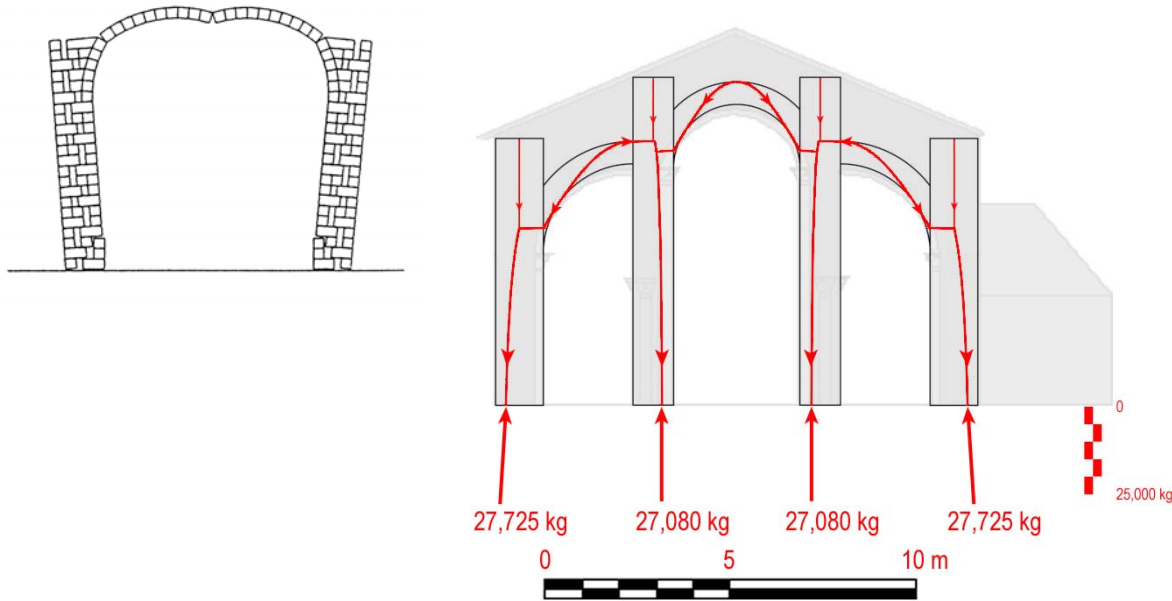


# Analysis of Historic Structures



**John Ochsendorf, Assistant Professor**  
**MIT Building Technology Program**

# Hagia Sophia, Istanbul



Image courtesy of Ozgu Bayrak, [structurae.de](http://structurae.de)

Completed in 537 AD, dome span of 32 m

# Hagia Sophia, Istanbul

Partial collapse of dome,  
due to earthquakes:

558 AD (east quadrant)

869 AD (west quadrant)

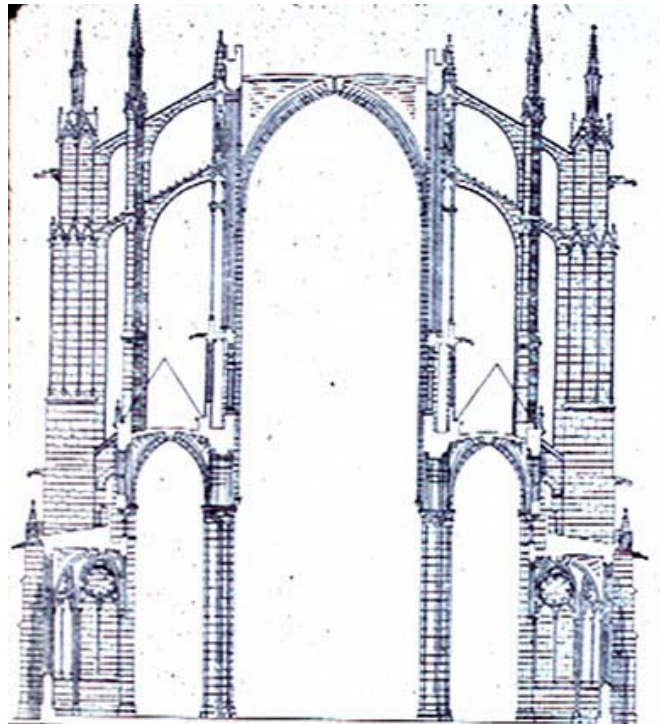
1346 AD (east quadrant)



