2022.05.03 Lecture Notes 3:15

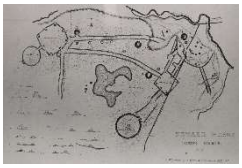
Lecture 1 – Valencia and Barcelona

(check PowerPoint box for video audio on)

Welcome to Guastavino in Pittsburgh.

My name is Matthew Schlueb, registered architect, practicing for two decades.
May have taken Gaudí classes **(???)**, this course follows Catalan tradition to Pgh.
Erin O'Neill assisting me with the course. Raise hands with questions.

Thankyou for taking this course, a pleasure for me to present this material to you.
I welcome your feedback to improve the class, as this is primarily for your benefit.




Before getting into Guastavino's work, some architectural historical context...
Go back 2K years, **Great Circle mound** (fork of Raccoon Creek & Licking River, what is today Newark, Ohi-yo) Largest geometrical earthworks in the world, four Roman Coliseums within Octagon, Giza Pyramid within Observatory Circle.

Moundbuilders mystery to modern archeologists: who?, when?, how?, why?
Architecture is a physical medium. After its creators are gone, may not know what they were thinking, but can **know what they were feeling**, **experiencing the space**.


2 months ago, visited first time, palpable sense of crossing a threshold to inside,


sensation of enclosure, despite no roof, **insideness**, apart from open wilderness.

Emotional sense of space, satisfying desire for gathering, community, safety.

Week ago, Gustav Mahler's Symphony No.1 Emotional energy of music:
Manfred Honeck (PSO Music Director, conductor): **polka** (active) or **waltz** (rest)
Great Circle mounded perimeter **wall** (enclosure/horz.), without **roof** (shelter/sky).
(Note: acoustics, Lecture 3, center top row of balcony vs. right side front balcony)

Heinz Hall (Loew's Penn Theater, Rapp & Rapp, 1927, Venetian lobby, Rococo):
(Note: Flat dome conceal mechanical equip., **La Massa Theater** by Guastavino)

Richard Serra's **Snake Eyes and Boxcars** (Geyserville, CA, 1990-1993)
12 forged (heated/pounded) corten steel blocks, 250 tons, 48"x41"sq. & 84"x41"sq.

"establish visual system to make the volume of the valley more tangible physically, to make the space more distinct" As **Great Circle** dealing with **weight**, **threshold**.

Artificial horizontal plane accentuating the **natural** contour of ground.
Great Circle **human-made** earth mounds accentuated by natural **landscape**.

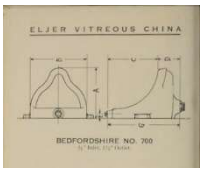
Richard Serra's **Shift** (King City, Ontario, 1970-1972) 8"x60"x90'-240' **wall**.
1st of 2 concrete works: "concrete too architectural for sculpture" no maintenance.

Garden House foundation: (Mars, PA, 2022.04.11) 3D (**form**) > 2D (**wall**)

Rafael Guastavino marks transition in architecture at the end of the 19th century, away from **building guilds** (mestre d'obres in Barcelona) guarded trade secrets from trial and error methods, passed down from father to son for generations, toward new **professional paper trades**, architects (École des Beaux-Arts in Paris) and engineers, designing from mathematic calculations, in plan and elevation, and municipalities issuing construction permits and establishing building codes.

Academia: Master Mason > Licensed Engineer
Technology: trial/error > computation
Specialization: Renaissance Man > structural, MEP, civil, ...
Aesthetic: feel of space > building science

Marcel Duchamp's **Fountain** (NY, 1917) non-functional > form (art)



Architecture includes art, and beyond to include function, as well as many others.
Advent of scientific method, computer age, big data, art fading from architecture.
Serra explored thresholds, enclosure, weight, perspective, scale, proxemics, ...
more importantly, feeling, behavioral, meaningful, ... 2022.05.01 8:16am oo

Science of building materials and their assembly (thermal, vapor, reflectivity, ...)
Even CMU Osher lists Architecture under Science, not Arts & Humanities.

