Guastavino in Pittsburgh

Lecture 4: Engineering & Material Innovations (2022.05.31)

Osher Lifelong Learning Institute
at Carnegie Mellon University
Matthew Schlueb, Instructor

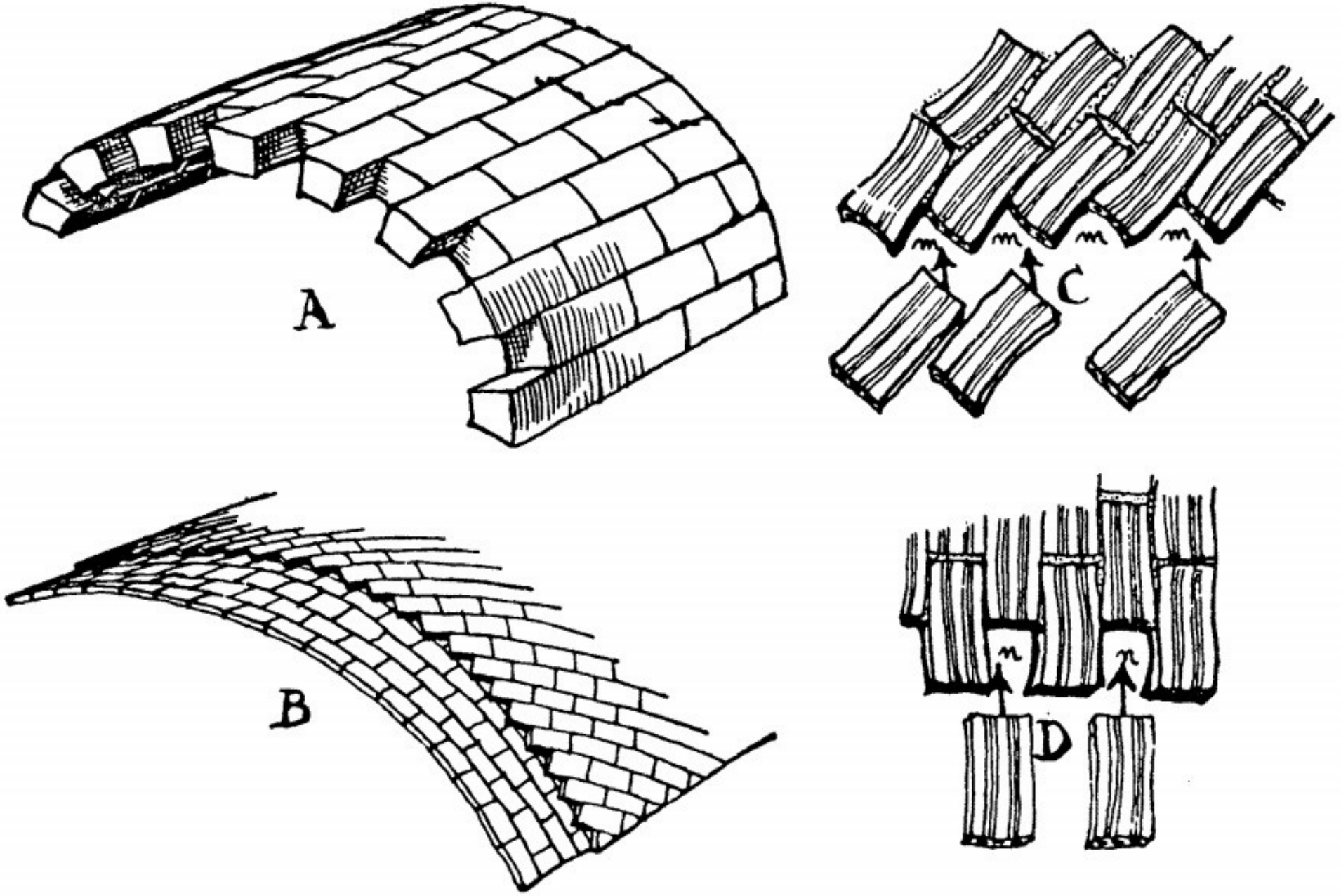


Fig. 1. Stone vs. tile vaults (Moya, *Bóvedas tabicadas*).

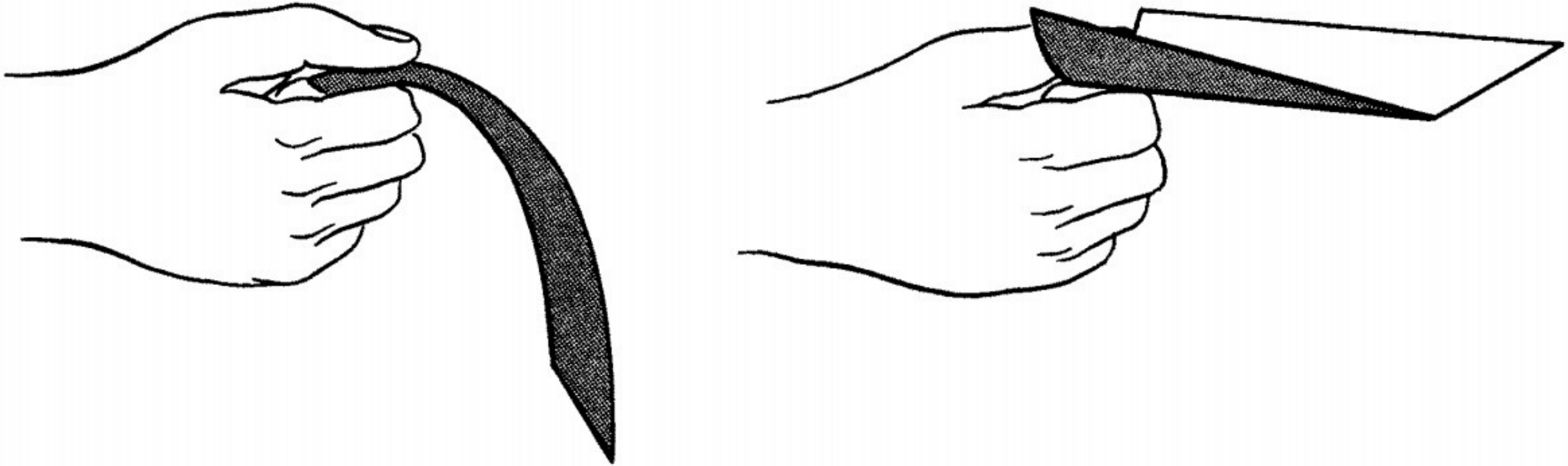
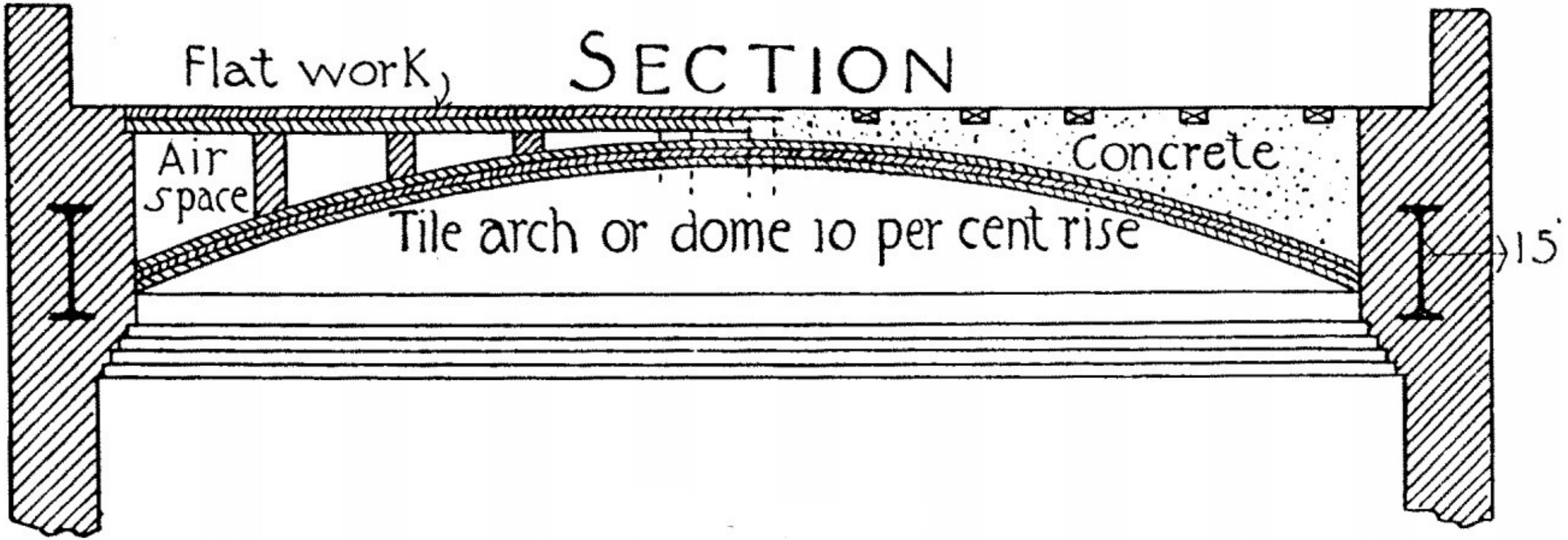
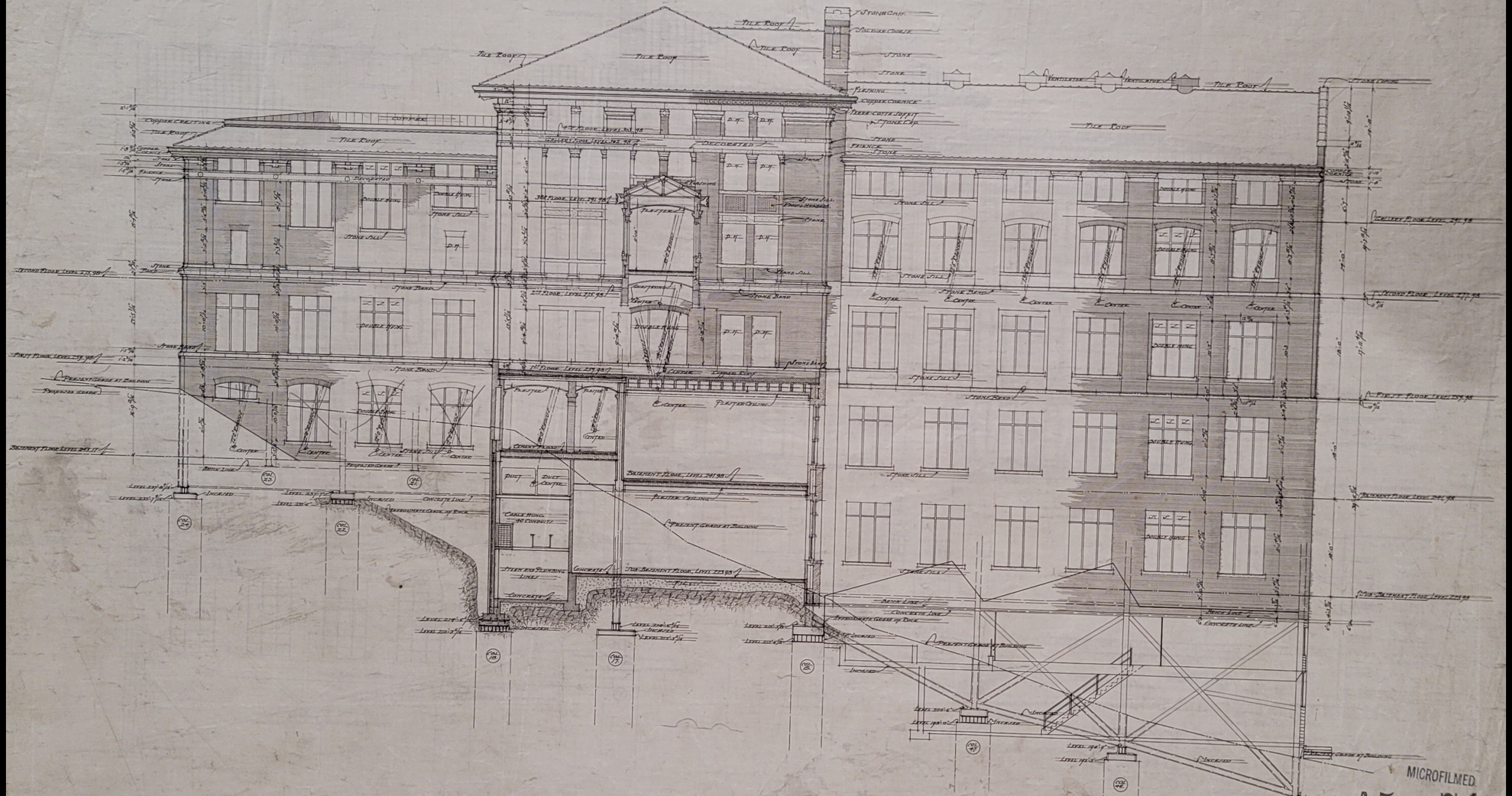
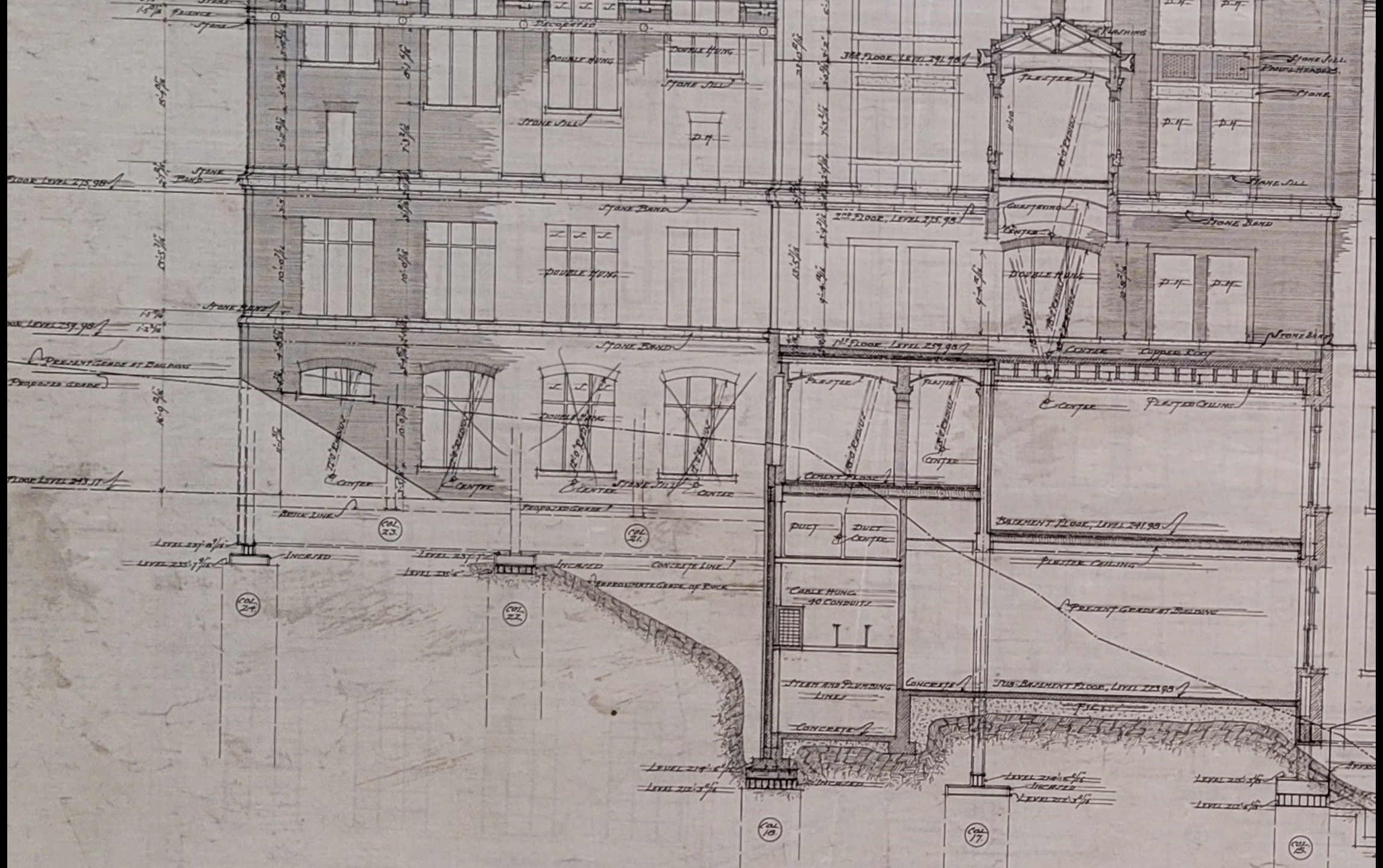
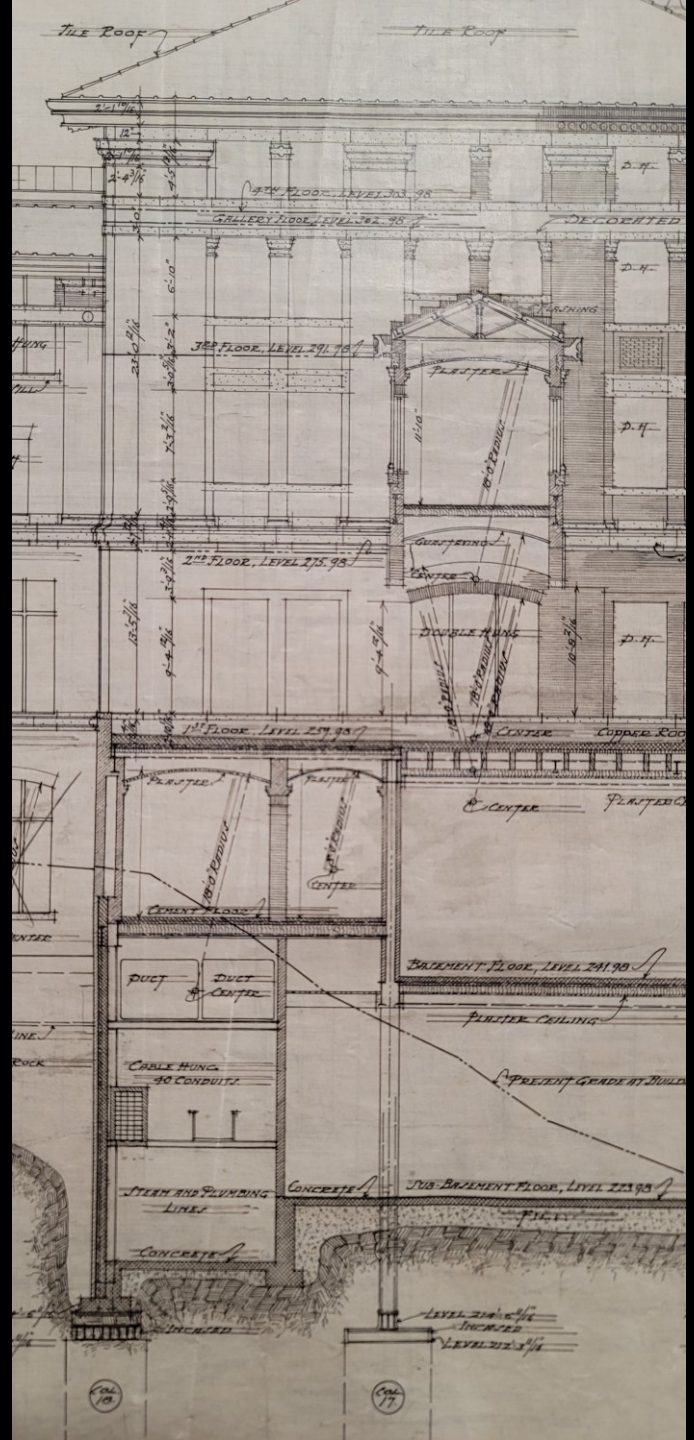


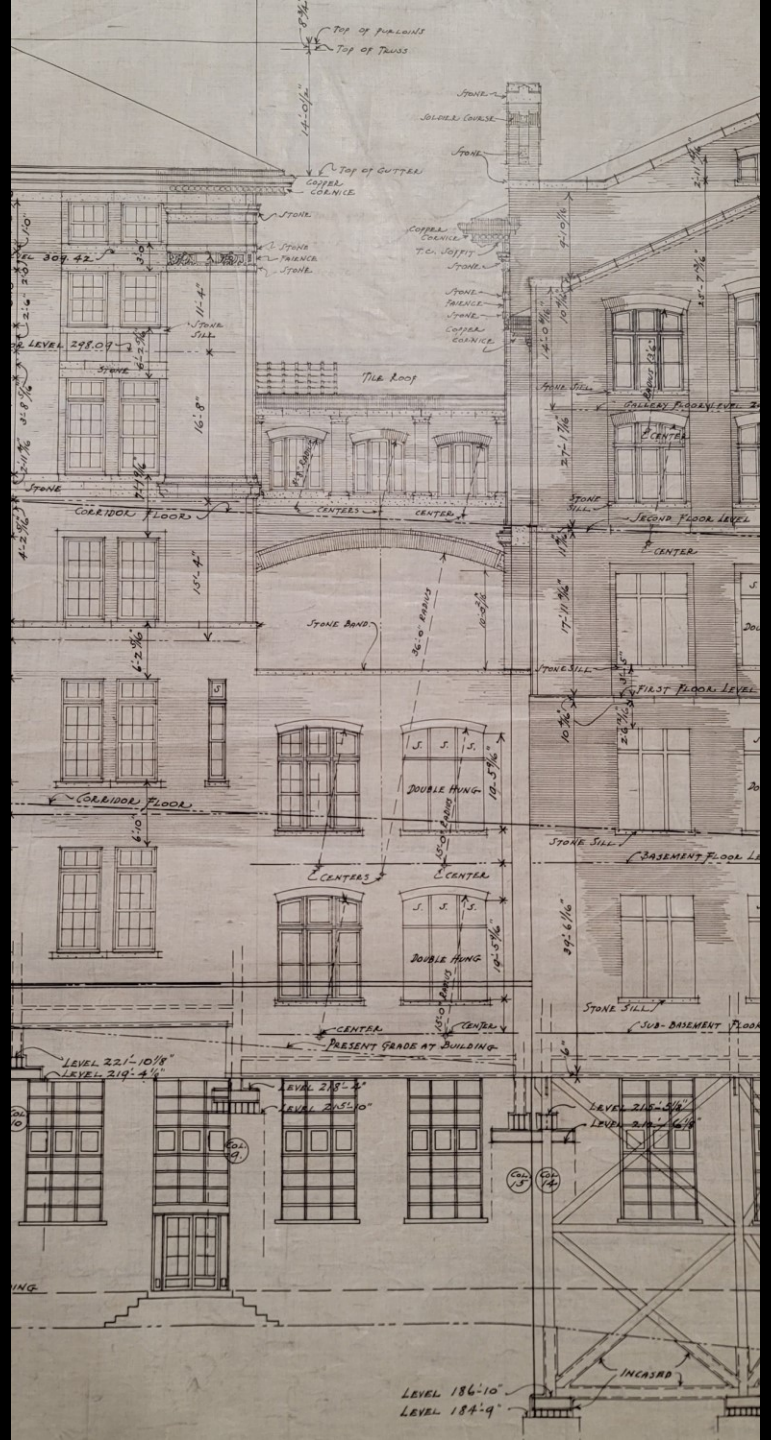
Fig. 2. A surface (paper), unable to support its own weight, can sustain that and more if given a slight curvature (Salvadori & Heller, *Structure in Architecture*, Englewood Cliffs, N. J., 1963).


