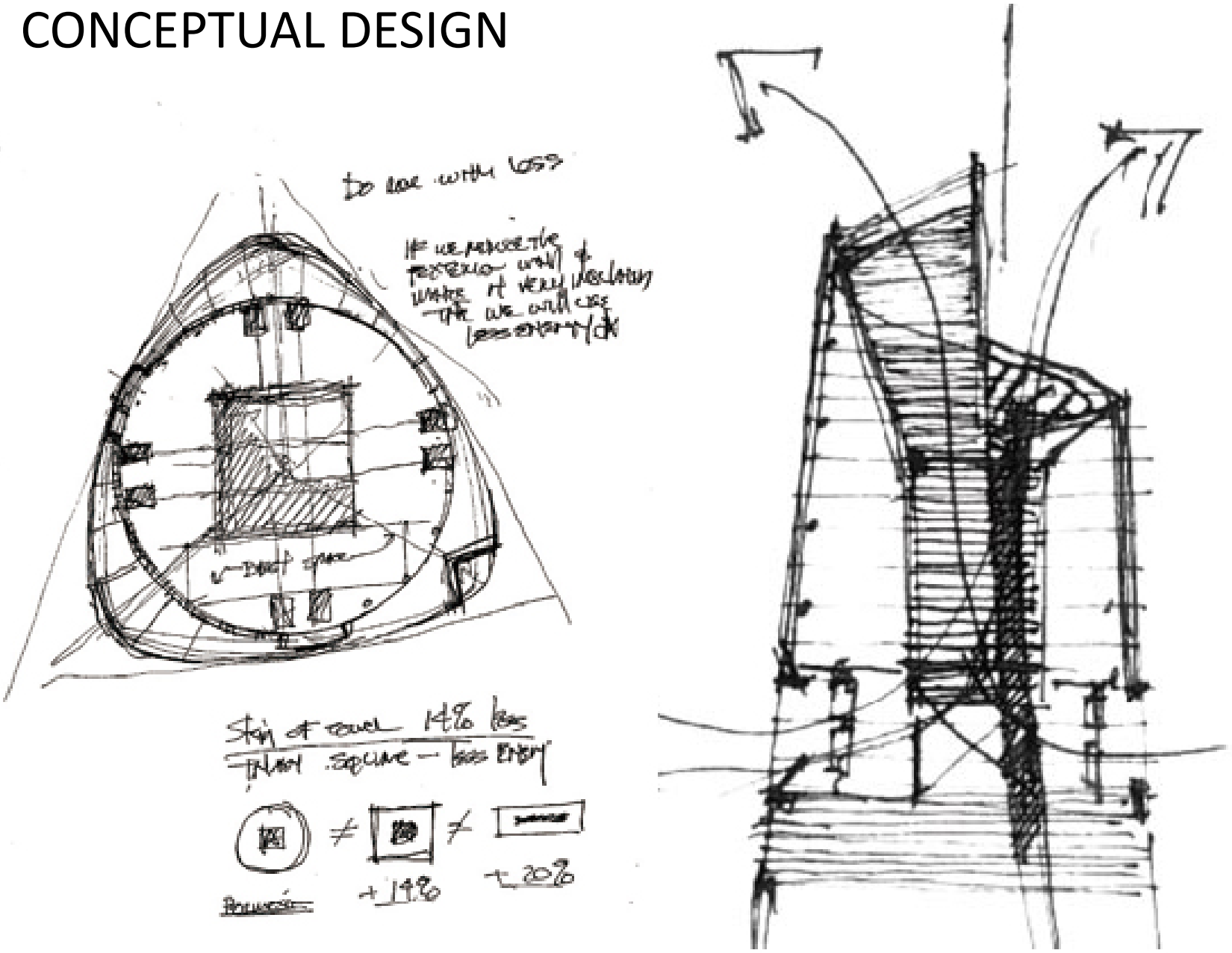
http://images.autodesk.com/flashassets/thegallery/galleries/shanghai_tower/3.taper/images/Shanghai_Tower_Taper_1.jpg

