The History of Masonry Construction

Types of masonry:
Brick
(concrete) Block
Stone

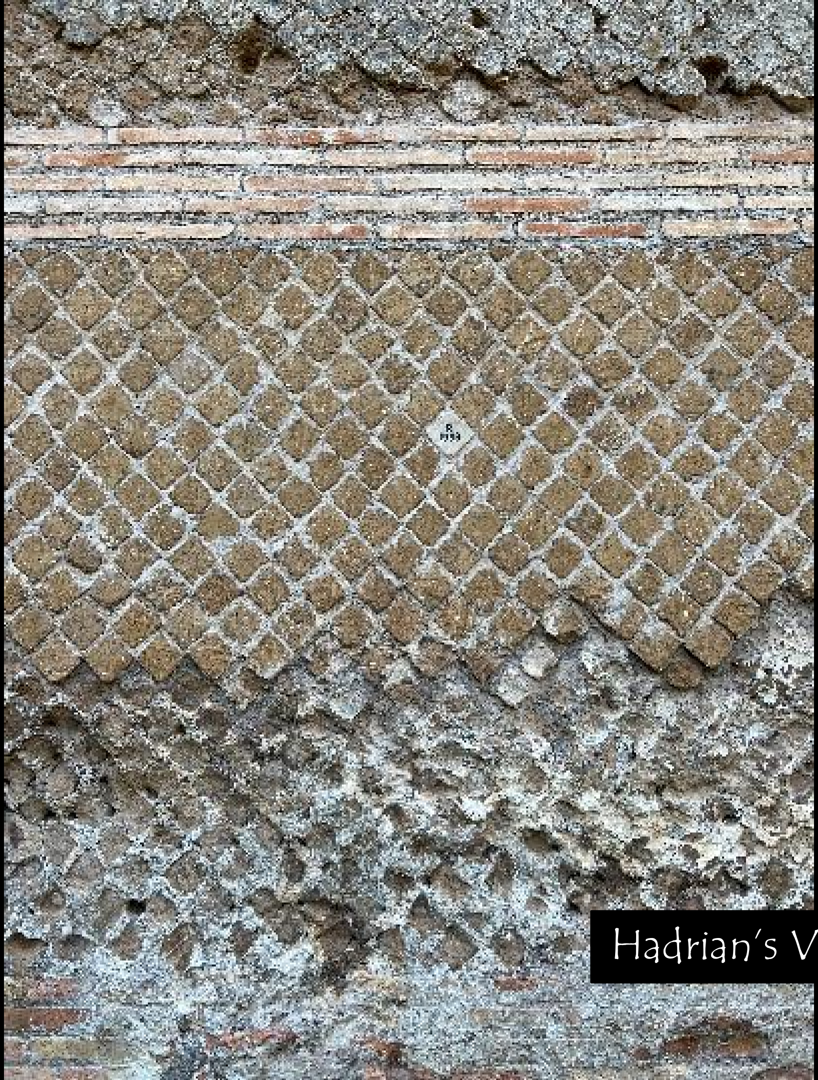
STONE units are usually CUT to shape

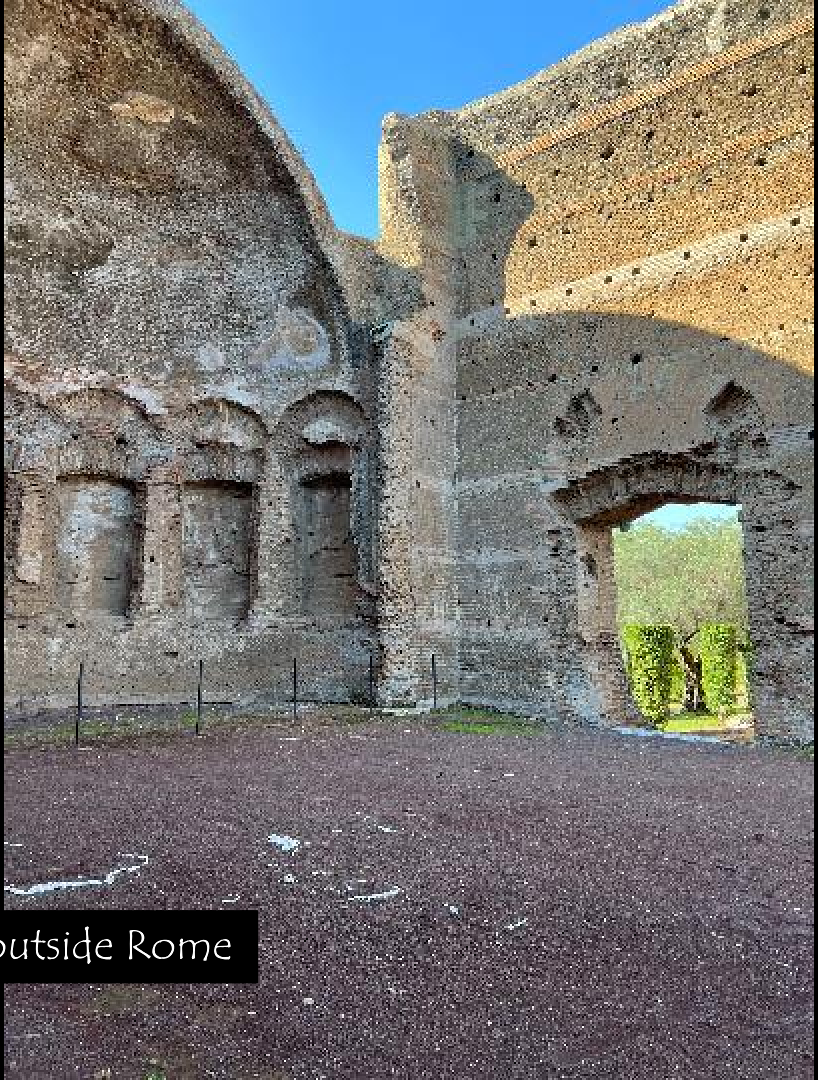
BRICK units are usually formed or extruded and need to be FIRED to harden them

CONCRETE BLOCK is extruded and needs to dry/cure to get its strength

TERRACOTTA units are formed and fired and often glazed

Pompeii,
Italy
69 CE





Hadrian's Villa outside Rome

Aqua Claudia and the Anio Novus as Part of the Porta Maggiore
Rome, Italy
200 CE

Giant Wild Goose
Pagoda
Xian, China
752 CE

ADOBE Construction
mud/clay + straw
left to dry in the sun

Masonry is usually laid in
COURSES
That is, a row of units

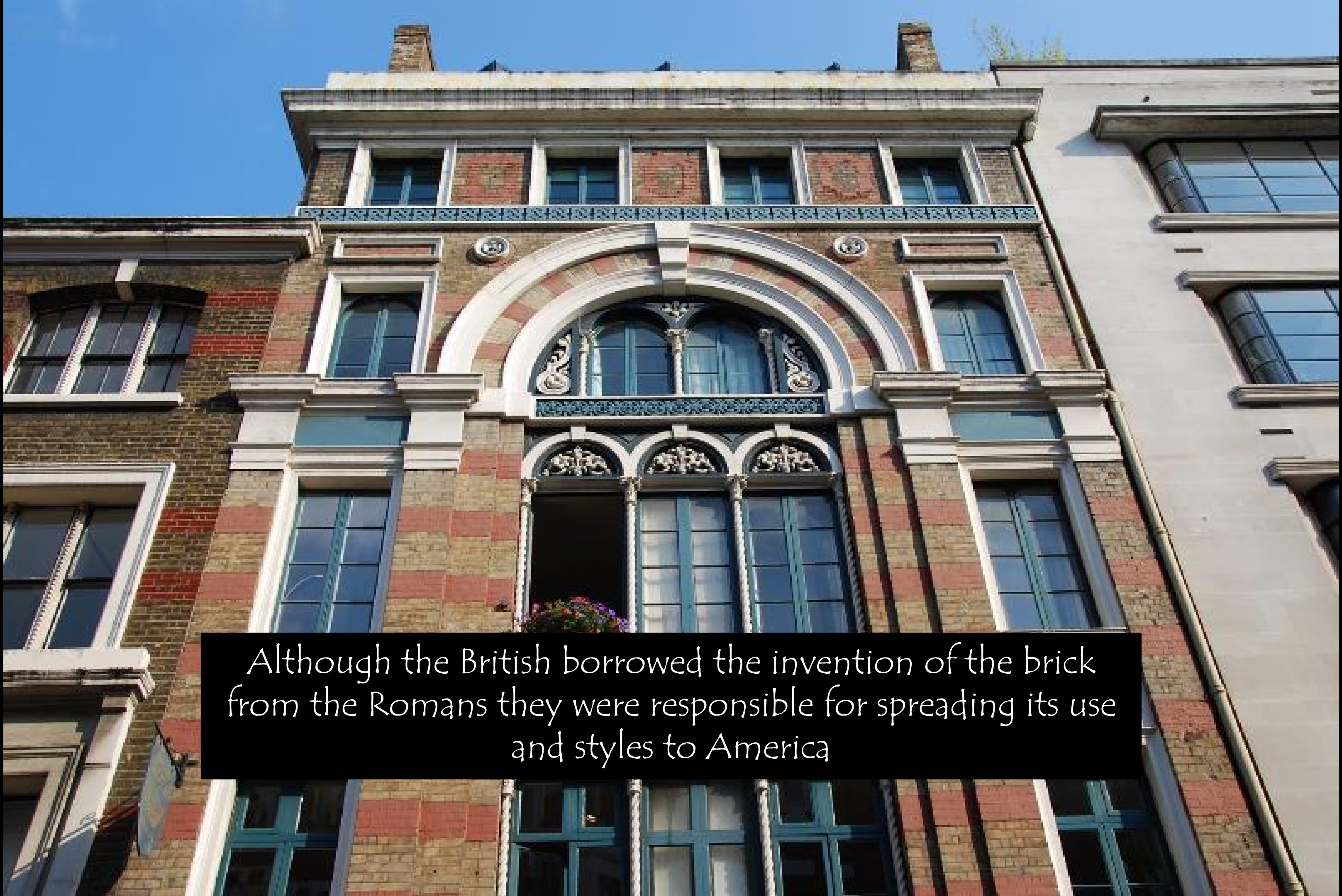
(note the spelling of course)

A single thickness wall
of masonry is called a

WYTHE

A SOLID Load Bearing Wall of Brick
is normally made of at least
2 WYTHES of brick
bonded down the middle with mortar

Brick is laid in various BOND patterns
there must be sufficient overlap
for structural performance


Although the British borrowed the invention of the brick from the Romans they were responsible for spreading its use and styles to America

St. Pancras Railway Station
London, England
George Gilbert Scott, William Henry Barlow
1868


The re-creation of a masterpiece
STATION
KING'S CROSS ST. PANCRAS STATION

Westminster Cathedral
London, England
John Francis Bentley Architect
1903
Byzantine Revival Style


DOMINE·JESU·REX·ET·REDEMPTOR
PER·SANGUINEM·TUUM·SALVA·NOS

British Georgian Style Architecture
1714-1830


10

Various Historic
Newport, Rhode Island, USA


NEWPORT
COMMUNITY
CHURCH

Monticello
Charlottesville, Virginia
Thomas Jefferson
1772

University of Virginia
Charlottesville, Virginia
Thomas Jefferson and Stanford White
1826

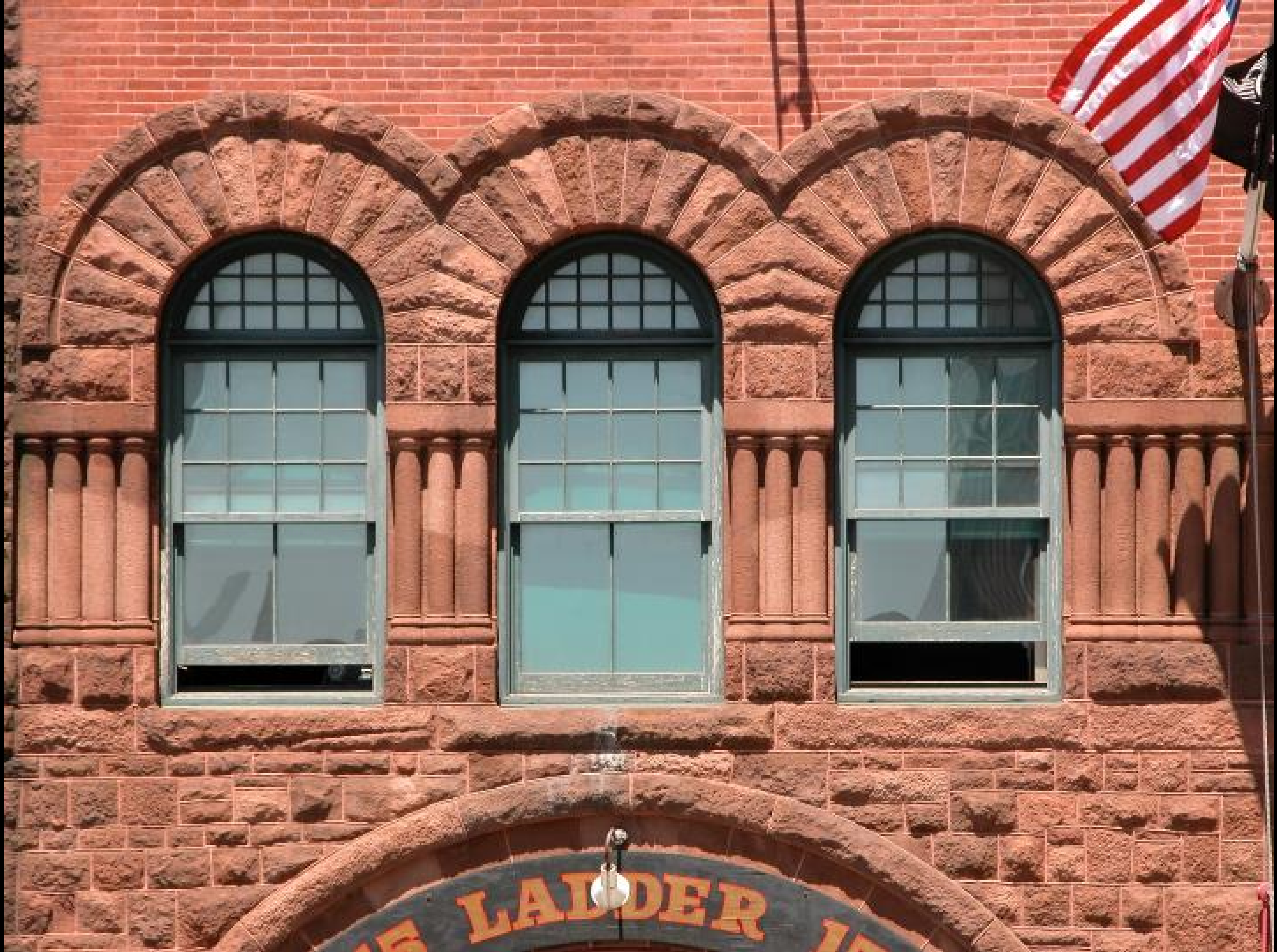
Boston sees the direct influence of British masonry styles as one of the earliest settled parts of America


MEMORIAE EORVM
PRO · PATRIA


FOR SALE


PARKING


15 LADDER 15
33 ENGINE 33
BOSTON
BOSTON


LADDER


CLAFLIN BUILDING

Boston Public Library
Boston, Massachusetts
McKim Mead and White Architects
1852


THE PUBLIC LIBRARY OF
CHOOSING TO PARTICIPATE


PEOPLE
DEDICATED

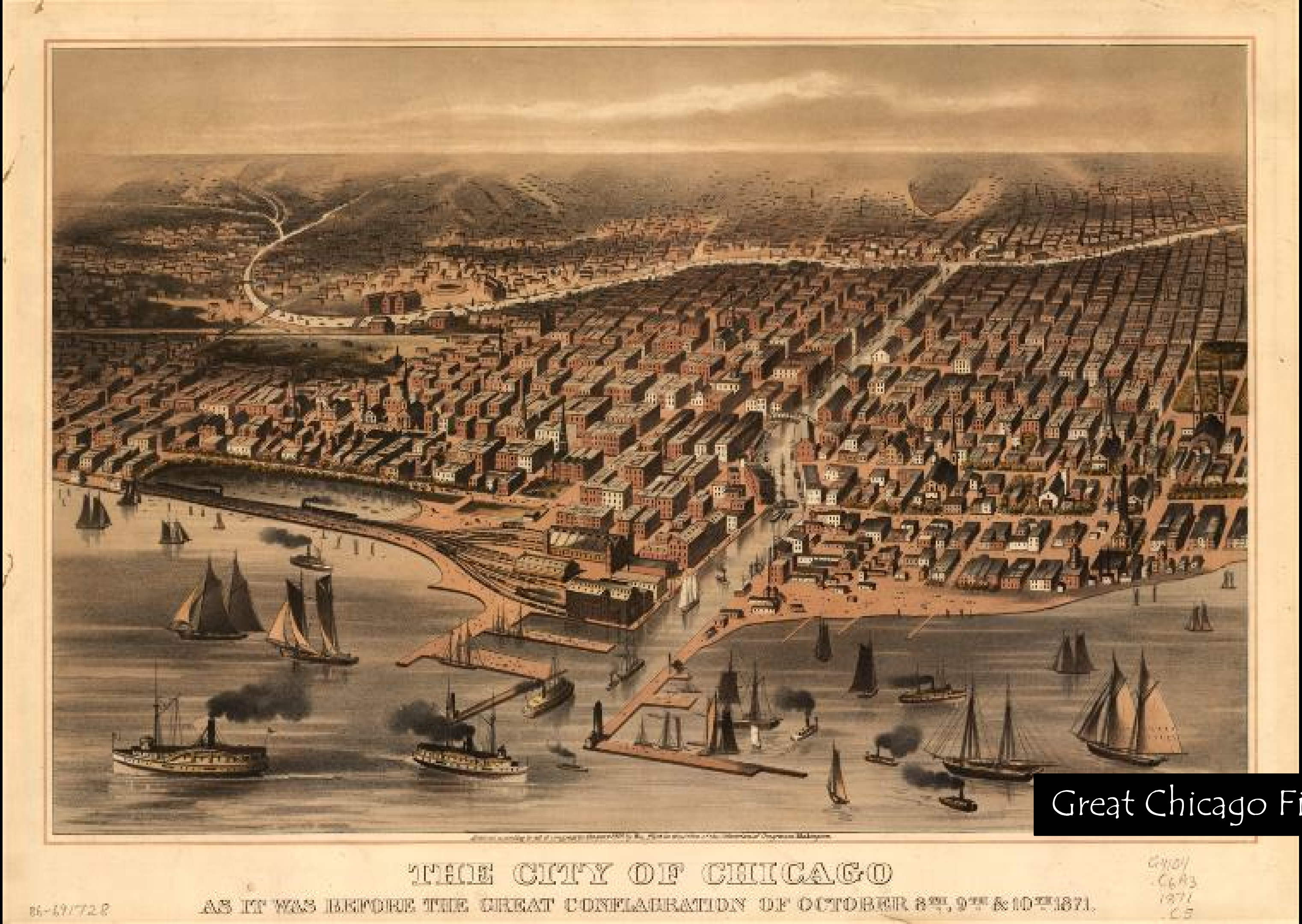
Brick masonry became the "go to" material in North American cities