SECTION
Flat work
Air space
Concrete
Tile arch or dome 10 per cent rise
15'

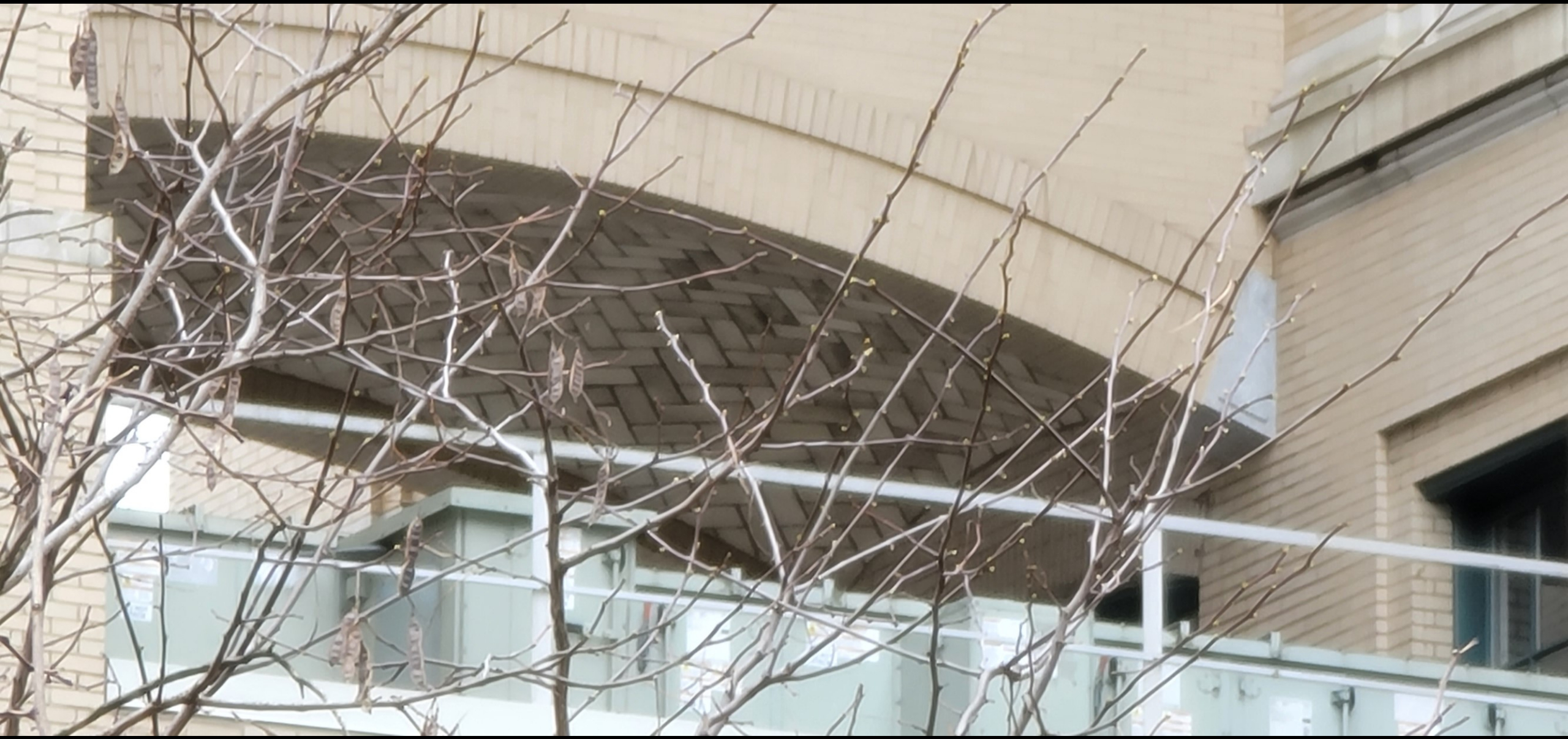

TILE ROOF
STONE CAP.
COPPER CORNICE
STONE
FLASHING
COPPER CORNICE
STONE CAP.
FENCE
STONE
VENTILATOR
COPPER CRESTING
COPPER
DECORATED
DOUBLE HUNG
STONE SILL
STONE BAND
PLASTER
PLASTER CEILING
COPPER ROOF
CONCRETE FLOOR
BASEMENT FLOOR, LEVEL 241.98
SUB-BASEMENT FLOOR, LEVEL 223.98
PRESENT GRADE AT BUILDING
PROPOSED GRADE
BRICK LINE
CONCRETE LINE
INCASED
CABLE HUNG
DUCT
STEAM AND PLUMBING LINE
CONCRETE
FLOOR
MICROFILMED
A5 -74

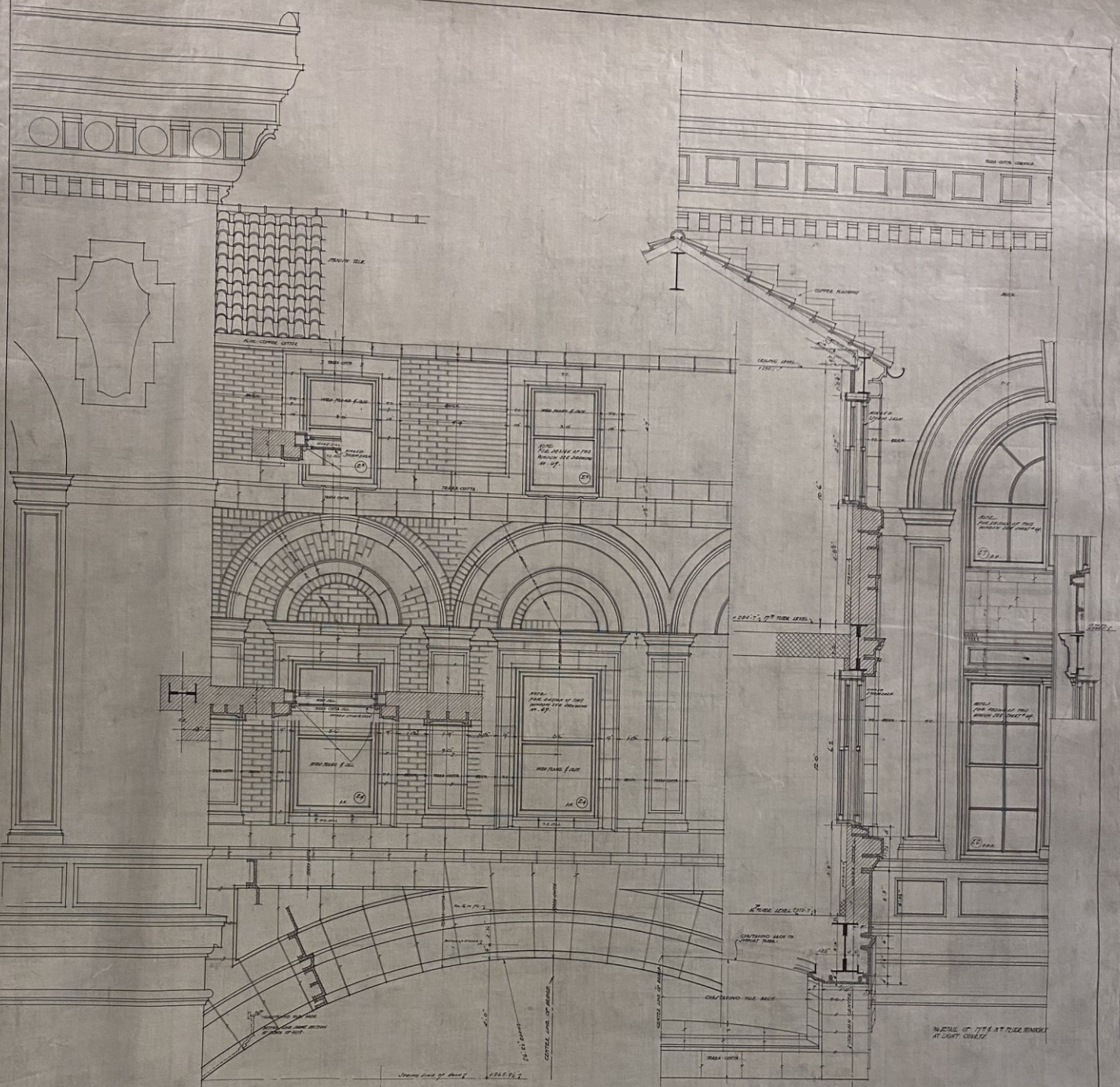

Stone
Fence
Recessed
Double Hung
Stone Sill
Stone Band
Floor Level 275.98
Stone Band
Stone Band
Double Hung
Stone Band
Present Grade at Building
Proposed Grade
Floor Level 243.11
Center
Stone Sill
Center
Base Line
Proposed Grade
Col. 23
Col. 21
Level 237'-0 1/16"
Level 235'-7 9/16"
Incased
Level 237'-7"
Level 235'-6"
Incased
Concrete Line
Approximate Grade of Rock
Col. 24
Col. 22
3rd Floor, Level 291.98
Flashing
Plaster
Stone Sill
Panel Header
Stone
Stone Sill
Stone Band
2nd Floor, Level 275.98
Gutter
Center
Double Hung
Stone Band
1st Floor, Level 259.98
Center
Copper Roof
Plaster
Plaster
Center
Plaster Ceiling
Center
Cement Floor
Duct
Duct
Center
Basement Floor, Level 241.98
Plaster Ceiling
Cable Hung
10 Conduits
Present Grade at Building
Steam and Plumbing Lines
Concrete
Sub-Basement Floor, Level 223.98
Pier
Concrete
Level 214'-6 1/16"
Level 212'-3 9/16"
Incased
Level 216'-6 1/16"
Incased
Level 212'-3 9/16"
Level 215'-3 9/16"
Level 212'-6 1/16"
Col. 10
Col. 17
Col. 8

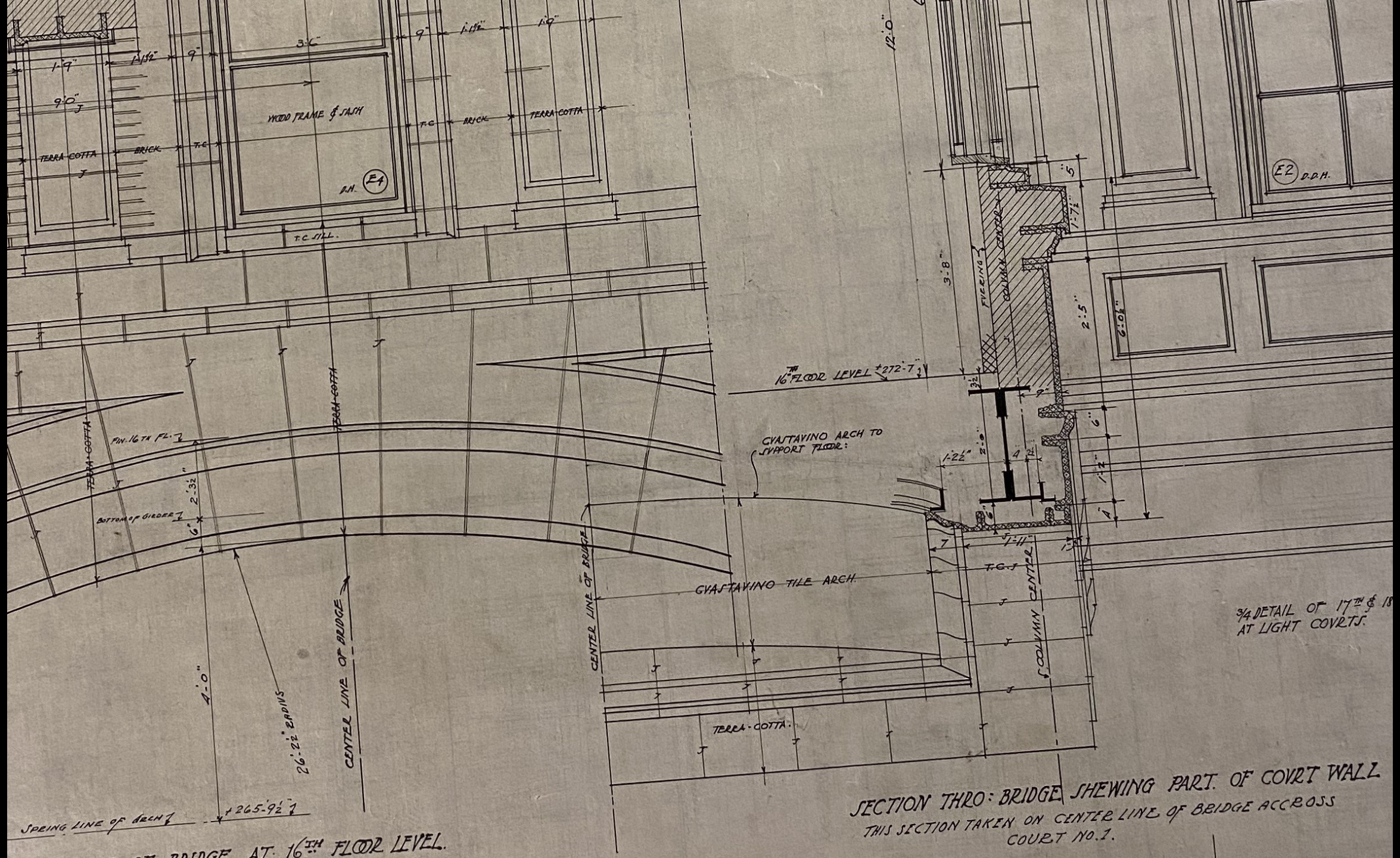

TILE ROOF
TILE ROOF
4TH FLOOR, LEVEL 303.98
GALLERY FLOOR, LEVEL 302.98
DECORATED
3RD FLOOR, LEVEL 291.98
PLASTER
GUSSETTING
CENTER
DOUBLE HUNG
2ND FLOOR, LEVEL 275.98
1ST FLOOR, LEVEL 259.98
CENTER
COPPER ROOF
PLASTER
CENTER
PLASTERED
CENTER
CEMENT FLOOR
BASEMENT FLOOR, LEVEL 241.98
DUCT
DUCT
CENTER
PLASTER CEILING
CABLE HUNG
TO CONDUITS
PRESENT GRADE AT BUILDING
STEAM AND PLUMBING LINES
CONCRETE
SUB-BASEMENT FLOOR, LEVEL 223.98
CONCRETE
INCASED
INCASED


TOP OF PURLOINS
TOP OF TRUSS
STONE
SOLDIER COURSE
STONE
TOP OF GUTTER
COPPER CORNICE
STONE
STONE
FAIENCE
STONE
COPPER CORNICE
T.C. SOFFIT
STONE
STONE
FAIENCE
STONE
COPPER CORNICE
LEVEL 298.07
STONE SILL
STONE
TILE ROOF
TILE SILL
GALLERY FLOOR, LEVEL
CENTER
STONE
CORRIDOR FLOOR
CENTERS
CENTER
STONE SILL
SECOND FLOOR LEVEL
CENTER
STONE BAND
STONE SILL
FIRST FLOOR LEVEL
DOUBLE HUNG
CORRIDOR FLOOR
STONE SILL
BASEMENT FLOOR LEVEL
CENTERS
CENTER
DOUBLE HUNG
STONE SILL
SUB-BASEMENT FLOOR
CENTER
CENTER
PRESENT GRADE AT BUILDING
LEVEL 221'-10 1/8"
LEVEL 219'-4 1/2"
LEVEL 218'-4"
LEVEL 215'-10"
LEVEL 216'-6 1/4"
INCASED
LEVEL 186'-10"
LEVEL 184'-9"

TILE ROOF
TILE ROOF
TILE ROOF
TILE ROOF
TILE ROOF
TILE ROOF
COPPER CORNICE
COPPER CORNICE
STONE
STONE
STON




HALF ELEVATION OF BRIDGE AT 16TH FLOOR LEVEL
SECTION THRO' BRIDGE SHEWING PART OF COURT WALL
THIS SECTION TAKEN ON CENTRE LINE OF BRIDGE ACCROSS COURT NO. 1.
DETAIL OF 17TH & 18TH FLOOR WINDOWS AT COURT COURT
TERRA COTTA
CHATTAHOO TILE ROOF
CENTRE LINE OF BRIDGE



SECTION THRO: BRIDGE SHEWING PART OF COURT WALL
THIS SECTION TAKEN ON CENTER LINE OF BRIDGE ACCROSS COURT NO. 1.

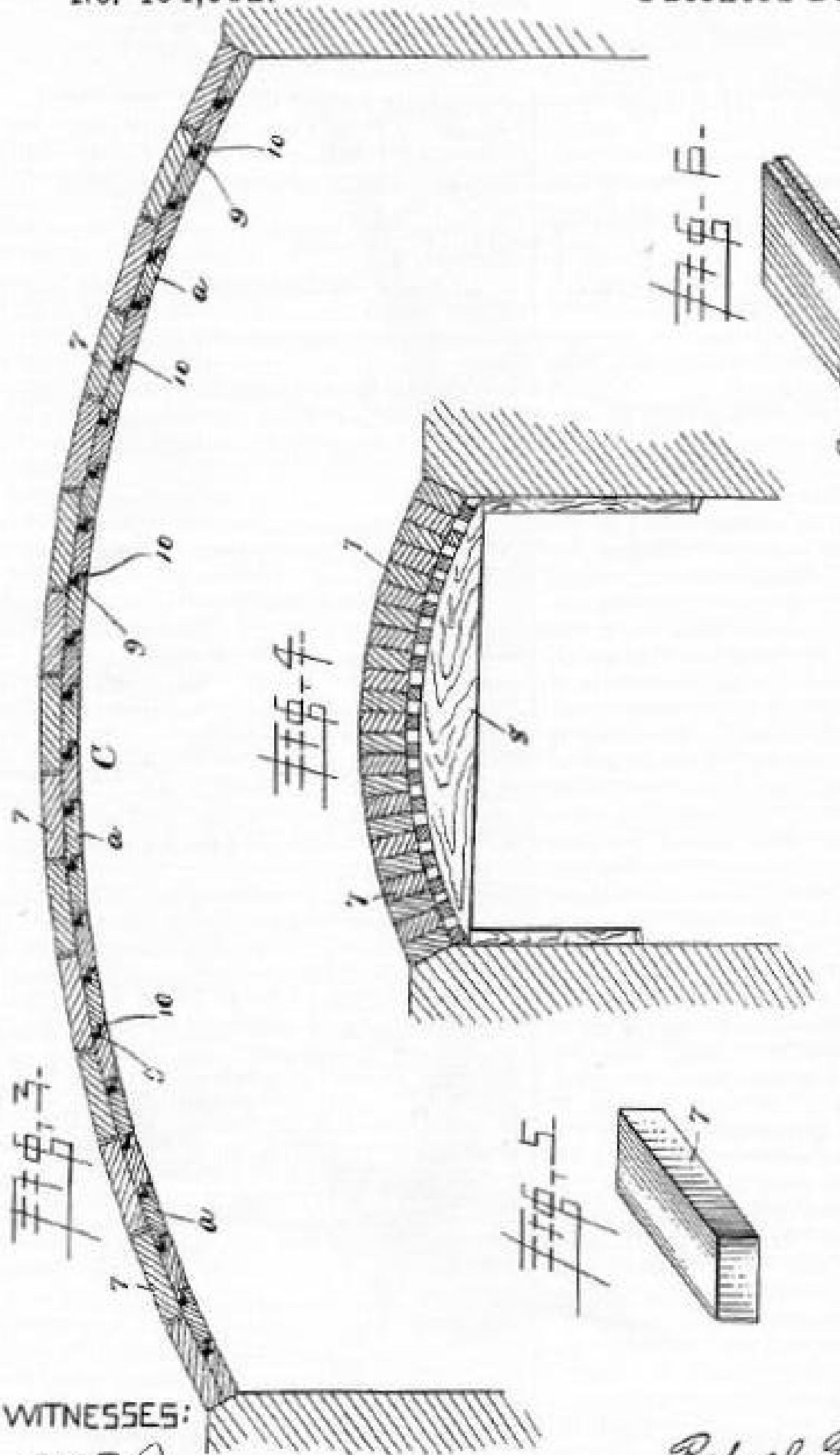
BRIDGE AT 16TH FLOOR LEVEL.

(No Model.) 2 Sheets—Sheet 2.

R. GUASTAVINO.

CONSTRUCTION OF BUILDINGS.

No. 464,562. Patented Dec. 8, 1891.



WITNESSES:
W. E. Bowen,
Benj. Miller.

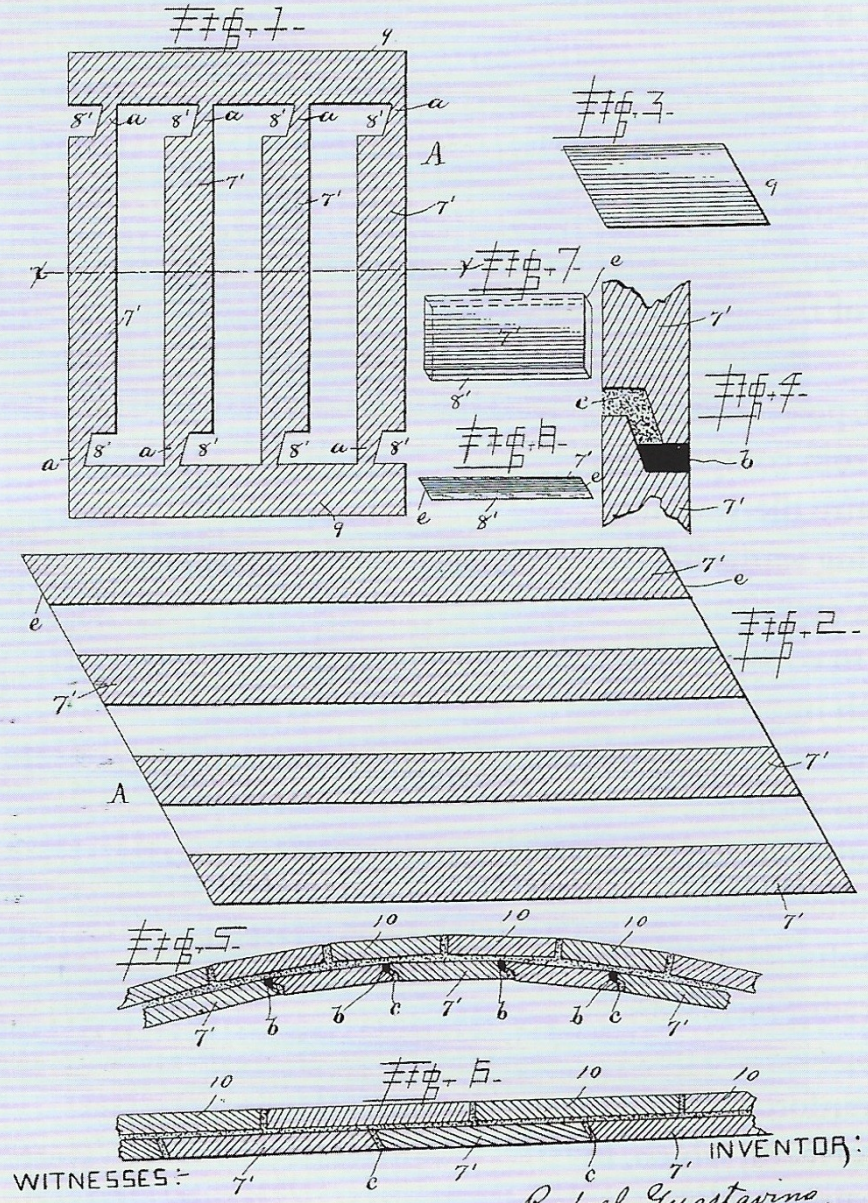
INVENTOR:
Rafael Guastavino,
By J. E. Ellis Bowen
Attorney.

(No Model.)

R. GUASTAVINO.

BUILDING TILE.

No. 548,160. Patented Oct. 15, 1895.



WITNESSES:-

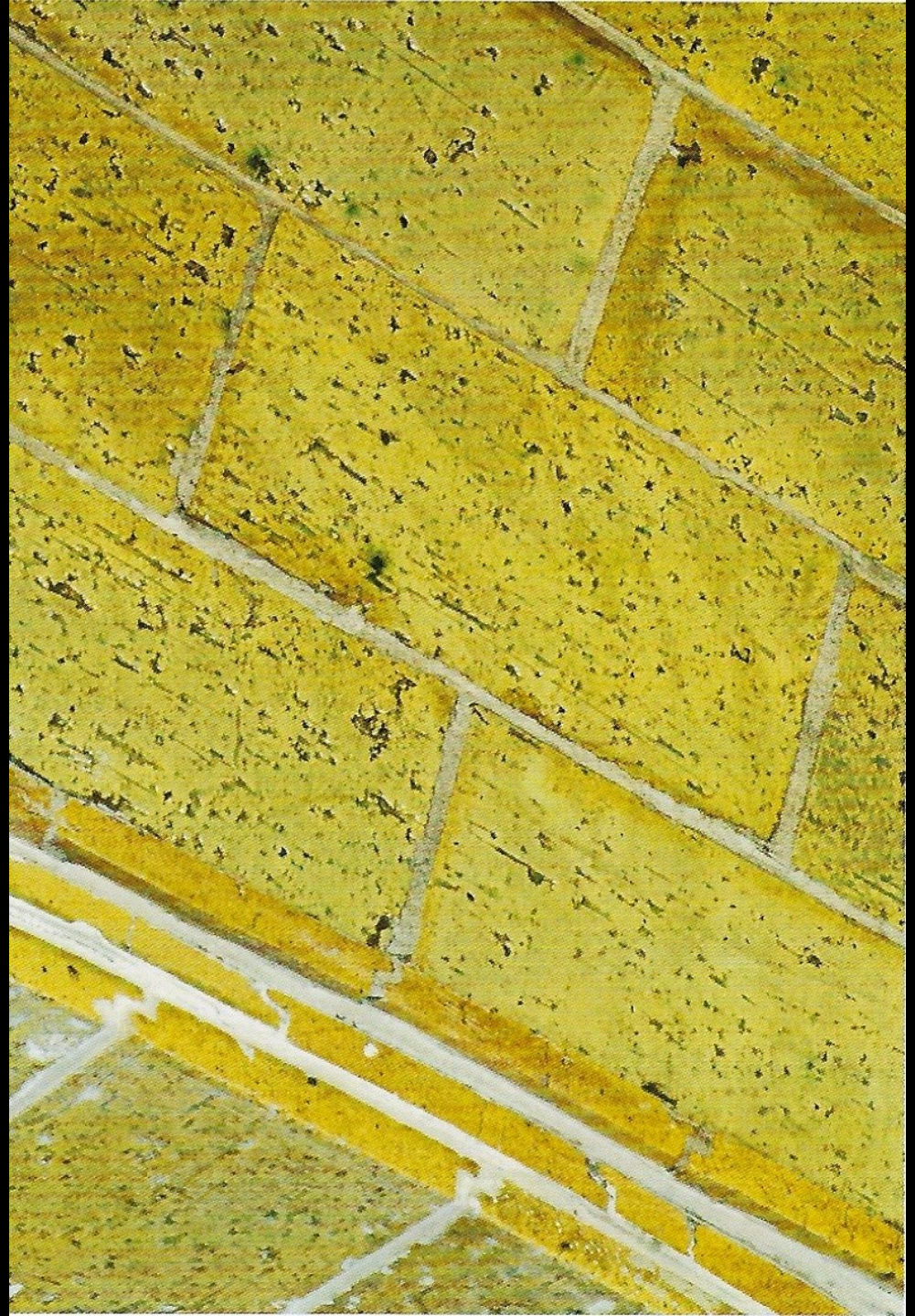
W. O. Bowen.