CONCEPTUAL DESIGN



http://www.gensleron.com/storage/post-images/WineyPost1Image1.jpg

CONCEPTUAL DESIGN



http://www.vmspace.com/uploads/magazine/512/r1.jpg

Huge glass **curtain walls** hung from upper decks

Image From:http://www.anotherpartofme.com/wp-content/uploads/2013/05/shanghai_tower03.jpg

Shanghai Tower

Sustainable Design

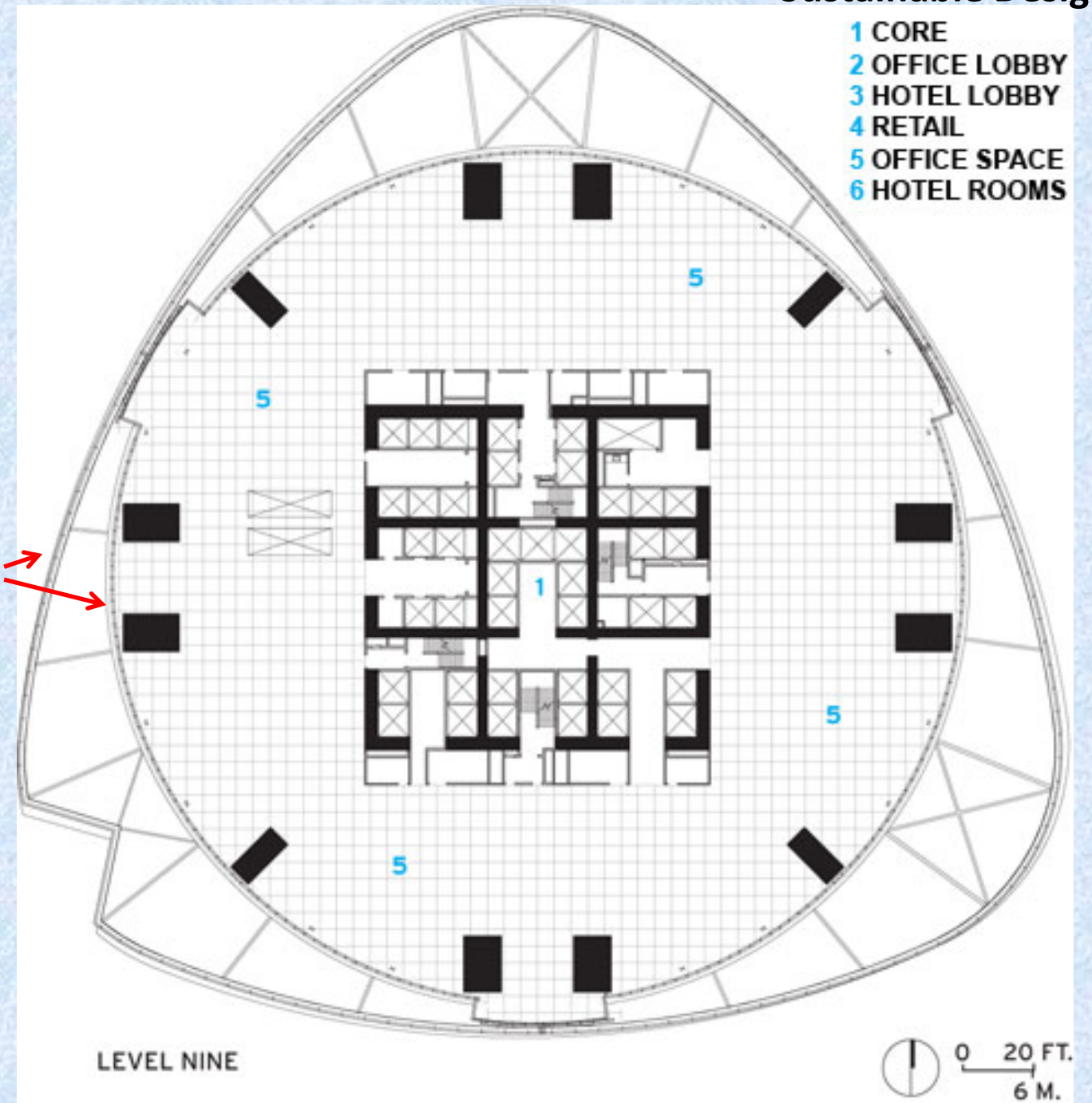
http://sites.psu.edu/khalqubbaj/wp-content/uploads/sites/4598/2013/09/ShanghaiTower_8_v2.jp g