TRAIL WEST
BOOTS•HATS
APPAREL
TRAIL WEST

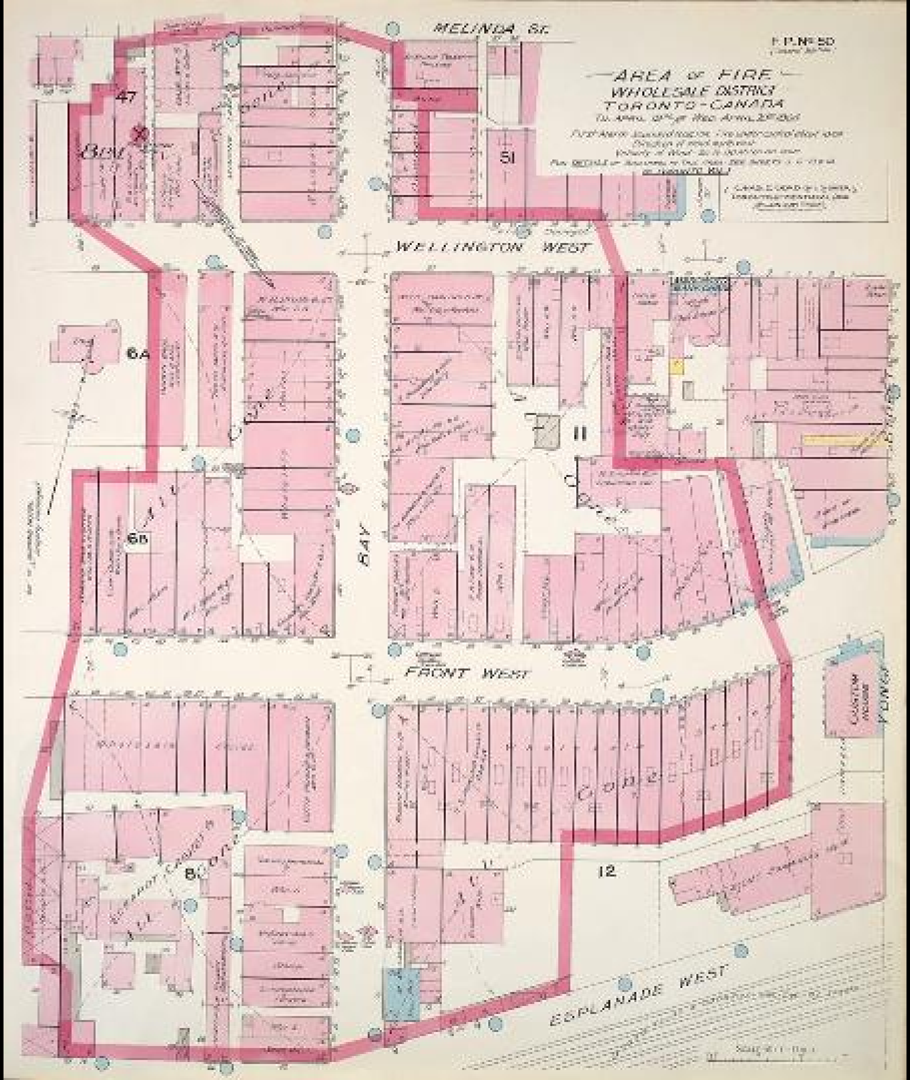

CE
J
COTTON-EYED
JOE
OF
NASHVILLE
GIFTS FASHIONS RECORDS
COTTON EYE JOES


EVERGREEN
BRICK WORKS
Bringing together nature,
culture and community
evergreen.ca

Many urban areas switched from wood construction to solid masonry late 1800s/early 1900s after some disastrous urban fires



Great Chicago Fire 1871



https://www.toronto.ca/explore-enjoy/history-art-culture/online-exhibits/web-exhibits/web-exhibits-significant-events/the-great-fire-of-1904/

Toronto Fire 1904

Various Historic
Buffalo, New York


VISITOR CENTER
617
MAIN
CEPAGALLERY
PRESERVATION


Electric Tower
Buffalo, New York
1912

Terra Cotta cladding

Buffalo City Hall
Buffalo, New York
Dietel & Wade; Sullivan W. Jones
1931

Prudential (Guaranty) Building
Buffalo, New York
Louis Sullivan and Dankmar Adler
1896


PRUDENTIAL (GUARANTY) BUILDING
ARCHITECT. LOUIS H. SULLIVAN,
CALLED THE FATHER OF MODERN
AMERICAN ARCHITECTURE EARLY
ALL-STEEL FRAME OFFICE BLDG.
WITH FINE TERRA COTTA VENEER
BUILT IN 1895
BUFFALO HOLDING CORPORATION
BUFFALO & ERIE COUNTY HISTORICAL SOCIETY
1966


PRUDENTIAL

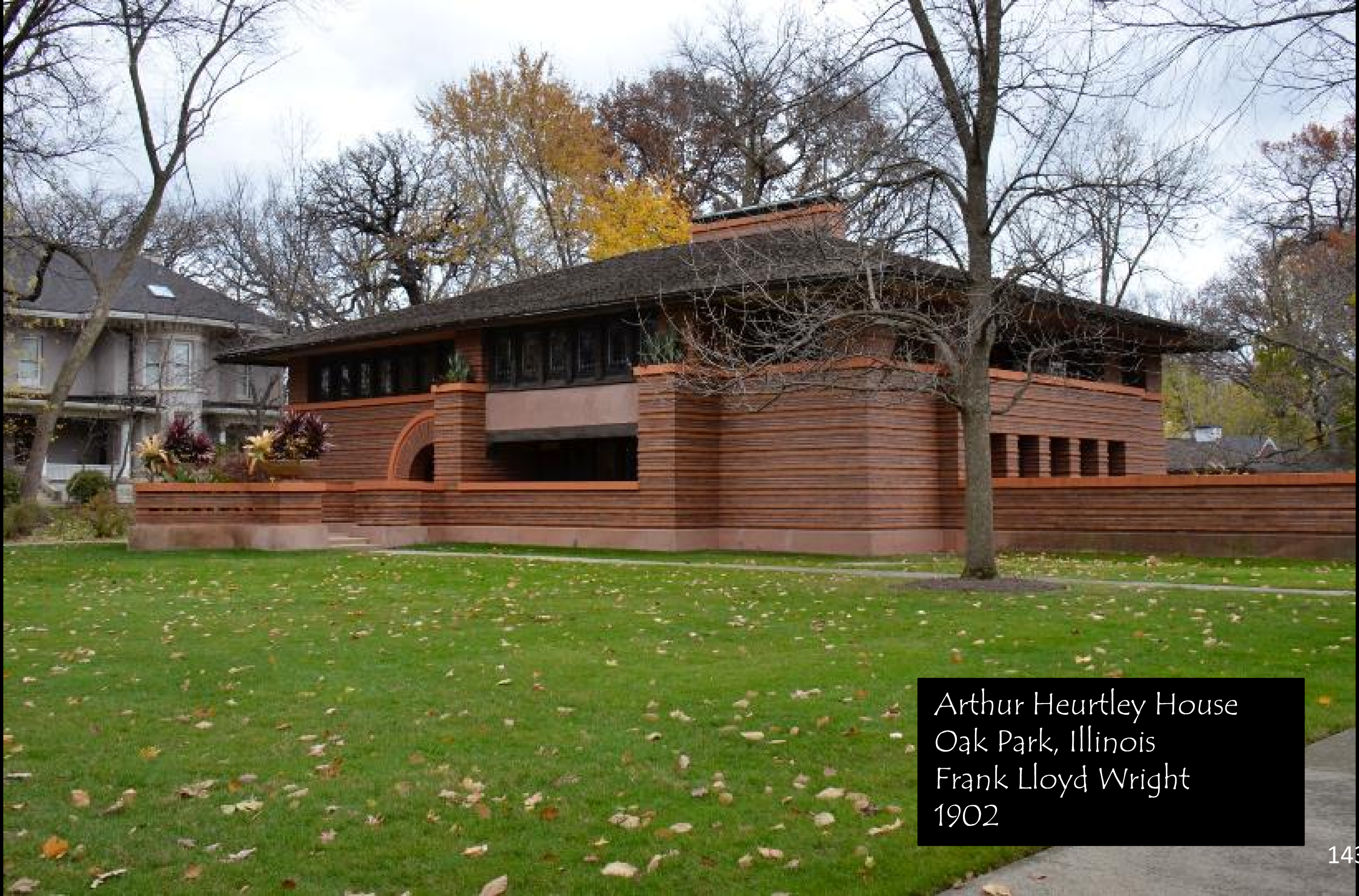

GUARANTY
Main Entrance
Located on
Pearl Street
All Exits are Monitored
and Videotaped

Unreinforced masonry proved incapable of resisting seismic forces leading to disuse in active areas

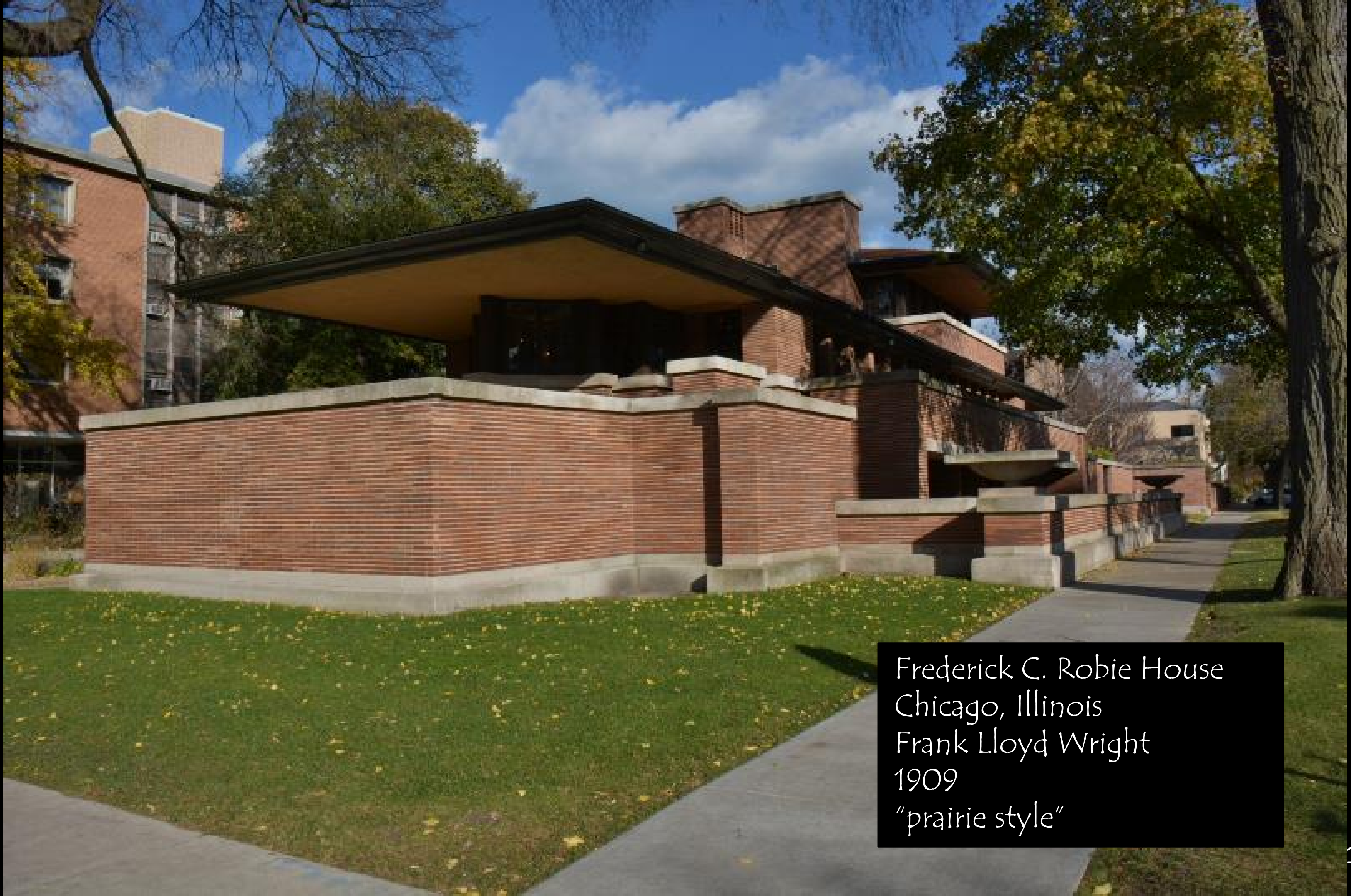
Great Kanto Japan Earthquake 1923

Frank Lloyd Wright Home and Studio
Oak Park, Illinois
1909

Nathan Moore House
Oak Park, Illinois
Frank Lloyd Wright
1895

Arthur Heurtley House
Oak Park, Illinois
Frank Lloyd Wright
1902



Frederick C. Robie House
Chicago, Illinois
Frank Lloyd Wright
1909
"prairie style"


living room


EXIT

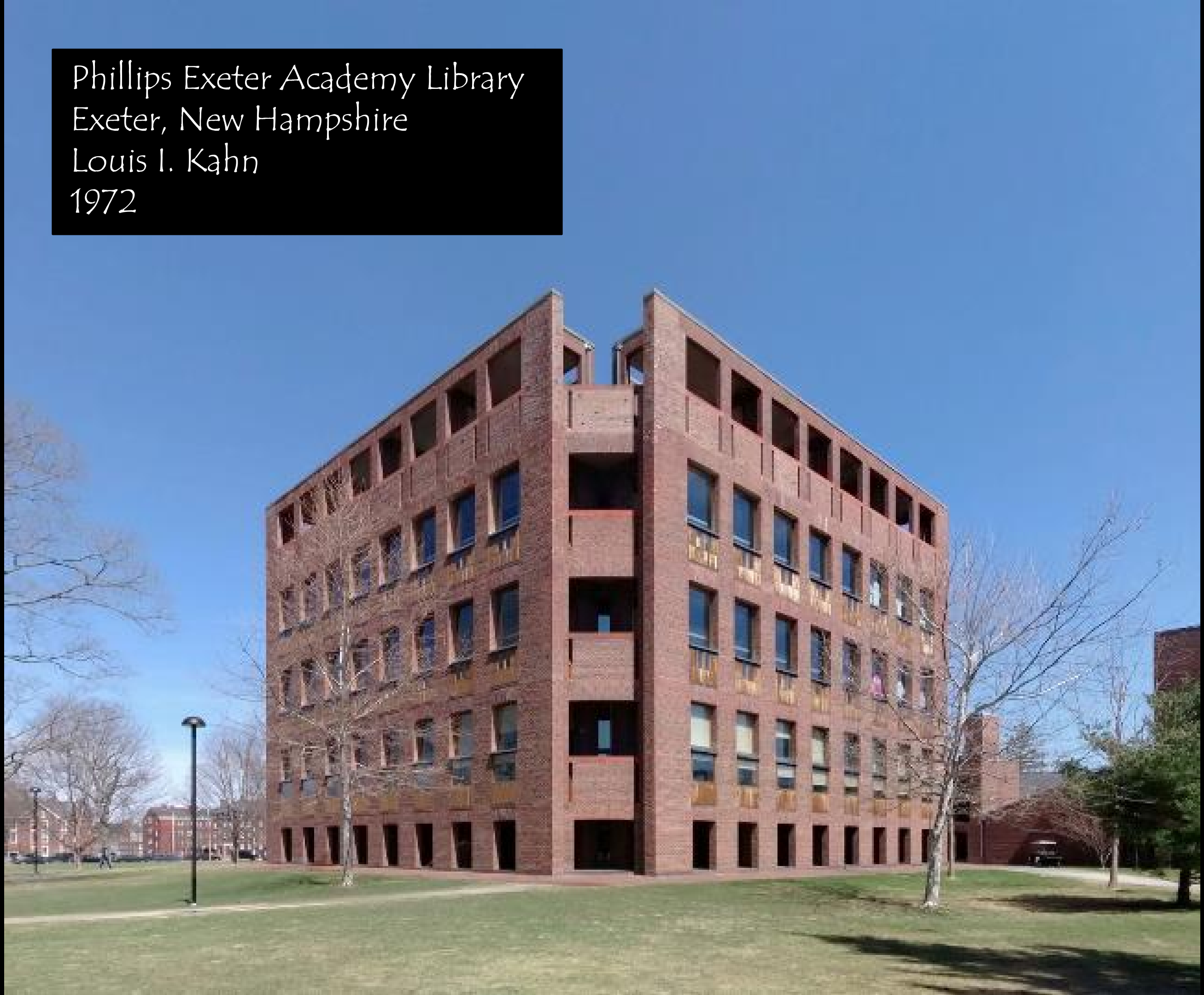
V C Morris Gift Shop
San Francisco, California
Frank Lloyd Wright
1948