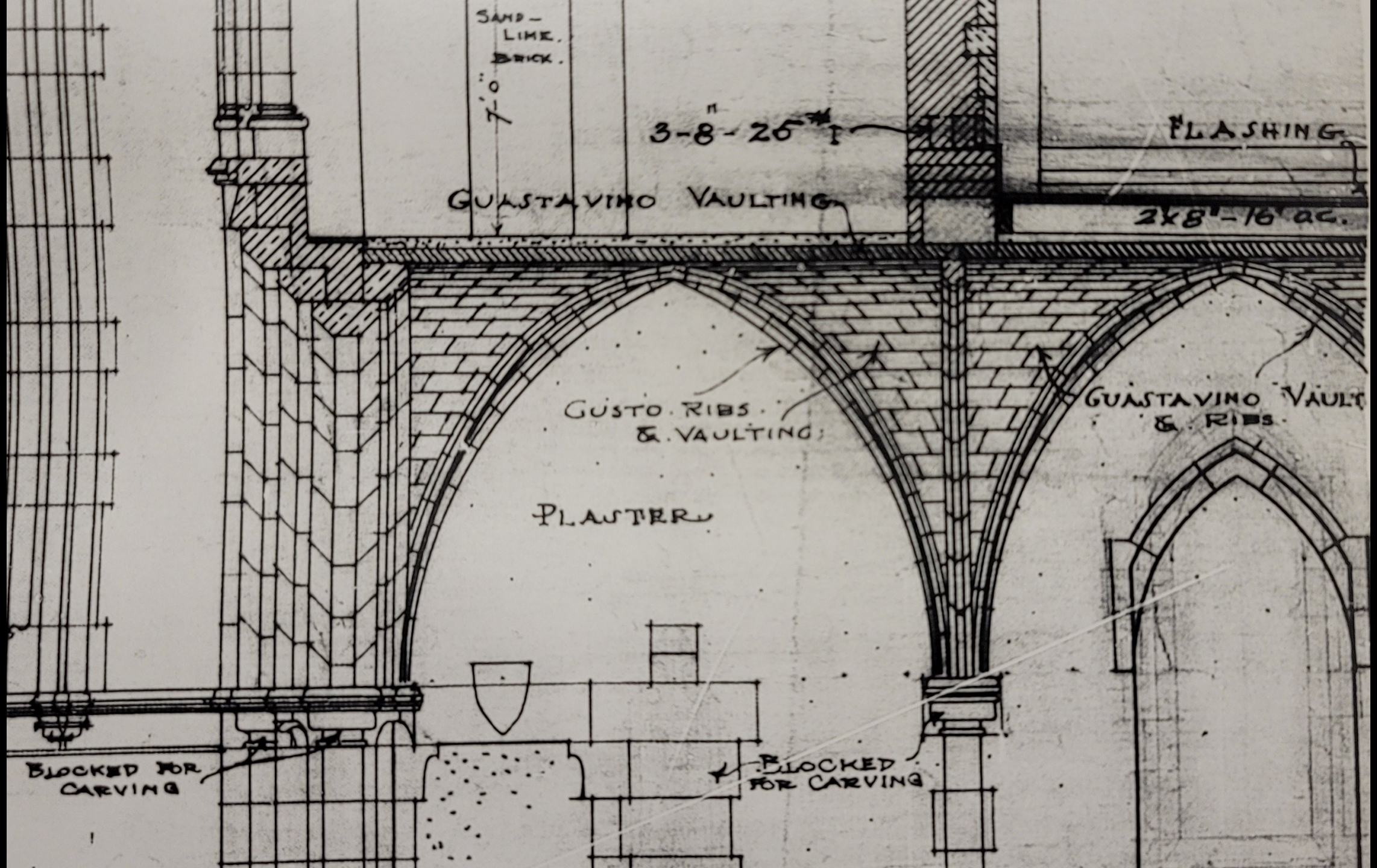
Benj Miller

INVENTOR:

Rafael Guastavino,

By J. E. M. Bowen attorney.




SAND-
LIME.
BRICK.
7'-0"
3-8"-25# I
FLASHING
GUASTAVINO VAULTING
2x8"-16" oc.
GUSTO. RIBS
& VAULTING
GUASTAVINO VAULT
& RIBS
PLASTER
BLOCKED FOR
CARVING
BLOCKED
FOR CARVING

SPECIFICATION COVER. COPYRIGHTED 1887, BY
E.C.SOLOMON DRAWING MATERIALS. 125 EAST 42ND STREET NEW YORK.

CHURCH AND PARISH HOUSE FOR CALVARY CHURCH, PITTSBURG, PENN.

Specification

FOR

EXCAVATION	PAGE	5
FOUNDATIONS	"	9
CUT STONE	"	15
BRICKWORK	"	24
STRUCTURAL STEEL	"	38
CARPENTERWORK	"	44
ROOFING	"	67
GAS FITTING	"	72
PLASTERING	"	76
PAINTING	"	78

CRAM, GOODHUE AND FERGUSON,
ARCHITECTS,
15 BEACON ST. BOSTON.

HEARTHS.

All hearths to be of sizes shown on plans unless otherwise directed by architects.

The brick hearth to be laid on edge.

All fireplaces where so shown to have iron tip ash dumps.

DAMPERS.

All fireplaces to have cast iron tip and slide dampers built in the full width of opening.

All dampers to be the "Ripley Cast Iron Fireplace damper", or equal.

IRON DOORS.

Provide and set 8" x 10" cast iron door and frame at the foot of every flue, except as otherwise shown.

Provide and set substantial iron doors with angle iron frames in basement where shown. Doors to be made of 5/16" boiler iron with heavy hinges, handles and latches. All to be carefully made to shut tightly against frames which are to be securely bolted to brickwork.

THIMBLES.

Furnish and set thimble of proper size in each flue.

Provide and build in all cast iron sleeves shown on drawings.

Provide and set a cast bronze grille in wall of Parish House to cover foot vent pipe from plumber's manhole.

MORTAR.

All mortar for laying up brickwork, except as otherwise specified shall be as follows.

One barrel Portland Cement.

Three barrels sand.

Two pails lime putty.

The lime to be slaked and stacked at least a week before using.

All mortar must be used immediately after mixing.

No mortar to be used which has been mixed over night.

CEMENT.

All cement to be of the same quality as called for in specifica-

Guastavino Vaulting:- The following portions of church will have unglazed, finished, pressed tile arch construction vaulted ceilings with moulded ribs of same material about 6" x 8"(exposed dimensions).

Allow and pay the R. Guastavino Co. the following amounts for the several parts of the work set complete.

North and South Ambulatories.....	$1150.	
North and South Transept Aisles.....	1704.	
North and South Vestibules of Church and vestibules of Morning Chapel.....	866.	
Porch at entrance to Parish House xxxxx.....	$350.	(Total
Crypt.....	2160.	$6230.

The above amounts include the scaffolding for setting work.

Tile for arches to be one inch thick and all arch work to be of not less than three thicknesses, except in very small vaults where two thicknesses will be allowed. All to be set in Portland cement mortar.

FIREPROOFING.

The following floors and roofs are to be entirely constructed of the Kahn system of hollow tile and reinforced concrete or equal approved by architects. Only such steel beams and girders being used as are shown on drawings.

The entire floor of church.

The gallery floor in church.

The bell deck floor in tower.

The tower roof.

The basement floor in Parish House.

The first floor over boiler room and fan room.

All floors throughout main staircase hall in Parish House.

Roof over coal storage.

Step supports and platforms of basement entrance(boiler room).

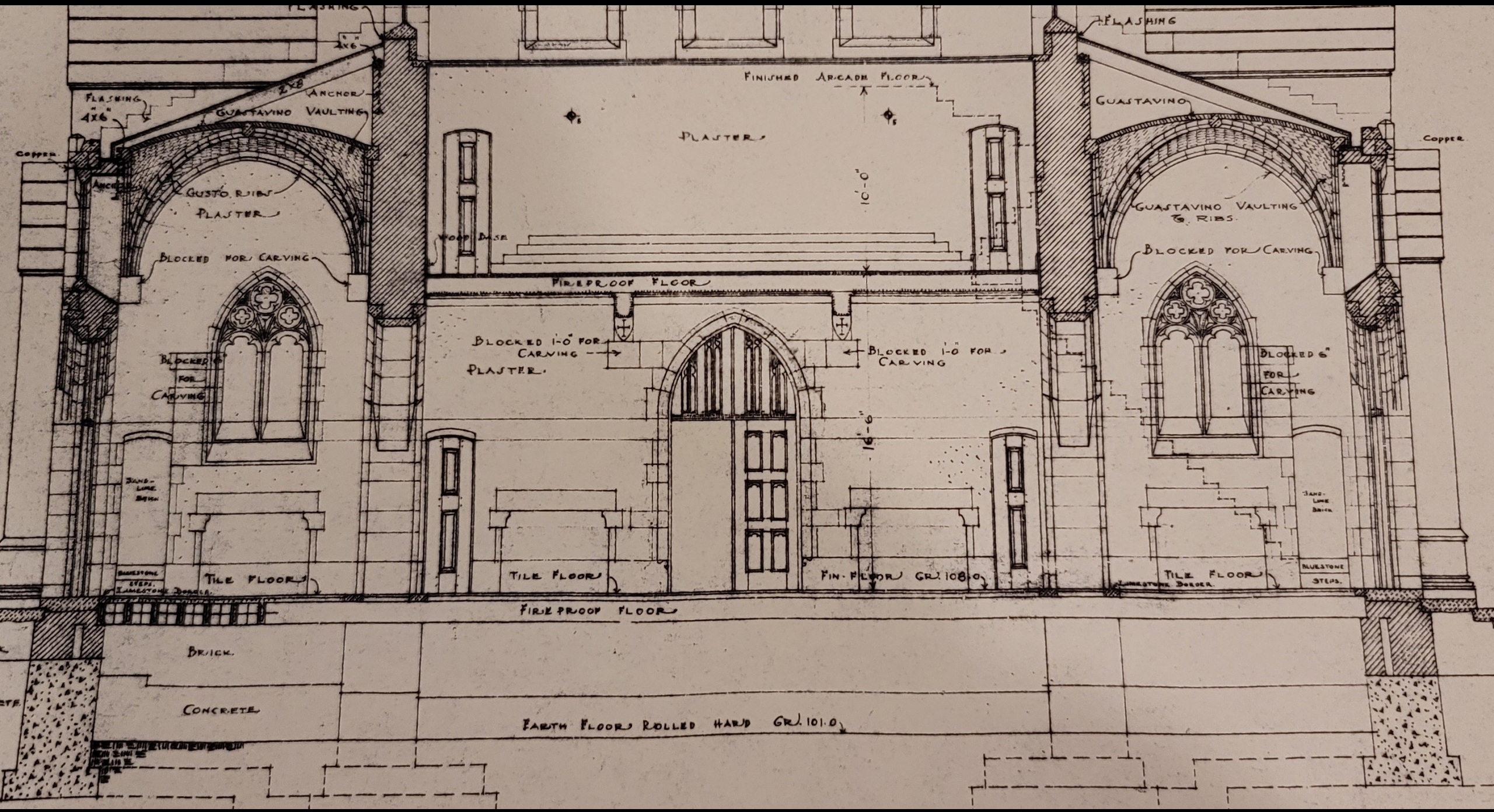
Triforium floors.

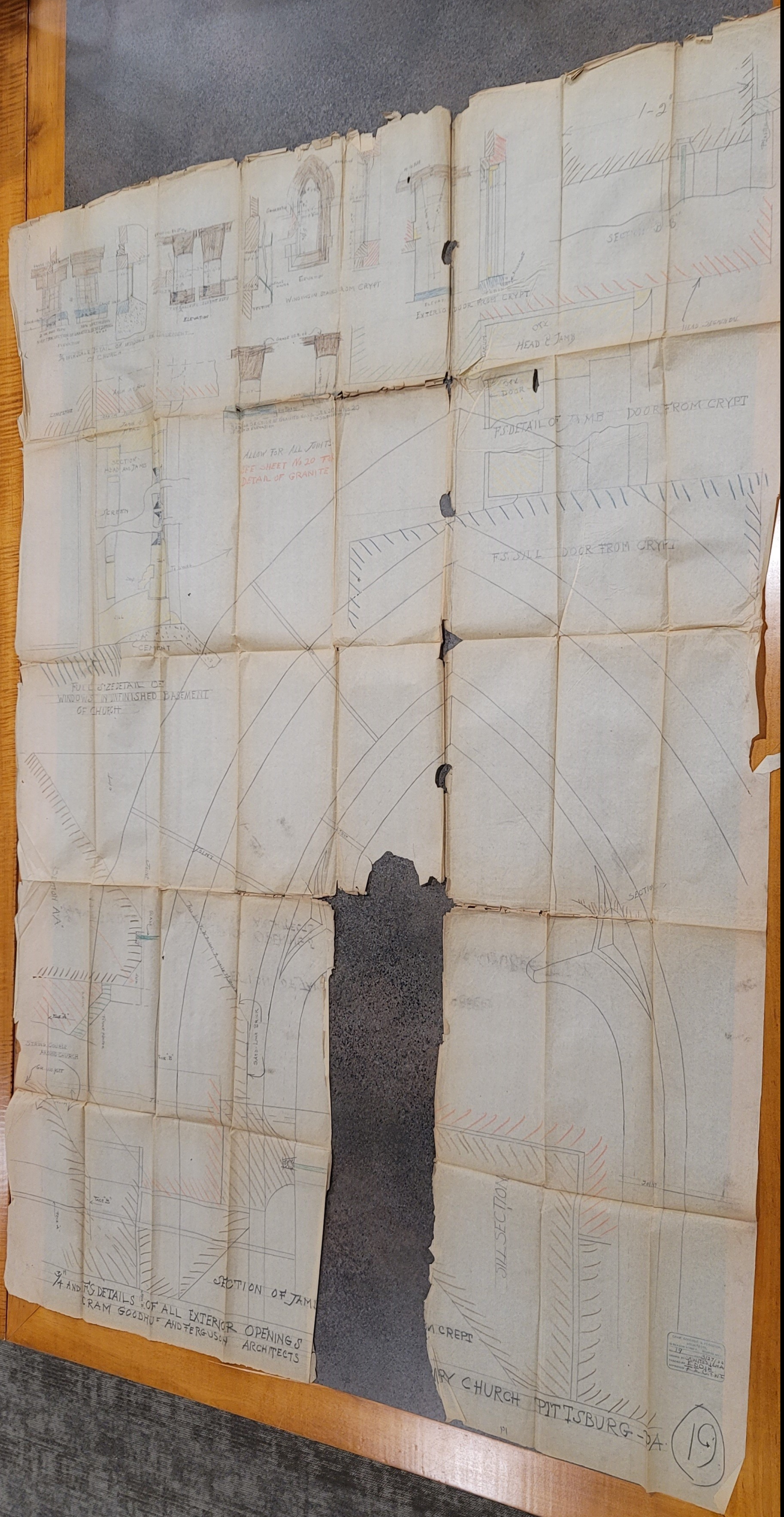
Organ chamber floor.

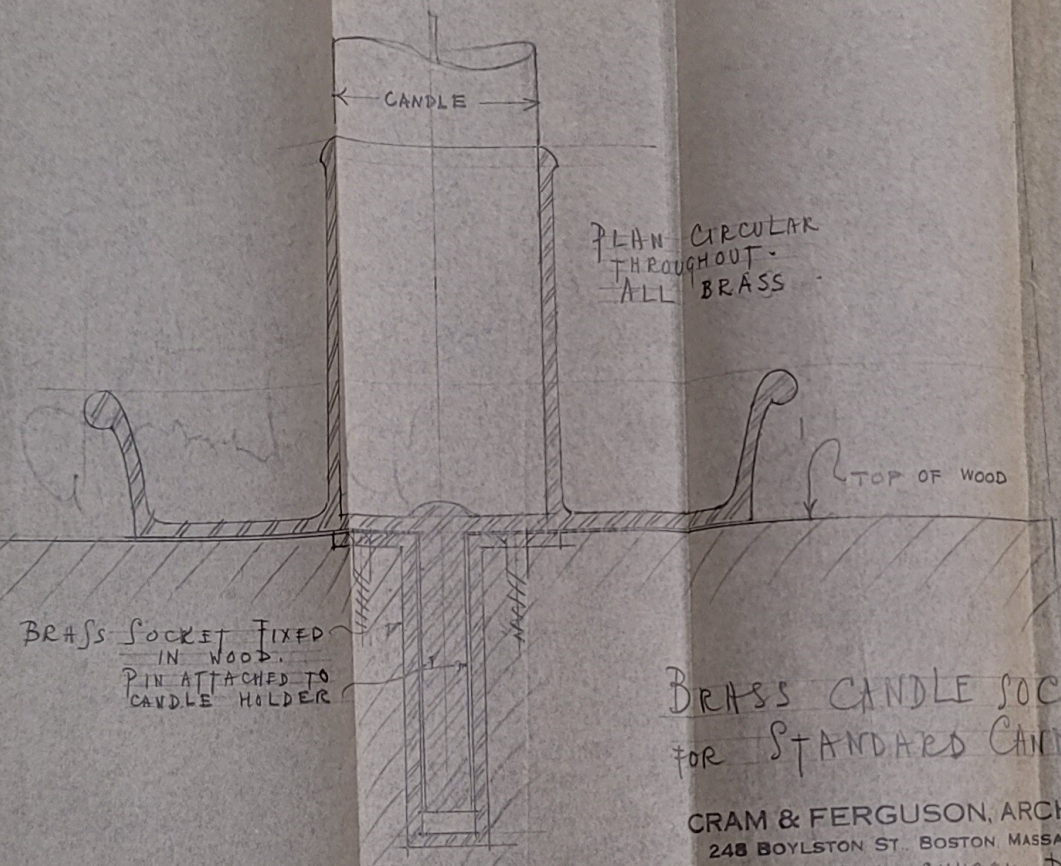
Floor over front entrance to church.

Floors over East Ambulatory.

Floors in Entrance vestibule to Morning Chapel, and elsewhere as shown on drawings.


FLASHING
2x6
FLASHING
4x6
2x8
ANCHOR
GUASTAVINO VAULTING
COPPER
ANCHOR
GUSTO. RIBS
PLASTER
BLOCKED FOR CARVING
BLOCKED 6" FOR CARVING
SAND-LIME BRICK
BLUESTONE STEPS.
LIMESTONE BORDER.
TILE FLOOR
FINISHED ARCADE FLOOR
PLASTER
10'-0"
WOOD BASE
FIREPROOF FLOOR
BLOCKED 1'-0" FOR CARVING
PLASTER.
BLOCKED 1'-0" FOR CARVING
16'-6"
TILE FLOOR
FIN. FLOOR GR. 108.0
FIREPROOF FLOOR
BRICK
CONCRETE
EARTH FLOOR ROLLED HARD GR. 101.0
FLASHING
GUASTAVINO
COPPER
GUASTAVINO VAULTING
G. RIBS
BLOCKED FOR CARVING
BLOCKED 6" FOR CARVING
SAND-LIME BRICK
TILE FLOOR
LIMESTONE BORDER.
BLUESTONE STEPS.

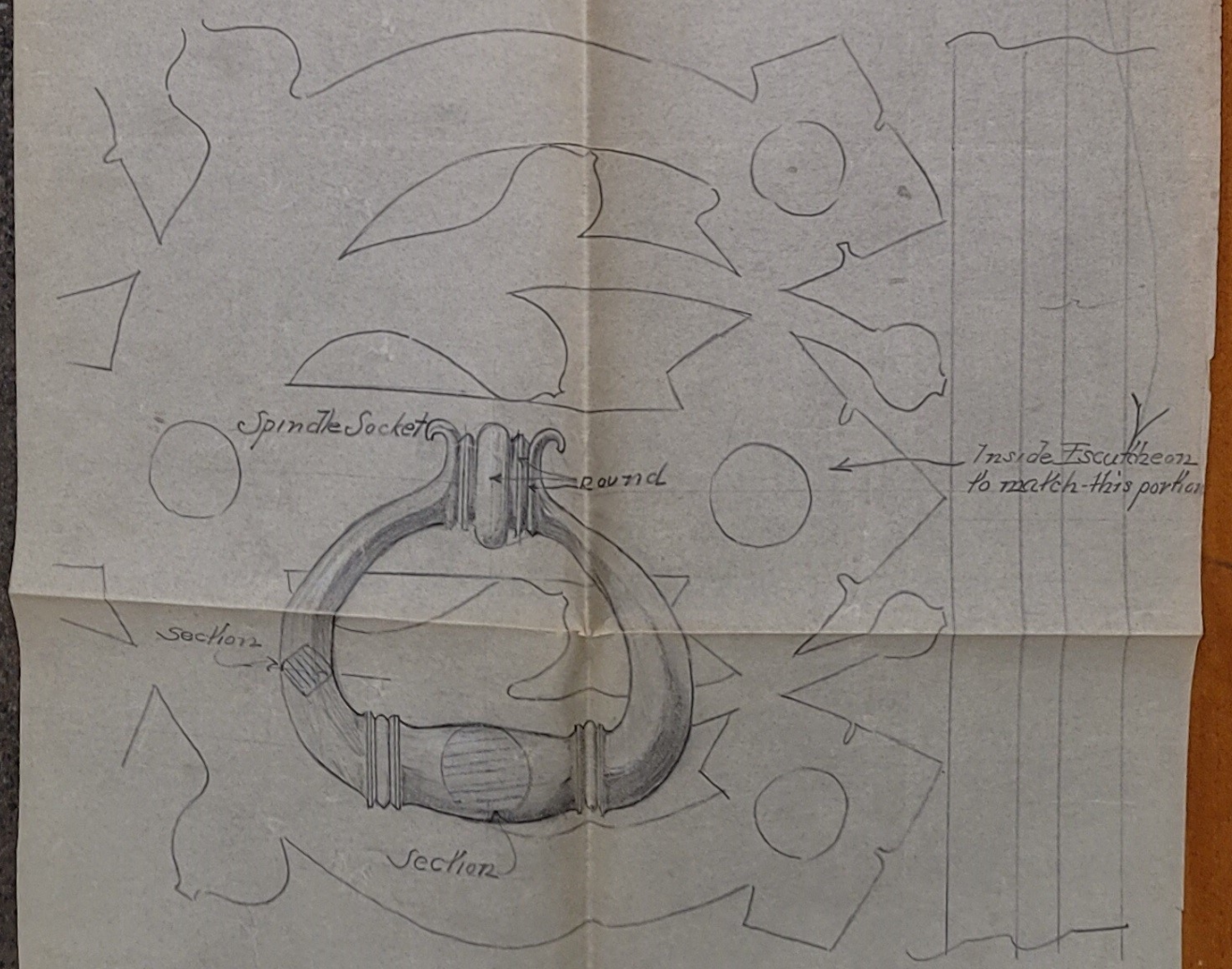

1-2"
SECTION "B"
ELEVATION
WINDOW IN STAIRS FROM CRYPT
EXTERIOR DOOR FROM CRYPT
HEAD & JAMB
DOOR
F.S. DETAIL OF JAMB DOOR FROM CRYPT
ALLOW FOR ALL JOINTS
SEE SHEET No 20 FOR
DETAIL OF GRANITE
SECTION HEAD AND JAMB
SCREEN
CEMENT
F.S. SILL DOOR FROM CRYPT
FULL SIZE DETAIL OF
WINDOWS IN UNFINISHED BASEMENT
OF CHURCH
SECTION "A"
SECTION "B"
SECTION OF JAMB
SILL SECTION
CRAM GOODHUE AND FERGUSON ARCHITECTS
CHURCH PITTSBURG PA.
19



BRASS CANDLE SOCKETS FOR STANDARD CANDLESTICKS.

CRAM & FERGUSON, ARCHITECTS
248 BOYLSTON ST. BOSTON, MASSACHUSETTS

WORK CALVARY CHURCH, PITTSBURG, PA.
DRAWING No. 23 SCALE F.S. DATE DEC. 8/27
DRAWN BY N. Cramer APPROVED BY
CONTRACTOR TO VERIFY ALL DIMENSIONS AT BUILDING BEFORE COMMENCING WORK



Elevation of Ring Handle W.I. both doors
both sides = to work latch one door.

MAIN ENTRANCE NARTHEX-DOOR.

NO. 49.

GUASTAVINO VAULT RIB

CALVARY CHURCH

PITTSBURG PENN.

49

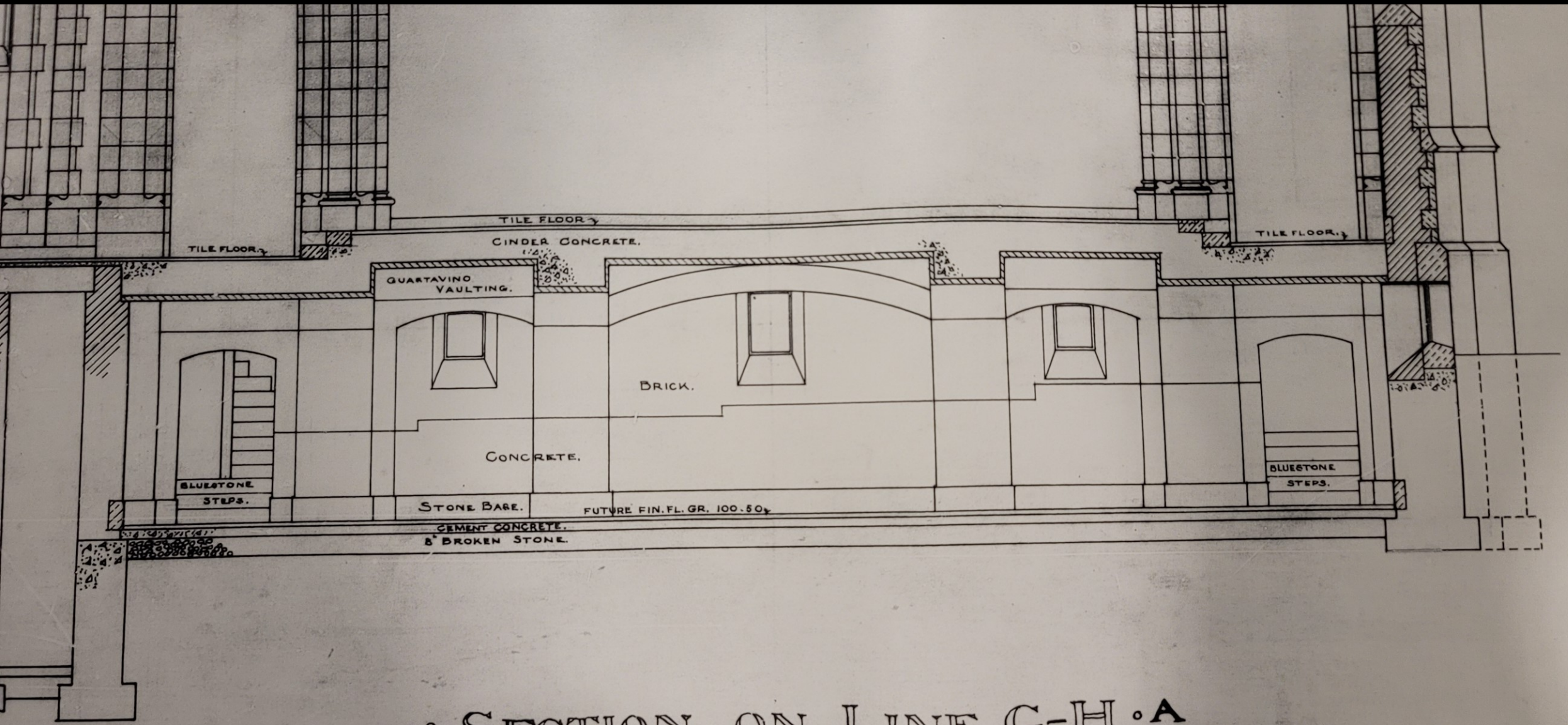
NO. 49.