Sustainable Design

Huge glass **curtain walls** hung from upper decks

http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2011/12/Shanghai-tower-6.jpg

Double outer walls allows for internal open spaces



http://www.china-sbs.com/userfiles/26.jpg

Shanghai Tower

Sustainable Design

1. Glass façade reduces wind loads by 24%. Therefore 25% less structural steel saves US$58 million

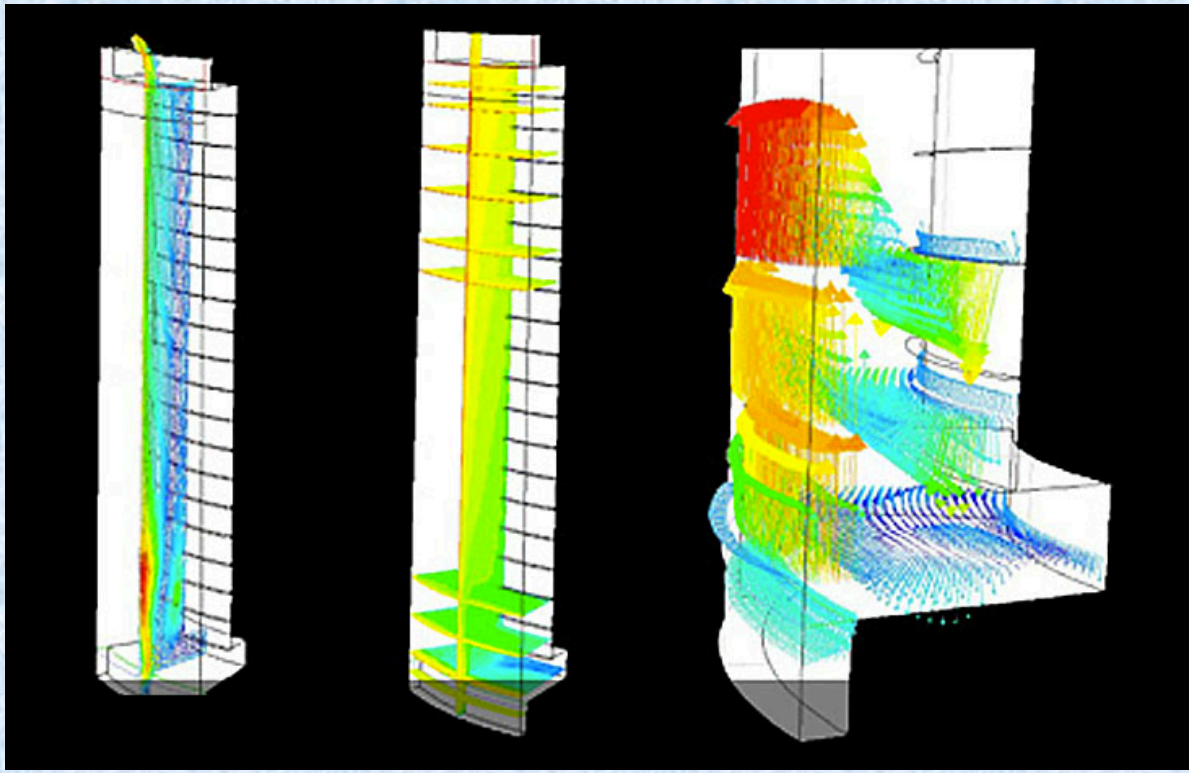
2. Construction practices optimized

3. Vertical-axis wind turbines at top generate 350,000 kWh of electricity per year

4. Double-layered insulating glass façade reduces need for air conditioning

5. Heating &cooling use geothermal energy

6. Rain water collection



Source: http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2011/12/shanghai-tower-bim.jpg