Image courtesy of Adrien Mortini, [structurae.de](http://structurae.de)

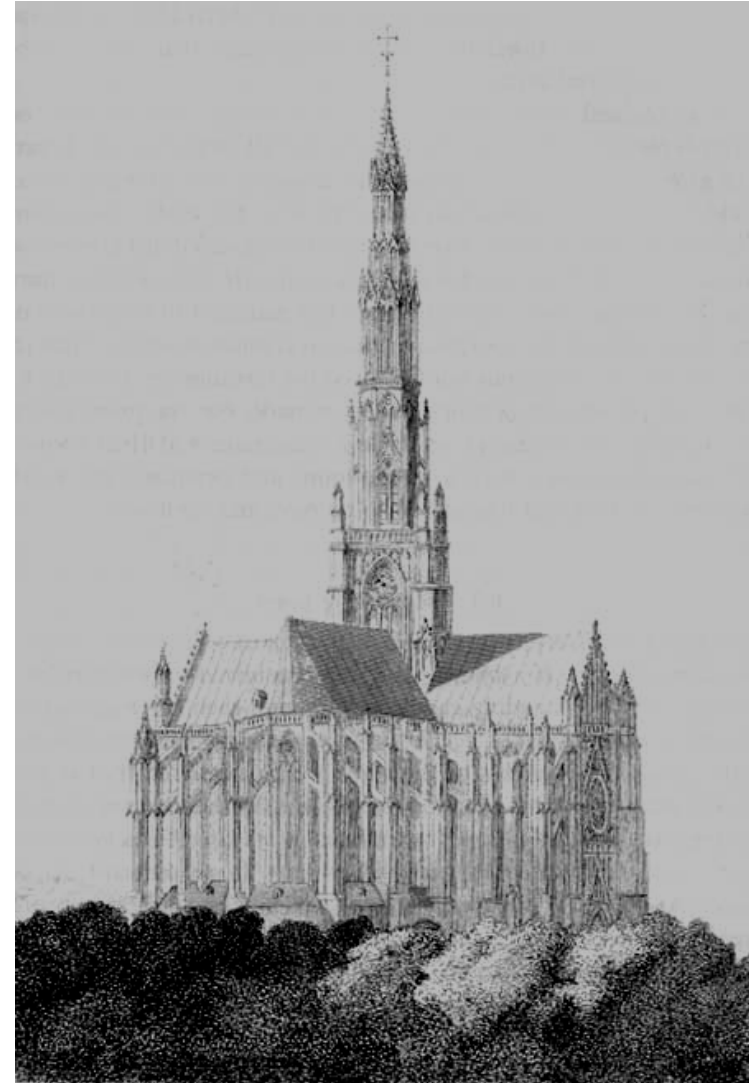
# Beauvais Cathedral

- Partial collapse in 1284



# Beauvais Cathedral

- Tower built in 1569
- Height of 153 m
- Supported on piers
- Tower collapsed 1573



# Basilica of St. Francis in Assisi, Italy

**13<sup>th</sup> C construction**

**Frescoes by Giotto**



Image courtesy of Rob Jaffe, [structurae.de](http://structurae.de)