F.S.D. OF GUASTAVINO VAULTING RIB.

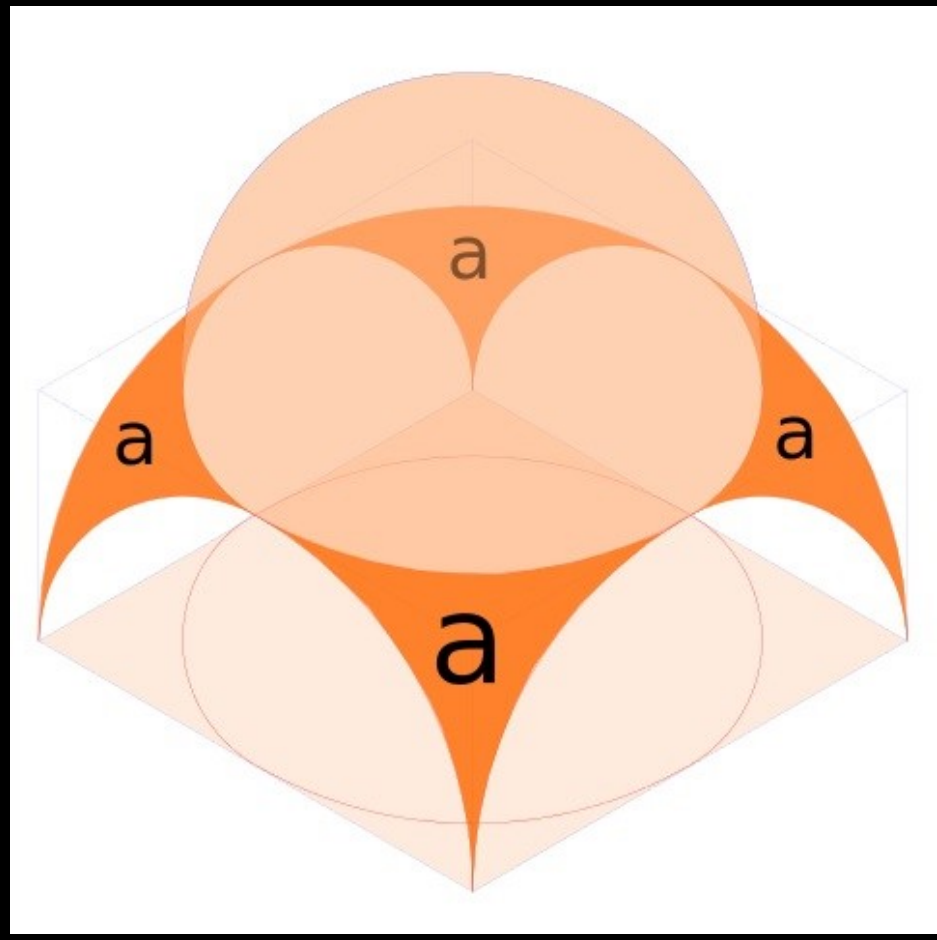
CALVARY CHURCH PITTSBURG PENN.

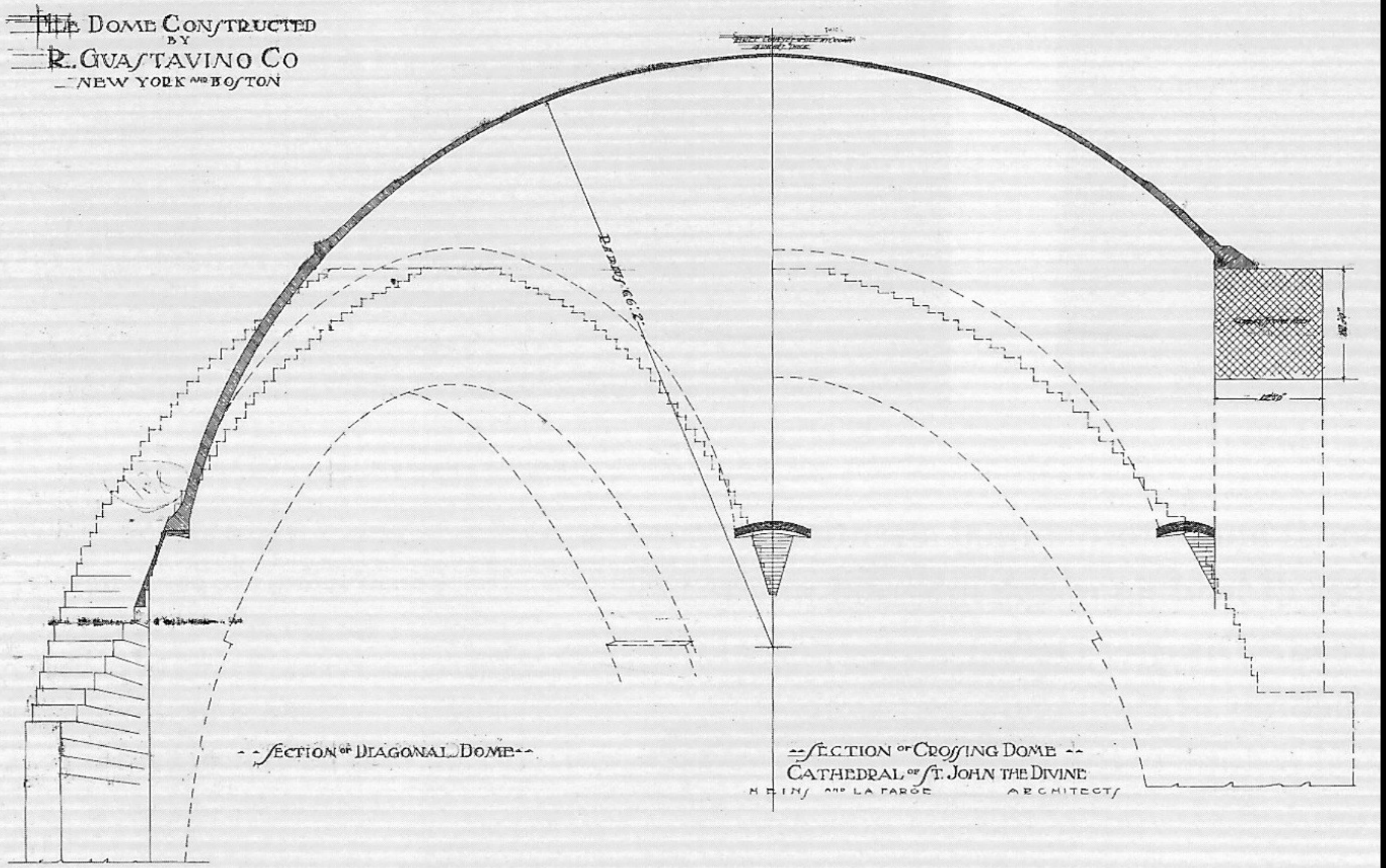
CRAM, GOODHUE & FERGUSON — ARCHITECTS.

BOSTON & NEW YORK.

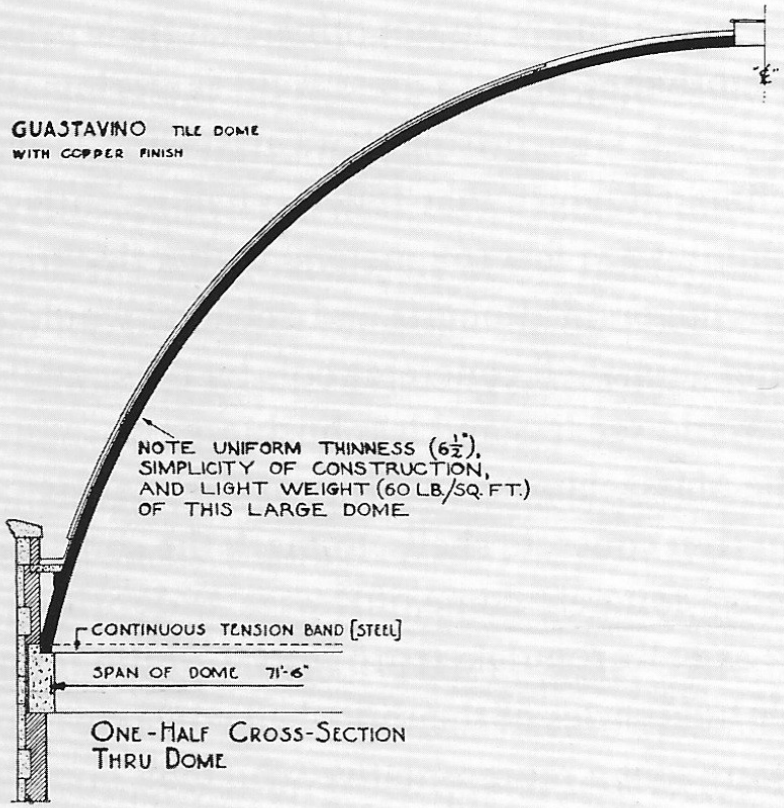


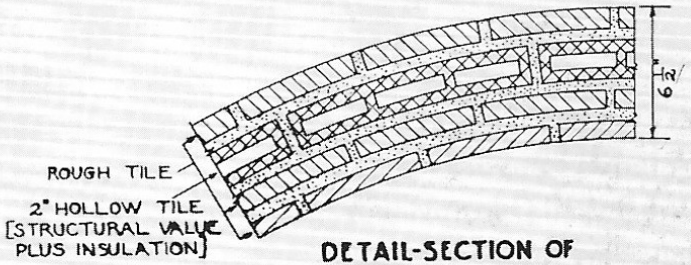
SECTION ON LINE G-H · A


a
a
a
a

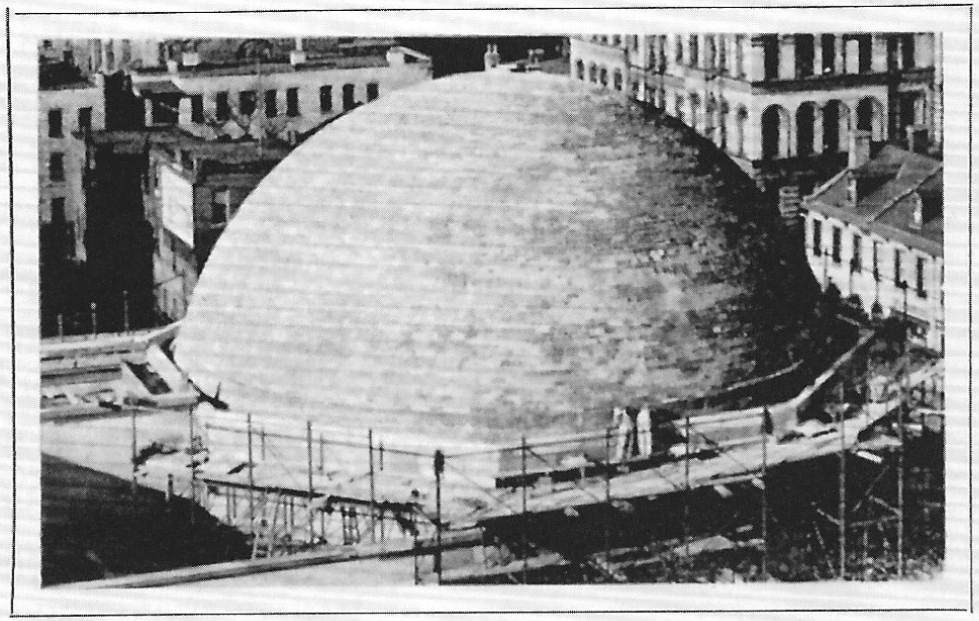

THE DOME CONSTRUCTED
BY
R. GUASTAVINO CO
NEW YORK AND BOSTON
SECTION OF DIAGONAL DOME
SECTION OF CROSSING DOME
CATHEDRAL OF ST. JOHN THE DIVINE
MEINS AND LA FARGE ARCHITECTS

GUASTAVINO TIMBREL ARCH CONSTRUCTION





DETAIL-SECTION OF TYPICAL TILE SHELL



BUHL PLANETARIUM DOME
PITTSBURGH, PA.
INGHAM & BOYD, Architects

See our catalog in Sweet's

R. GUASTAVINO COMPANY

500 FIFTH AVE., NEW YORK 40 COURT ST., BOSTON

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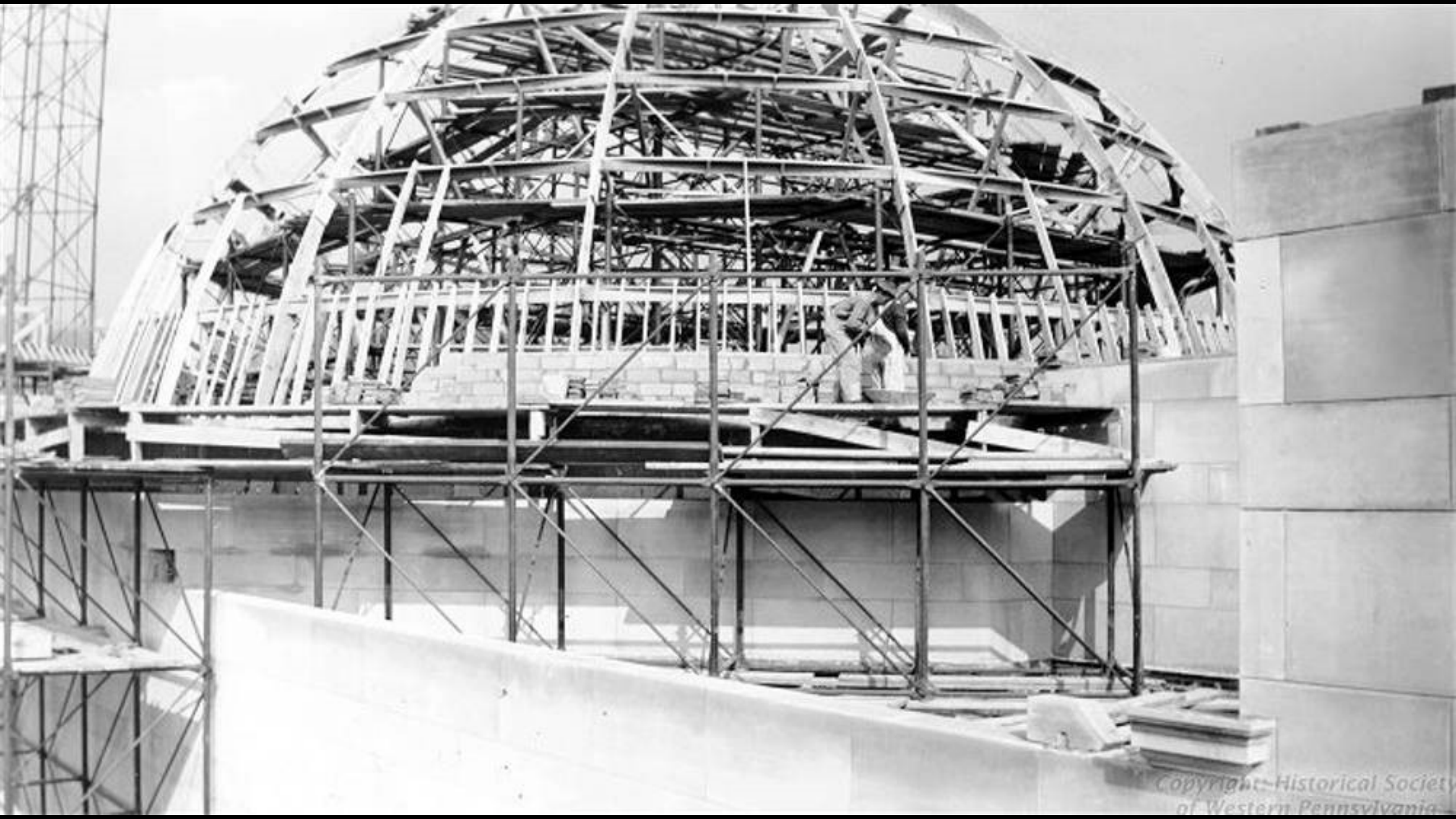

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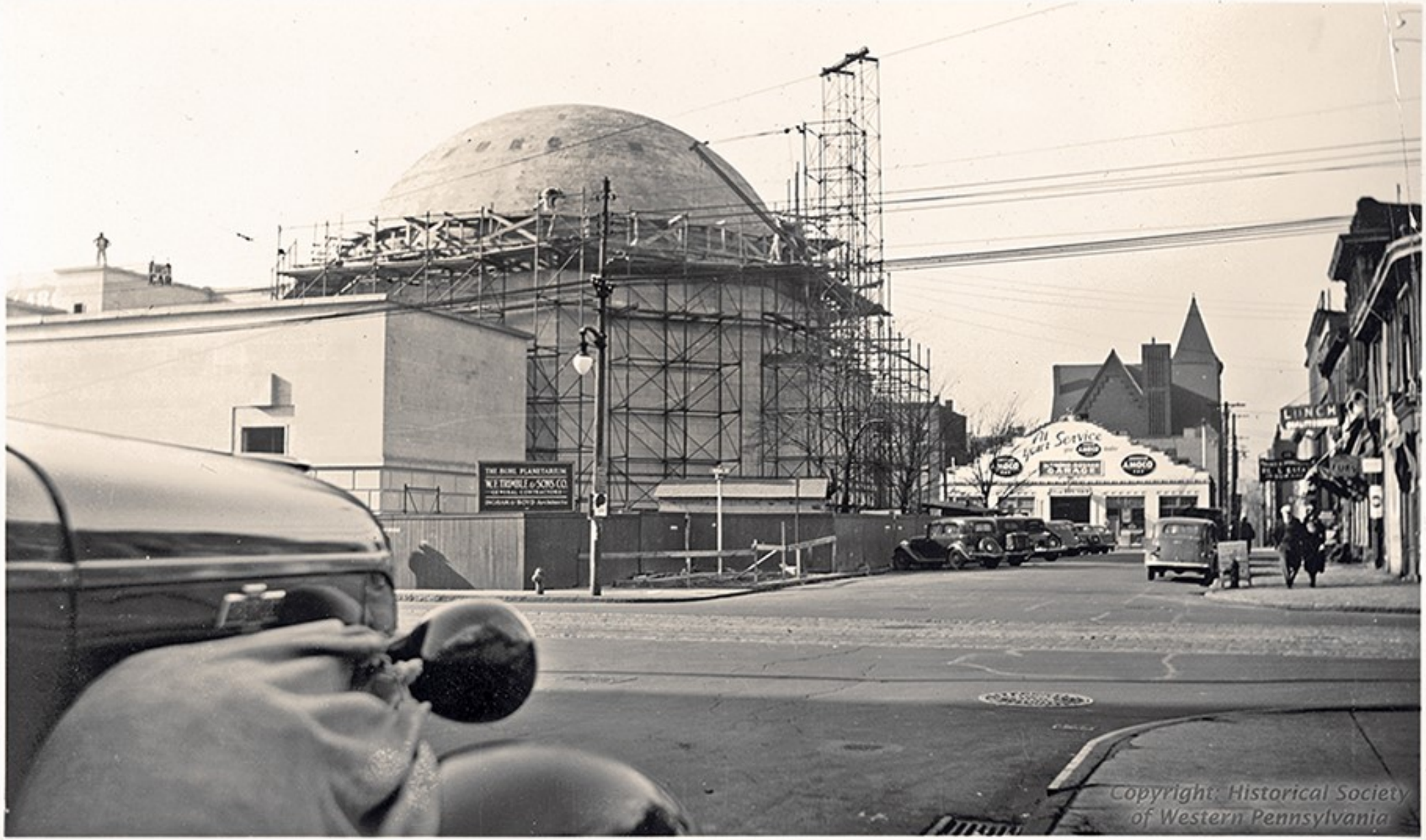
AL PLANETARIUM
NOV 4 1938



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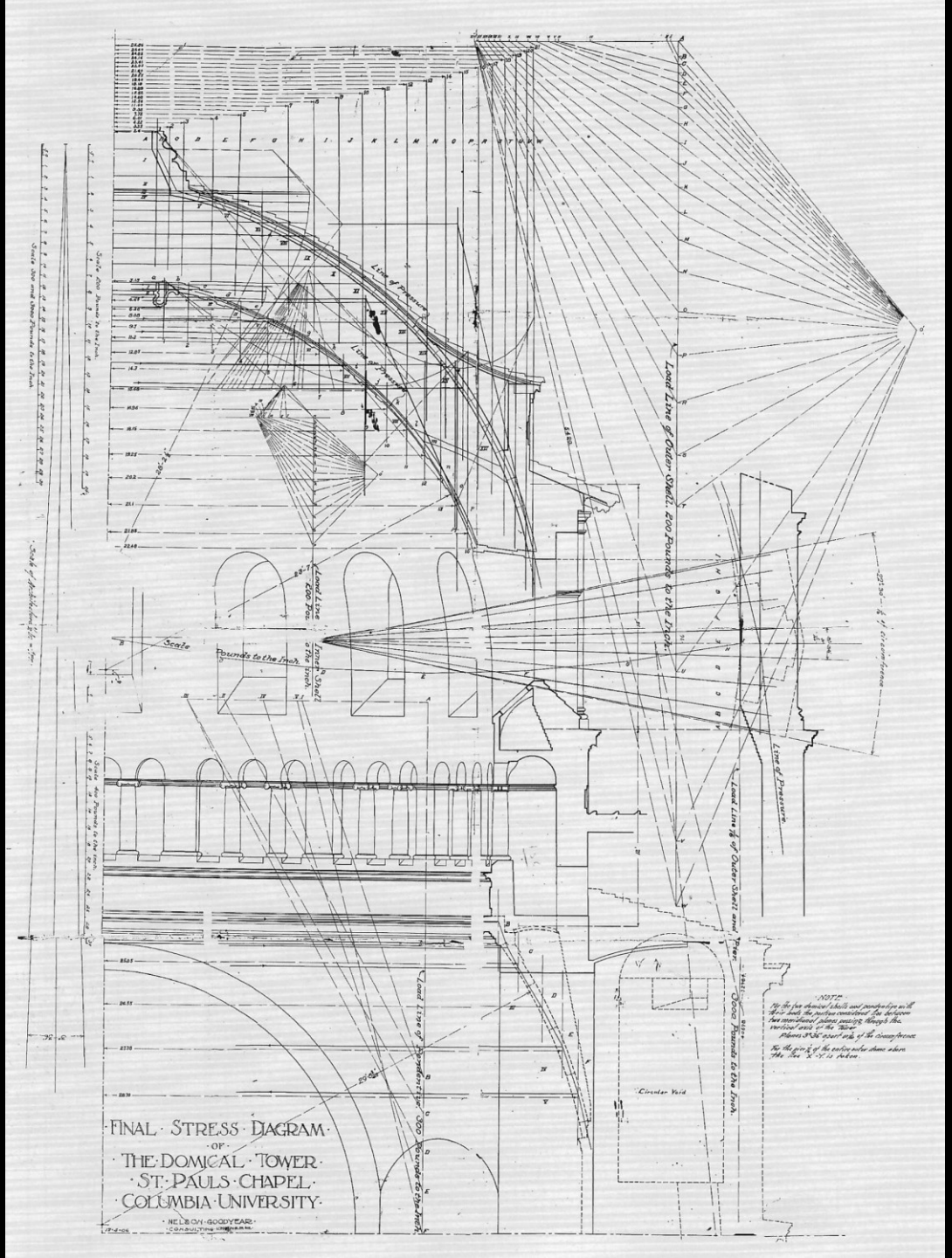
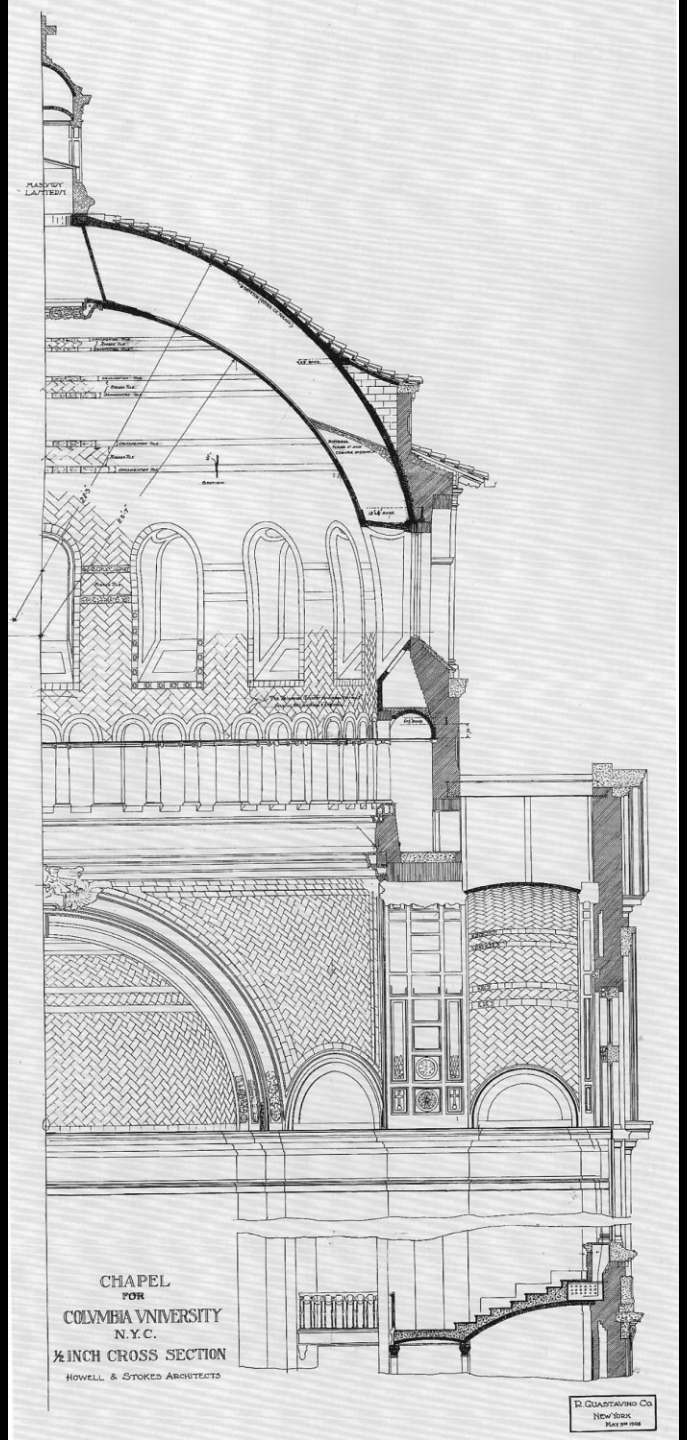
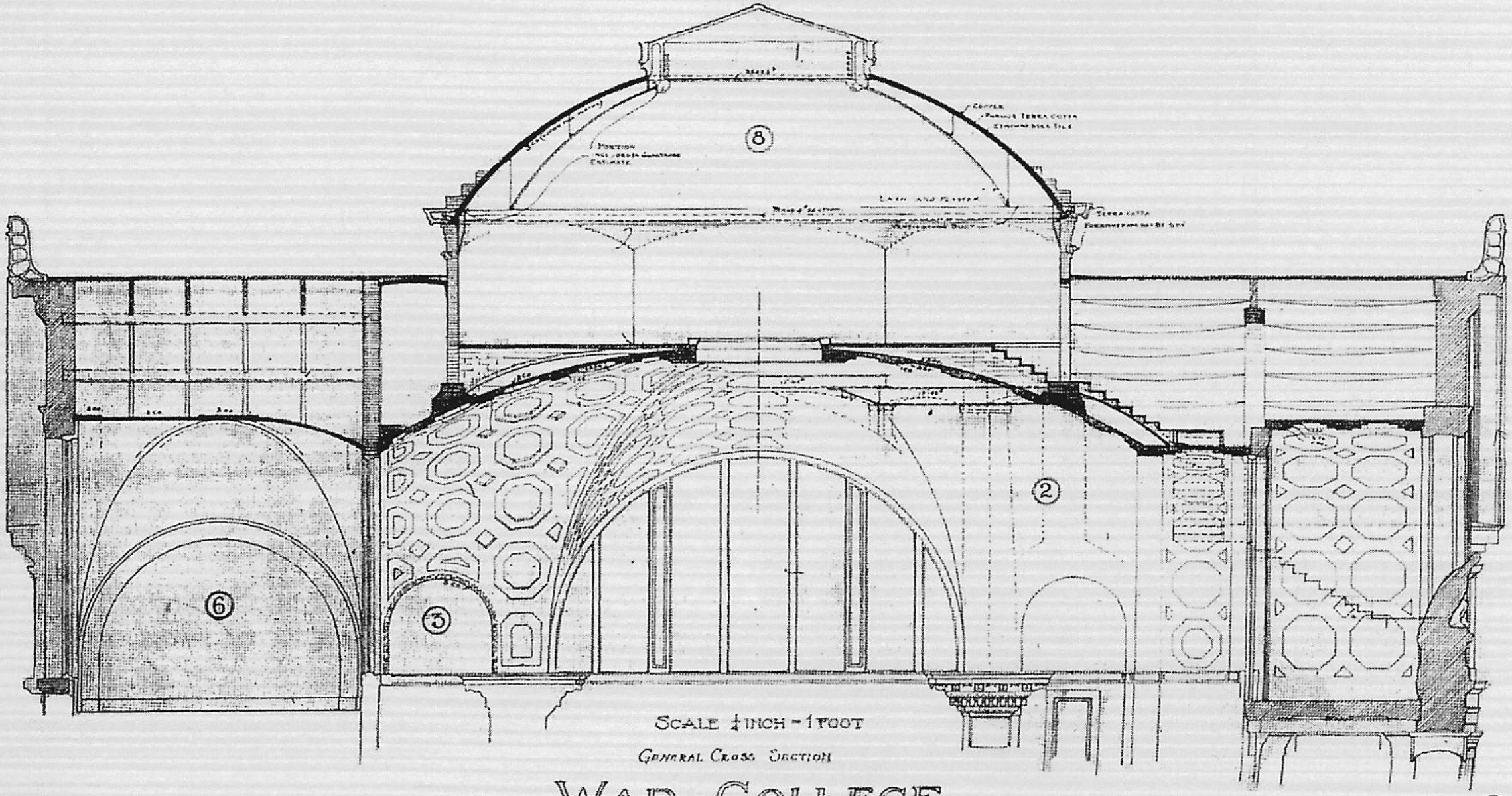
BUHL PLANETARIUM NOV 18 1938