In addition to **Guastavino** marking transition, also innovated in many facets:
Lecture 3: Guastavino's material innovations in building science (sustainability)
Lecture 4: Guastavino's geometric innovations in architecture (form, style)
Lecture 5: Guastavino's structural innovations in engineering (thin shell tile)
Lecture 6: Guastavino's decorative innovations in ornament (finishes)

Today's lecture: **Rafael Guastavino**'s work in Valencia and Barcelona

Rafael Guastavino Moreno, born in Valencia (March 1, **1842** into large family of 13 brothers/sisters, musical craftsmen), worked for Inspector of Public Works.
In **1861** began at **Escola Especial de Mestres d'Obres** (**Masters of Works**), under visionaries **Juan Torras** and **Elias Rogent**, both also taught **Antoni Gaudí** a decade later. Courses in mechanics, descriptive geometry, and construction, in thin tile brickwork, **Catalan vaulting originating in Valencia**, but did not formally graduate until 10 years later, in 1872.
Studied violin to be a musician: discipline, precision, **curvature in tension**.

Lockey Hill Cello Circa 1780, **Charles Brooks** (2022)

In **1875** enrolled in new **Escola Provincial d'Architectura in Barcelona**, one year after **Gaudí** (matriculated in 1874, awarded degree on March 15, 1878),
more rigorous theoretical and academic training. Guastavino did not complete.
Illustrating Guastavino's training and approach toward design and construction, more practical methods of the building guilds, learning by hands-on experience. By contrast, title of architect required a well-rounded training in on-site technical skills and design innovation. Architecture schools promoted a sense of discovery, combined with desire for national expression, led to Catalan Art Nouveau in 1900s.

Earliest record of Catalan tile vaulting technique dates back to a letter from **Aragonese King Peter IV** writing to masons from his court in **Zaragoza**, asking them to travel south to **Valencia** to learn a vaulting technique recently discovered.

"we have started the works at the royal (palace) of Valencia and we have found a work of plaster and brick..., very lightweight, and of low cost, and for this reason we ask you send Farayg and one of the best experts so that they can **see** how this work is made and reproduce it here in a similar way" signed June 20, **1382**.

Compared to traditional stone vaulting, tile vaulting was revolutionary. Builders marveled at its **economy** of material, **speed** of construction, miraculous **thinness**, and high **load** capacity.

Two key innovations:
Laid flat = thinner = less weight = less lateral thrust = less walls/buttressing.

Fast setting plaster = without wooden formwork/centering, building out from wall interior corners in successive arcs, fitting tile between two perpendicular edges.

History of plaster:
clay plaster (over wood lath): clay + sand + water + plant fibers + manure.
lime plaster/quicklime (frescos): limestone 1500 degrees + water + CO2.
gypsum/**plaster stone** (alabaster): calcium + sulfate + dihydrate (CaSO4+2H2O).
burnt gypsum/**plaster of Paris** (Montmartre quarry): gypsum 300 degrees + water, used for mortar to hold first layer of tiles in Catalan thin shallow vaulting.
cement plaster/Portland cement: limestone + clay 2700 degrees + gypsum + water, low cost, versatile, widespread, 10% of carbon dioxide emissions (mine & heat).

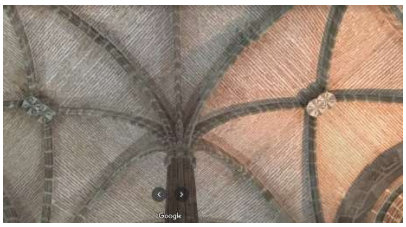

3:55
BREAK???
4:05

Before **1382**, in **Zaragoza**, much of construction was in brick, of **Mudéjar style** (historical synthesis of Christian and Muslim civilizations combined in the origins of Spanish culture. Most authentic / original Spanish contribution to Western art.), as in the cellar vaults from the **Convent of Santo Domingo**, completed **1283**. Thin, long bricks are stacked in layers to form arches and vaults.

Of note, a detail characteristic of Mudéjar the **stepping of bricks** corbelling to form the pointed arch transforming from circular vault. Note shallow intermediate arch.