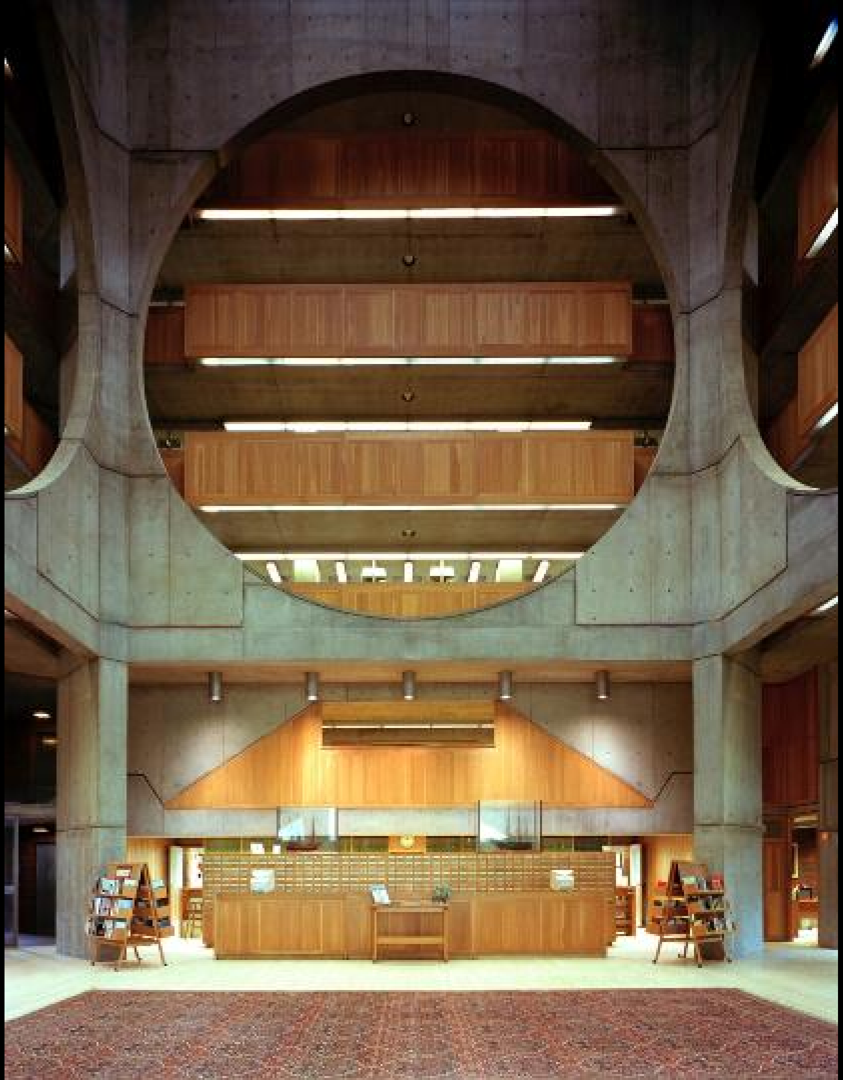

ALLERY
1 4 0

MIT Chapel
Cambridge, Massachusetts
Eero Saarinen
1955

Rothko Chapel
Houston, Texas
Philip Johnson
1971


CHAPEL


Phillips Exeter Academy Library
Exeter, New Hampshire
Louis I. Kahn
1972



Palmer Museum of Art
Penn State University
State College, Pennsylvania
Charles W. Moore
1990

"post modern"

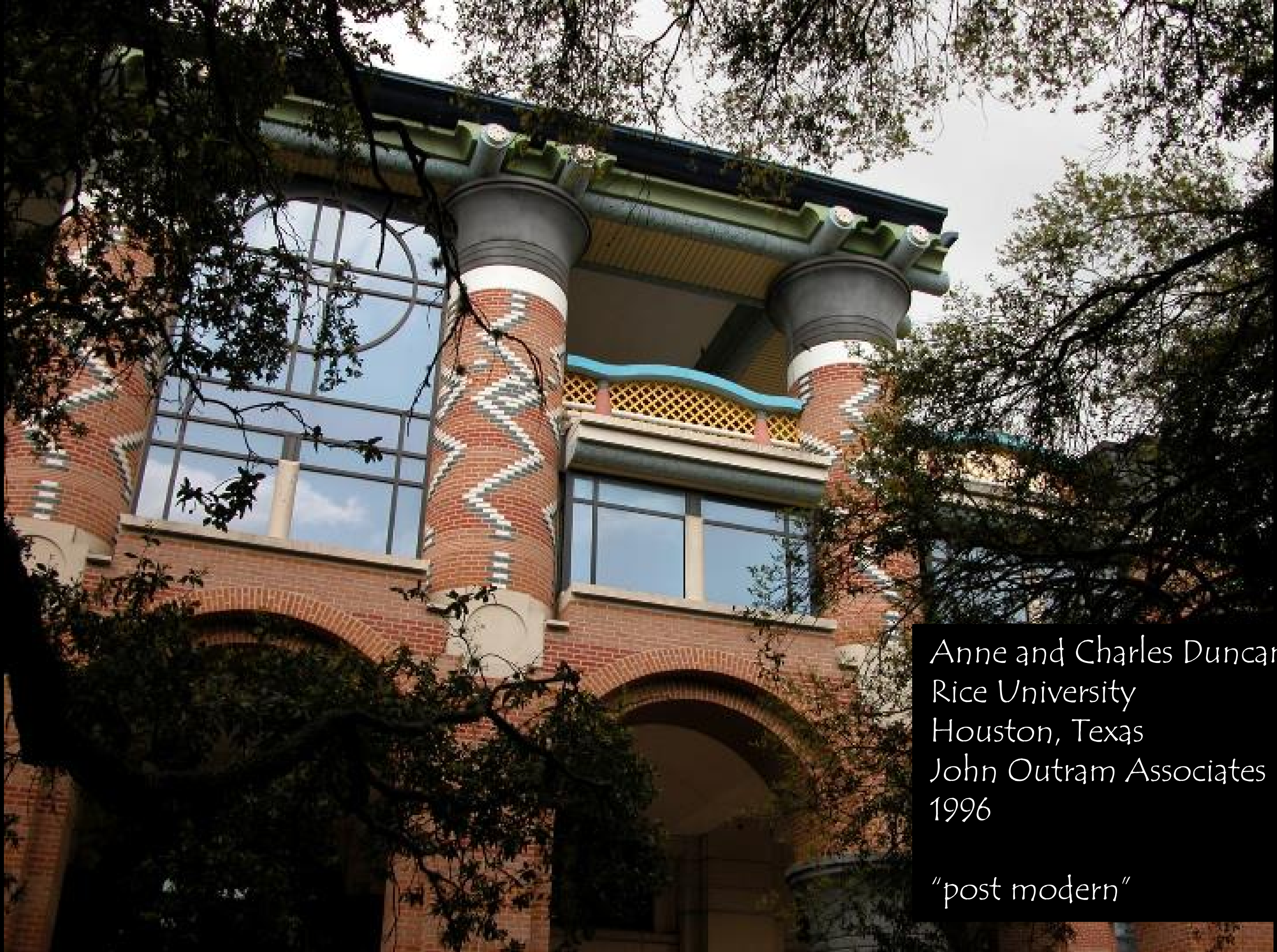
Brown College
Rice University
Houston, Texas
Michael Graves
2002

Not very good wall detailing! Fat mortar joints, no rain screen, easily absorbs water, not good for us up north.

Herring Hall
Rice University
Houston, Texas
Cesar Pelli Architect
1984

"post modern"


Cesar Pelli & Associates
Architects

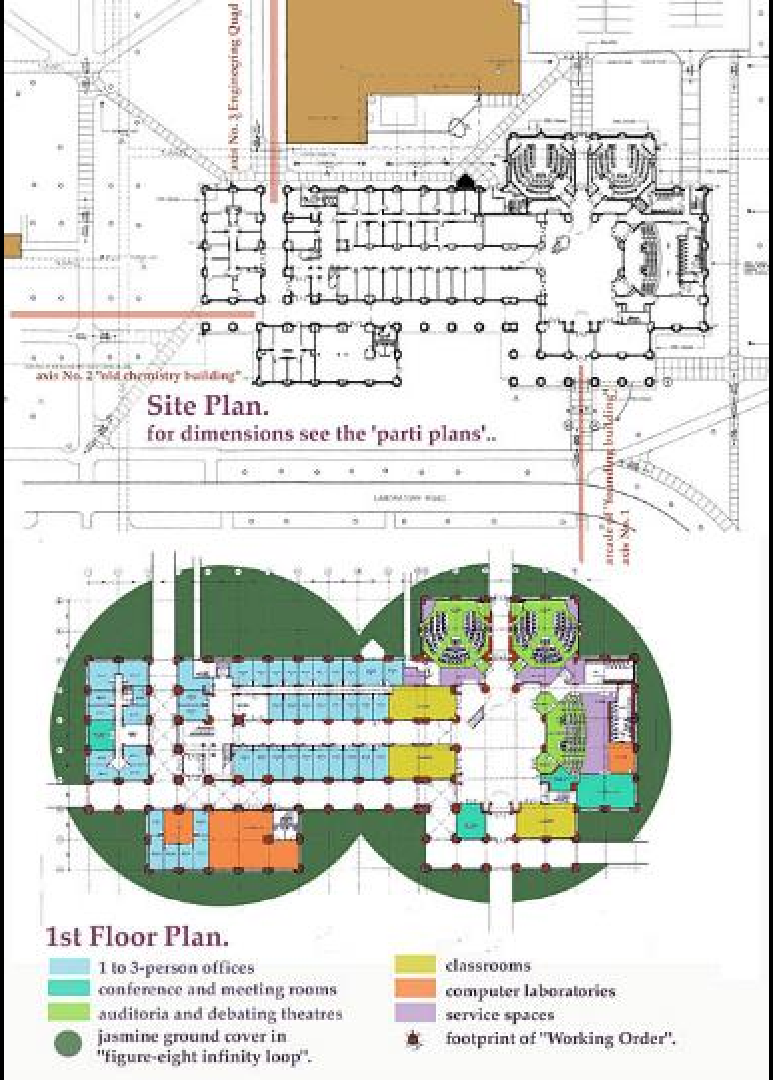


Anne and Charles Duncan Hall
Rice University
Houston, Texas
John Outram Associates
1996

"post modern"

Long Section on East West axis

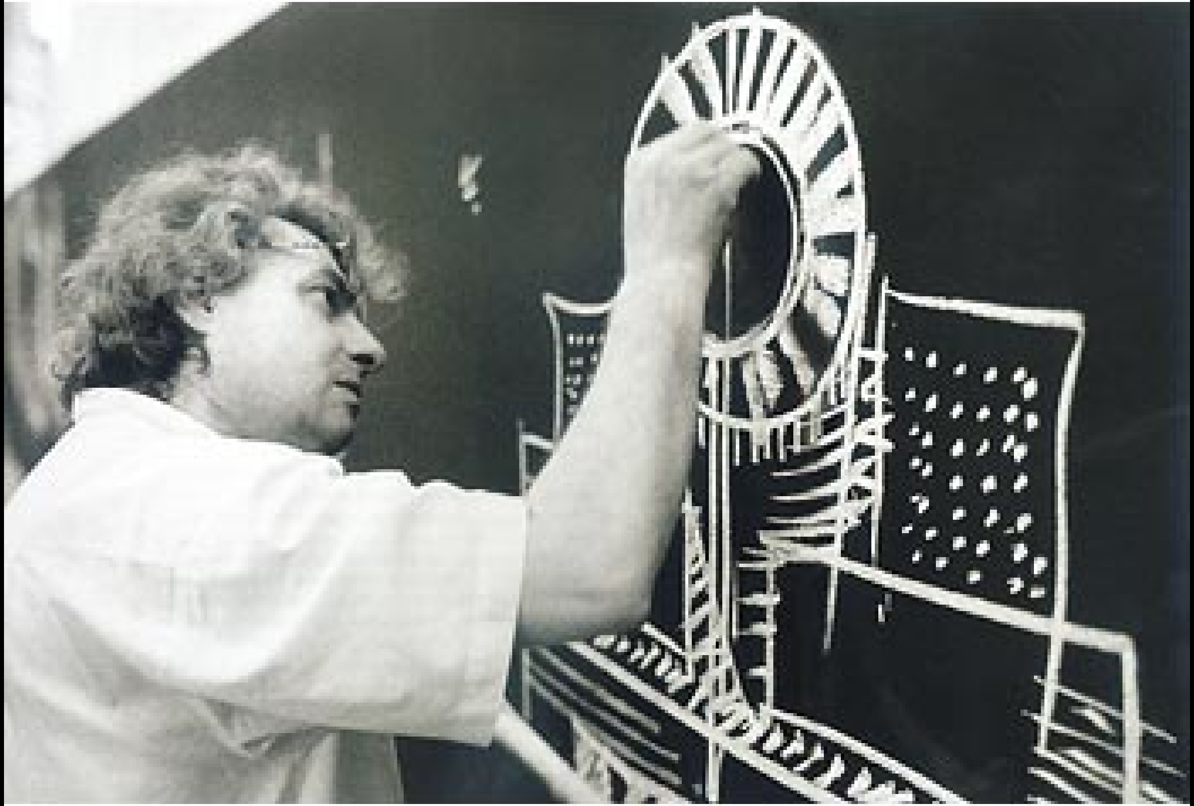
Scale: Working Order ''Hypostyle Module is 18'8'' c/c.
'Working Column' diameter is 6'0'',
Corridor through 'Walking Order' is 4'0''.