Photo: Mark Brueggenjohann


FINAL · STRESS · DIAGRAM
OF
THE · DOMICAL · TOWER
ST · PAULS · CHAPEL
COLUMBIA · UNIVERSITY
NELSON · GOODYEAR
CONSULTING ENGINEERS
Load Line of Outer Shell. 200 Pounds to the Inch.
Line of Pressure
Scale
Pounds to the Inch
Circular Void
NOTE


CHAPEL
FOR
COLUMBIA UNIVERSITY
N.Y.C.
½ INCH CROSS SECTION
HOWELL & STOKES ARCHITECTS
R. QUASTAVINO CO.
NEW YORK



SCALE ¼ INCH = 1 FOOT

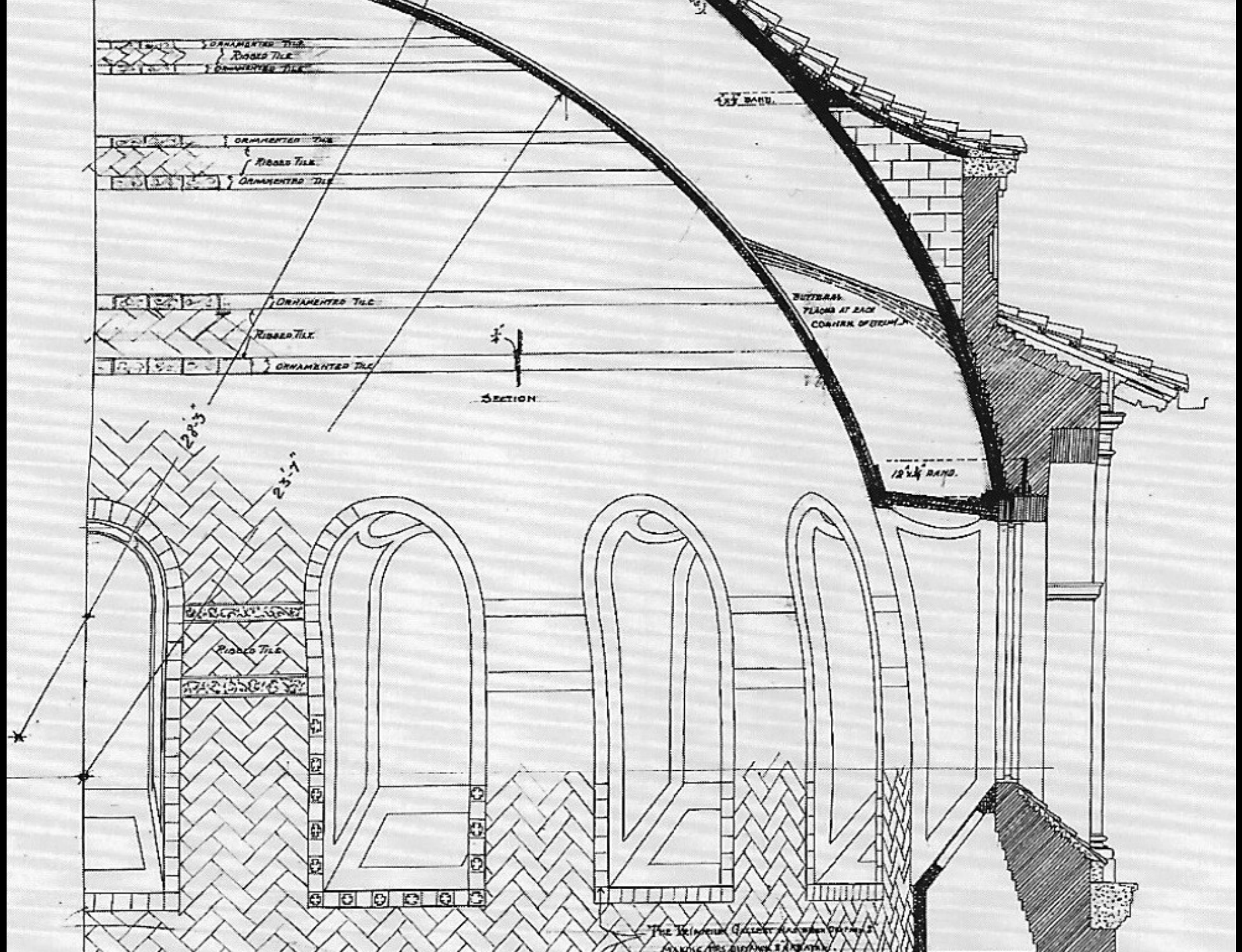
GENERAL CROSS SECTION

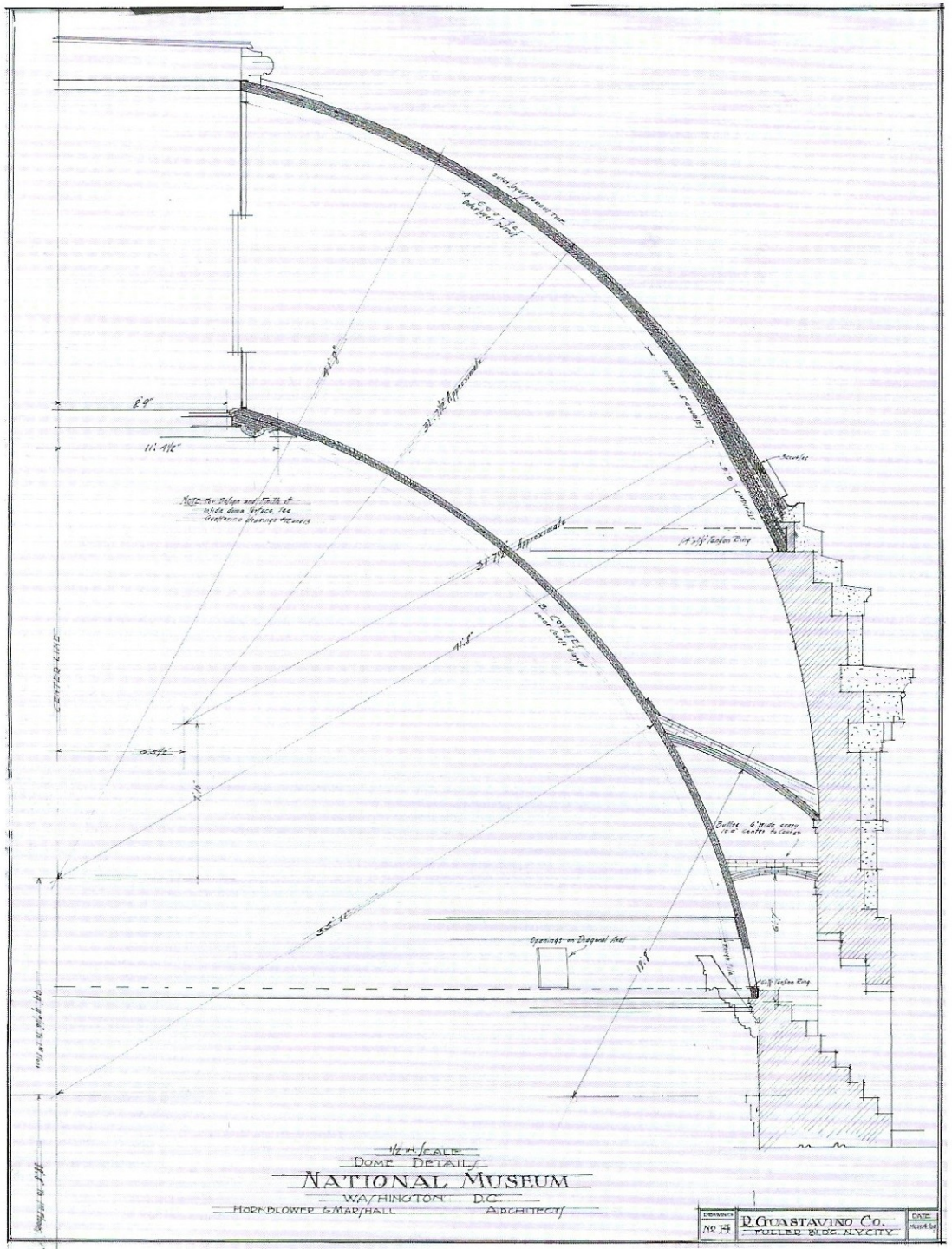
WAR COLLEGE

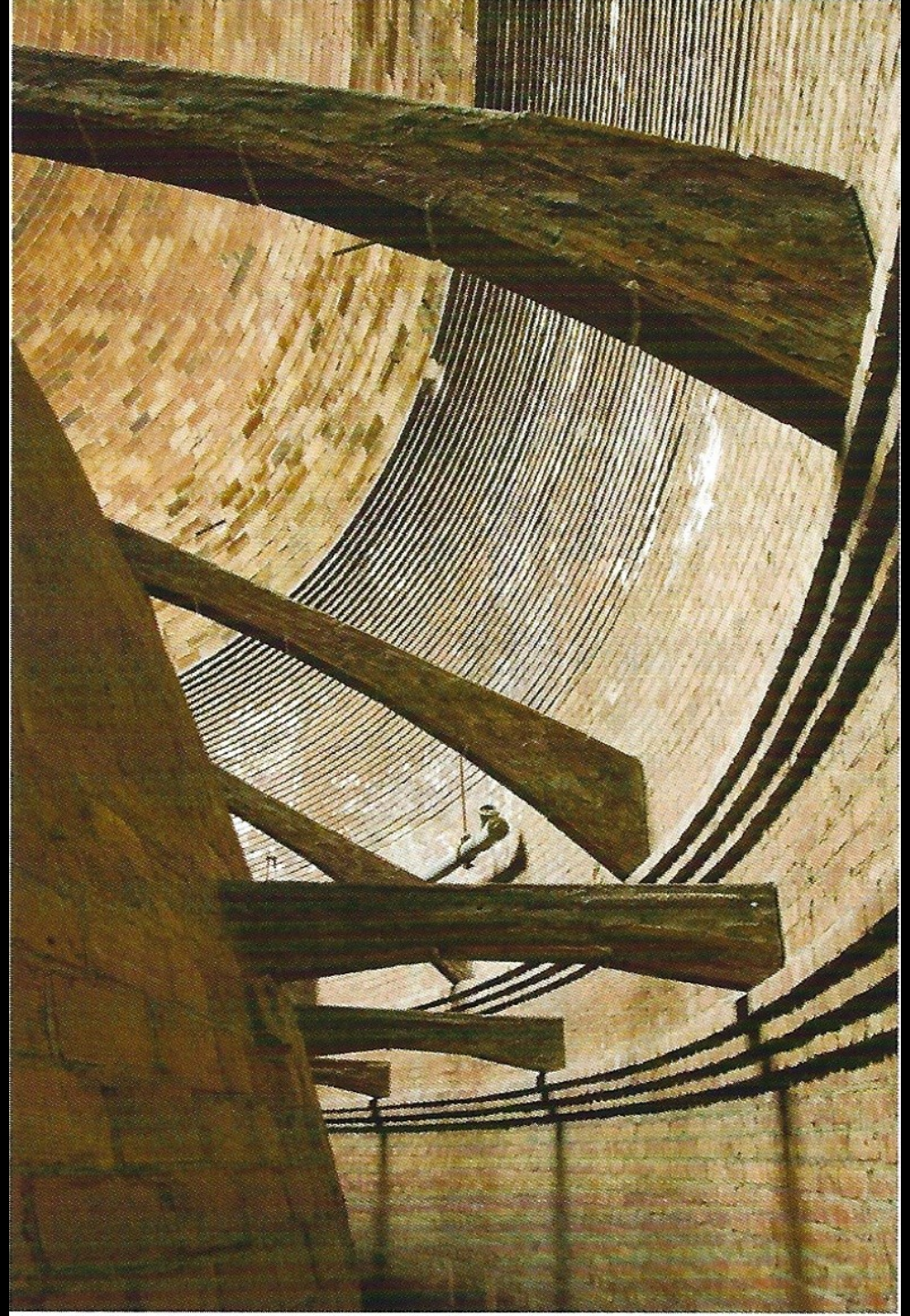
McKIM MEAD & WHITE ARCHTS
NEW YORK

2

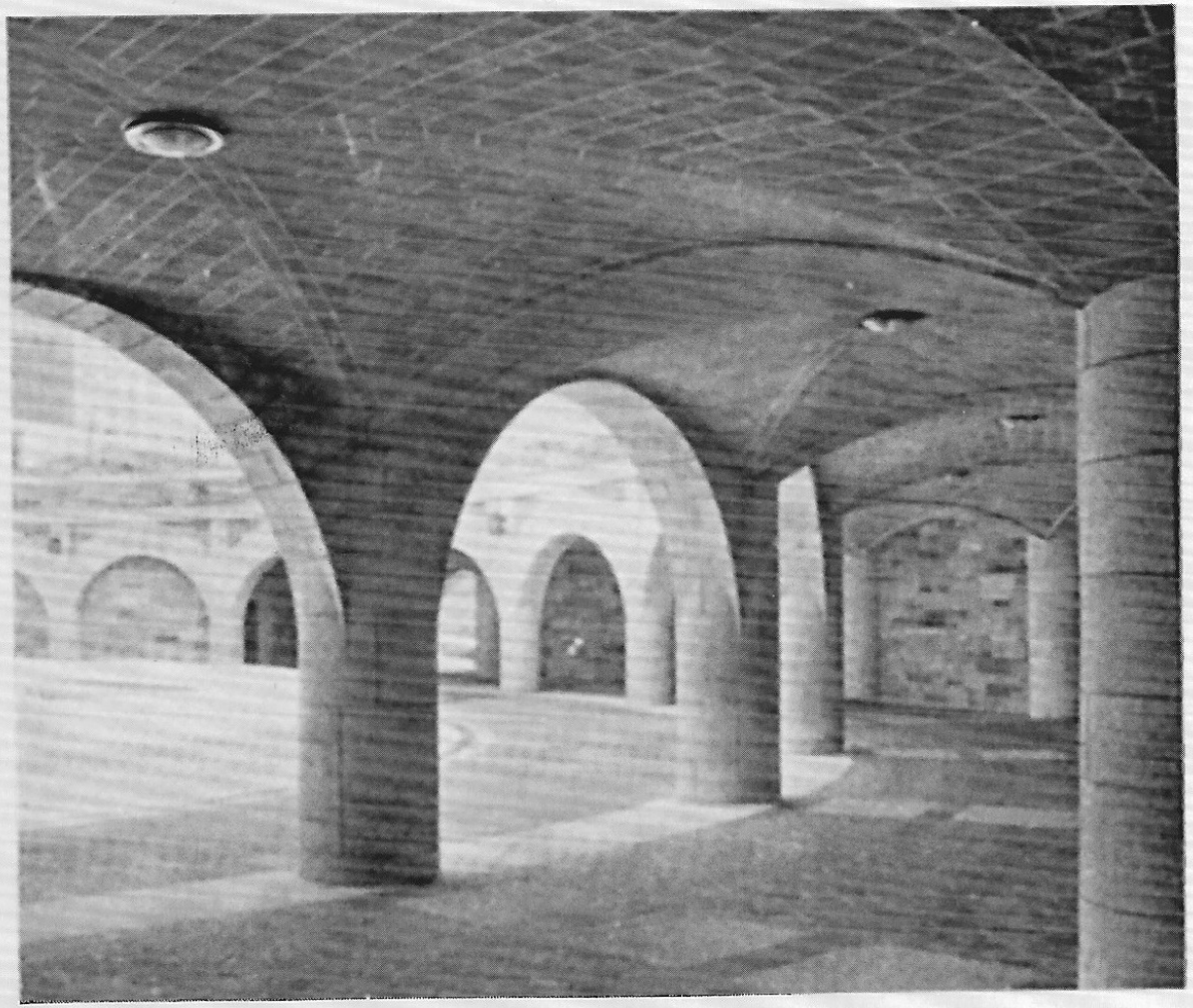
R. GUASTAVINO CO.
NEW YORK
APRIL 7TH 1908


ORNAMENTED TILE
RIBBED TILE
ORNAMENTED TILE
ORNAMENTED TILE
RIBBED TILE
ORNAMENTED TILE
ORNAMENTED TILE
RIBBED TILE
ORNAMENTED TILE
SECTION
BUTTERN. PLACED AT EACH CORNER OF STEUM
28'-3"
23'-7"
RIBBED TILE


1/2 in. Scale
Dome Detail
National Museum
Washington D.C.
Hornblower & Marshall Architects
R. Guastavino Co.
Fuller Bldg. N.Y. City
No 14
Drawing No.
Date
Drawn by
Center Line
Approximate
Openings on Diagonal Axes
Bolts 6" wide cross
Note the Edge and Faces of
Acoustic
Tiles



GUASTAVINO TIMBREL ARCH CONSTRUCTION



GUASTAVINO CONSTRUCTIVE TILE VAULTS
HENRY HUDSON PARKWAY, NEW YORK CITY
Madigan & Hyland, Consulting Engineers

Typical Constructive Tile ceiling with Texture Tile soffit, providing strength, light weight, permanence, economy and freedom from upkeep—

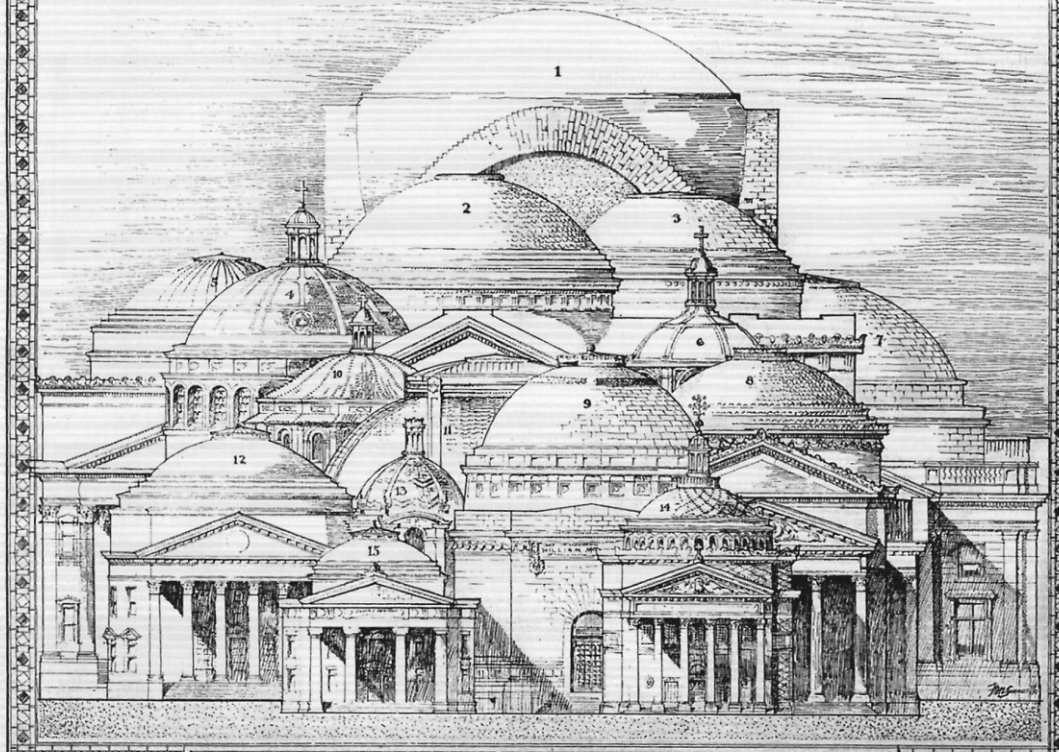
- **FIREPROOF**
- **VARIETY of finish**
- **ADAPTABLE to any form of vaulting**

Our Engineering Department will be glad to suggest the most economical adaptation of Guastavino vaults on receipt of your preliminary drawings.

