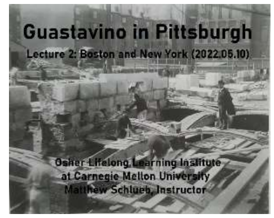
2022.05.10 Lecture Notes

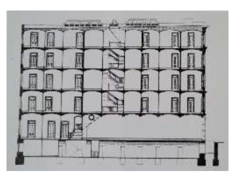
**Lecture 2 – Boston and New York**




3:15

(check PowerPoint box for video audio on)

In **1864**, Guastavino married an orphan adopted by his **Uncle Ramón**, named **Pilar Exposito**. They had three sons within five years (**Josep**, **Ramón**, **Manuel**). After two years apart due to his infidelity, they had a fourth son, **Rafael III**, born May 12, 1872. When Guastavino was unfaithful again, Pilar and the three oldest sons left for Argentina on **February 26, 1881**. To avoid social stigma of a failed marriage, Guastavino and his youngest son Rafael Jr. (nine years old), along with his housekeeper and her two daughters, set sail for New York. They left suddenly, even before the completion of the grand **La Massa theater**. Encouraged by his reception at the **Philadelphia Exposition** 5 years earlier, he felt the growing cities in the United States had tremendous business opportunities. Educated as a Master of Works, in the Catalan building techniques, with two decades of experience constructing thin tile structural vaults. He never returned.



However spoke no English and struggled to adjust to American building practices. In **1883**, with $40K he brought from Spain, **designed and constructed** two blocks of tenement housing in New York City, using tile vaulted floors and roof. However, lost the project and investment, wiped out financially, because he did not have clear title to the property. Returned to hire draftsman at $25 per week.

In **1883**, won a competition to design a German Jewish social club (Progress Club) on East 59th Street and **1884** designed a synagogue on Madison Avenue, both in Spanish Moresque style. Led to close association with accomplished real estate broker **Bernard Levy**, hired to design West Side row houses in **1885** and **1886**.



In the **1880s**, America had little tradition in masonry vaulting, instead cheaper, less permanent timber framed construction. Rapid growth by Industrialization, had greater risk of fire. **Chicago Fire of 1871** burned six square miles, 19K buildings.

Balloon framing, thinner studs, resulting from new machines producing wire nails.

**Boston Fire of 1872** burned 700 hundred buildings. Some builders attempted all-masonry construction to address demand for fire-proof buildings. However, masonry was heavy and therefore required large walls and buttressing to resist outward thrusts by the weight of masonry arches and vaults.

Additionally, expertise in masonry design and construction was difficult to find, only few dozen masonry vaulted buildings were built in United States before 1850s, so massive spans sought by architects in **1880s**, in a country without a formalized system for educating master builders, created unfilled demand.

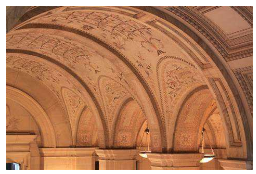
Because of the **Boston Fire**, developers were willing to pay a premium for fireproof buildings, resulting in tremendous innovations with the use of terracotta tile in combination with iron beams. Portland cement was used in structural concrete, however high cost to import from England, was not used widely until **late 1890s**.

In **1885**, encouraged by **Bernard Levy**, Guastavino patented his structural tile vaulting system for fireproofing buildings. 24 patents **1885-1937**. [Lecture #3] Patents gained credibility in American building industry, worked as a vault builder going forward, rather than an architect responsible for entire building design.
In **1888**, gained investors ($230K) to open **Tile Fire-proof Building Company** of New York.

3:35

In **1885** Guastavino entered two architectural design competitions, didn't win either, however, in both cases he eventually built his fireproof system for floors in the buildings of the winning architect.

The second competition was for **Boston Public Library** (**1889-1895**) by architects **McKim, Mead and White**, built to rival **New York Public Library** (1895-1908) and **Carnegie Public Libraries** (1883-1888-1916).