This **'stepping'** is a physical manifestation, an expression of a way of thinking, not only of incremental acts, each brick projecting a little further than the previous one, until a complete series of pieces combine to make up a whole, able to extend out across a great expanse. But also, it records a problem solving, a puzzling, figuring out a way to create an open space in the wall, by arranging the bricks in a particular configuration, interlocking them so they can support the weight of the wall over a voided space, simply by the fitting of each brick tightly within the others.

This way of puzzling, the mindset of a mason, is precisely what developed this new innovation of vaulting in Valencia around 1382. What is called **bóveda tabicadas**, Spanish for 'vault partitions' because the bricks are now laid flat like partition wall (interior, non-load bearing partition walls traditionally made of flat bricks on end), so the wide face is visible on the surface. Catalan **maó de pla** 'brick of flat'.



Before 1382 (**Monastery of Santo Domingo, Eastern Gallery, in Valencia**), the wide face of brick sandwiched together in vault webbing, providing more surface area for mortaring together, to transfer heavy loads carried by the vaults and arches.

But then in **Refectory**, master mason **Juan Franch** turned the bricks 90 degrees, orientating wide faces outward, to cover more surface area in fewer bricks.
This was precisely the point, what triggered the inception of this new way of doing. This mason in **Valencia**, working on the **Monastery of Santo Domingo**, that the **Aragon King** wrote about in letter to his masons of **Zaragoza**, was using the bricks as an inexpensive alternative to the traditional stone, to fill in the webbing between the Gothic stone ribs. He wanted to save the time and expense to cut the stones.

And, once resolved to take a short cut, why not take it even further, but trying to use the as few of the substituted bricks as possible, to lay them as quickly as possible?

With this simple act of substitution, turning to the thin tile bricks that Catalan masons are most familiar with having worked with for centuries, a new way of constructing vaults was created, that was **structurally more efficient**, materially **less expensive**, and the time to construct **much faster**. And, because terracotta bricks are much lighter than stone, the **profile of the vaults could flatter**, since they create less lateral load, that was typically handled with the more vertical vaults of the **pointed Gothic arches** or the earlier **circular Roman arch**. [Lecture 4]

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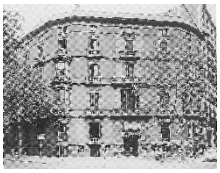
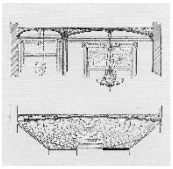
In **1866** (24 years old), not yet licensed as a master of works, designed a 4 story house, would build 6 years later as his own residence.





1871, displayed several house designs at **Barcelona Exposition of Agriculture, Industry, and Fine Arts**. Built a number of significant houses in Barcelona, including **Camilo Julia house** (**1874**), considered important precedent for *Modernisme*, Catalan Art Nouveau. Built with tile vaulting, innovation in concern for public health: natural ventilation to provide clean air, through tubular system of flues interconnected through masonry floors and walls, to "secure absolute absence of dampness" to remove "impure air". [Lecture 3: Building Science]

1873, presented a model of a house at **Universal Exposition in Vienna**, as part of the Spanish delegation.

1876, presented photographs and drawings of three house designs, incorporating tile vaulting floor systems, in large artistic-industrial exhibition of works by 26 alumni from **Escola Especial de Mestres d'Obres in Barcelona**.

In **1876**, Guastavino was selected to present architectural designs for the **Centennial Exposition in Philadelphia**. He submitted 21 photographs of completed works and a new design titled 'Improving the Healthfulness of Industrial Towns', receiving Honorable Mention, proposing tubular constructions.

In **1868**, received his first significant commission, as a result of his practical knowledge gained by hands-on training at **Escola Especial de Mestres d'Obres**, the **Battló Textile Factory** (in Barcelona, same **Casa Battló** by Gaudí in 1904).

His uncle, **Antonio Guastavino**, owned major textile factory in Barcelona, where Rafael gained insights into factory design and operation, constant technological innovation driven by fierce economic competition. Used to win competition to design and build the one of the most impressive and influential factories of the great 19th century textile mills, became a landmark in Catalan industrial architecture. Encompassed 4 city blocks in expanding Eixample district outside Barcelona.