Refer to Sweet's—Catalog 40, Section 10

R. GUASTAVINO CO.

500 Fifth Ave., New York
40 Court St., Boston

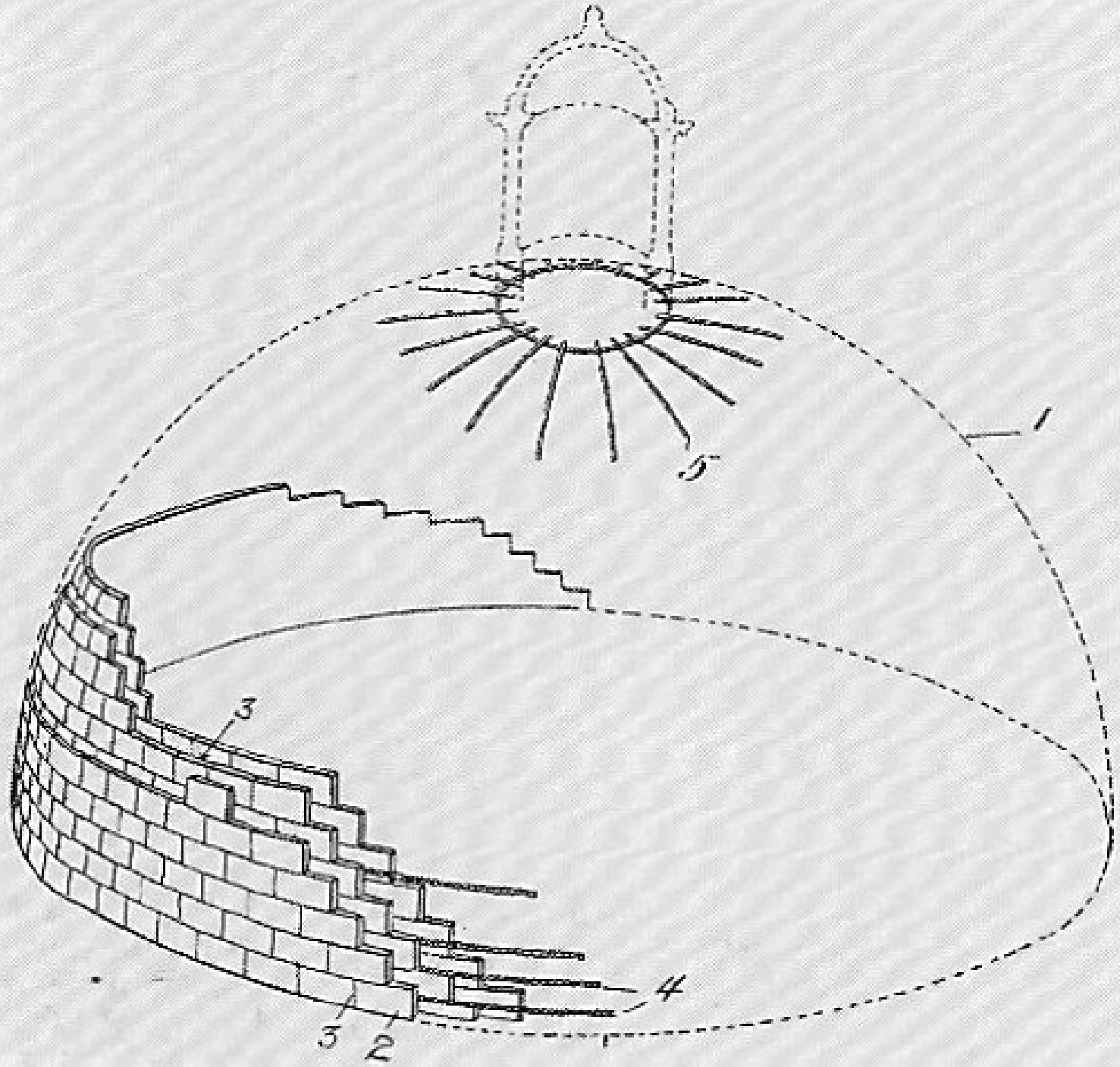


SOME DOMES CONSTRUCTED BY
R. GUASTAVINO CO.

BOSTON

NEW YORK

BUILDING and LOCATION	SPAN	ARCHITECTS
1. Cathedral, St. John the Divine, New York City	135 ft. at base	Heins & La Farge
2. National Museum, Washington, D. C	80	Hornblower & Marshall
3. Institute of Arts and Sciences, Brooklyn, N. Y.	64	McKim, Mead & White
4. St. Francis de Sales Church, Philadelphia, Pa.	61	Henry D. Dagit
5. Bank of Montreal, Montreal, P. Q.	69	McKim, Mead & White and A. T. Taylor
6. Church of St. Barbara, Brooklyn, N. Y.	43	Helmle & Huberty
7. Girard Trust Company, Philadelphia, Pa.	101	McKim, Mead & White and Allen Evans
8. University of New York, New York City	70 ft. at base	McKim, Mead & White
9. McKinley National Memorial, Canton, Ohio	56	H. Van Buren Magonigle
10. St. Paul's Chapel, Columbia U., N. Y. City	52	Howells & Stokes
11. Rodef Sholem Synagogue, Pittsburgh, Pa.	90	Palmer & Hornbostel
12. University of Virginia, Charlottesville, Va.	70	McKim, Mead & White
13. Elephant House, Bronx Park, New York City	34	Heins & La Farge
14. Madison Sq. Presby'n Church, N. Y. City	46	McKim, Mead & White
15. J. J. Jermain Memorial Library, Sag Harbor, N. Y.	30	Augustus N. Allen


1
5
3
4
3
2

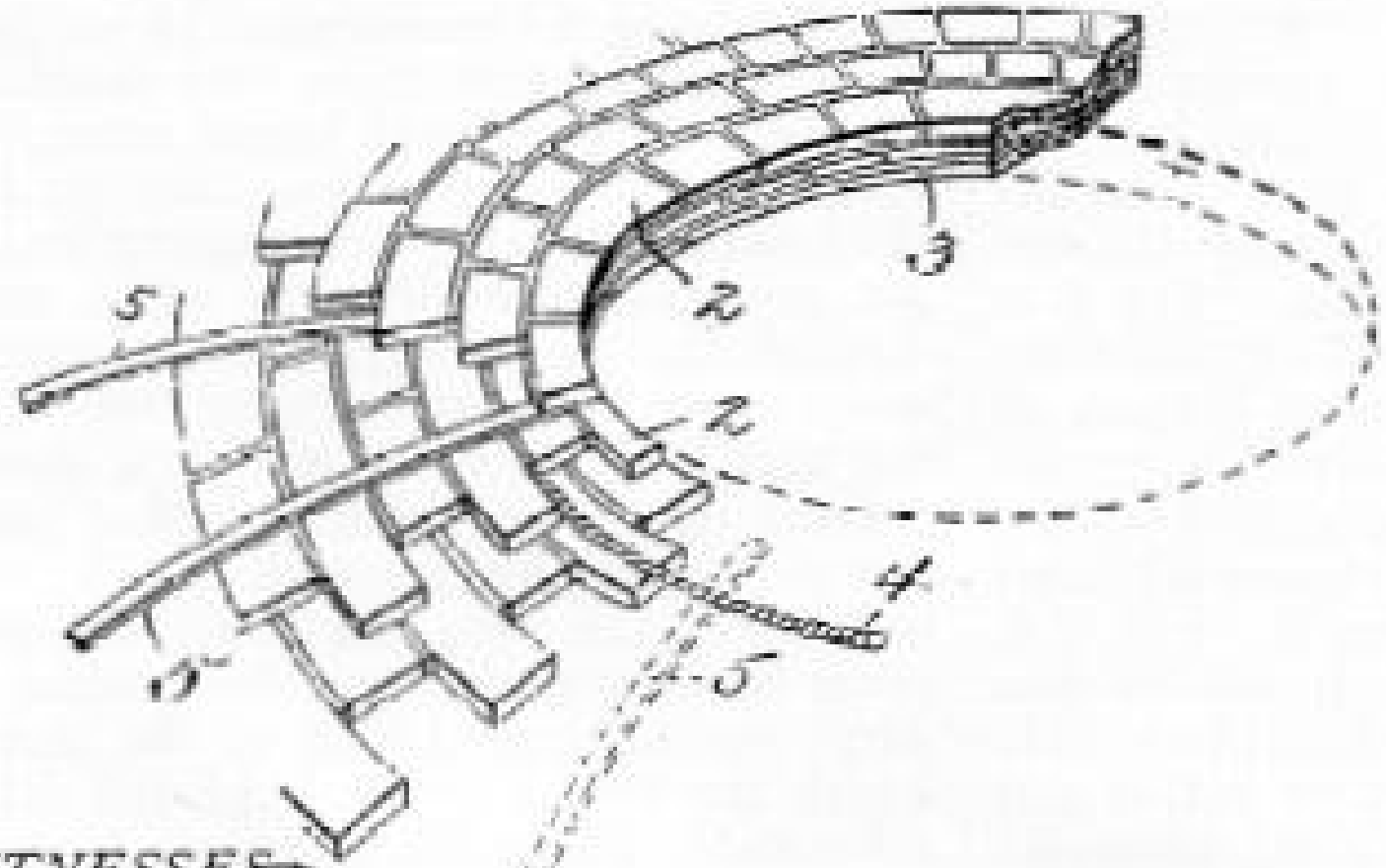


FIG. 2.

WITNESSES:

W. F. Hoyle.

R. C. Braddock.

INVENTOR

Rafael Grastavino

BY

Henry M. Brigham

Attorney

EMERGENCY

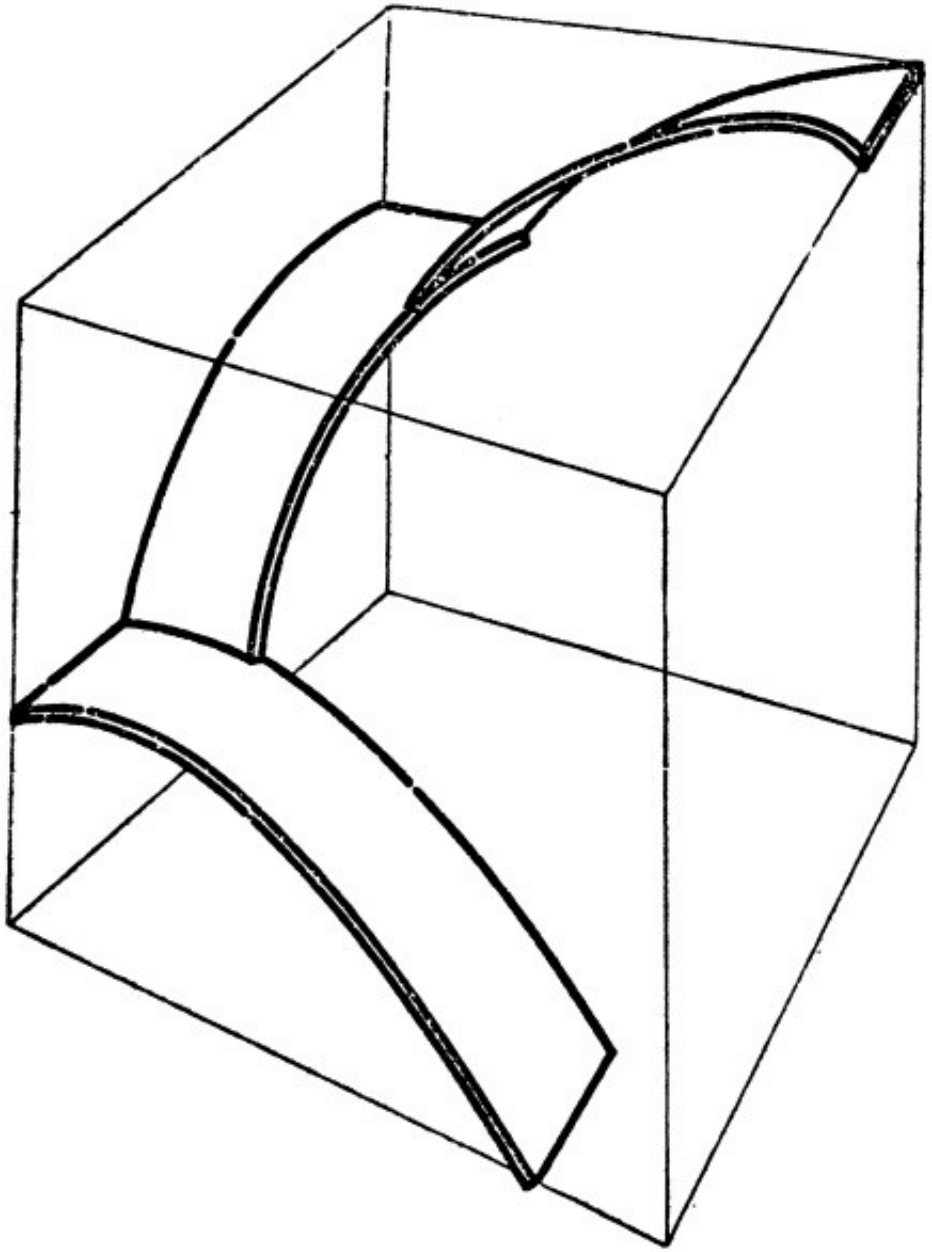


Fig. 21. Diagram of Catalan stair vault that ascends in parabolic stages, each springing from the cantilevered edge of the one below (Casinello, *Bóvedas de ladrillo*).

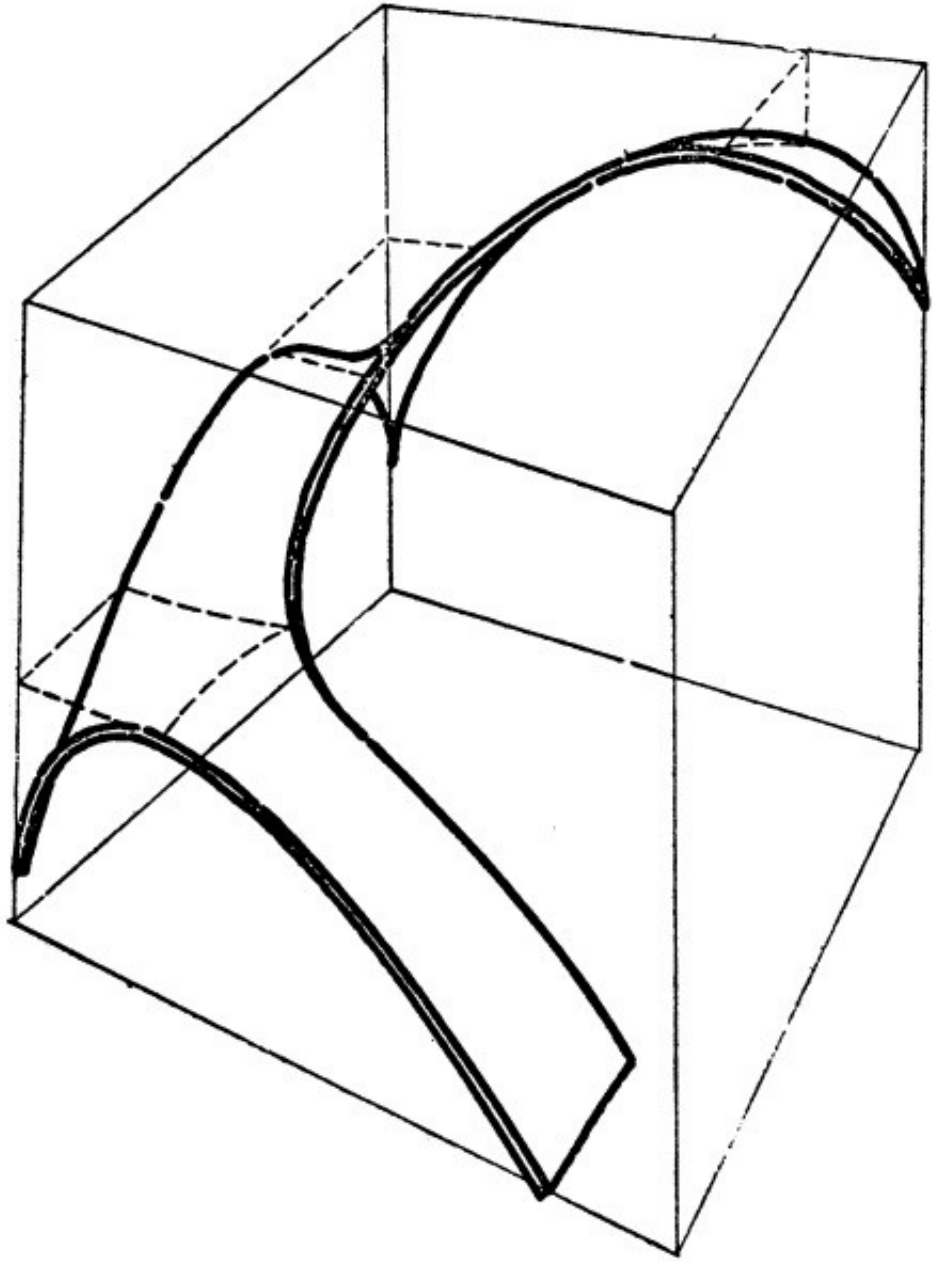


Fig. 22. Diagram of Catalan stair vault with pendentive corners (Casinello, *Bóvedas de ladrillo*).

See Revised Detail of Roof Construction — Sheet #14

Limestone Coping

Ornamental Ironwork by Contractor for Ornamental Iron.

Limestone

Stone left for Carving

OMIT CARVING

Granite

Plaster Fin.

Wood Floor Wood Base

Timbrel Vault

Timbrel Vault

Timbrel Vault

Metal Frame & Sash

Timbrel Arch

Stone left for Carving

Brick in pattern

Clock

Stone

Stone

Special tile round outlet for light

Metal Frame & Sash Plate Glass

Metal Frame & Sash Plate Glass

Bronze Guards

Bronze Guards

Bronze Guards

Stone

Stone

Cement Base

Quarry Tile Floor

Cement Base

Granite

Brick Bring

Granite Base

Granite Steps

Waterproofing

Brick Facing walls

Grap on step

Reinforced Concrete beam

OMIT THIS LAMP.

Rough Stone for Carven

Brick Arch

Timbrel Arch

Timbrel Arch

Timbrel Arch

Timbrel Arch

Timbrel Arching

Timbrel Arching

Cement Hearthstone

Tile Floor Cement Base

Cement Base

Tile Floor Cement Base

Cement Base

Guastavino Tile selected

Guastavino Tile selected

Guastavino Tile selected

Cement Tempers

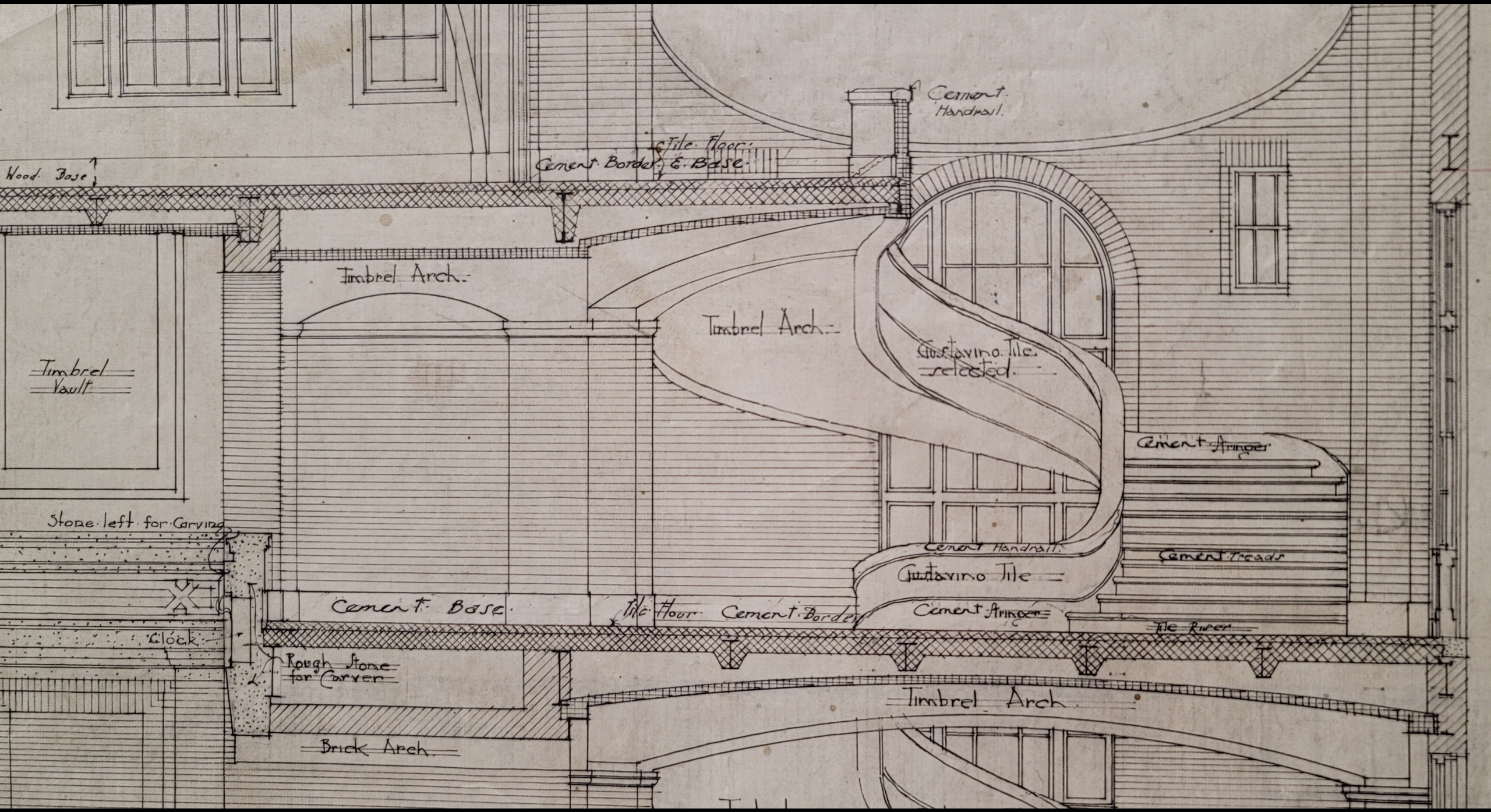
Cement Tempers

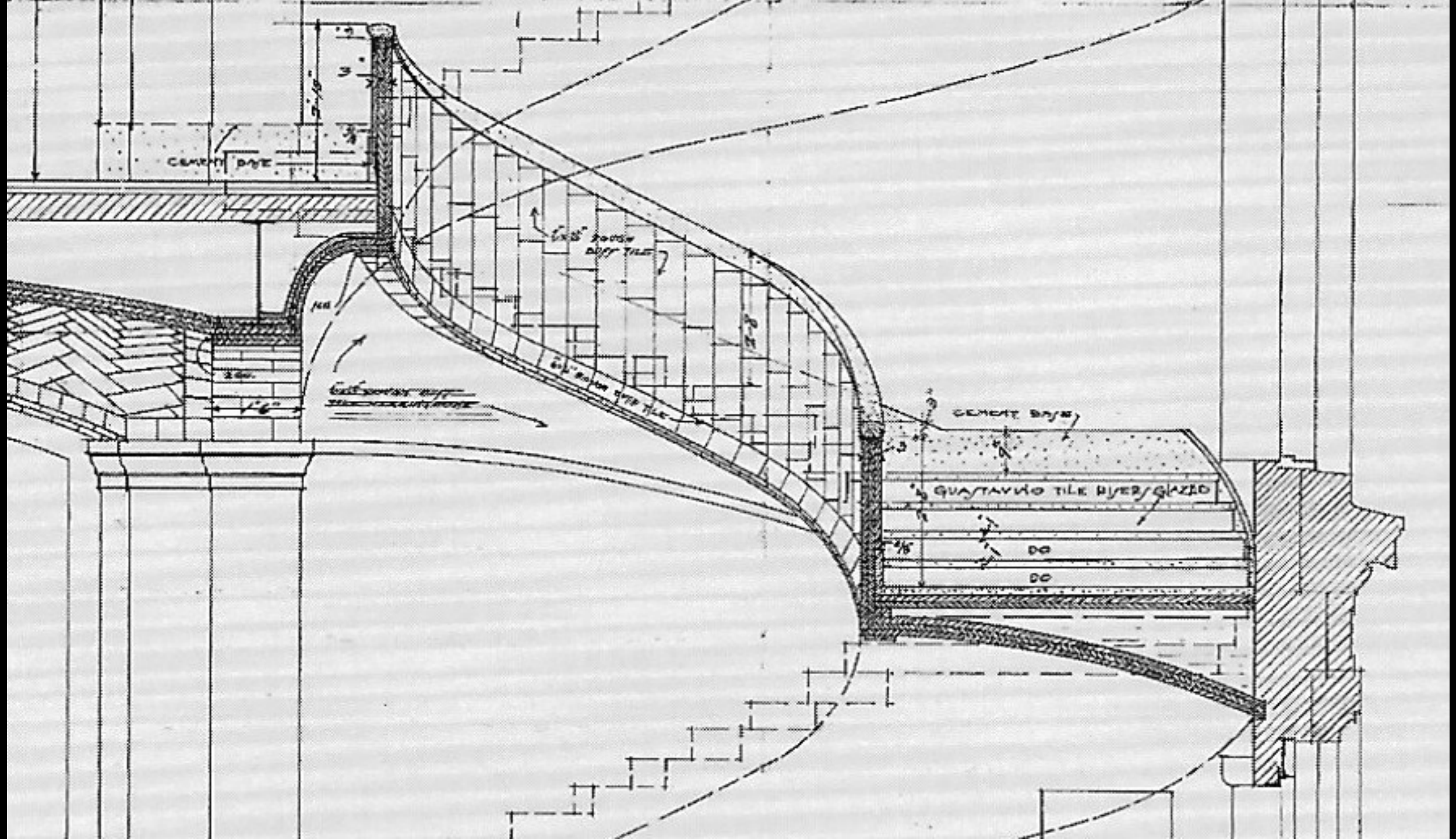
Cement Tempers

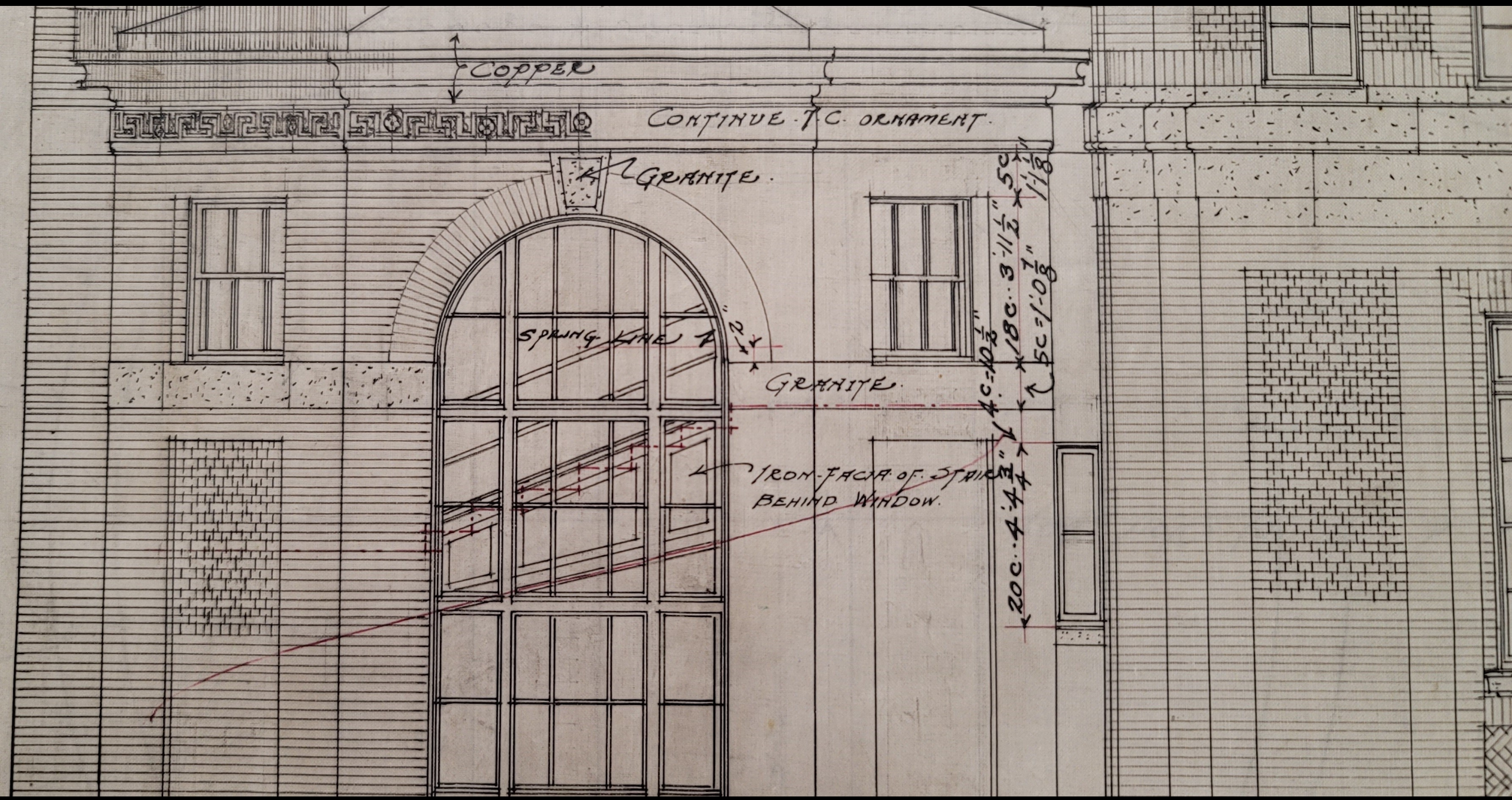
Cement Treads

Cement Treads

Wood Doors with Lights


Cement Handrail.
Tile Floor
Cement Border & Base
Wood Base
Timbrel Arch
Timbrel Arch
Timbrel Vault
Gustavino Tile selected.
Cement Stringer
Stone left for Carving
Cement Handrail
Cement Treads
Gustavino Tile
Cement Base
Tile Floor
Cement Border
Cement Stringer
Tile Riser
Clock
Rough Stone for Carver
Timbrel Arch
Brick Arch