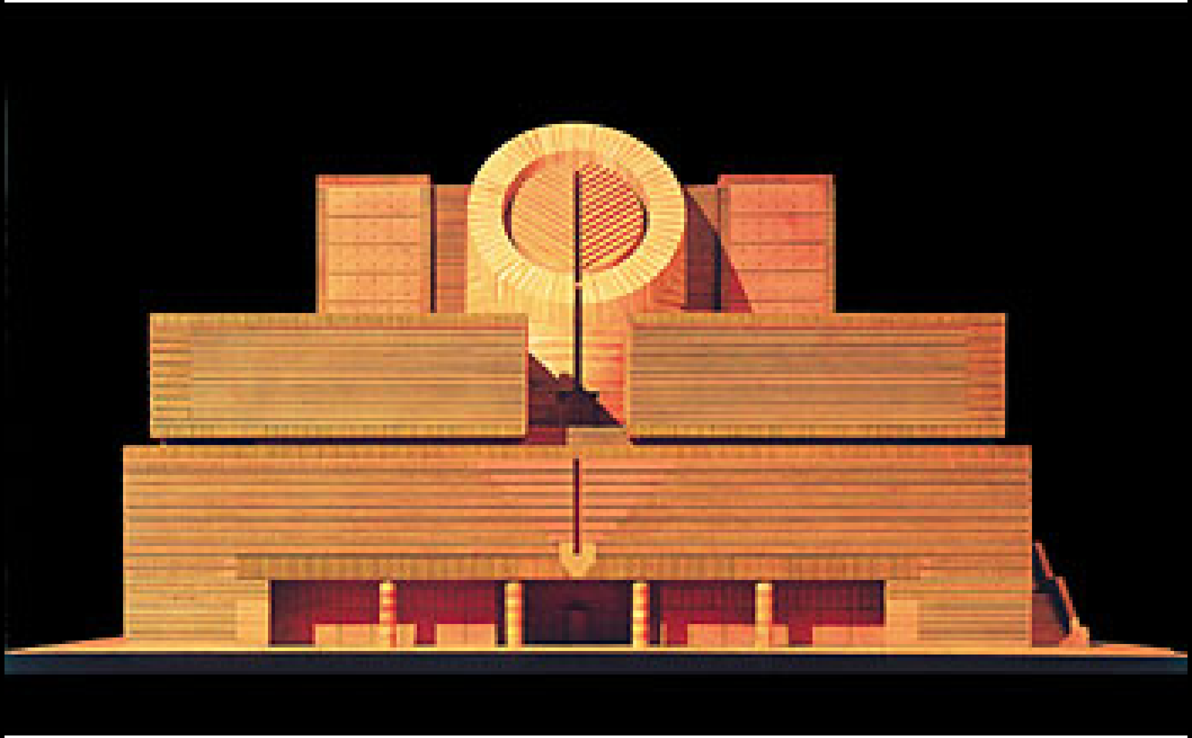

axis No. 2 "old chemistry building"
Site Plan.
for dimensions see the 'parti plans'..
1st Floor Plan.
1 to 3-person offices
conference and meeting rooms
auditoria and debating theatres
jasmine ground cover in "figure-eight infinity loop".
classrooms
computer laboratories
service spaces
footprint of "Working Order".

from a stylistic perspective
brick has invited an eclectic attitude towards styles
and revivalism

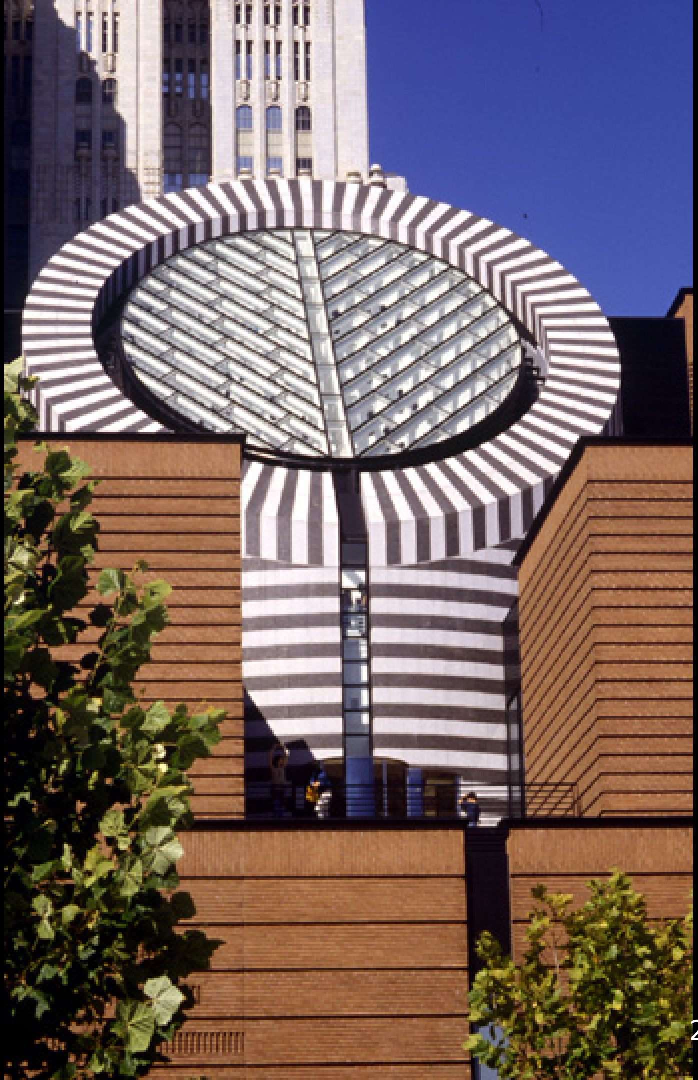
brick can be made as large precast panels and hung from the building to make a rain screen saving time laying brick at height (scaffolding issue) in inclement weather

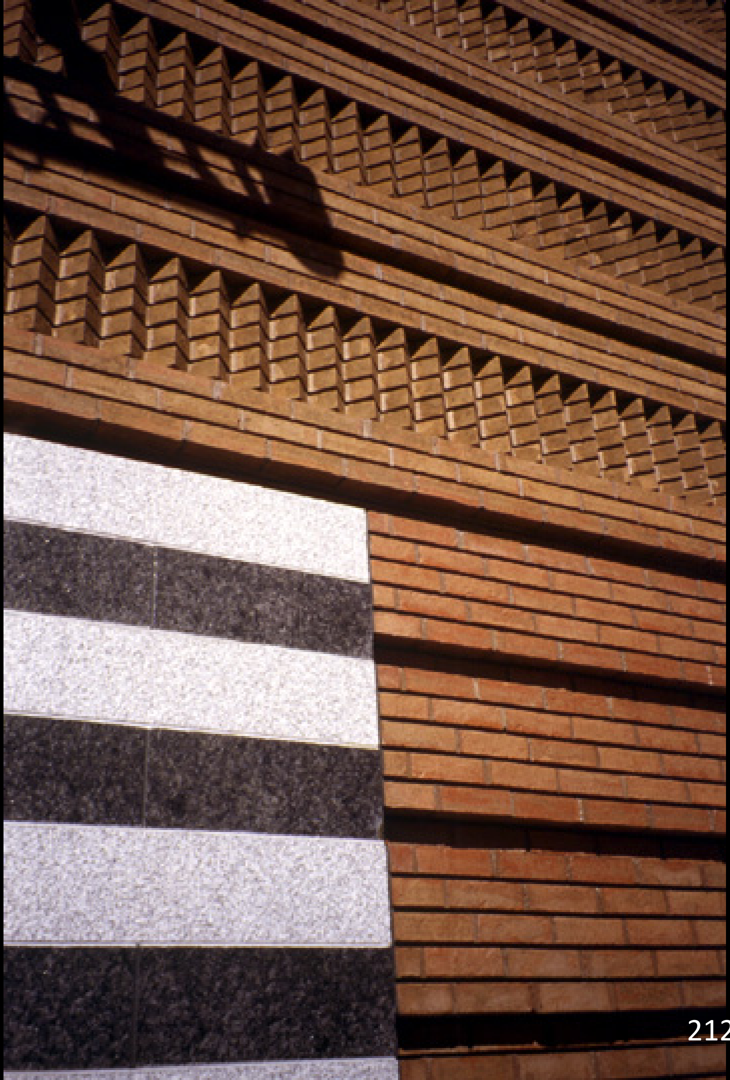
Museum of Modern Art
San Francisco, California
Mario Botta
1995






Think
outside
the



Millennium Science Complex
Penn State University
State College, Pennsylvania
Rafael Vinoly Architects
2011


SCIENCE COMPLEX

Dr Chau Chak Wing Building
Sydney, Australia
Frank Gehry
2015


Different detailing is ESSENTIAL in cold climates!

Do NOT copy details from warm or temperate climates as they need not be concerned with creating a rain screen in the same way

Ray and Maria Stata Center
MIT University
Cambridge, Massachusetts
Frank Gehry
2004

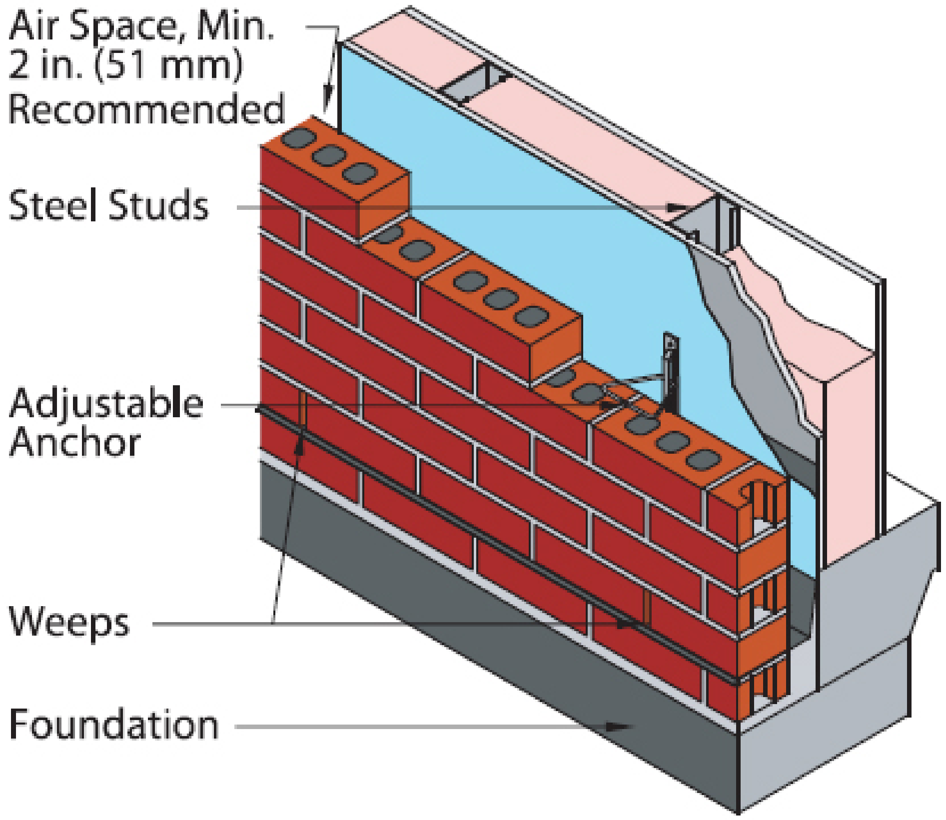
"deconstructivist"

Hydro Block Housing
Toronto, Ontario
Jack Diamond Architect
1978

University of Waterloo COOP Education Building
Suffering from effluorescence

Veneer as Rainscreen:

- Creates equal pressure on both sides of the veneer
- Vented to allow for air pressure equalization
- Drain holes at bottom to allow water to escape
- Flashing at base to direct water



Brick Veneer/Steel Stud Wall

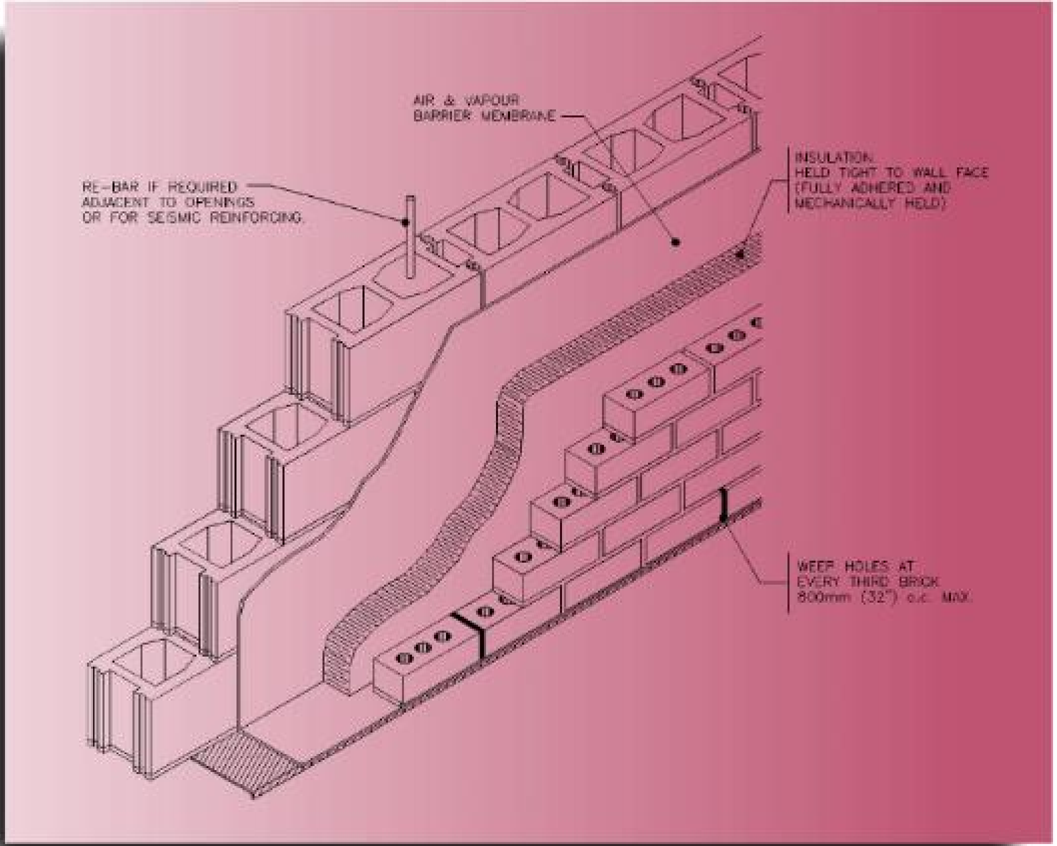
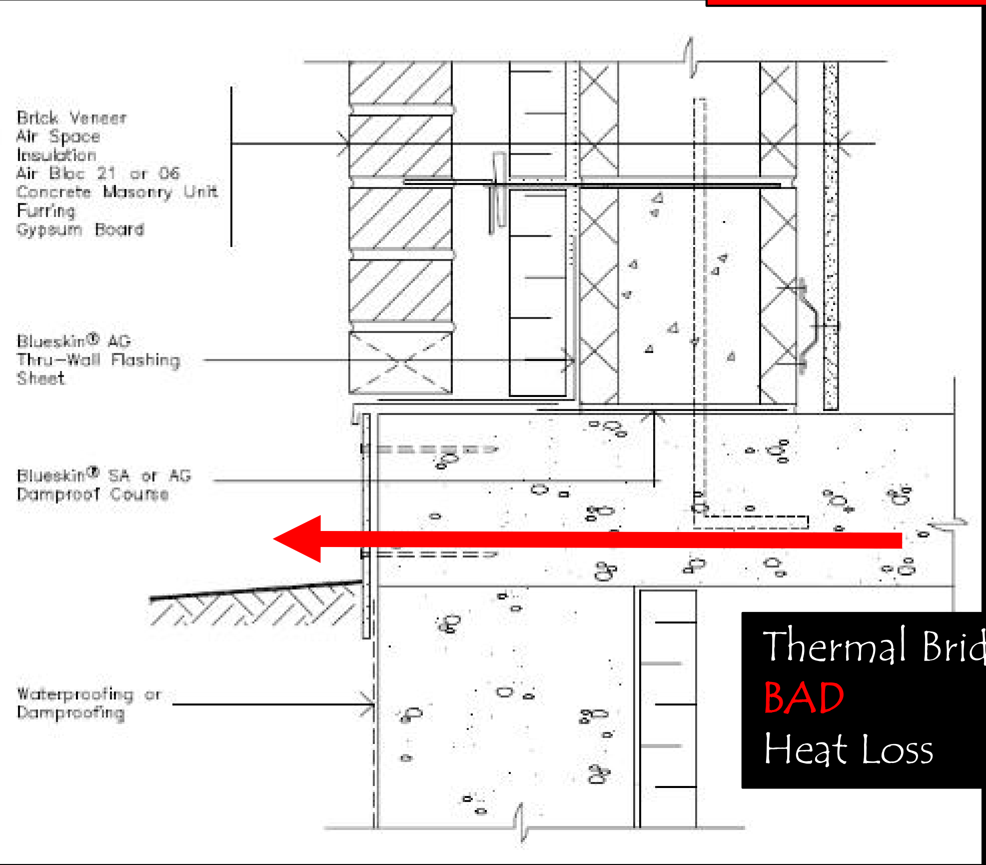
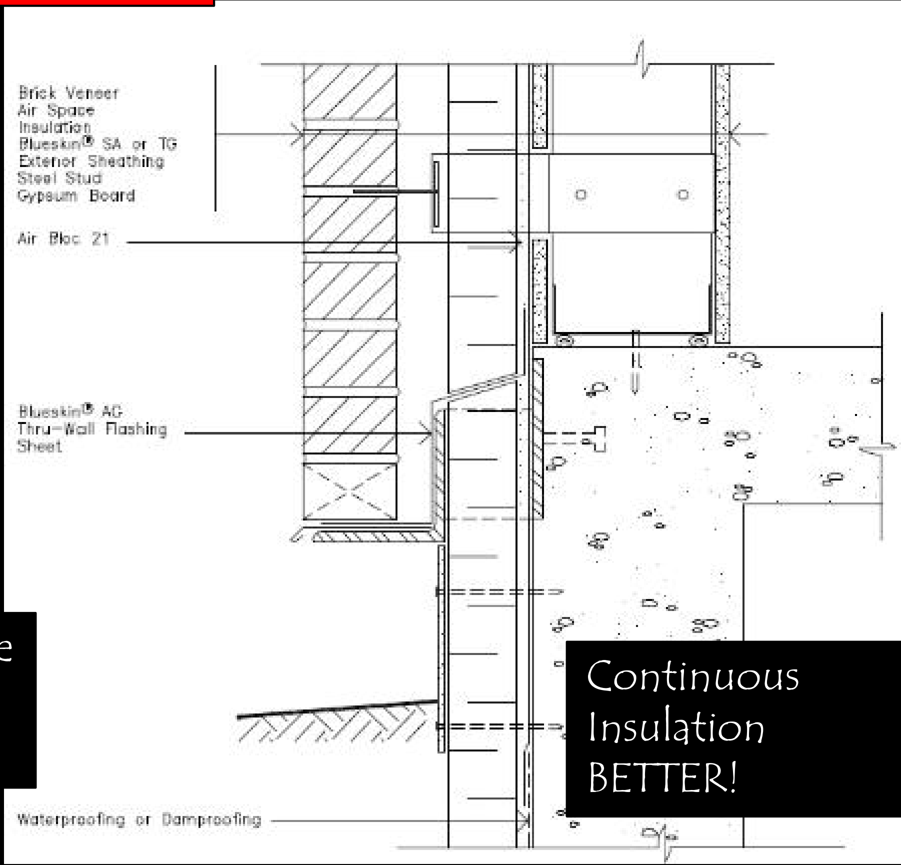