**Charles McKim*** (design) 'monumental civic building, bring art/culture to public'
**William Mead** (engineer)
**Stanford White***

* - protégés of **H.H. Richardson**

The trustees for the Boston Public Library demanded the Library be fireproof. **Material Sciences**, testing construction assemblies, was not yet standardized, so **empirical methods** were used to demonstrate a building system's abilities.

Guastavino built a **test vault**, loaded on top with 112,578 lbs. of iron weights, the equivalent of 8 adult elephants, then lit a fire under it to demonstrate that the thin layers of structural clay tile were fireproof. Building officials, architects, engineers, developers, and the press all attended, amazed that the tile vault system worked.

[Children's book: Immigrant Architect: Rafael Guastavino and the American Dream, 2019]

3:40pm

On **March 27, 1889**, Guastavino met **Charles McKim** on the **Boston Library site** as first floor was to be built with iron beams. Next day met with job superintendent, who wrote letter to McKim: “Mr. Guastavino thinks it is a great pity that the whole ground floor could not have been put in by his system, with no beams whatever – only a few girders. He says if we would give him all the iron beams for the ground floor (that are already on the site) he would sell the iron and build the whole ground floor for nothing… We are quite favorably impressed with the Guastavino system and have quite a bit of it drawn in our sections… it will be decided at once that we are going to use it.”

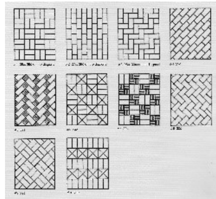
McKim’s design specified load capacity of 500#/sq.ft., so on **April 20, 1889** Guastavino **built a small vault section to test the loading** of 12,200#/22sq.ft. (550#/sq.ft.). **May 9, 1889** drawings were altered for Guastavino system and on **May 14, 1889** given the contract to substitute tile vaults for iron beams. Put out to bid, with Guastavino the only bid, since the system was patented (1885). From the commission, he founded the **Guastavino Fireproof Construction Company**.

+3

Guastavino was able to mobilize workmen and construction materials to the site in a matter of days. From **June 15th to July 1, 1889**, his company installed 5K sq.ft. of vaulting in the Boston Public Library, 400 sq.ft. per day. He was so confident in the company’s efficiency, he guaranteed to supply and place 4K sq.ft. per week.

After seeing completed vaults, **McKim** decided to leave tiles exposed, rather than the traditional decorative plastering finish. Guastavino had procured both glazed and unglazed tiles in a higher level of finish than usual at the time, which became the first use of exposed tile vaults in U.S. and Spain for Guastavino, although he knew of the exposed tile vaults of the **Monastery of Santo Domingo** (1382).

3:50



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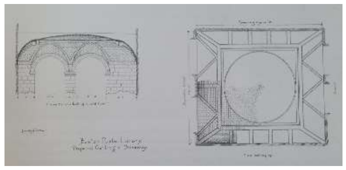
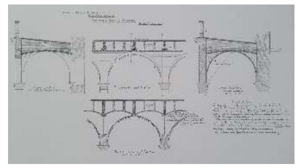
Guastavino developed variety of decorative patterns for the tiling, with the variety of alternative tile patterns ranging in labor costs from 26 to 34 cents per sq.ft.





McKim trusted Guastavino to carry out this detailing in the construction.
From Boston Library construction, Guastavino became know as tile vault builder, Commissioned by other architects, rather than becoming licensed architect himself.

Following the success of the Library, McKim, Mead and White relied on the Guastavino company for their largest projects and **McKim**'s confidence in the vaulting system convinced other architects to use it as well.

In **1892**, an architect wrote McKim asking his opinion of the Guastavino system and he wrote back that his firm should visit the new Library to inspect the system first hand, adding "I would not hesitate to place my entire confidence in the Guastavino system."

By the **early 1890s**, the company established offices in Minneapolis, Chicago, and Providence, in addition to the New York and Boston offices.

