Masonry...

Being the study of brick, block, and stacked stone

Simple way to build

- Stacking stone on stone…when there was no stone
- Adobe…'earth-stone' - mud straw, clay & secret ingredient (dung) 5,000 years old
- Fired clay brick about the same age
- Concrete masonry unit approx 1915
- Glass masonry unit approx. 1937

Key innovators

- Eutruscan, Meso-Americans : Corbel …(incremental cantelievers)
- Greece, Egypt …lintels
- Roman….arches and vaults
- Arabic … vaults
- Europe … Flying Buttress

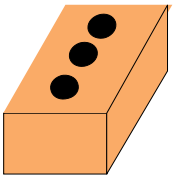
Brickmaking

- Soft mud process - for hand pressing 20-30% water
- Dry press - for machine pressing 10% water
- Stiff mud - extruded, wire cut column of brick 12 - 15% water

- Dry 1-2 days
- Fire in kiln

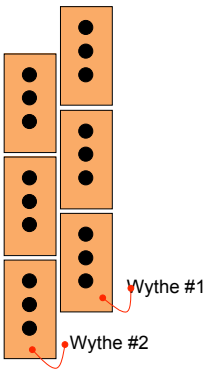
Part I… the brick masonry unit

- The brick has been a basic building block for masonry construction for thousands of years.
- It's size is generally based on a width/length/height that is easy to pick up and position with one hand



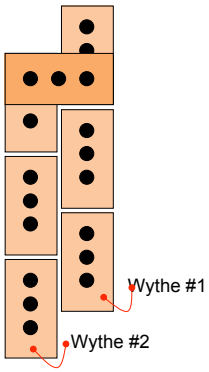
The basic brick wall

- The brick wall prior to 1940 was most often solid brick.
- Bricks were laid up side by side, each vertical row of bricks being called a wythe
- Each horizontal layer of brick is called a course. This is a plan view of a stretcher course for a two wythe wall.



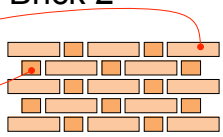
Keeping it together

- Bricks would be laid cross-wise to tie the wythes together. These are header bricks.
- Header bricks could be a whole horizontal layer (course) or be interspersed with stretcher courses

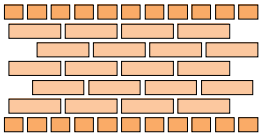


Bonding Brick 2

- Alternating stretchers and headers in each horizontal course produces the Flemish bond

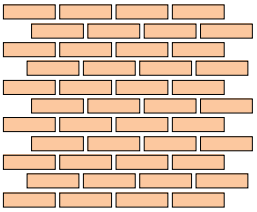


- A row of headers every 6th horizontal course with running bond in-between produces a Common bond



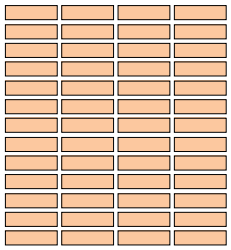
Sructural & Non-structural bonds

- Overlapping stretchers with no headers produces the Running bond, the most basic structural bond (and a tip-off that this is only a one wythe veneer!) But overlap in the bed joints provides some mechanical keying action between courses, giving some structural ability to resist lateral loads.



No key…no structure

- Aligning the head joints with all stretchers produces the stack bond. Since no bed joints overlap, there is little mechanical keying between the courses making this the weakest (considered nonstructural) bond.



Every face has a name

If we see the long face horizontally, it's called a stretcher

Turn the long face vertical and it's a soldier

More faces, more names

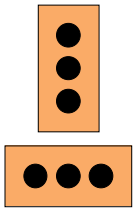
The end face of the brick, seen horizontally is a header. The header is usually used to tie the wythes together

The end face of the brick, seen vertically is a rowlock, often used for window sills and tops of walls.