Figure 2.2: Typical BV/CMU Drainage Wall

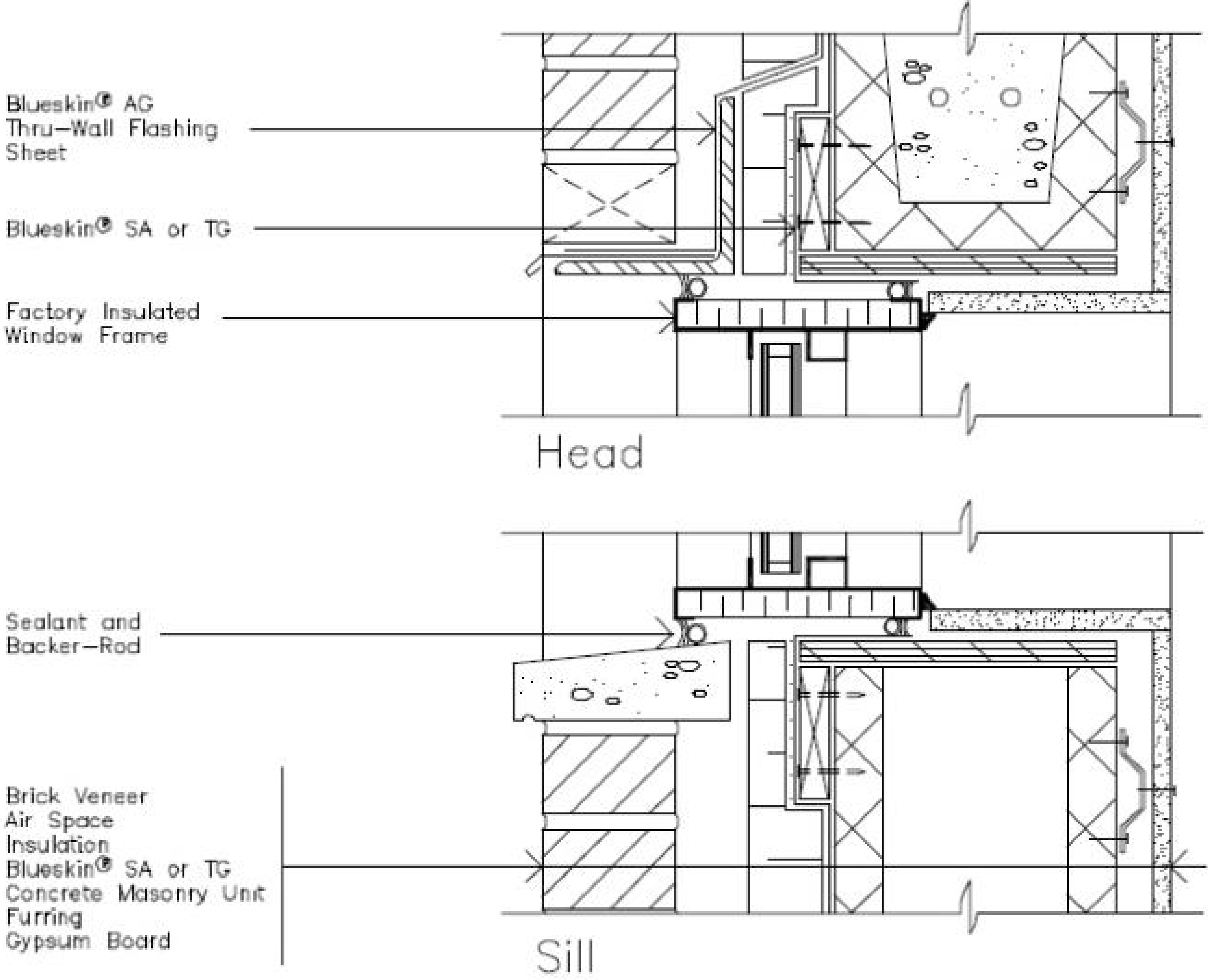
Concrete Block (CMU) Back up wall



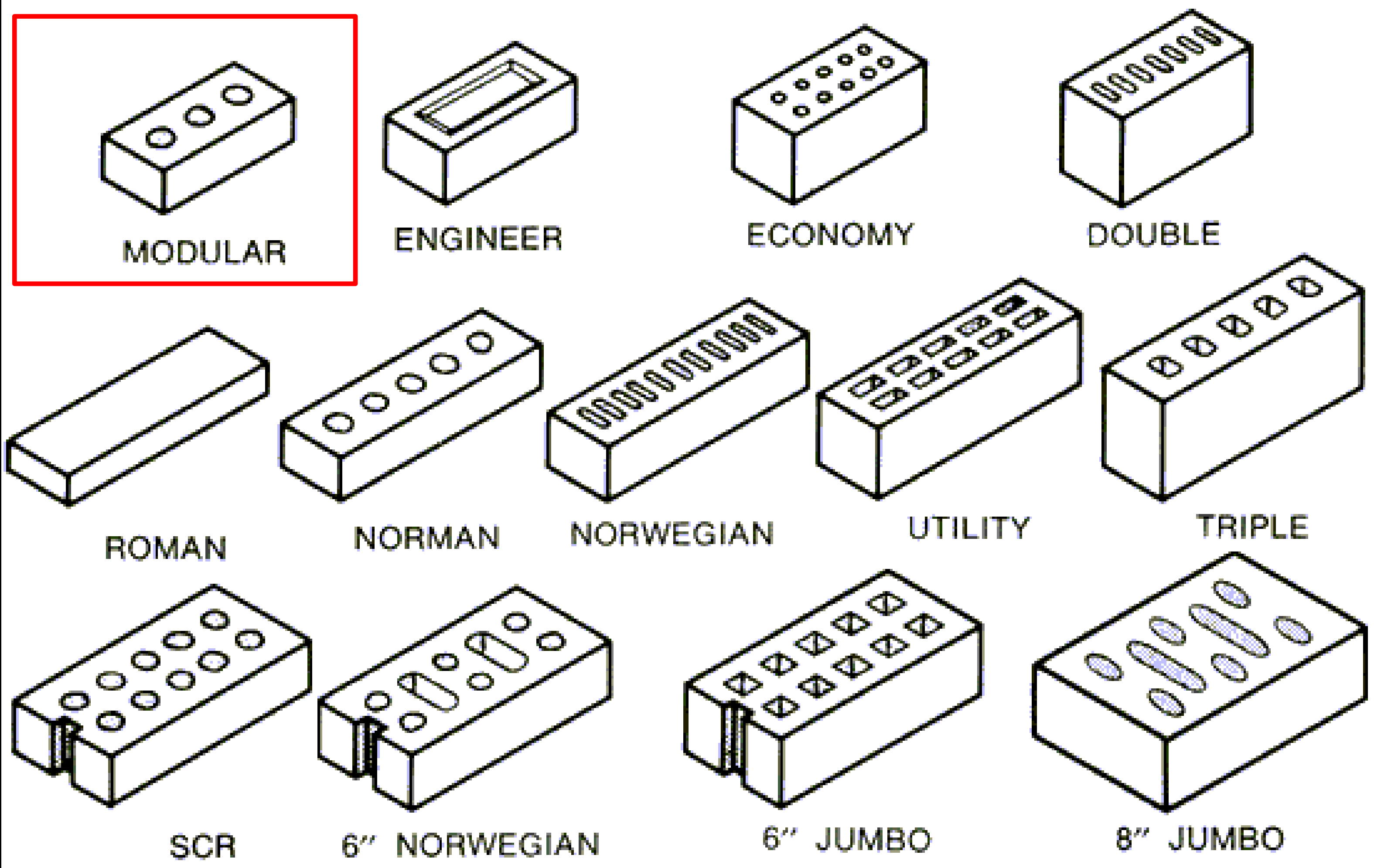
Thermal Bridge
BAD
Heat Loss



Continuous
Insulation
BETTER!


Blueskin® AG
Thru-Wall Flashing
Sheet
Blueskin® SA or TG
Factory Insulated
Window Frame
Head
Sealant and
Backer-Rod
Brick Veneer
Air Space
Insulation
Blueskin® SA or TG
Concrete Masonry Unit
Furring
Gypsum Board
Sill

Brick Construction


MODULAR
ENGINEER
ECONOMY
DOUBLE
ROMAN
NORMAN
NORWEGIAN
UTILITY
TRIPLE
SCR
6″ NORWEGIAN
6″ JUMBO
8″ JUMBO

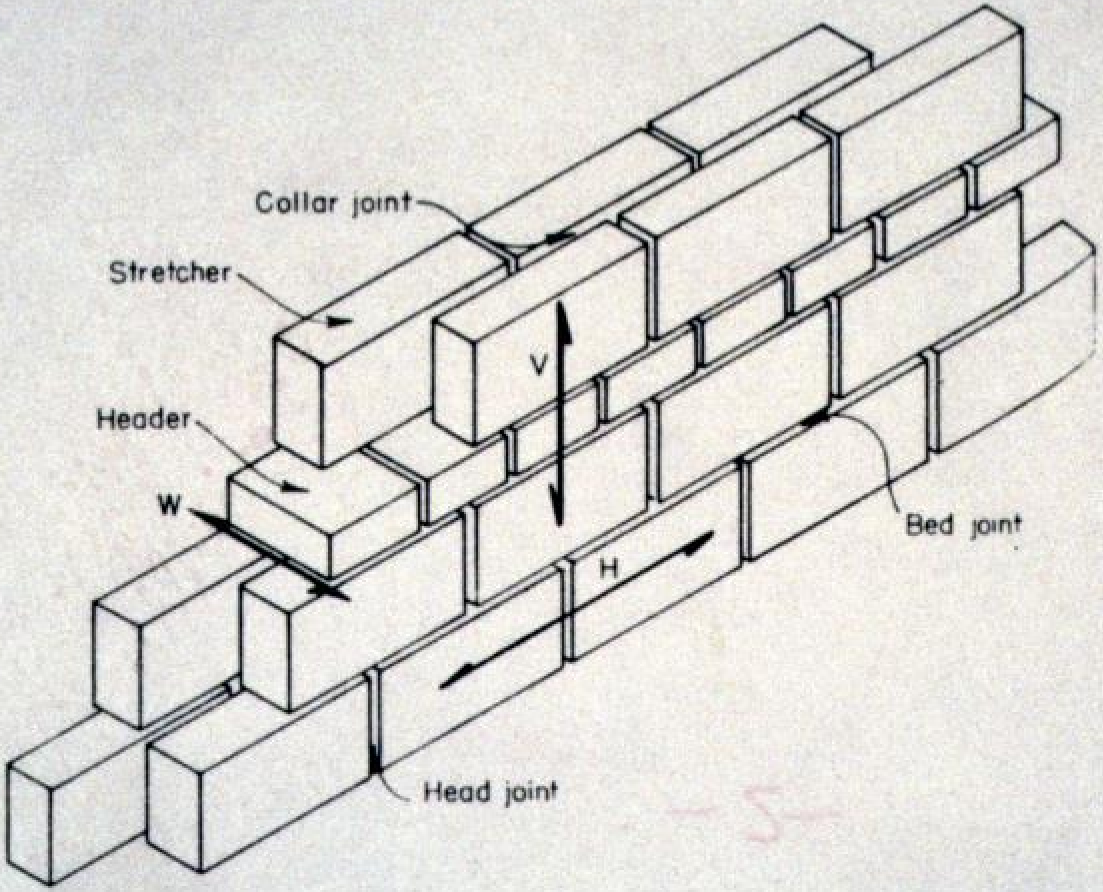
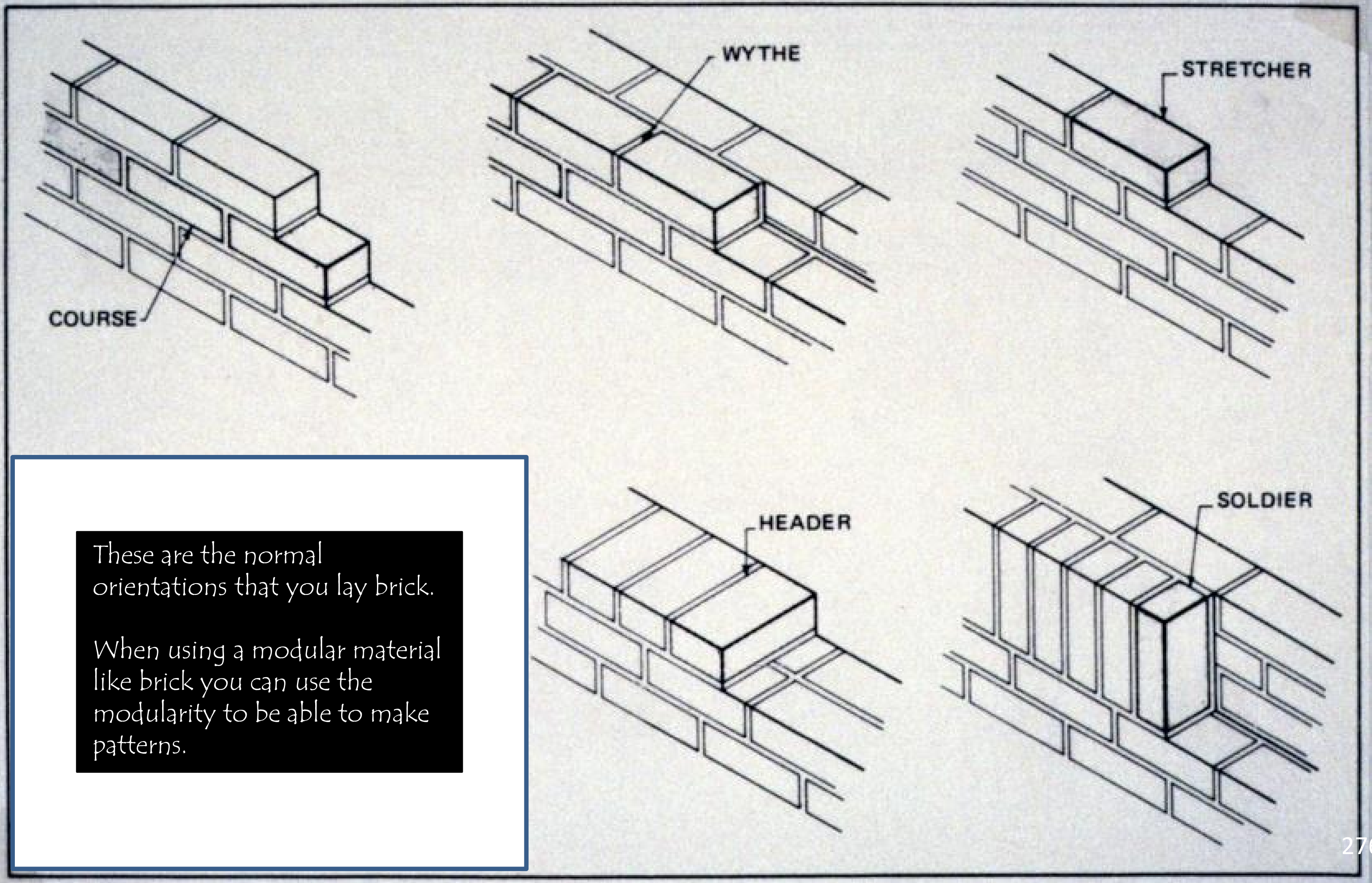
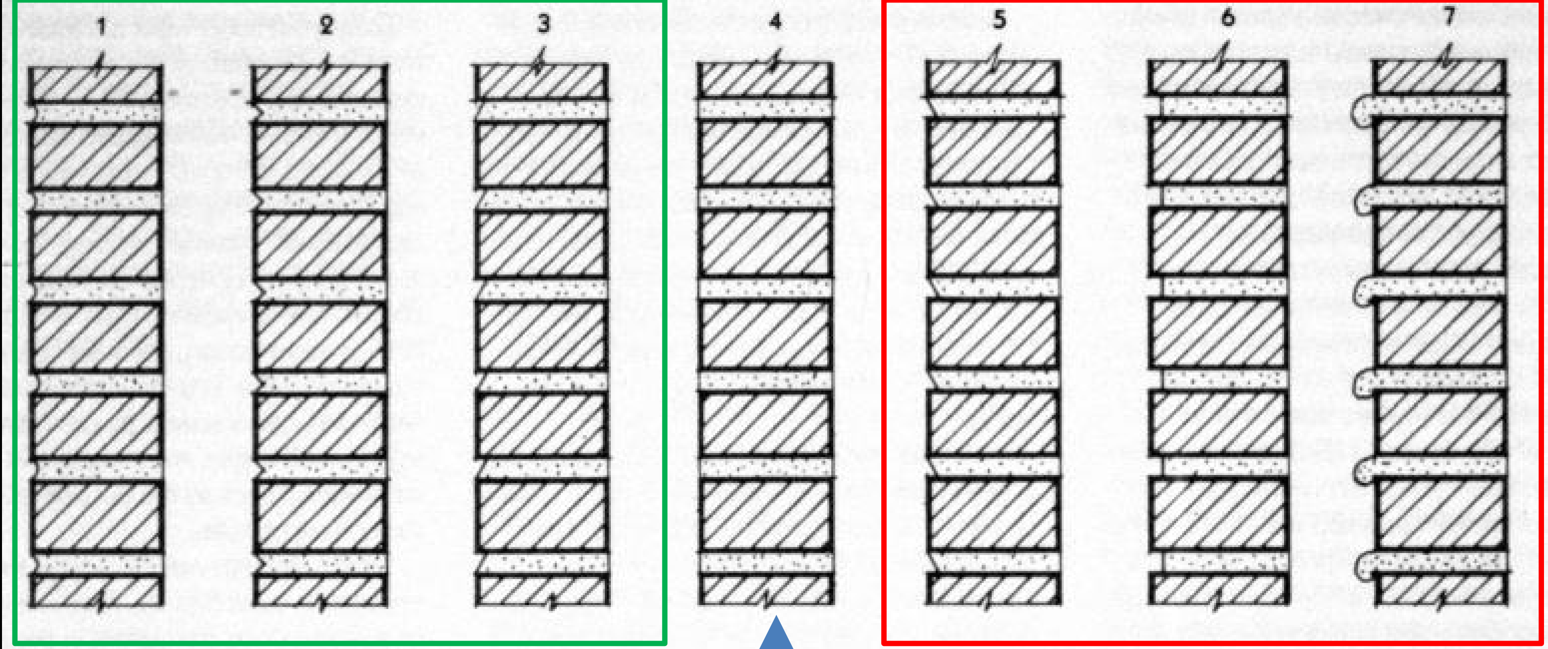


Fig. 4-2. Basic terms and bonding directions.