3:55pm

**BREAK ???**

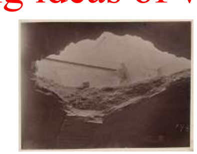
4pm

After winning the bid for constructing the vaults for the **Boston Public Library** in **May of 1889**, Guastavino was invited to lecture on the **Theory and History of Cohesive Construction** (made of adhesive cement mortar, as opposed to Gravity Construction with Stone) **applied to the Timbrel Vault** (made of bricks on end), delivered to the Society of Arts at MIT on **October 24th 1889**, he noted:

“Up to the years **1866 to 1868** (Gaustavino enrolled in 1875), the professors of the **Academy of Barcelona**, one of the most illustrious of Europe, and a city where tiles are more in use than in the rest of the world, did not commence to pay any attention to this style, and when at last they did, it was only to comment incidentally on its resistance and its possible utility; but they did not make it a study, notwithstanding the fact that they were constantly walking over floors constructed by this system. So small was its significance to them as a science! On the other hand, this want of attention is explained by the lack of cements proper for such kind of construction. The want of proper cements, and of an invariable brand, on which to based the calculations, was one of the main obstacles which involved the Catalan and Valencian architects.”

This passage illustrates the divide between the building guilds (mestre d’obres) that built from guarded trade secrets, of which Guastavino identified and the professional paper trades (architects studying at École des Beaux-Arts), trusting certifications of material standards and calculated methods.

**Trusting empirical methods**, working directly with the material at hand, Guastavino counselled architecture students: "Let them go to nature instead of to crude engineering and the conflicting ideas of various ages."



Hole created through an arch of a Guastavino vault, during the construction of the Boston Public Library, when a 2 ton stone fell from work above (1889). Both the arch and vault around the hole remained intact, did not fall, proving the strength of the structural tile system.

More specifically, Guastavino points to the specification of cement in 'cohesive' construction, as the obstacle to adoption by the professional architectural trades.

The **Portland cement** Guastavino adopted in his earliest vaults back in Spain, selected for its superior 'cohesive' strength (a mortar so tenacious that tiles will ordinarily break or split before the mortar would part), was invented by **Mr. Aspdin** and patented back in (October 21st) **1824**, named after the polished Portland stone, that has a similar look to the Portland cement when smoothed with a trowel.

Although this advanced cement was known, the high cost of importing from England slowed its adoption by the Spanish architects.

In fact in this lecture, Guastavino expressed precisely his concerns with the materials manufactured by these newly mechanized industries, largely still in their infancy in the 1890s, when he said, "In some cases the risk and danger caused by the irregularity of the materials were so plain that the workmen were afraid, compelling me to remain in the works to inspire confidence and success."

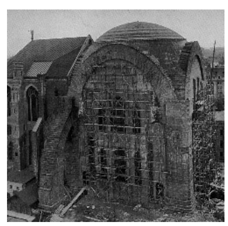
Today, we take material testing and manufacturing consistency as a given, the backbone for architect's to specify specific building products and way assembled.

St. John the Divine
Crypt Vaults (**1900**)

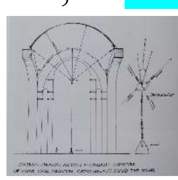
However, here we also see how Guastavino was present on site, personally guiding these craftsman through the construction process, managing the unexpected situations that arise on every jobsite, related to the unusual conditions, unforeseen circumstances, and often substandard materials.  This was the true talent of Guastavino, a true **mestre d'obres (master of works)**, his knowledge gained from hands on experience, as and innovative spirit, adapting continuously.

Guastavino continued in his lecture, "Nothing was done about investigating these structures, to which I have referred, and no co-efficients were derived. This only can be obtained when we can depend upon materials with mathematical regularity, and with powerful apparatus for determining their reliability."

"In countries like this where we can find more than twenty guaranteed brands of quick-setting Portland cement of different degrees, and in a country where the clay can be used for those constructions with advantage and regularity of manufacture, and finally, in a country where we have powerful apparatus, co-efficients can be obtained as we have been doing for the past five years."
"From these special advantages it seems these works have culminated in the United States, …with specimens that have no rivals in any part of the world for lightness and resistance."



In **1909,** one year after his father's death**, Rafael Jr.** supervised the firm's largest dome, with diameter of **132 feet**, in **New York's Cathedral of St. John the Divine**.