Sustainable Design

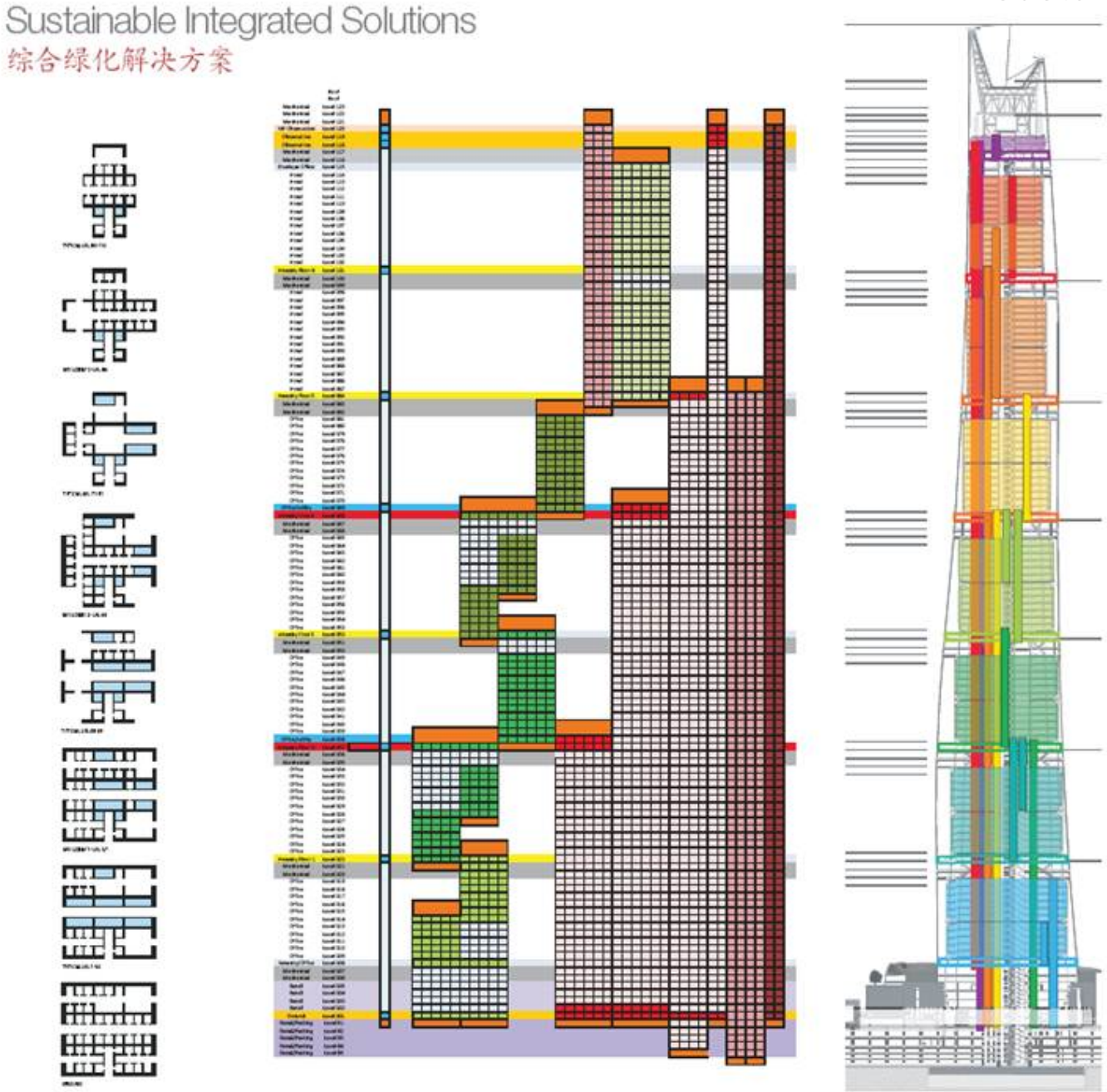


Image From:http://4.bp.blogspot.com/-UGNergNxHYA/UCPj3Bp2gDI/AAAAAAAAHQk/KaEbJhj_qH8/s1600/Shanghai_Tower_worlds_tallest_skyscrapers_Blueprints_Structural_Models_and_floor_plans_by_Gensler_world_of_architecture_worldofarchi_08.j

Shanghai Tower

Has a concrete core,
and structural steel.