CEMENT BASE
CEMENT BASE
GUASTAVINO TILE RISER/GLAZED
DO
DO

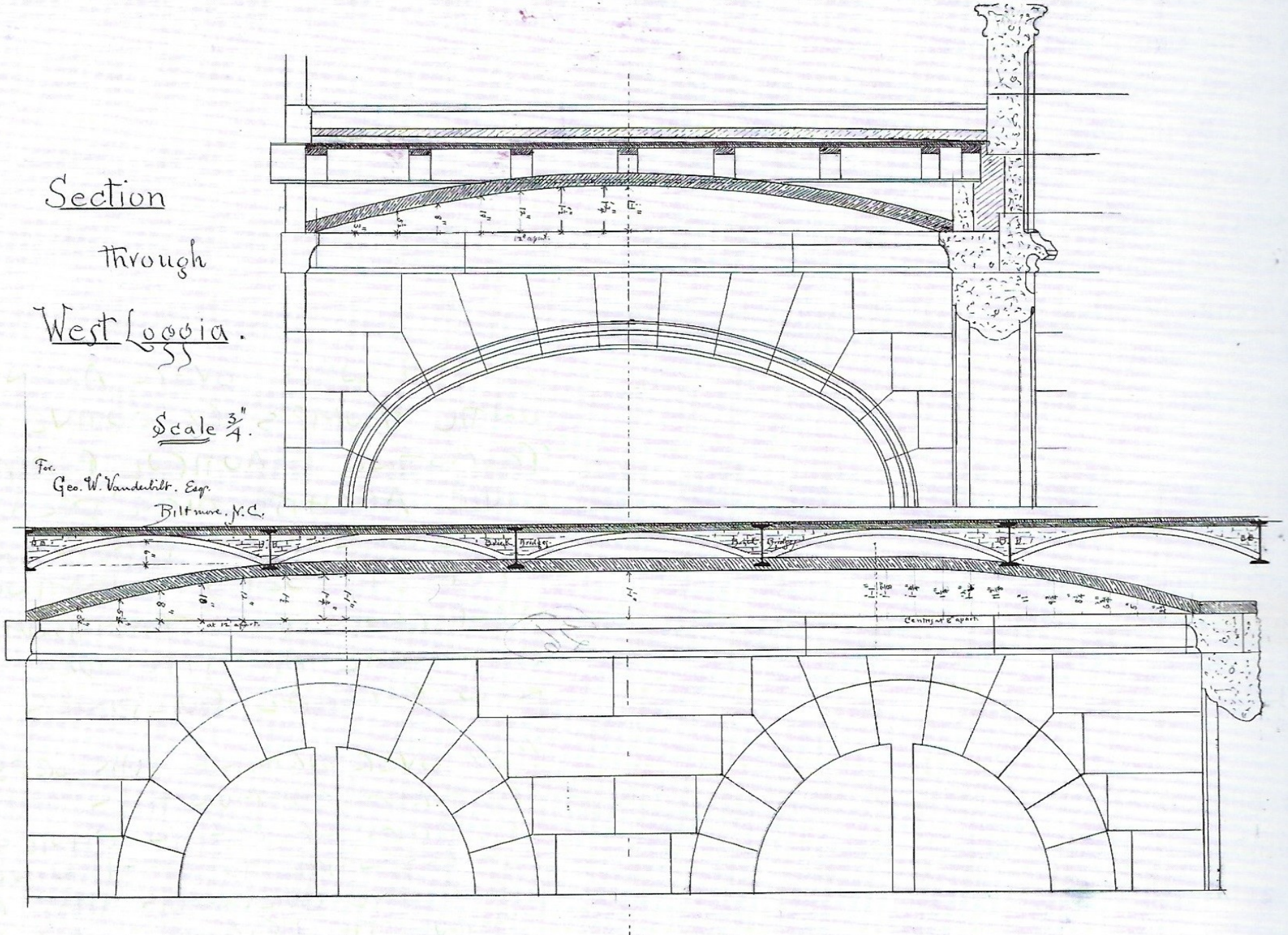

COPPER
CONTINUE T.C. ORNAMENT.
GRANITE.
SPRING LINE
GRANITE.
IRON FACIA OF STAIR
BEHIND WINDOW.
4C=10 1/2"
18C. 3'-11 1/2"
5C
5C=1'-0 7/8"
20C. 4'-4 3/4"
1'-1 1/8"

Academic Advising Center
Dean's Office
Economics
English
Information Systems
HUMANITIES and SOCIAL SCIENCES
Carnegie Mellon

Section through West Loggia.

Scale 3/4".

For
Geo. W. Vanderbilt. Esqr.
Biltmore, N.C.



Federal St. Bridge, looking East, Pittsburgh, Pa.

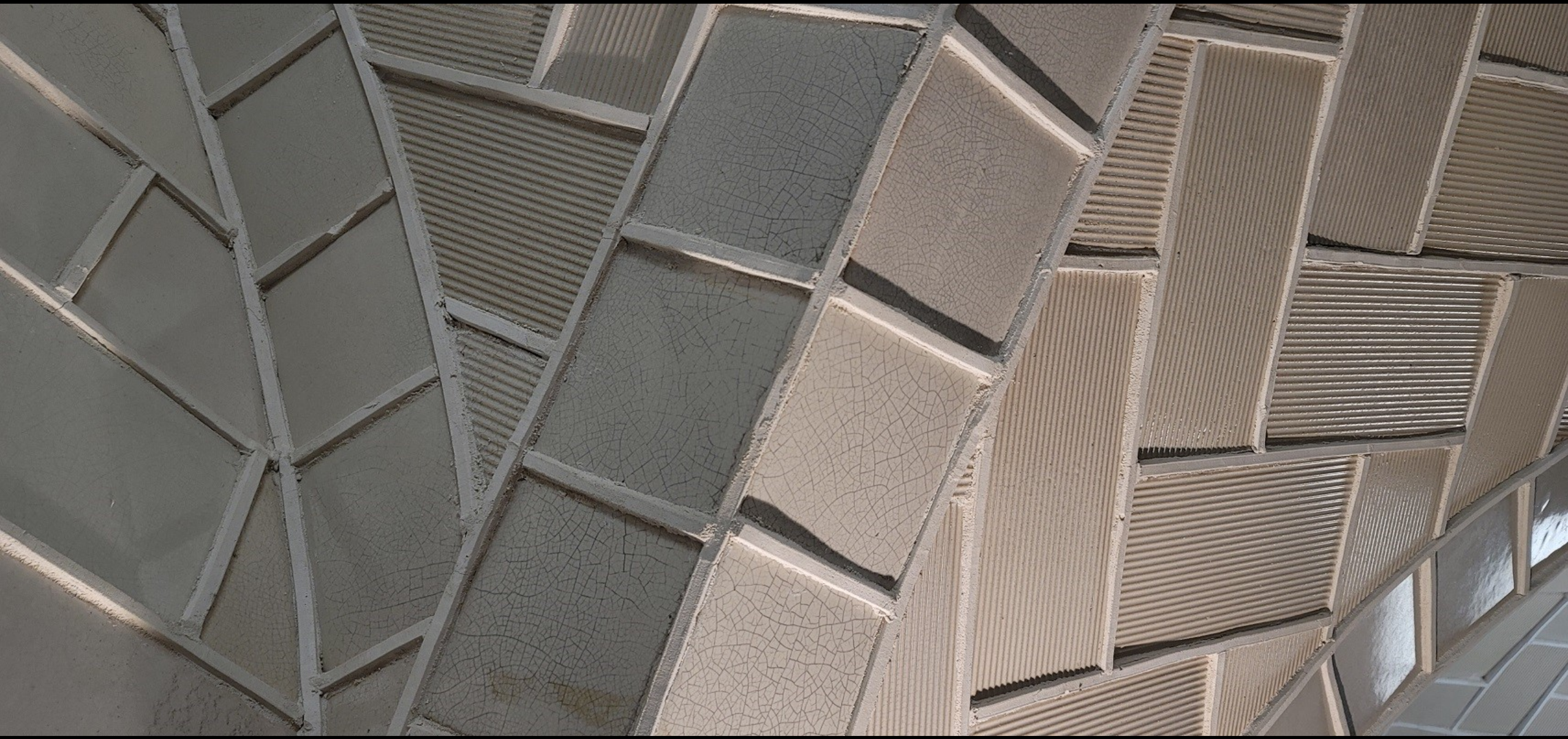
EXIT
EXIT

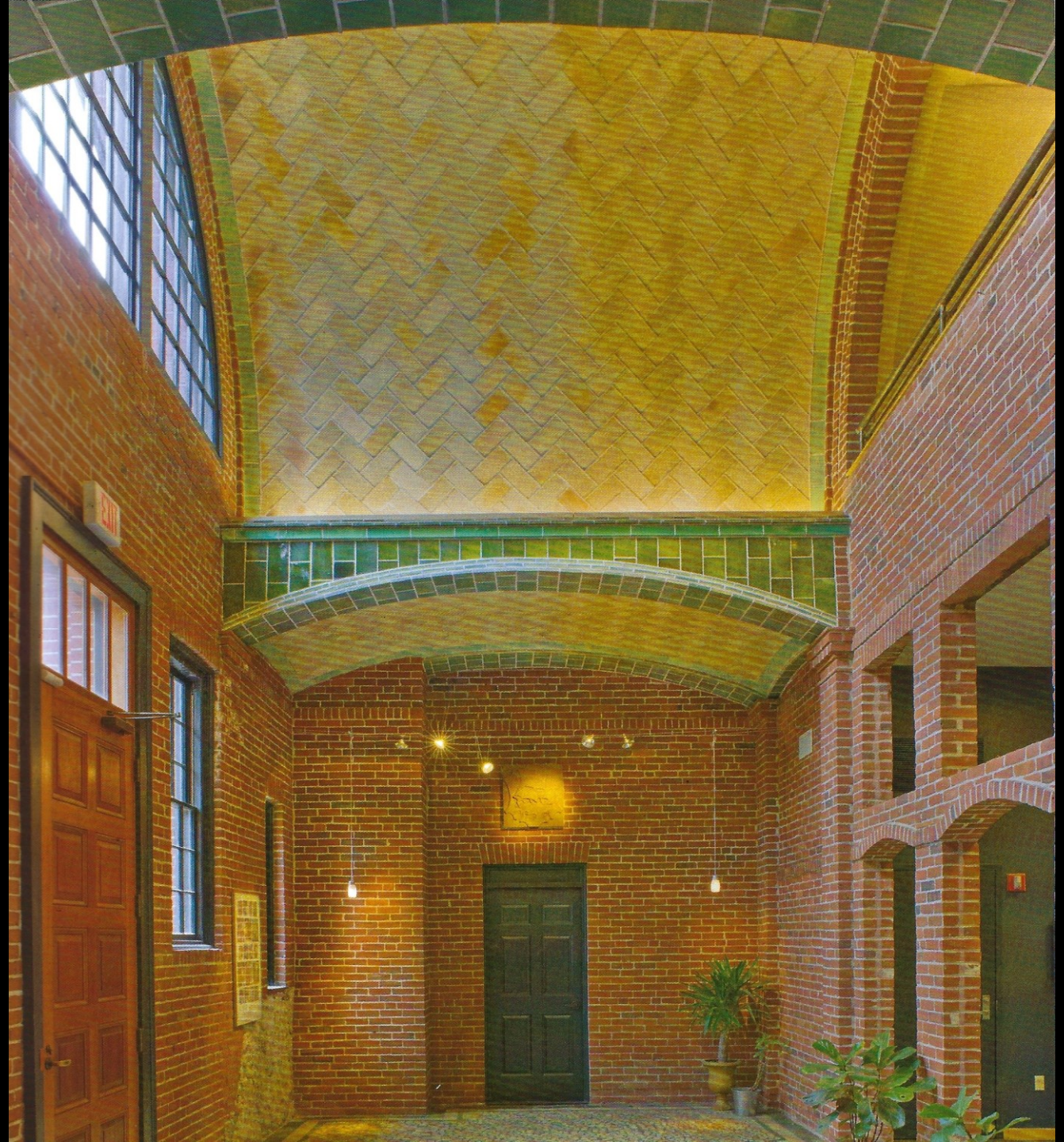
54
2641

CHATHAM UNIVERSITY 2007

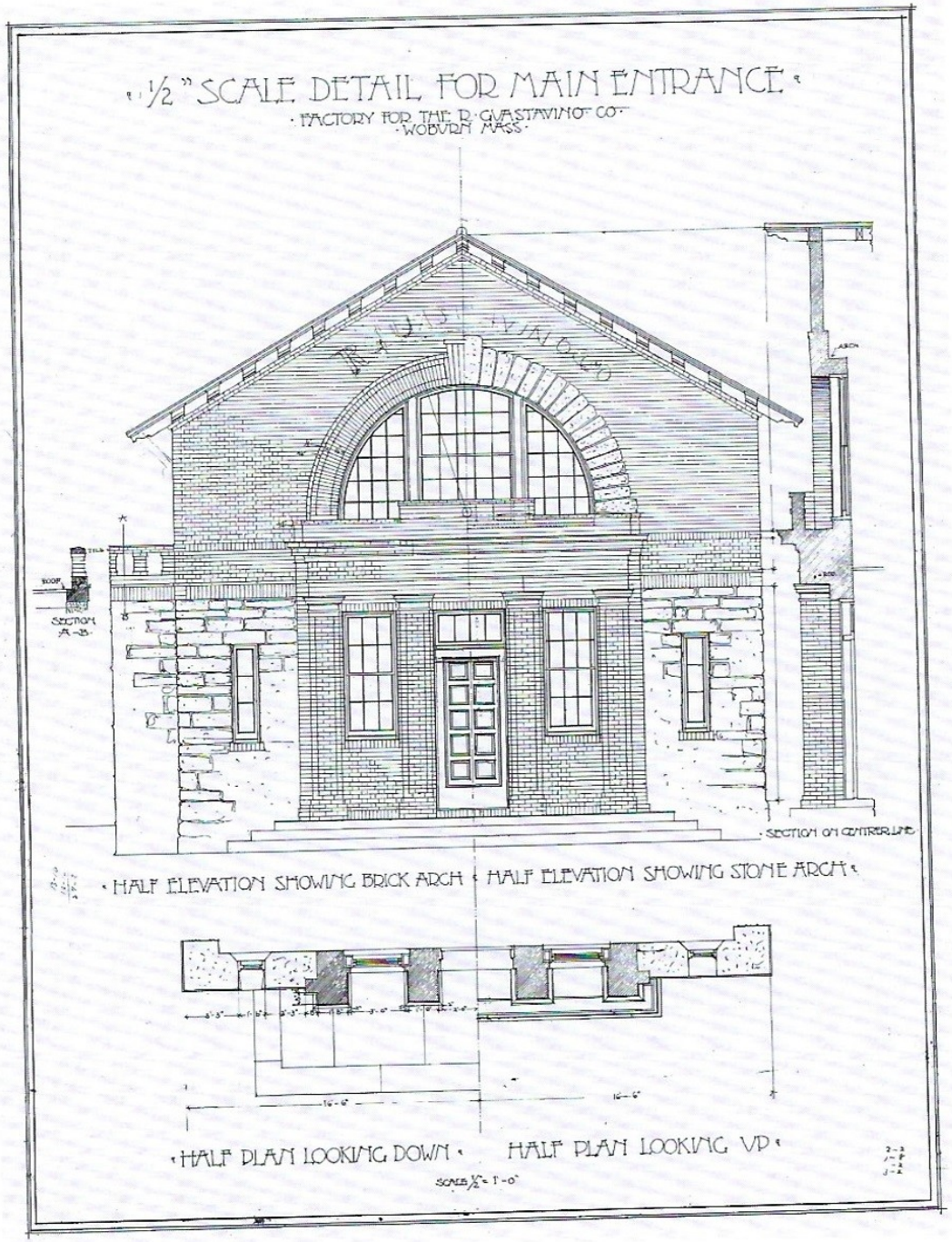
CHATHAM UNIVERSITY 2007
PENNSYLVANIA FEMALE COLLEGE 1869
CHATHAM COLLEGE 1955

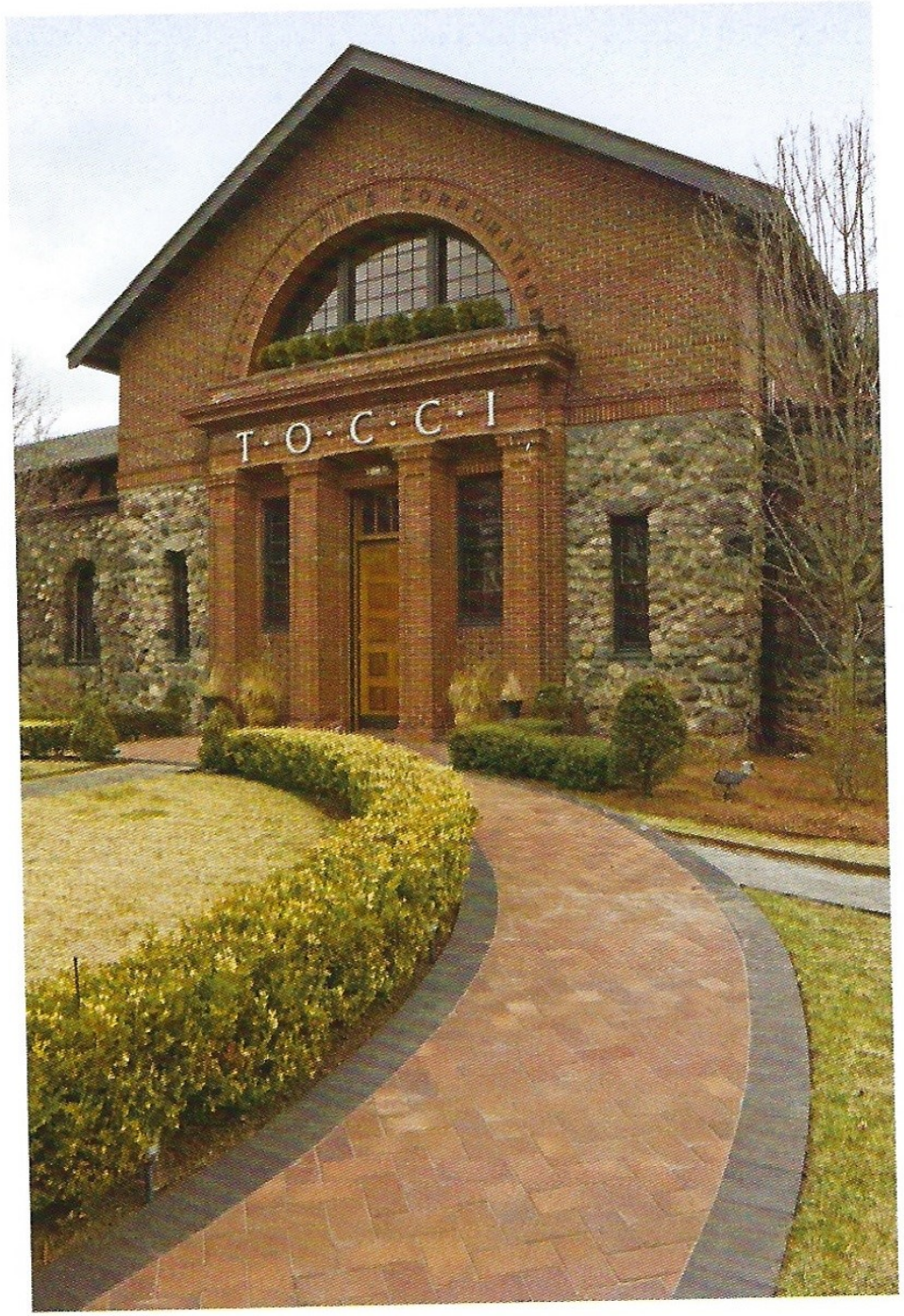
EXIT

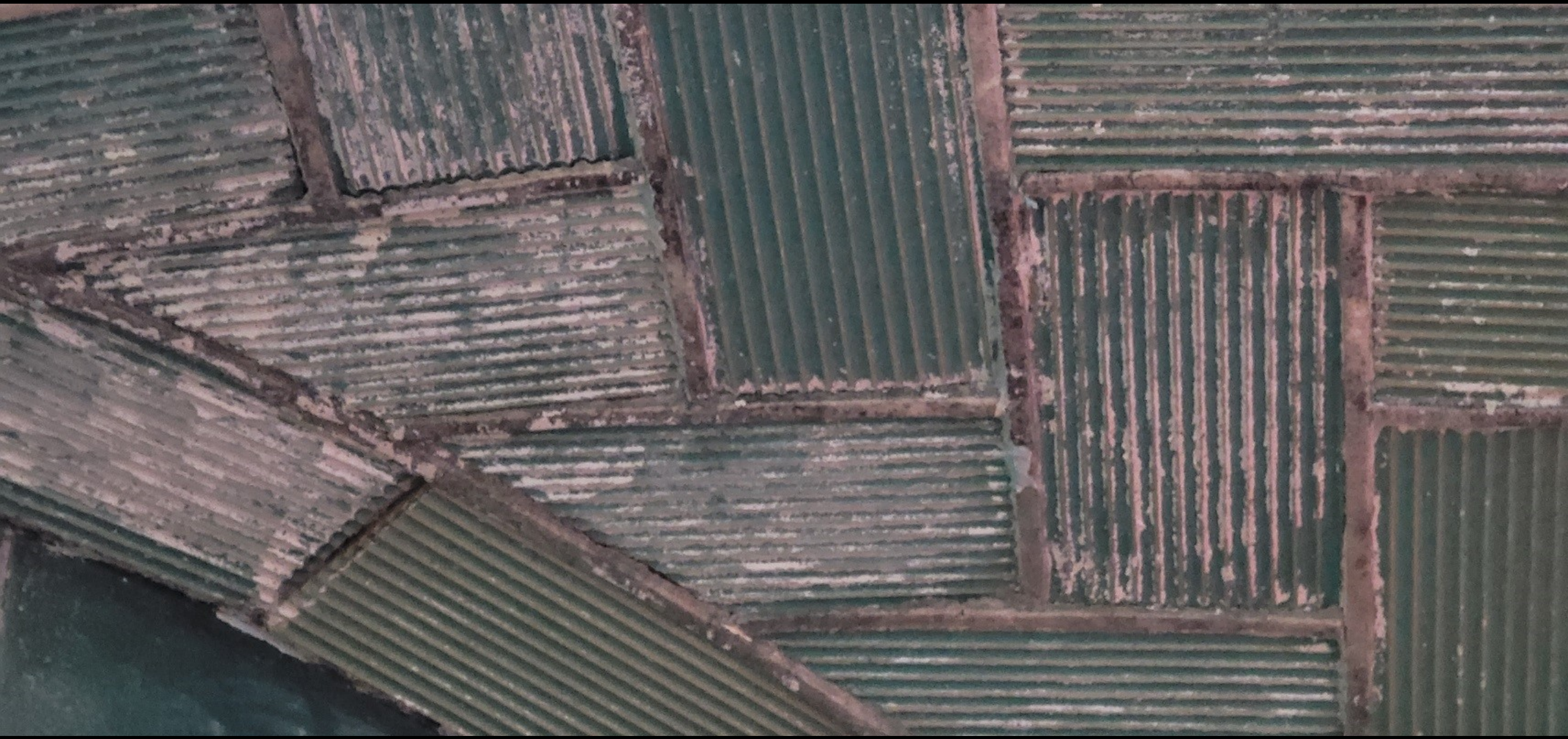



EXIT

R. GUASTAVINO.


½" SCALE DETAIL FOR MAIN ENTRANCE
FACTORY FOR THE R. GUASTAVINO CO.
WOBURN MASS.
SECTION A-B
SECTION ON CENTER LINE
HALF ELEVATION SHOWING BRICK ARCH
HALF ELEVATION SHOWING STONE ARCH
HALF PLAN LOOKING DOWN
HALF PLAN LOOKING UP
SCALE ½" = 1'-0"


T·O·C·C·I



106. COMPOSITIONS,
COATING OR PLASTIC.

86

72/17 Cross References Examin.