# 1871 Fire in Chicago



# Boston Public Library, 1889-1890





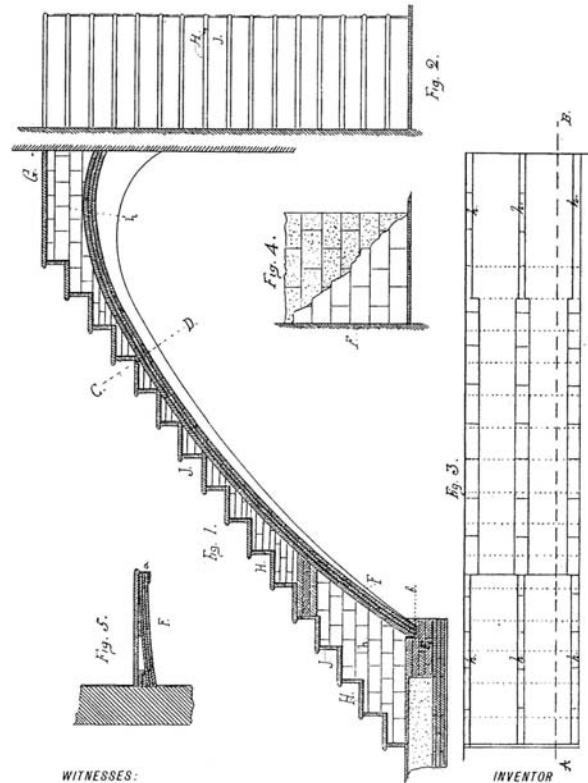
# 1886 Patent for Fireproof Building

(No Model.)

R. GUASTAVINO.  
FIRE PROOF BUILDING.

No. 336,047.

Patented Feb. 9, 1886.



WITNESSES:

*Francis Guyer M. S.*  
*Prothonotary*

INVENTOR  
*Rafael Guastavino*  
BY *J. W. Dorney*  
ATTORNEY

# R. Guastavino Co. (1889-1962)

**SOME DOMES CONSTRUCTED BY  
R. GUASTAVINO CO.**

BOSTON		NEW YORK	
BUILDING AND LOCATION	SPAN	BUILDING AND LOCATION	SPAN
1. Cathedral, St. John the Divine, New York City	131 ft.	1. University of New York, New York City	50 ft.
2. National Museum, Washington, D. C.	80	2. McKinley National Memorial, Canton, Ohio	85
3. Institute of Arts and Sciences, Brooklyn, N. Y.	54	3. St. Paul's Chapel, Columbia U., N. Y. City	55
4. St. Francis de Sales Church, Philadelphia, Pa.	41	4. Scull School, Honesdale, Philadelphia, Pa.	60
5. Bank of Montreal, Montreal, P. Q.	48	5. University of Virginia, Charlottesville, Va.	77
6. Church of St. Barbara, Brooklyn, N. Y.	43	6. Harbison House, Bronx Park, New York City	24
7. Grand Trust Company, Philadelphia, Pa.	123	7. Madison Sq. Presbyterian Church, N. Y. City	44
		8. J. J. Jerome Memorial Library, Sag Harbor, N. Y.	38
		9. Van Nostrand Magazine	
		10. Horatio & Stokes	
		11. McKim, Mead & White	
		12. Horatio & Stokes	
		13. McKim, Mead & White	
		14. Horatio & Stokes	
		15. McKim, Mead & White	
		16. Augustus N. Allen	

# Essay of 1893

ESSAY  
ON  
THE THEORY AND HISTORY  
OF  
COHESIVE CONSTRUCTION,  
APPLIED ESPECIALLY TO THE TIMBREL VAULT.

---

*READ BEFORE THE SOCIETY OF ARTS,  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,  
BOSTON,*

BY  
R. GUASTAVINO, ARCHITECT.

*SECOND EDITION.*

BOSTON  
TICKNOR AND COMPANY  
211 TREMONT STREET  
1893

# Load Testing by Guastavino Sr.



# Load Testing by Guastavino Sr.



# Spiral Staircases in Compression



# Tiffany Building, NY, 1906



NEW YORK, 100 Broadway  
**R. GUASTAVINO COMPANY**  
FIREPROOF CONSTRUCTION  
100 BROADWAY, NEW YORK  
NEW YORK, 100 Broadway

# Grand Central Station, NY, 1913



Image courtesy of Adrien Mortini, [structurae.de](http://structurae.de)



# Guastavino Vaulting

- Research questions
  - Mechanics of tile vaults
  - Calculation methods used by Guastavino
  - Analysis of complex forms, like spiral staircases
  - etc