Not tallest building,
but doesn't aspire to
be – it's something
completely new

A

VERTICAL GREEN CITY

http://www.e-architect.co.uk/images/jpgs/shanghai/shanghai-tower-g070813-3.jpg

However,

We hopefully won't rely entirely on artificial interior worlds – no matter how well we can make them "Sustainable"

http://www.e-architect.co.uk/images/jpgs/shanghai/shanghai-tower-g070813-3.jpg

https://en.wikipedia.org/wiki/Shanghai_Tower

Frank Lloyd Wright

Price Tower

Bartlesville, Oklahoma 1952

Wright persuaded Harold Price to build headquarters on 19 floors instead of 3 by showing how power, climate control, plumbing, and communications are **simpler & more efficient** via a central stack [1]

http://0.tqn.com/d/architecture/1/0/9/v/PriceTower.jpg

Frank Lloyd Wright's Earliest Influences

The origins of Sustainable Design

[Froebel 2013, PENN Rare Book 2014, Huxtable 2004, Storrer 2017, Wright 1957, Burns 2001]

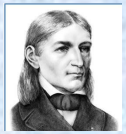
From 2018 Wunderlich Lecture Series on Frank Lloyd Wright

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

20 to 26 years old (1887-1893)


Frank Lloyd Wright

Frank Lloyd Wright begins developing his "**ORGANIC ARCHITECTURE**"

" ***Bowels, circulation, and nerves were new*** *in buildings."*

"A desire for ***simplicity*** *that would yield a* ***broader deeper comfort*** *as organic…* ***Organic simplicity****… Ruthless but harmonious order I was taught to call nature … on the farm…* ***Beauty in growing things.***"

Organic Architecture **PHILOSOPHY**

[Wright 1954, Wright 1957]

Frank Lloyd Wright

- ***"Grow Form in realm of human spirit"***
- ***"Human Scale is true Building Scale"***
- ***"Forms more naturally significant of idea and purpose"***

- **Oppose:**
  - **Neoclassicism**
  - *"Senseless **excess**"*
  - *"Senseless **expedience"***
  - **Victorian ornamentation and compartmentilization**
- ***"True ornament had to mean something … Integral ornament"***

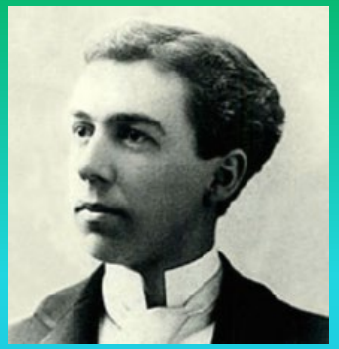
- Building ***"Plasticity… like skin surface defined by skeleton …***

  Esthetic and structure become one … FORM AND FUNCTION ARE ONE"

  Similar but different from the phrase coined by his Mentor **Louis Sullivan: "Form Follows Function"** which is similar to the ideas of Sculptor Horatio Greenough (1805-1852) on "Functionalism"

The origins of Sustainable Design

His “Organic Architecture” was revolutionary in creating over 100 years ago what is considered Green Architecture today



Frank Lloyd Wright

Although considered a Modern Architect, his ideas were very different from other Modernists

Frank Lloyd Wright’s Modern Architecture vs that of Mies van der Rohe and Le Corbusier

Sometimes people prefer being more grounded and close-to-the-earth

Especially if the building site, and the context of the surrounding environment, seems more compatible with building horizontal

In Kyoto, no buildings are allowed taller than 60 meters to protect the overall quality of this historic city

Kyoto Japan 2013


Kyoto 2013
No buildings taller than 60 meters

Kyoto 2013

No buildings taller than 60 meters

No buildings taller than 60 meters

Kyoto 2013


No buildings are allowed
taller than 60 meters
No buildings taller than 60 meters
Kyoto 2013