Sailors & Flashers

The side face of the brick, seen vertically is a sailor

The side face of the brick, seen horizontally is a flasher

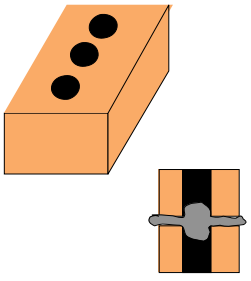


Brick sizes

Name	width	height	length
Modular	3 5/8”	2 1/4”	7 5/8”
Standard	3 3/4”	2 1/4”	8”
Roman	3 5/8”	1 5/8”	11 5/8”
Norman	3 5/8”	2 1/4”	11 5/8”
Jumbo	5 5/8”	3 5/8”	11 5/8”

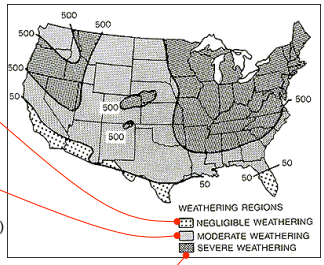
Cores

- The holes (cores) make the brick lighter, easier to handle.
- They also make a more even firing of the clay possible
- They help establish a mechanical key type of joint from one brick to another as the mortar squeezes into the cores
- When the mortar cures, it would have to be sheared off for the brick to move sideways



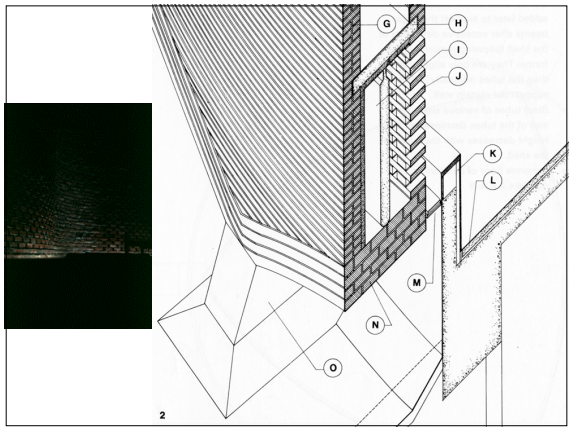
Brick & weathering

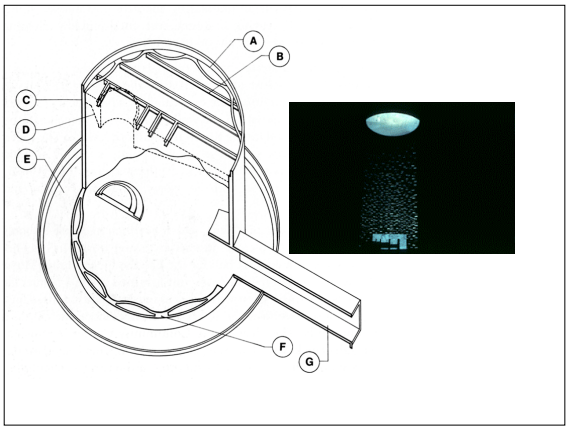
- Generally the longer a brick is fired, the harder it will get.
- Types:
  - NW for Negligible Weathering exposure (extreme South Florida, South Texas)
  - MW for Moderate Weathering exposure. (not as many freeze / thaw cycles per season)
  - SW for Severe Weathering exposure. (many freeze-thaw cycles per season)



Quality

- FBX-Most precise color / size
- FBS - close size precision / wide color variation
- FBA - non-uniform size / color



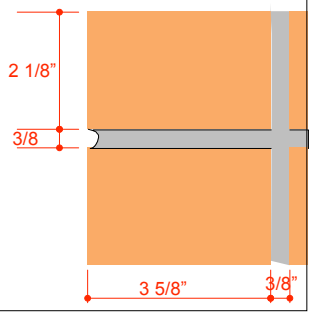


Mortar

- Not Glue! Makes mechanical bond to the brick, resists movement by shear.
  - Types
    - 'M' = high strength 2,500psi used where masonry is exposed to severe frost, frost below grade, or high lateral loads
    - 'S' = medium high strength 1,800psi used for normal compressive loads
    - 'N' = medium strength 750 psi general above grade use
    - 'O' = medium to low strength, 350 psi for non-loadbearing interior partitions
  - Mortar components: Portland cement (for strength); hydrated lime (for workability); aggregate - sand (filler); water (for the hydration process)
  - Begins to set up in 90 min. Only re-temper (add water) once