These are the normal orientations that you lay brick.

When using a modular material like brick you can use the modularity to be able to make patterns.



Good performance

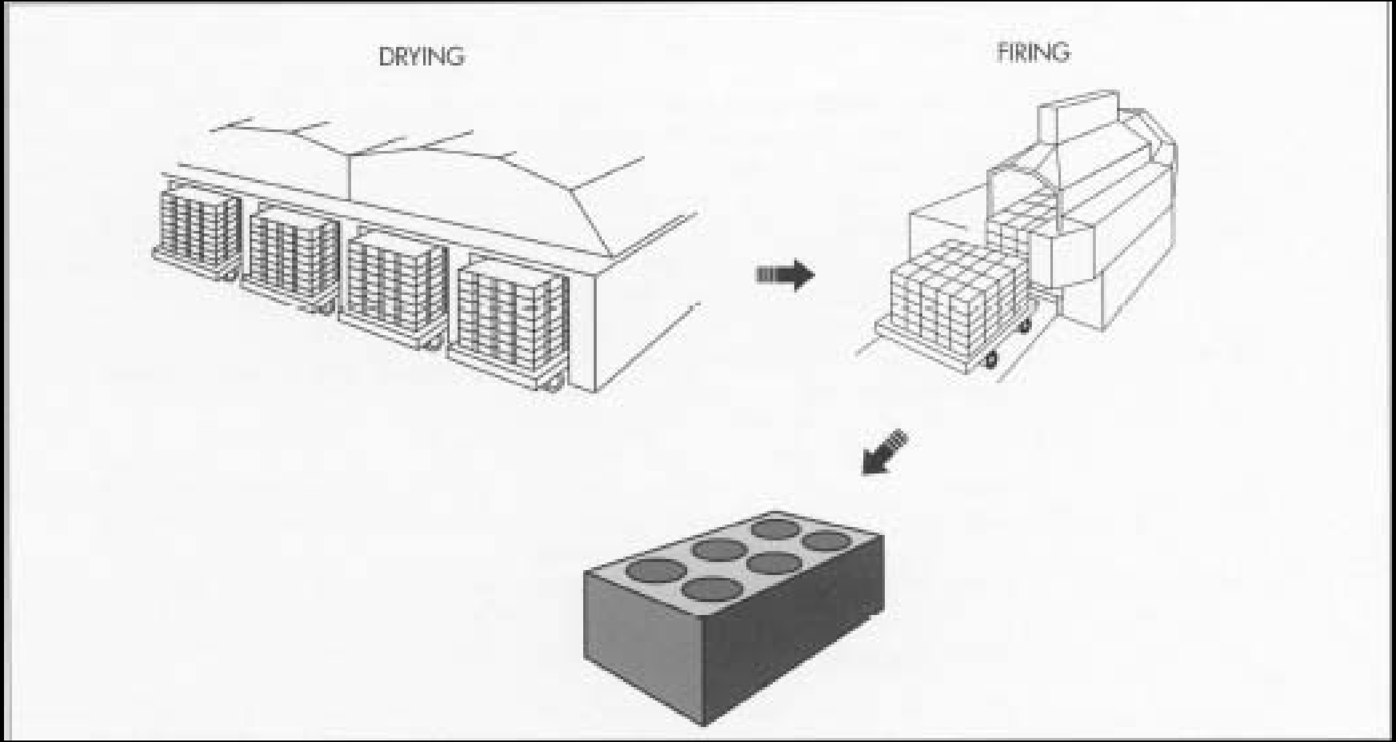
Bad performance

Chosen for interior walls or when it is parged as in a foundation wall

1. Concave joint
2. V-joint
3. Weathered joint
4. Flush joint — not recommended for rain resistance.
5. Struck joint — not recommended for rain resistance
6. Raked joint — not recommended for rain resistance
7. Extruded — not recommended for rain resistance

Fig. 13 Types of mortar joint treatment

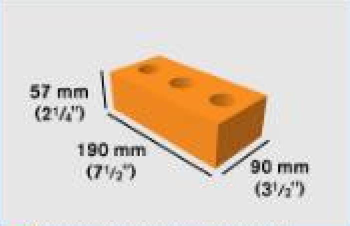

SITTIG TOOL
SITTIG TOOL


DRYING
FIRING


ARISTO
R Carr

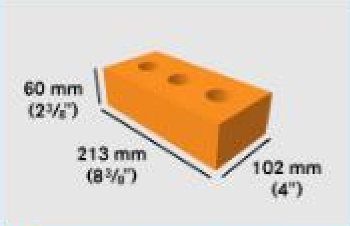
The following are specifications and illustrations of Hanson Brick's standard production sizes.

metric modular



Download Coursing Chart

ontario



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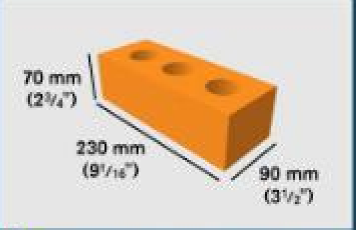
CSR*



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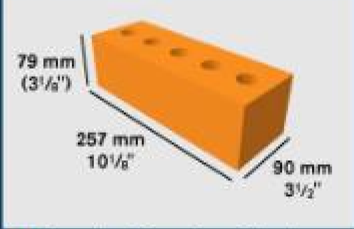
MAX*



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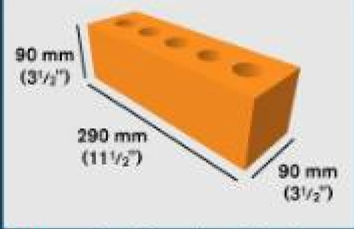
metric jumbo



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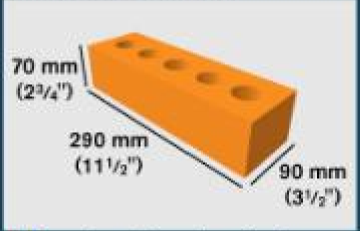
engineer norman



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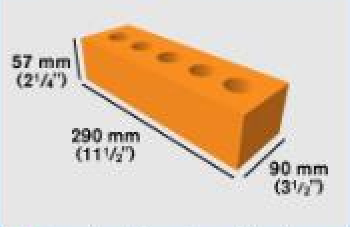
metric norman



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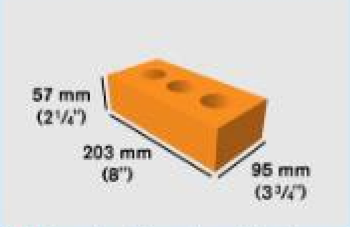
quebec



Download Coursing Chart

imperial modular

Download Coursing Chart

* Substitute a bed depth of 87 mm for CSR and MAX sized bricks produced in the Ottawa plant.

Metric Modular

190mm length x 57mm height x 90mm bed depth
7 1/2" length x 2 1/4" height x 3 1/2" bed depth

NOTES:
- 3 Metric Modular brick courses out with one Metric Modular concrete block
- Approximately 7.0 Metric Modular brick covers one square foot
- 75 Metric Modular brick covers one square metre
- Imperial dimensions are rounded

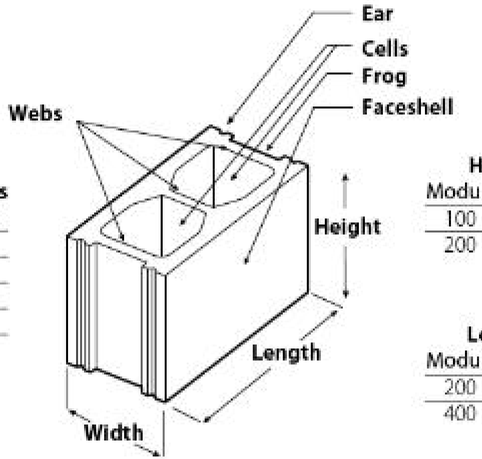
	vertical coursing (always one brick + one joint in the table below)			horizontal coursing		
No. of courses	10mm joint	3/8" joint	1/2" joint	10mm joint	3/8" joint	1/2" joint
1	67	0'-2 5/8"	0'-2 3/4"	190	0'-7 1/2"	0'-7 1/2"
2	133	0'-5 1/4"	0'-5 1/2"	390	1'-3 3/8"	1'-3 1/2"
3	200	0'-7 7/8"	0'-8 1/4"	590	1'-11 1/4"	1'-11 1/2"
4	267	0'-10 1/2"	0'-11"	790	2'-7 1/8"	2'-7 1/2"
5	333	1'-1 1/8"	1'-1 3/4"	990	3'-3"	3'-3 1/2"
6	400	1'-3 3/4"	1'-4 1/2"	1190	3'-10 7/8"	3'-11 1/2"
7	467	1'-6 3/8"	1'-7 1/4"	1390	4'-6 3/4"	4'-7 1/2"
8	533	1'-9"	1'-10"	1590	5'-2 5/8"	5'-3 1/2"
9	600	1'-11 5/8"	2'-0 3/4"	1790	5'-10 1/2"	5'-11 1/2"
10	667	2'-2 1/4"	2'-3 1/2"	1990	6'-6 3/8"	6'-7 1/2"
11	733	2'-4 7/8"	2'-6 1/4"	2190	7'-2 1/4"	7'-3 1/2"
12	800	2'-7 1/2"	2'-9"	2390	7'-10 1/8"	7'-11 1/2"
13	867	2'-10 1/8"	2'-11 3/4"	2590	8'-6"	8'-7 1/2"
14	933	3'-0 3/4"	3'-2 1/2"	2790	9'-1 7/8"	9'-3 1/2"
15	1000	3'-3 3/8"	3'-5 1/4"	2990	9'-9 3/4"	9'-11 1/2"
16	1067	3'-6"	3'-8"	3190	10'-5 5/8"	10'-7 1/2"
17	1133	3'-8 5/8"	3'-10 3/4"	3390	11'-1 1/2"	11'-3 1/2"
18	1200	3'-11 1/4"	4'-1 1/2"	3590	11'-9 3/8"	11'-11 1/2"
19	1267	4'-1 7/8"	4'-4 1/4"	3790	12'-5 1/4"	12'-7 1/2"
20	1333	4'-4 1/2"	4'-7"	3990	13'-1 1/8"	13'-3 1/2"
21	1400	4'-7 1/8"	4'-9 3/4"	4190	13'-9"	13'-11 1/2"
22	1467	4'-9 3/4"	5'-0 1/2"	4390	14'-4 7/8"	14'-7 1/2"
23	1533	5'-0 3/8"	5'-3 1/4"	4590	15'-0 3/4"	15'-3 1/2"
24	1600	5'-3"	5'-6"	4790	15'-8 5/8"	15'-11 1/2"
25	1667	5'-5 5/8"	5'-8 3/4"	4990	16'-4 1/2"	16'-7 1/2"
26	1733	5'-8 1/4"	5'-11 1/2"	5190	17'-0 3/8"	17'-3 1/2"
27	1800	5'-10 7/8"	6'-2 1/4"	5390	17'-8 1/4"	17'-11 1/2"
28	1867	6'-1 1/2"	6'-5"	5590	18'-4 1/8"	18'-7 1/2"
29	1933	6'-4 1/8"	6'-7 3/4"	5790	19'-0"	19'-3 1/2"
30	2000	6'-6 3/4"	6'-10 1/2"	5990	19'-7 7/8"	19'-11 1/2"
31	2067	6'-9 3/8"	7'-1 1/4"	6190	20'-3 3/4"	20'-7 1/2"
32	2133	7'-0"	7'-4"	6390	20'-11 5/8"	21'-3 1/2"
33	2200	7'-2 5/8"	7'-6 3/4"	6590	21'-7 1/2"	21'-11 1/2"
34	2267	7'-5 1/4"	7'-9 1/2"	6790	22'-3 3/8"	22'-7 1/2"
35	2333	7'-7 7/8"	8'-0 1/4"	6990	22'-11 1/4"	23'-3 1/2"
36	2400	7'-10 1/2"	8'-3"	7190	23'-7 1/8"	23'-11 1/2"
37	2467	8'-1 1/8"	8'-5 3/4"	7390	24'-3"	24'-7 1/2"
38	2533	8'-3 3/4"	8'-8 1/2"	7590	24'-10 7/8"	25'-3 1/2"
39	2600	8'-6 3/8"	8'-11 1/4"	7790	25'-6 3/4"	25'-11 1/2"
40	2667	8'-9"	9'-2"	7990	26'-2 5/8"	26'-7 1/2"

Concrete Block Construction

Concrete block can be used as a
LOAD BEARING
wall as a single WYTHE depending on the height
and thickness of the units

Figure 3.1: Typical Concrete Block Masonry Unit (Hollow Unit, with Flanged Ends) (Ref. 2)

Modular	Width Actual	Faceshell mm	Webs mm
100	90	20	20
150	140	25	25
200	190	30	30
250	240	35	35
300	290	35	35



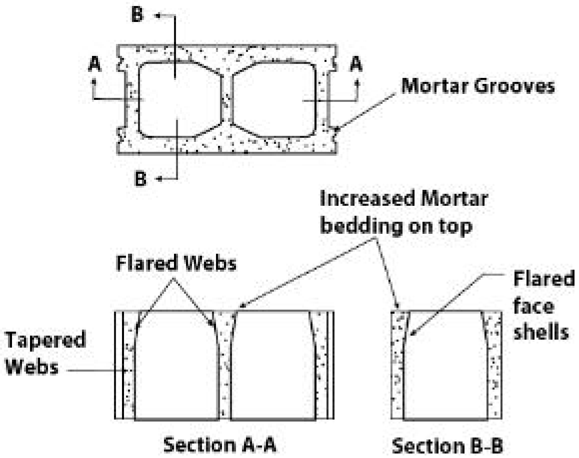
Height

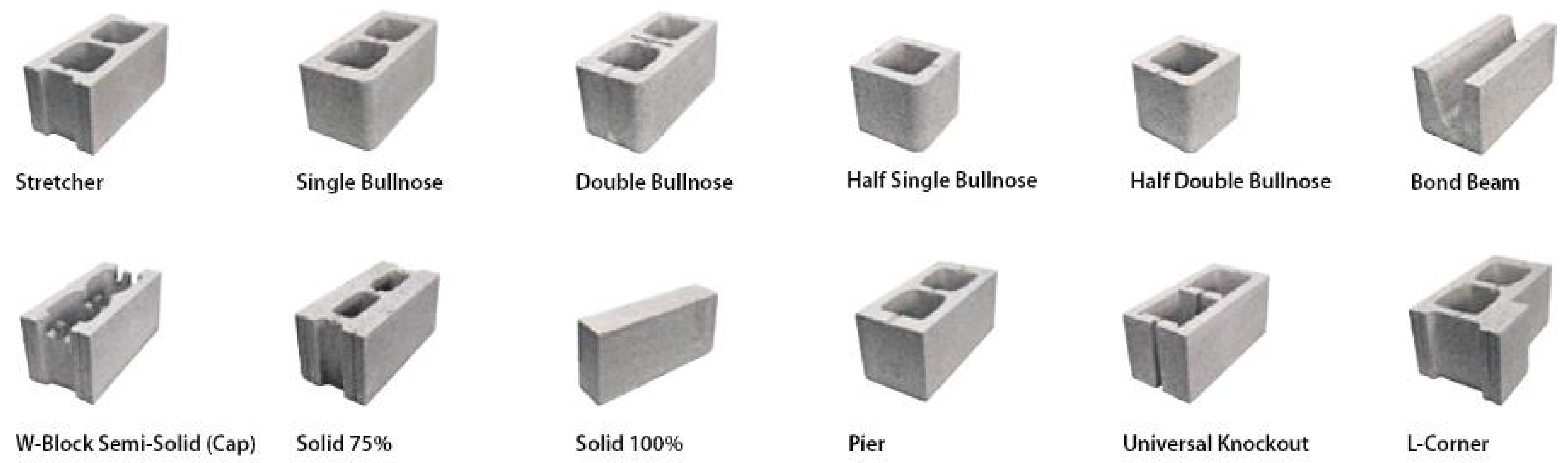
Modular	Actual
100	90
200	190

Length

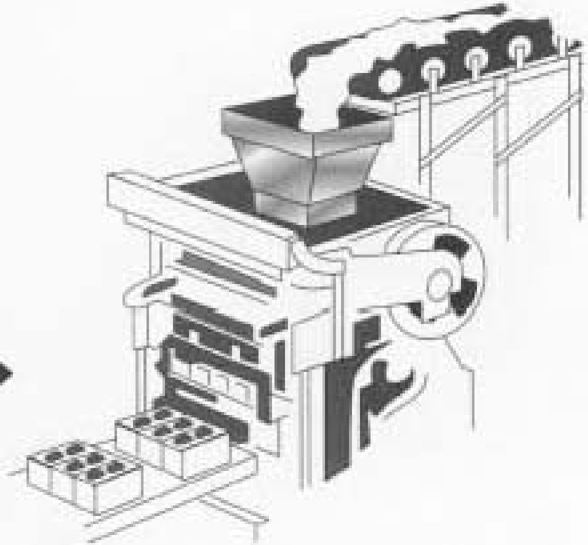
Modular	Actual
200	190
400	390

Figure 3.2: Typical Concrete Block Masonry Unit (Hollow Unit, with Flanged Ends)




Stretcher
Single Bullnose
Double Bullnose
Half Single Bullnose
Half Double Bullnose
Bond Beam
W-Block Semi-Solid (Cap)
Solid 75%
Solid 100%
Pier
Universal Knockout
L-Corner

The weigh batcher is used to measure the proper amounts of each material.