No buildings taller than 60 meters
Kyoto 2013


Kyoto 2013
No buildings taller than 60 meters


Kyoto 2013
No buildings taller than 60 meters


Kyoto 2013
No buildings taller than 60 meters


No buildings taller than 60 meters
Kyoto 2013


No buildings taller than 60 meters
Kyoto 2013


No buildings taller than 60 meters
Kyoto 2013

Kyoto 2013

No buildings taller than 60 meters


Kyoto 2013
No buildings taller than 60 meters


No buildings are allowed taller than 60 meters
浄土宗は、法然上人のみ教えをうけ、過去、いま、そして明日への「いのち」を慈しみ、新しい共生（ともいき）文化を創造します。
浄土宗21世紀劈頭宣言
法然共生
愚者の自覚を
家庭にみ仏の光を
社会に慈しみを
世界に共生を
浄土宗 総本山 知恩院
No buildings taller than 60 meters
Kyoto 2013


Kyoto 2013
No buildings taller than 60 meters

Frank Lloyd Wright

known more for Horizontal Architecture

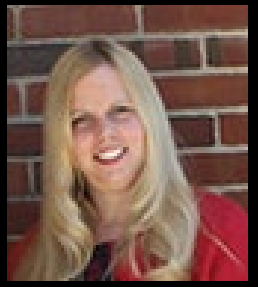
… designing on a Human Scale ,

…. and with a great respect for Nature

2015 Etown Architecture Students & Faculty field trip

Professor Kozimor-King
works at Falling Water

2015 Etown Architecture Students & Faculty field trip



But scraping the sky can be part of quality Urban Design

where buildings compliment each other,
and their surroundings

And a vertical culture is established

Austin Texas in early 1980's

- U Texas BS Architectural Engineering

  with many classes on the upper floors of high-rises

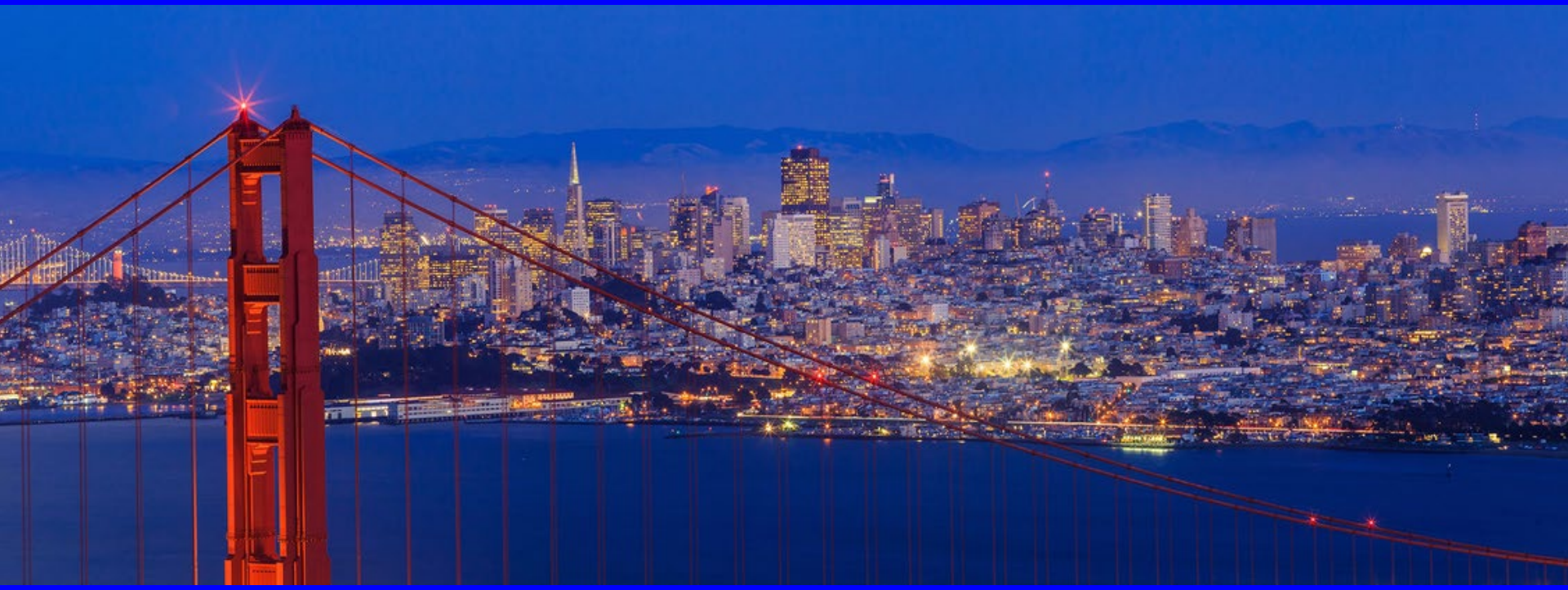
- Then worked for Developers

https://www.pinterest.com/pin/186195765984993266/-meeting/san-diego-skyline/