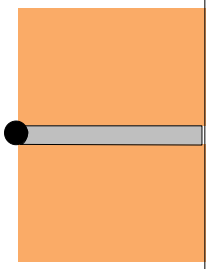
Joint width

- Typically, mortar joints are 3/8 of an inch thick.
- Dimensions of brick usually take this into account, the 2 1/8" thickness of a modular brick, added to the 3/8 mortar joint (x 3 courses) gives the 8 inch high masonry module.



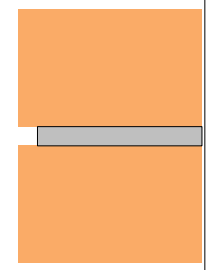
Tooled…concave

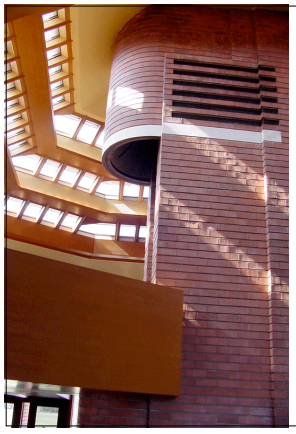
- The most common way to finish a mortar joint is to force a rod across the mortar as it sets up.
- This compresses the mortar, increasing it's moisture resistance and makes a smooth surface with no place to hold rain, or snow, or sleet, or ice.



Raked

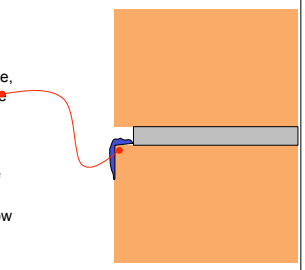
- To increase the horizontal emphasis of his buildings, Frank Lloyd Wright would specify a raked joint for the bed joints….in a dark mortar color; a flush joint for the head joints …in a color matching the brick. (you might have to buy the masons a lot of coffee to get this done today)





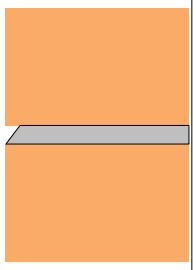
Raked subtracts

- The raked joint is made by scraping out mortar to the depth specified by the architect.
- It leaves a shelf for snow, ice, rain… so the brick should be top quality (SW)
- The mortar is not compressed by raking so is more porous. Should be the best quality (M)
- But it makes the best shadow



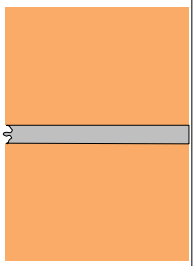
Weathered

- An alternative to the raked joint is the weathered or struck joint.
- Like the raked it joint it uses a process where mortar is scraped out of the joint.
- Unlike the raked joint this joint leaves no shelf for moisture to build up on, but still makes a deep precise shadow.



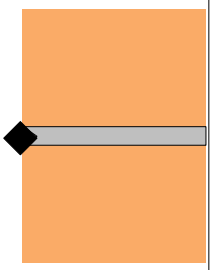
Historic

- The beaded joint was an effort to bring precision to the mortar when the brick was imprecise.
- The projecting bead, formed by pushing a slotted rod into & along the mortar would make a precise line and shadow, tricking the eye into a perception of precision.



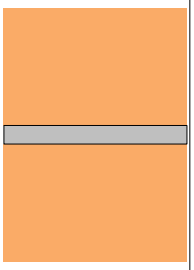
Vee

- The ‘V’ or vee joint is another mortar joint formed by compressing a square rod into the mortar.
- This compacts the mortar & helps it resist mortar penetration.