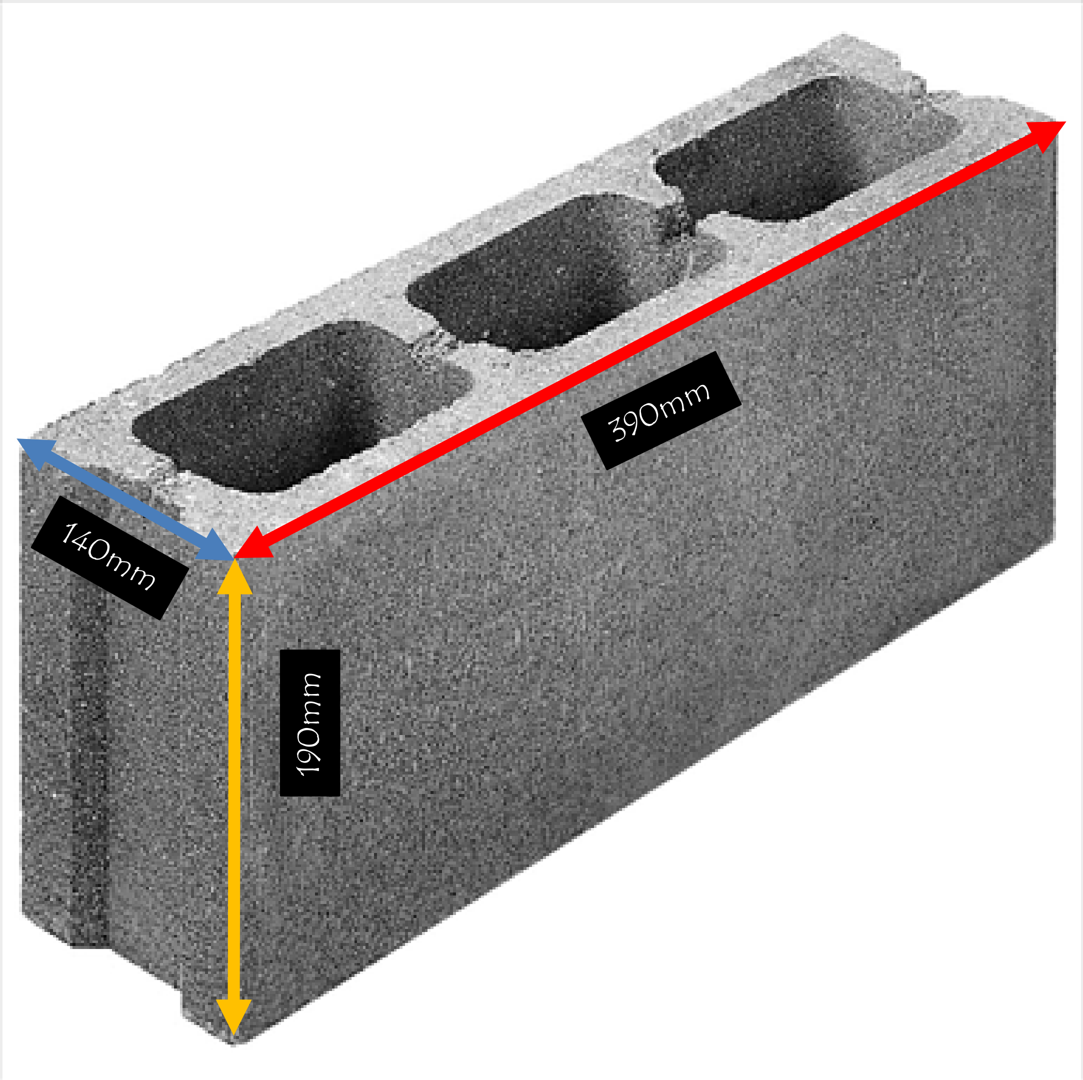


The concrete comes off a conveyer and is forced into molds. The rotating brushes remove loose material.


SESSER

Mortar joints are 10mm making the module 200 x 400mm

The surface texture is pretty porous. When used as a foundation this means you need to parge it with cement to make it ready to take your bituminous dampproofing materials.


390mm
140mm
190mm

Brick veneer can be supported by 3 typical "back up walls"

- **Wood frame (typical for low rise houses) (YOUR FINAL PROJECT)**
- Steel stud (can be used on houses but more typical for mid to high rise construction either residential or commercial)
- Concrete block (typical for institutional and commercial construction)

The brick is tied to the support wall with galvanized steel brick ties that are placed around 400 to 600 mm on center horizontally and vertically

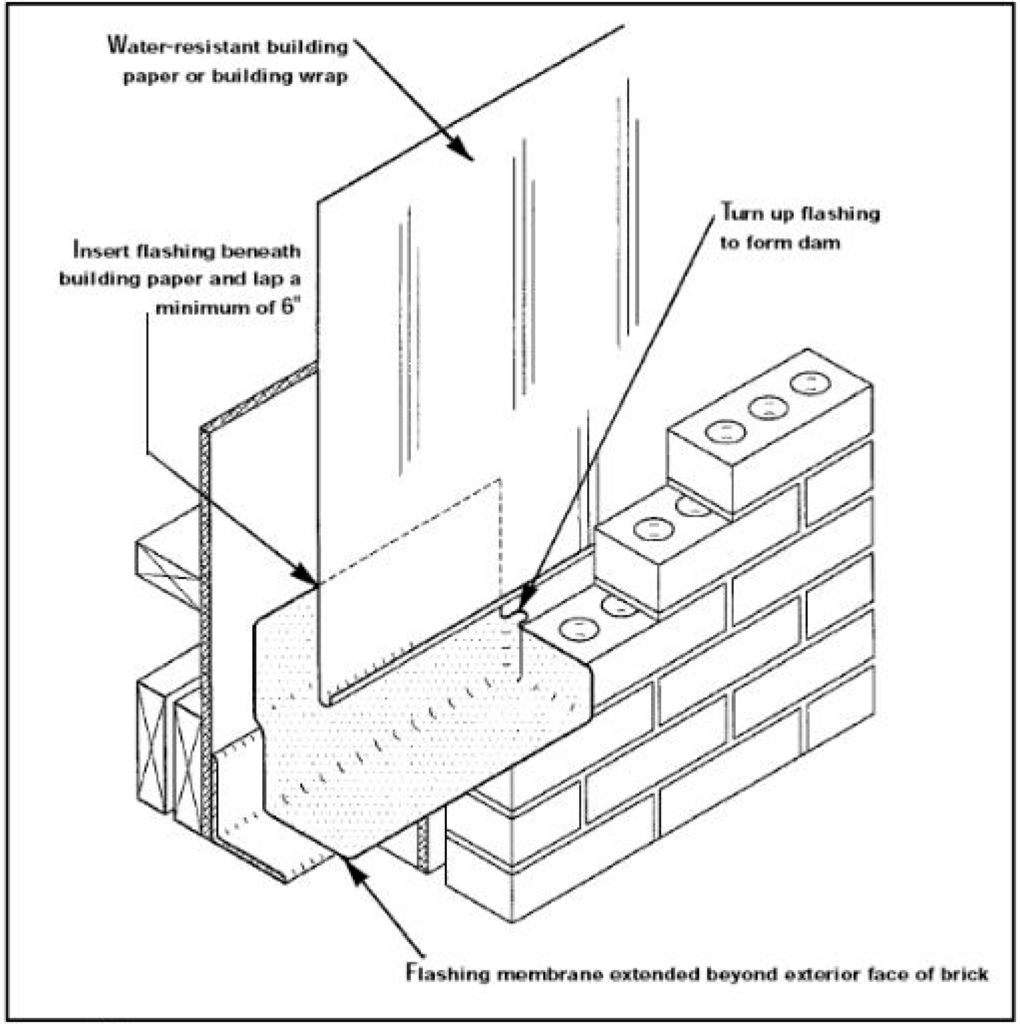
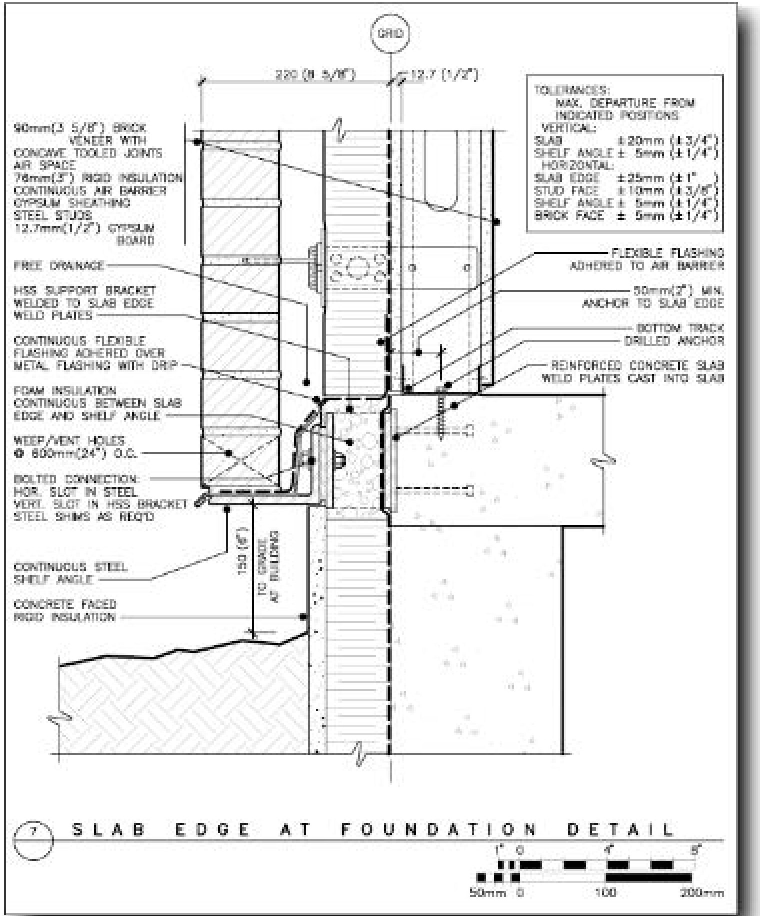
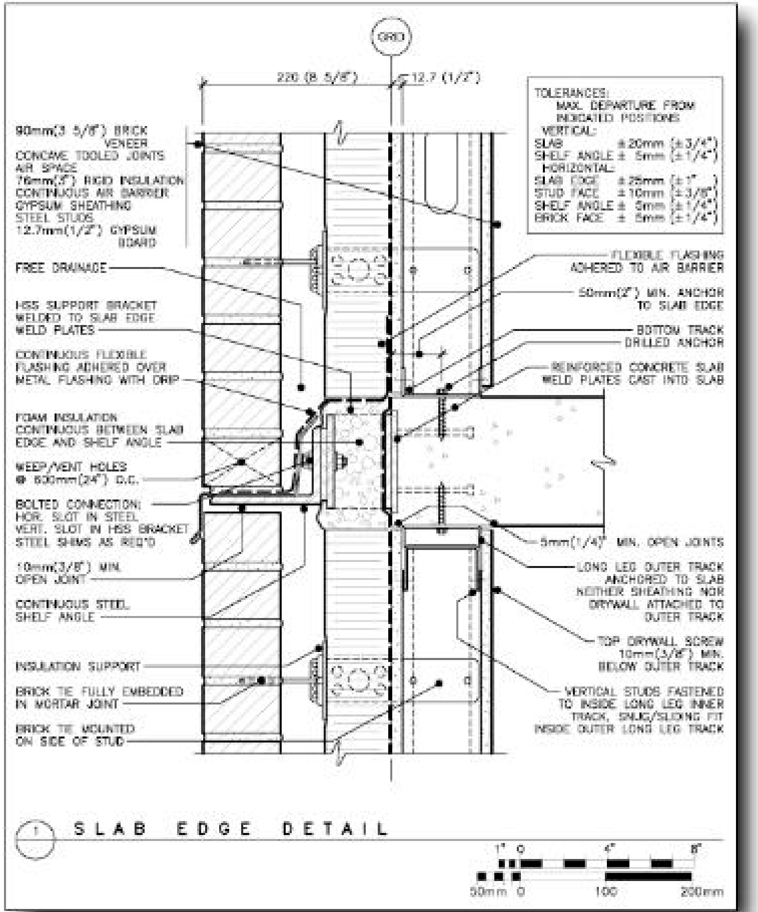