Recent Austin skyline

San Diego in mid-1980's …. One office in hi-rise working for developers, then worked for Planning Commission while in 2nd degree program in Urban Design at UCSD

San Francisco in late 1980's …. Frequent meetings in downtown San Francisco skyscraper , and lived in the city, while working for an A&E firm, and starting grad school in Physics (to lead to M.Eng and PhD in Hi-Tech, then IBM Research)



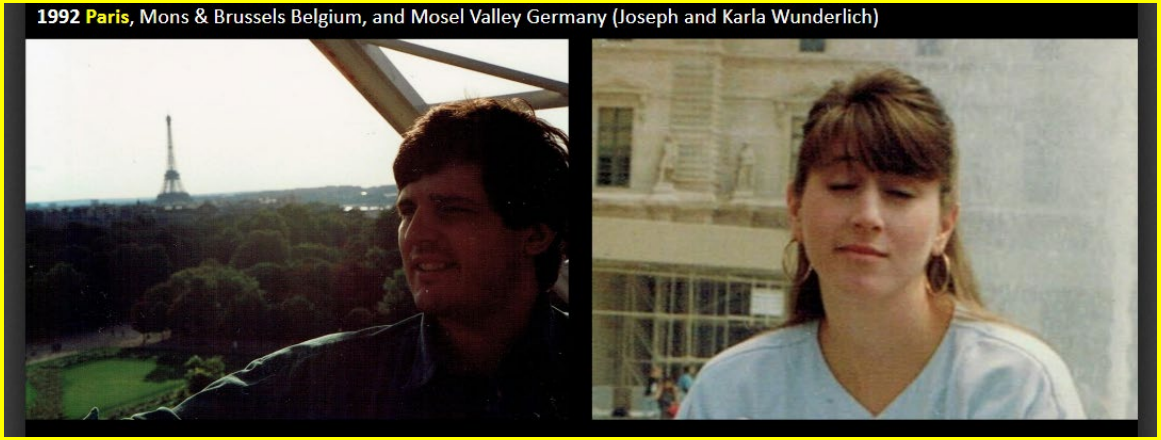
So can skyscrapers be a “Joyful” thing?

VIDEO: https://www.youtube.com/watch?v=A_u2WFTfbcg

Things up high can certainly be “Joyful”

VIDEO: https://www.youtube.com/watch?v=A_u2WFTfbcg

So yes, tall things can be joyful, including skyscrapers



Architectural Studies Minor

ART 105	Drawing I	4.00	**Core "CE"**
ART 280	History of World Architecture	4.00	**Core "NCH"**
ART 210 ART 120	Drawing II ***OR*** Sculpture	4.00	
EGR 343	Green Architectural Engineering	3.00	

Select **one** of the following elective options - 4 credits

EGR 396	Spring Seminar ***AND***	**1.00**
EGR 276	Sustainable Resource Engineering & Design	**3.00**

OR one *of the following options with an emphasis in Architecture***

EGR 280	Engineering Research/Project	4.00
ART/EGR 471	Internship	4.00
ART/EGR 481	Independent Study	4.00

ART/EGR	499A Architecture Design Studio	2.00	
ART/EGR	499B Architecture Design Studio	2.00	**SLE**

Contact Advisors: Joseph Wunderlich Phd or Patricia Ricci PhD