W. C. SABINE & R. GUASTAVINO. 1,197,956

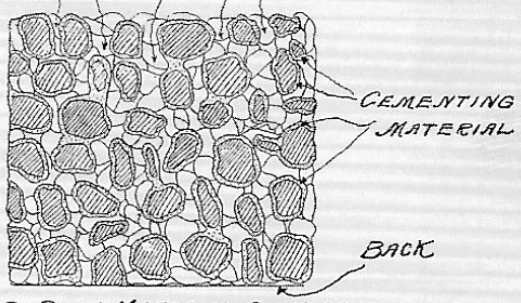
SOUND ABSORBING MATERIAL FOR WALLS AND CEILINGS.

APPLICATION FILED NOV. 8, 1915.

1,197,956. Patented Sept. 12, 1916.

FIG. 1

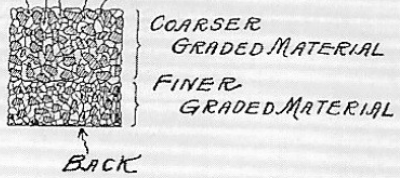
INTERCOMMUNICATING CHANNELS EXTENDING TO AND OPENING THROUGH THE FACE



GRANULAR BODY MATERIAL SUCH AS SAND OR PUMICE GRADED TO A SUBSTANTIALLY UNIFORM SIZE — GRANULES OR PARTICLES BONDED AT POINTS OF CONTACT AS SHOWN BY SECTIONED PARTICLES.

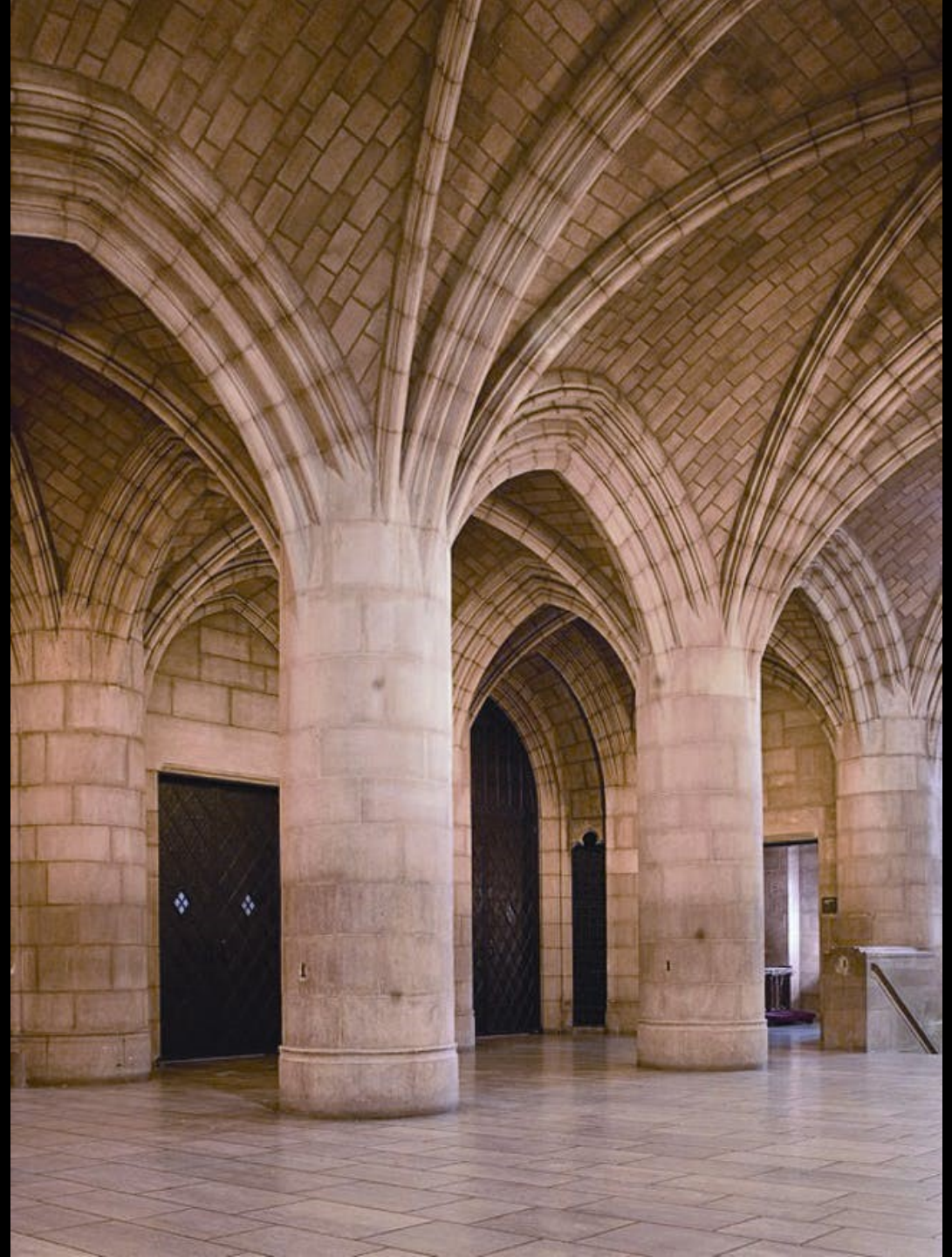
FIG. 2

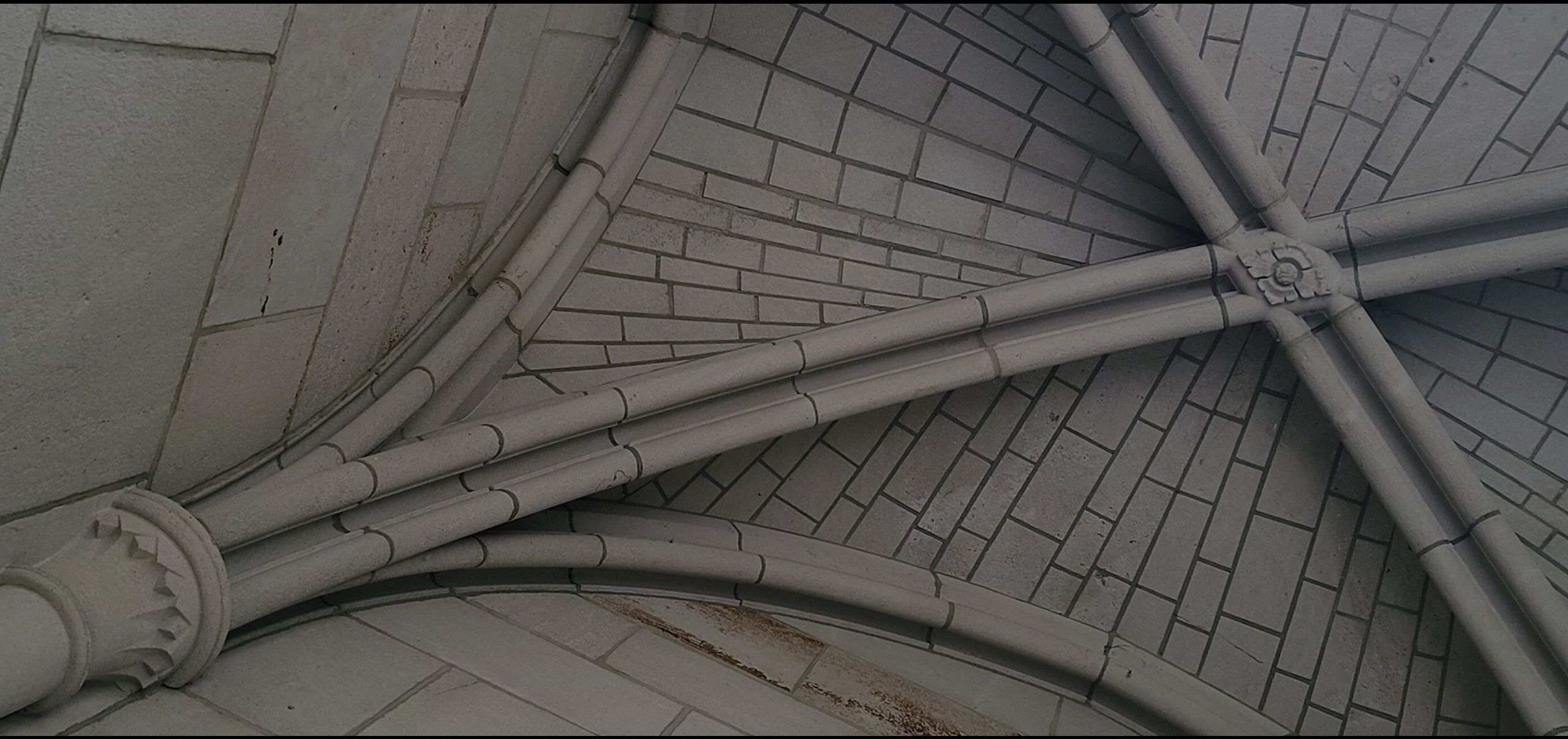
INTERCOMMUNICATING CHANNELS EXTENDING TO AND OPENING THROUGH THE FACE



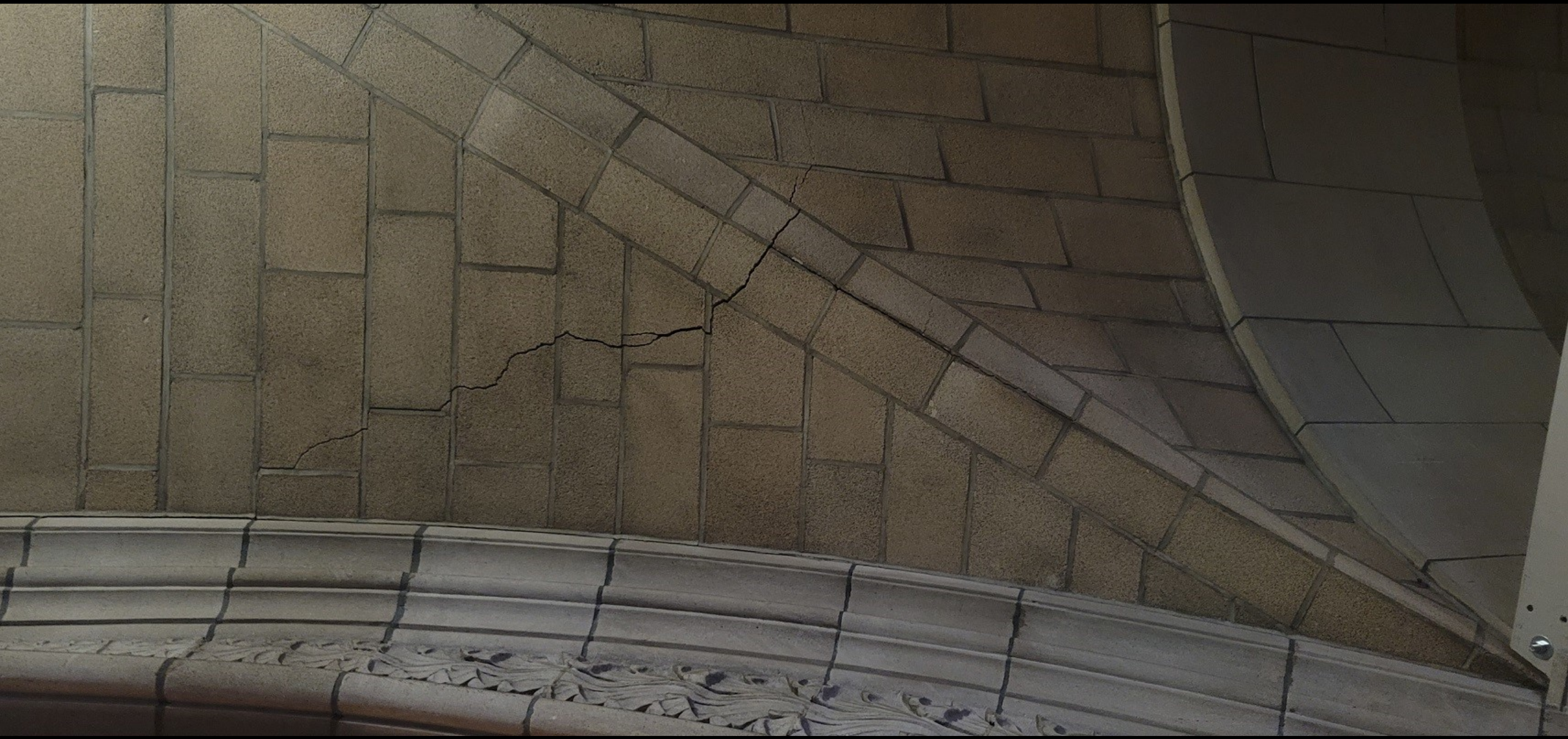
WALLACE CLEMENT SABINE
RAFAEL GUASTAVINO,
INVENTORS

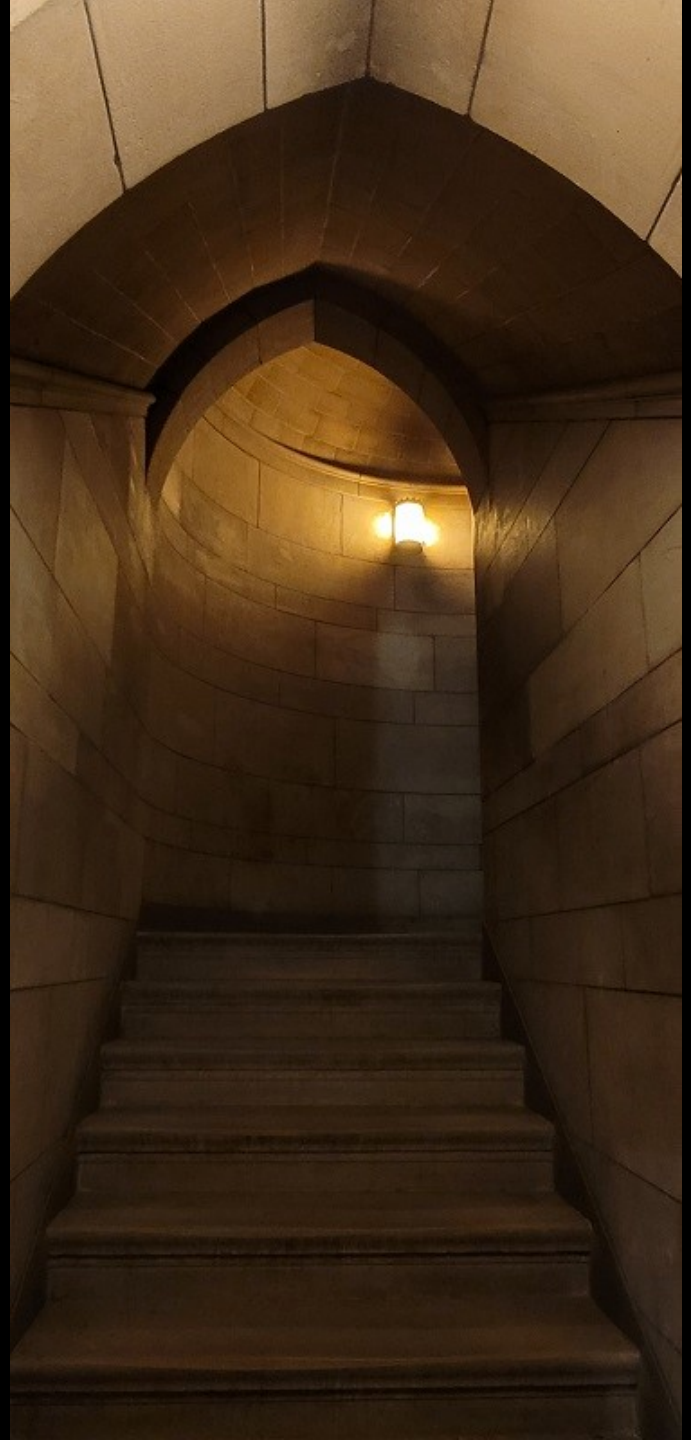
BY,
Henry N. Brigham ATTORNEY



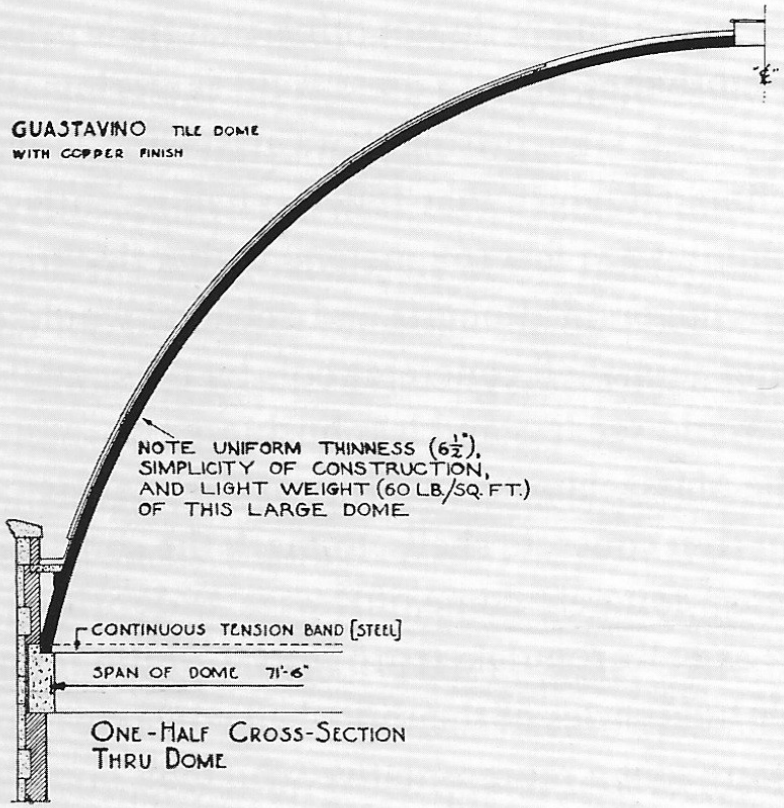


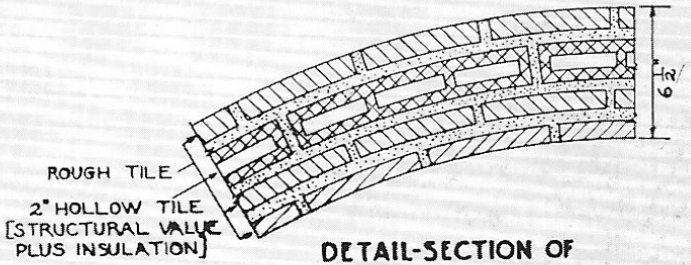
is always
in progress.
EXIT



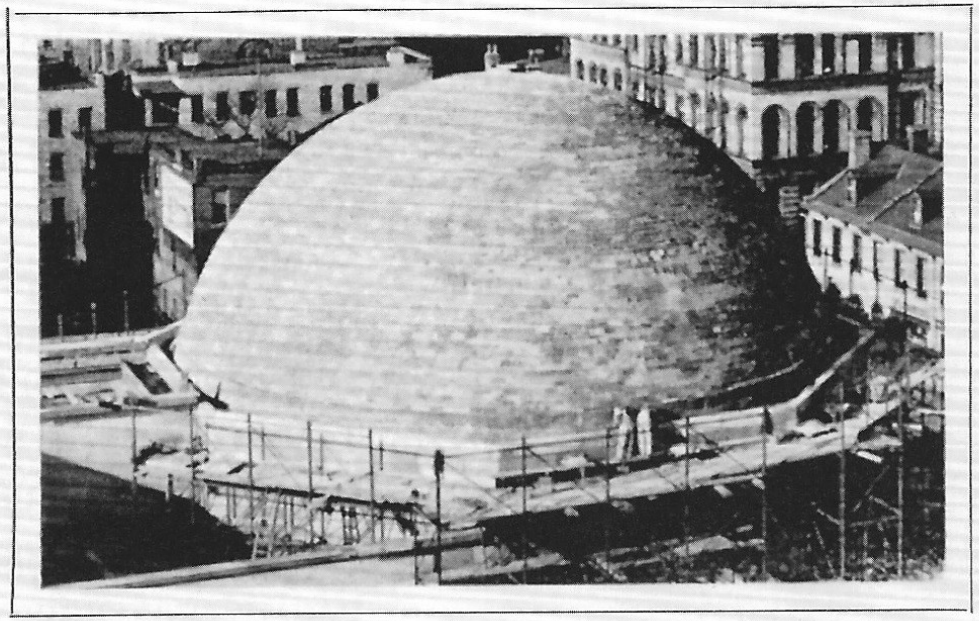


GUASTAVINO TIMBREL ARCH CONSTRUCTION





DETAIL-SECTION OF TYPICAL TILE SHELL

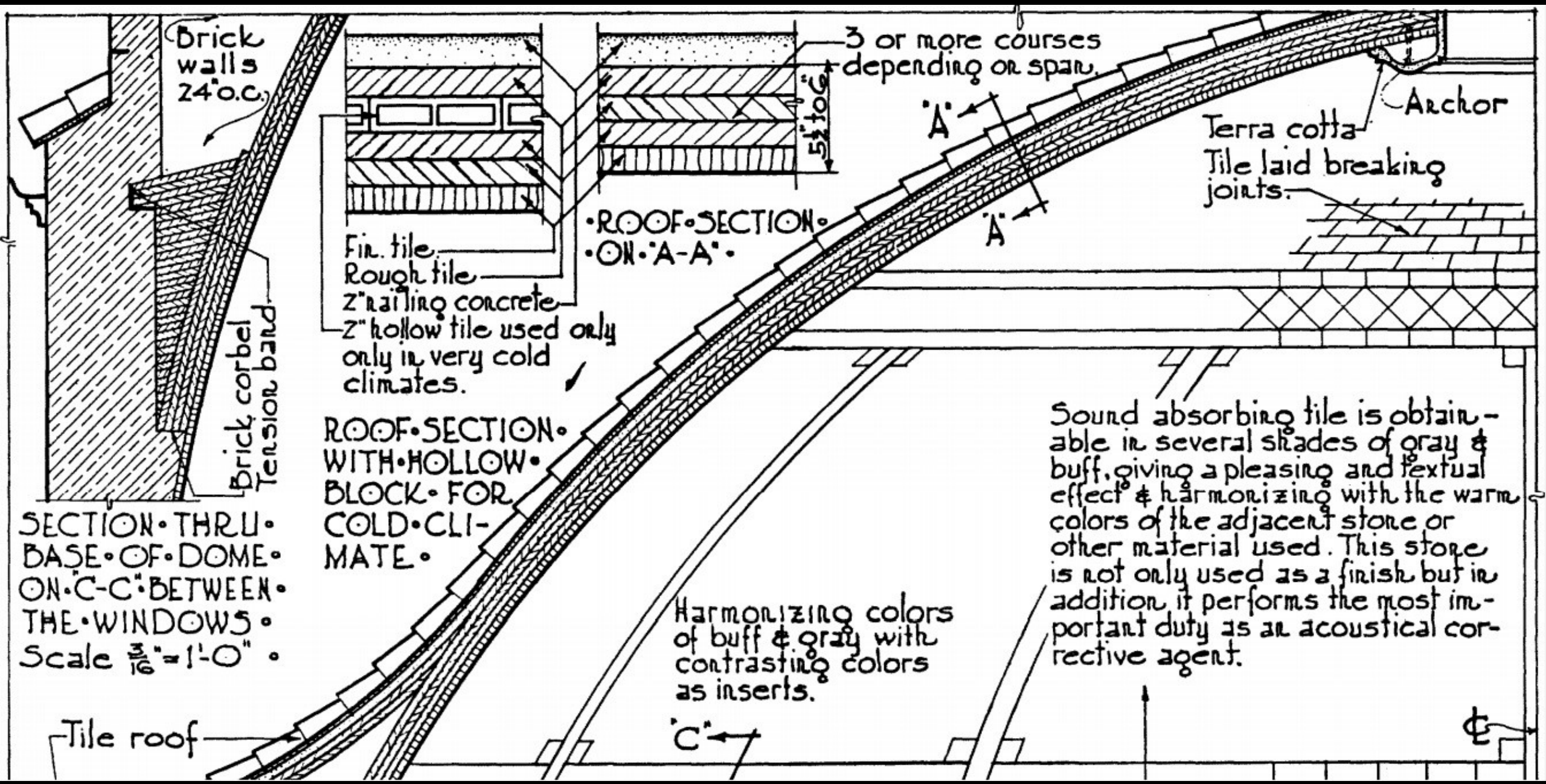


BUHL PLANETARIUM DOME
PITTSBURGH, PA.
INGHAM & BOYD, Architects

See our catalog in Sweet's

R. GUASTAVINO COMPANY

500 FIFTH AVE., NEW YORK 40 COURT ST., BOSTON


Brick walls 24" o.c.
Brick corbel
Tension band
SECTION • THRU • BASE • OF • DOME • ON • "C-C" • BETWEEN • THE • WINDOWS •
Scale 3/16" = 1'-0" •
Fin. tile
Rough tile
2" railing concrete
2" hollow tile used only only in very cold climates.
• ROOF • SECTION • ON • "A-A" •
ROOF • SECTION • WITH • HOLLOW • BLOCK • FOR COLD • CLI-MATE •
3 or more courses depending on span.
5½" to 6"
"A"
"A"
Terra cotta
Tile laid breaking joints.
Anchor
Sound absorbing tile is obtain-able in several shades of gray & buff, giving a pleasing and textual effect & harmonizing with the warm colors of the adjacent stone or other material used. This stone is not only used as a finish but in addition it performs the most im-portant duty as an acoustical cor-rective agent.
Harmonizing colors of buff & gray with contrasting colors as inserts.
"C"
Tile roof
℄