Figure 3. Isometric of flashing above opening

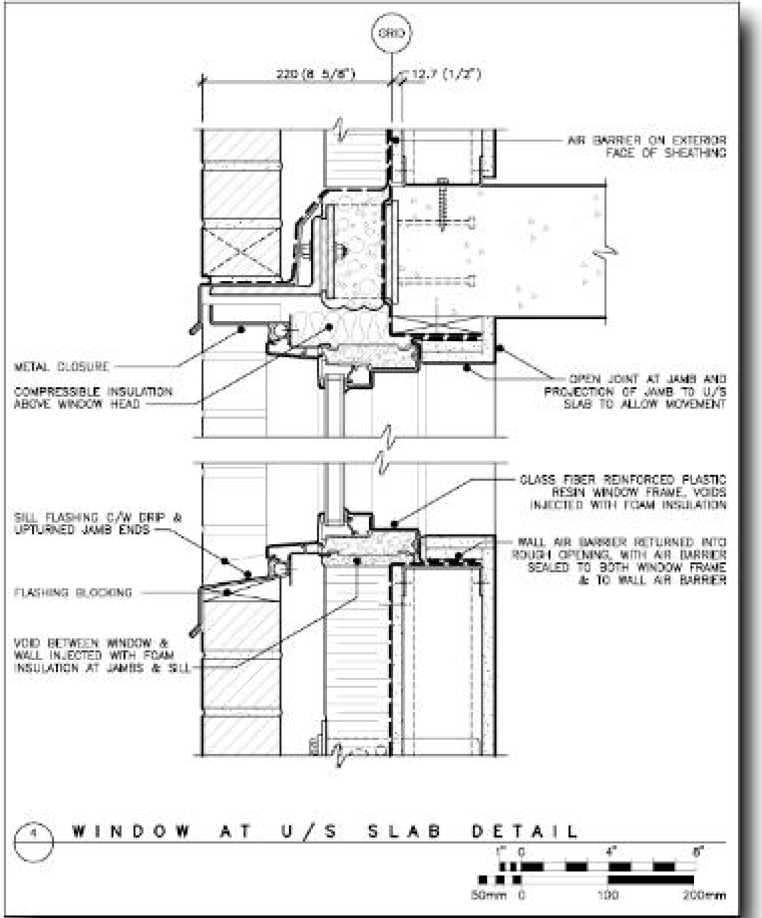
Steel Stud Back Up Wall



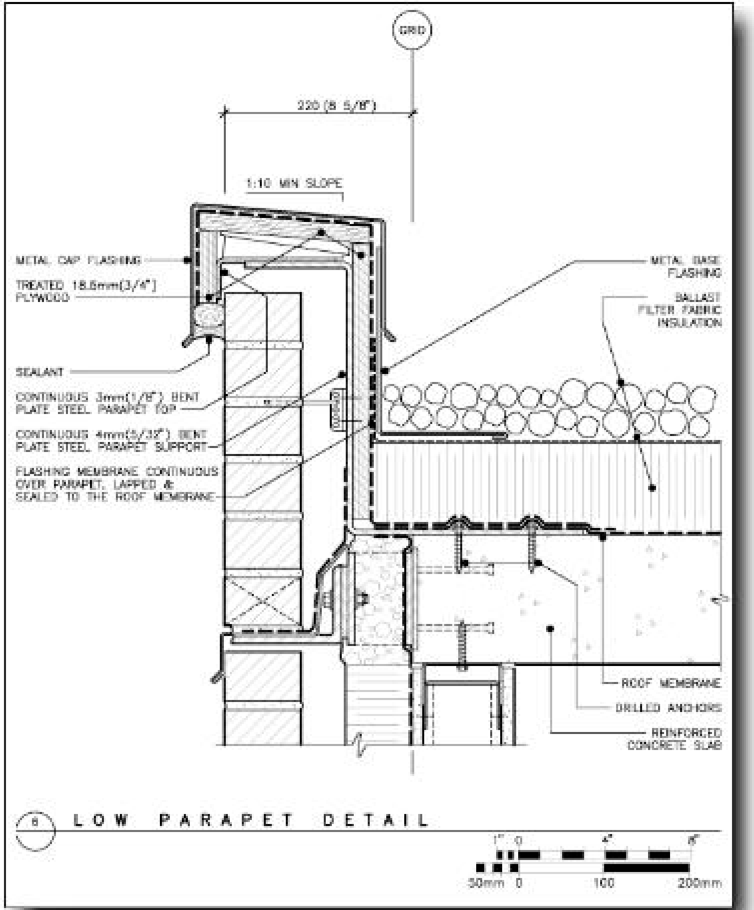
Detail 7: Slab Edge at Foundation



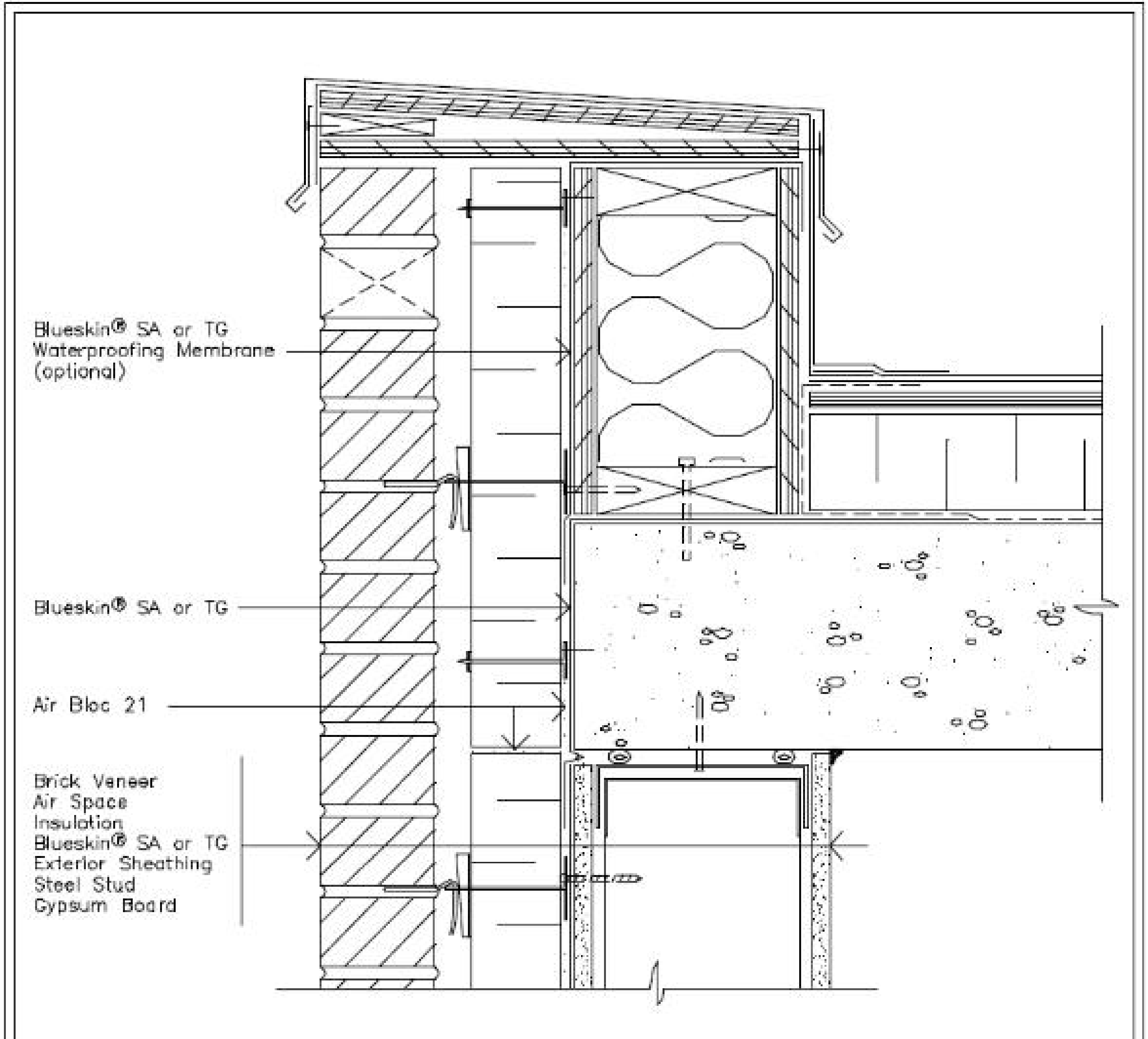
Detail 1: Slab Edge



Detail 4: Window at U/S Slab



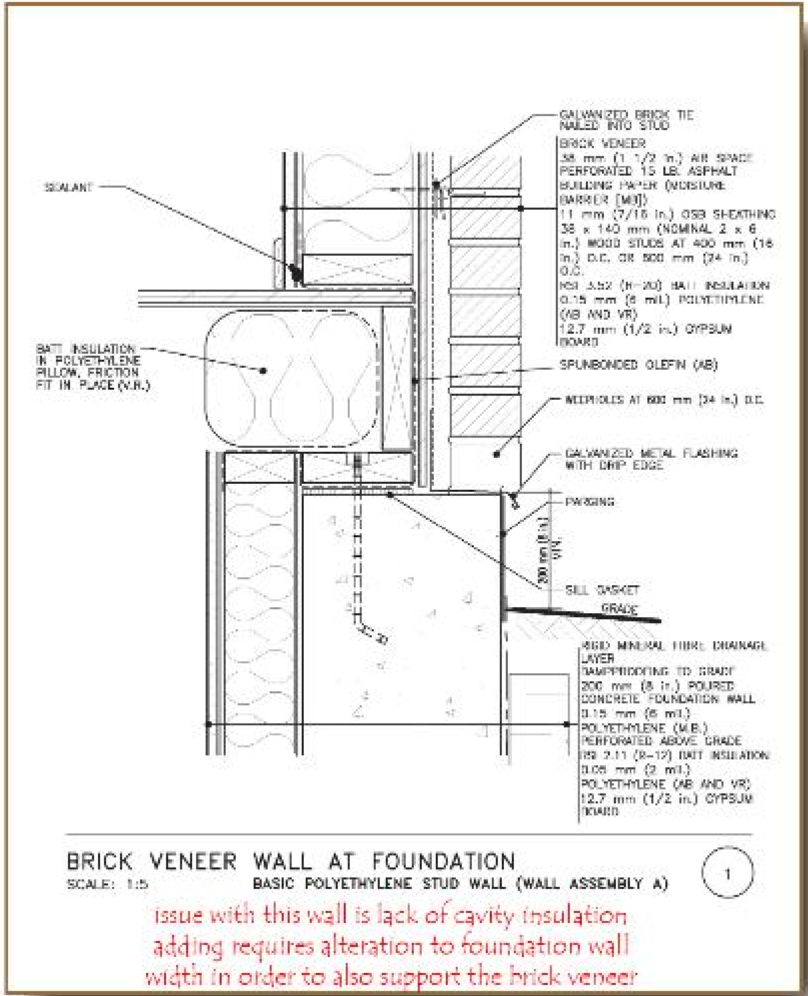
Detail 6. Low Parapet


Blueskin® SA or TG
Waterproofing Membrane
(optional)
Blueskin® SA or TG
Air Bloc 21
Brick Veneer
Air Space
Insulation
Blueskin® SA or TG
Exterior Sheathing
Steel Stud
Gypsum Board

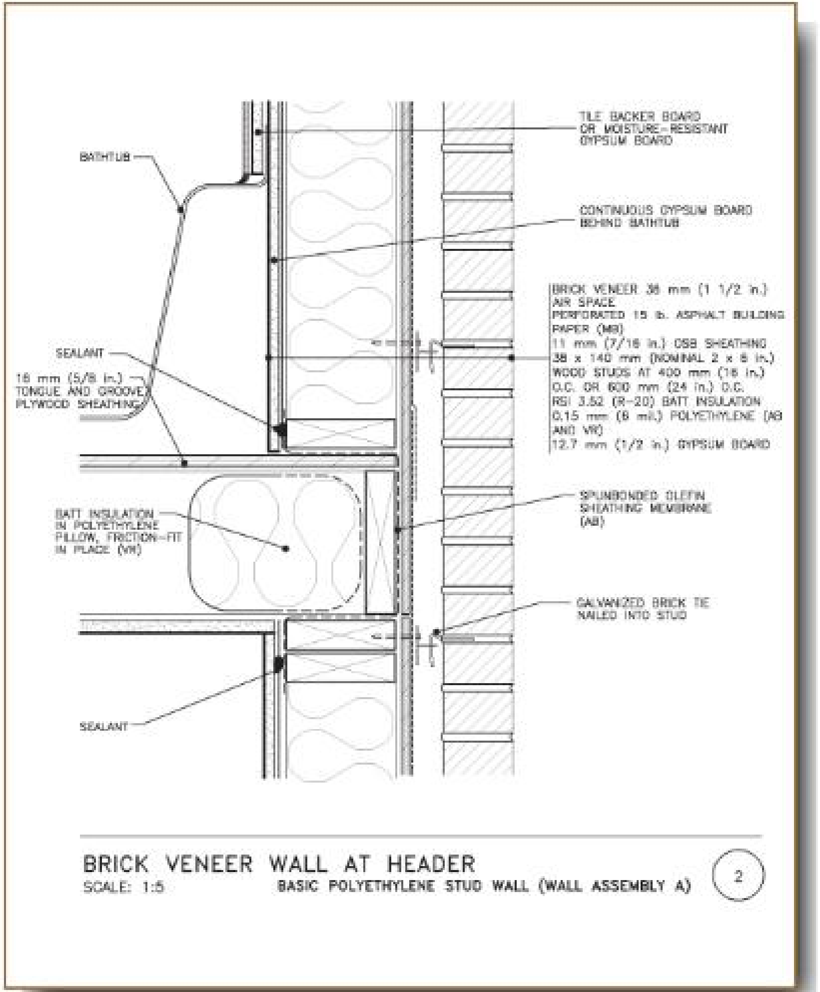
The Details of Brick and Concrete Block Construction (stuff needed for the final project)

Wood Frame Back Up Wall

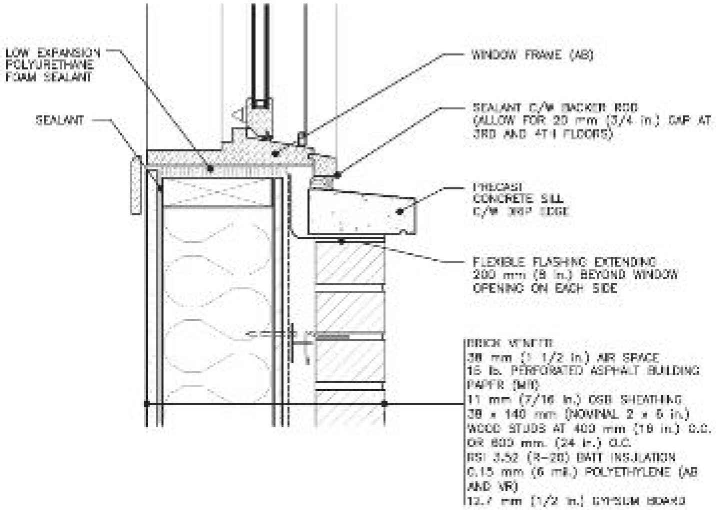
When you do your final project, please be sure to add 38mm of rigid insulation in the cavity.



Detail 1: Brick Veneer Wall at Foundation



Detail 2: Brick Veneer Wall at Header



the rough framed opening is always larger than the window in order to allow the placement of shims that allow the carpenters to ensure that the windows are plumb and square

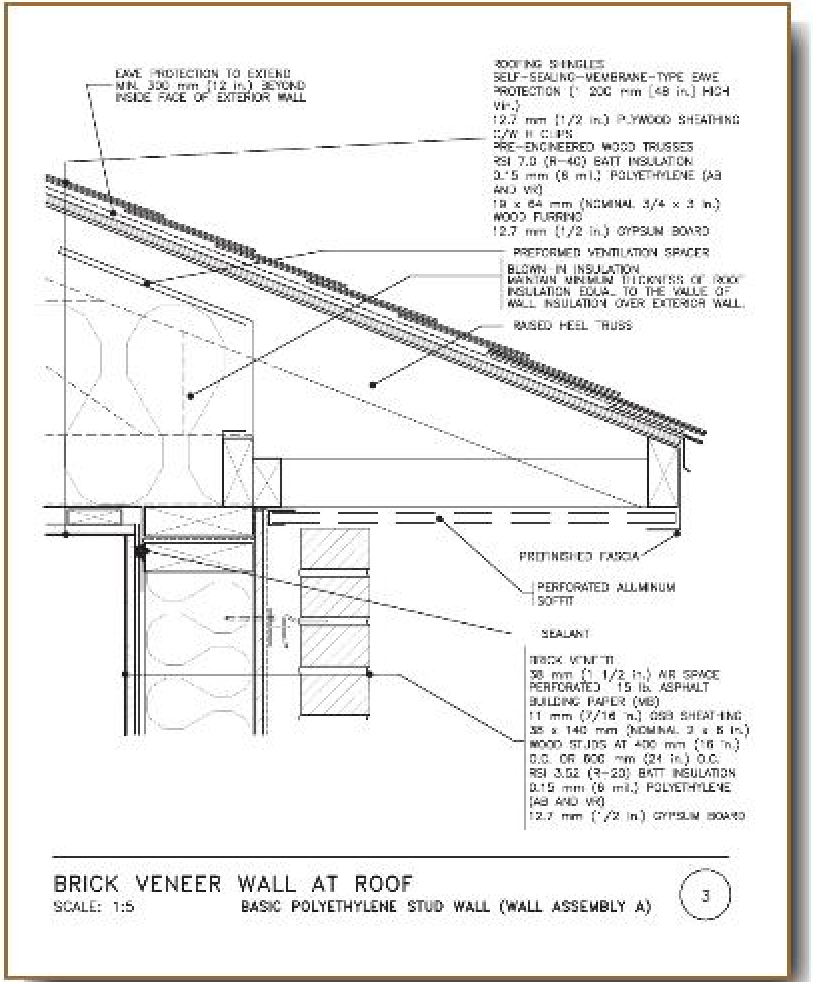
WINDOW OPENING

SCALE: 1:5

(WALL ASSEMBLY A)

17

Detail 17: Window Opening, A



Detail 3: Brick Veneer Wall at Roof

BASEMENT OR CRAWLSPACE CONSTRUCTION:

- 250mm thick concrete foundation wall on 200 x 400 concrete footings;
- 100 mm deep concrete floor slab with 150 x 150 welded wire mesh, on vapour barrier on 150 mm gravel on undisturbed soil;
- 100 mm diameter weeping tiles around perimeter, with 200mm pea gravel cover and filter cloth; backfill
- Foundation wall to have: bituminous dampproofing; 50mm polystyrene insulation on exterior and a drainage board/matt. Leave the inside face of the concrete wall unfinished;
- *Ensure no thermal bridge where this meets grade*. Protect the insulation from UV radiation and damage by lawnmowers.

GROUND FLOOR CONSTRUCTION:

WALL: CHOICE of: 90mm brick veneer or wood cladding
25mm air space; 38mm polystyrene insulation; Tyvek (aka spunbonded olefin facer…); 13mm exterior grade plywood or OSB; 38x140mm wood studs with 140mm batt insulation; vapour barrier; 13mm gypsum board

GROUND FLOOR: 19mm plywood on 38 x 286 joists; basement/crawlspace ceiling unfinished

WINDOW: operable wood window (*approximate* a section, don't get bent out of shape drawing it exactly, but be sure to have it located correctly to cover the air space in the wall surrounding). Precast concrete window sill.

CEILING CONSTRUCTION: 38 x 184 joists; 300 mm fiberglass batt insulation: vapour barrier; 13mm gypsum board

ATTIC CONSTRUCTION:
ROOF: asphalt shingles on building paper on 13mm roof sheathing or OSB on 38 x 235 rafters with 38 x 89 collar ties; detail the fascia and soffit; show a rain gutter; ensure that air can circulate from the soffit through to the attic (put in the product that keeps the air path clear from the soffit to the attic and holds back the insulation.

Remember to use the "ganged" notation for major assemblies!

Add your scale figure

Line weight differentiation

And Good Luck!