The scale of the project and speed of construction demonstrated his talent for managing major projects, launching his career in Barcelona, national and international recognition at 28 years old.

Contemporary newspaper account: "The works of the grandiose factory that the Batlló brothers are raising in the Ensanche are proceeding very quickly under the expert direction of the master of works **Rafael Guastavino**, who has knowledgeably presented the facades without excessive rendering, producing beautiful effect through the combination of stone masonry with brick."

Guastavino responded with letter to the editor: "For some time the local papers have attributed the direction of the factory of the Batlló brothers to me: this is inexact. In all buildings of this nature there exists two thought processes, represented by two distinct faculties whose attributions or limits are well defined. One represents the principal, the eminently useful, that constitutes the design and direction of the factory. This corresponds to the engineer, to whom all are subordinate for this type of building. The other represents the secondary, the design and direction that is purely and simply **architectonic**. The first part corresponds exclusively to my distinguished friend **Mr. Alejandro Marye**. The second pertains to one who does not like to have his name published, if it hurts other's feelings."


Exterior noteworthy for Catalan decorative brickwork mixed with stone.
Spacious structure of the large vaulted staircases of the main building.
Public marveled 200ft. tall octagonal brick chimney, flared at base.

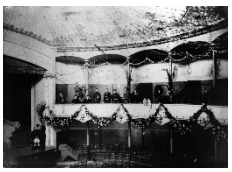
The most successful part of the design, was the factory floor submerged underground, the roof supported by a grid (12'x17') of columns and Catalan vaults.


Tile vaulting had been used in textile factories for decades in Catalonia, however iron columns supporting the tile vaulting was significant construction innovation, as was scale (**Rem** bigness), 330ft. x 260ft.: 86Ksq.ft. (original plan: 134,500sq.ft.), and speed: 2 years to complete.


At the center of each bay was a round oculus, providing natural light & ventilation,
The grid of columns creating an open, spacious floor for manufacturing.
Tall chimney releasing coal exhaust far away from the 2,450 workers.

But most significantly, was one of his earliest material innovations, the use of Portland Cement in place of the traditional lime based mortar. **Lime** had been used since the **Monastery of Santo Domingo** in **1382**, until in the 1800s **gypsum** was introduced by the **École des Beaux-Arts**, referred to as **Plaster of Paris**, which was fast-setting, hardening more quickly. However, Guastavino decided to used **calcium** found in **Portland Cement** imported from London at great expense, as it was rare in Spain at the time. Compared to lime or gypsum, the calcium provided greater strength and water resistance. [Lecture 5: Structural Innovations]

January 1889, after 2 decades of social conflict and labor strife, bomb was exploded in factory office, forcing temporary closure, "prelude to the industrial death of Catalonia", closed permanently in 1895.



Guastavino's greatest achievement in Spain came in **1880**, commissioned to design and build a new theater, **La Massa in Vilassar de Dalt**, a town outside Barcelona.

This building would showcase his tile vaults to the public, in a 56ft. span dome,

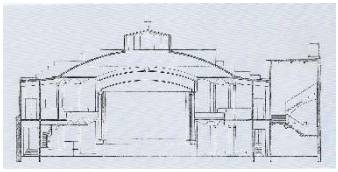
providing unobstructed views of the stage, rising 10ft. to 13ft. oculus at center.

2002 Renovation

Ignasi de Solà-Morales

The shallow dome is supported on 14 slender iron columns at the perimeter, which are buttressed with 13 transverse vaults over and under the balcony, the outward thrust also contained by an iron band imbedded around the base of the dome.

With the use of the superior strength, calcium mortar, the dome is astonishingly only **2 inches thick** (2 layers of thin clay tiles), with 17 radial ribs at **4 inches**.



Thin compression shells in concrete would not be built on this scale for 40 years. Hired Oct. (**1880**), started construction in Nov., inaugurated March 13, 1881.

Moundbuilders: works in clay, curvature/profile of mound (BeauxArts plan/elev), wall without roof, roof without wall: suspend this sheltering mass weightless. Transform material via constructs, only in the doing, **mastering the work**.