Workers installed each day's eighteen-inch ring, advancing the masonry away from the walls while standing on the previous day's work--**150 feet** above the stone floor. Miscalculation could have been death, but work was completed without incident.

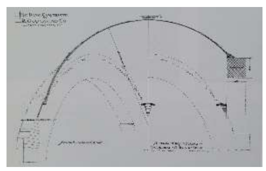
With no scaffolding, supporting beams, or buttresses, the Guastavino company was able to build far more quickly and at a much lower cost than any other dome in history. It was proclaimed an engineering masterpiece. The dome garnered national and international attention, thrusting Guastavino Jr. into newspapers. **Sept. 19th** headline in the **New York Herald** read "Disaster Defied on the Cathedral Dome: Young Architect Upsets All Theories of Engineers and Erects Vast Structure."

4:30

The dome for the St. John the Divine marked a new epoch in the construction of masonry domes. Crowds would gather to watch, fascinated by the work.

**Guastavino Jr.** placed the dome in the lineage of the world's greatest domes, writing: "The dome, which was erected in a few weeks time, compares very favorably in size with the world's largest domes, the greatest the **Pantheon** at Rome being 142 ft. in diameter; **St. Peter's** at Rome and the Duomo at Florence are about 139 ft. At Constantinople there is a dome of **St. Sophia's** mosque of 115 ft. diameter and the dome of **St. Paul's** London measures some three feet less."


From start to finish, took only 5 weeks to fill in the pendentives between the four granite arches completed in 1908 and another 10 weeks to complete dome atop.



132 ft. span, measuring only 4.5 inches thick. The cost of the dome was $10,300. Conceived as temporary until the cathedral could afford to build a spire, the dome remains, with no plans for replacement.

Through innovations in building science, Guastavino's structural tile vaults **anticipated the modernist thin-shell structures in reinforced concrete** that didn't come along until a half-century later and **creating curvilinear forms** unduplicated for over a century, until the advent of computer aided design to manage complex computations and coordination of today's **parabolic structures** (**Felix Candela, Pier Luigi Nervi, Frank Gehry, Zaha Hadid**).

In fact, Guastavino had started his experiments using poured concrete, but gave this up, and to the end of his life insisted that it was inferior to tiles which made unnecessary the use of centering and protected the mortar from the impact of fire.

He argued that a revival of the art of masonry was needed to meet the building requirements of the day and that cohesive masonry in tile or a perfected concrete would be the material of the future.

4:40

End today's lecture with a story:
On **Oct.17, 1961**, just 2 decades after the last Guastavino vault was completed in Pittsburgh, **George Collins**, a professor of the History of Art and Architecture at Columbia University, sat in the back of **St. Paul's Chapel** (**1907**) on campus, during a memorial service for a colleague.

His eyes wandered to the ornate herringbone pattern of tiles on the dome above, the curves and colors reminded him Gaudí's work in Barcelona, on whom he had recently completed a book. As he studied the ceiling, he realized that it used the same vaulting technology that Gaudí had used.

This discovery caused him to look more carefully at the architecture of the Upper West Side of Manhattan. To his surprise, he found Spanish tile vaulting in buildings all around him, in the Riverside Church (1930), Cathedral of St. John the Devine (1909), and several buildings on Columbia University's campus.

As he looked further, he discovered more examples around the city, **Grand Central Station** (1913), **Carnegie Hall** (1891), **Ellis Island** (1917), **Queensboro Bridge** (1909), **Pennsylvania Station** (1910). Seemed every block in NYC had a tile vault.

In **May of 1962**, he traveled to **Pittsburgh** to give a lecture and found 30 of the most significant buildings in the city with the vaulting. Realized what looked like a decorative tile finish was actually a structural system of interlocking tiles, legendary in Spain and soon discovered that one family named Guastavino had built all of these vaults across United States.

Reached out to surviving relative of the company that had just officially closed in **July 12, 1962**. After liquidated, he arranged for drawings to be donated to **Avery Library** at Columbia, preserving the history.

Guastavino's name was a household name with architects just a couple generations ago, all but forgotten. How can this be? What else has been lost?