Flush

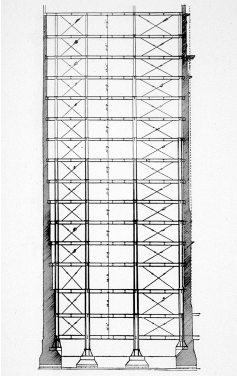
- Perhaps the simplest joint is the flush joint. Mortar projecting beyond the face of the brick is scraped flush with the surface of the brick.
- Since the mortar is scraped off, there is no compressing of the mortar, and it remains as porous as the raked joint.
- Used with mortar dyed to match the brick, this can increase the monolithic appearance of the wall.



Mario Botta, Artisan Housing

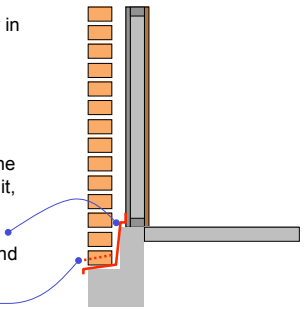
The end of the wall

- Masonry bearing walls fell out of use as buildings got taller.
- To carry the loads of tall buildings such as the Monadnock building in Chicago, the walls at the building base had to be over six feet thick!…too much floor space lost.



Complex walls

- Brick masonry is often used today as a veneer in cavity walls.
- A cavity wall puts an airspace behind the brick…expecting a leak…the water moves through the brick, hits the cavity but cannot cross it, so it falls to the cavity bottom, is collected on through wall flashing, and is drained out through weeps in the brick wall



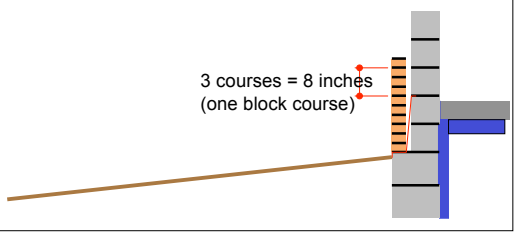
Copper beginning

- Here a paper thin sheet of copper flashing covers the brick ledge, and extends up one block above the interior floor level.
- This through wall flashing will collect any moisture coming into the cavity and weep it to the exterior.

PVC flashing

- In multistory veneer walls, galvanized steel angles often hold up the brick.
- Any interruption in the cavity must be flashed and wept to get rid of moisture in the wall

The contemporary masonry wall



String & Storypole

- Laying a course of brick to a specific level height requires a guide.
- Here the mason has set a stringline after transferring the coursing elevations from a storypole prepared for this project

Bed

- The Mason lays mortar on top of the bricks (and ties) already in place on the course below.
- This mortar will form the bed joint.

Furrow

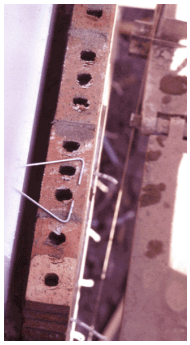
- The mason turns over the trowel and forms a furrow in the bed joint.
- This pushes mortar to the outside faces of the brick, ensuring enough mortar to slow down the passage of water into the joint.

Butter & Press

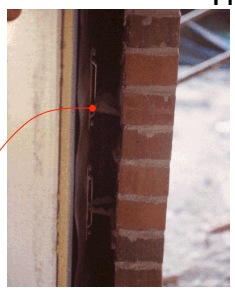
- The mason picks up a brick, butters mortar on each end (the head joints) and presses the brick into the furrowed mortar of the bed joint…just to the height of the stringline.

Strike & Tie

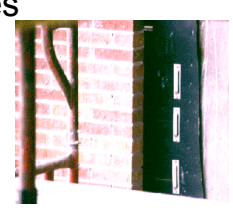
- With the head joints filled, the brick pressed into the bedjoint to the height of the stringline, the mason trims the mortar that squeezed out of the back of the head and bed joints, then trims the excess mortar from the face joint.
- The excess mortar from the back trimming often falls into the cavity and can contribute to making a moisture path from the outside of the wall to the inside



Ties

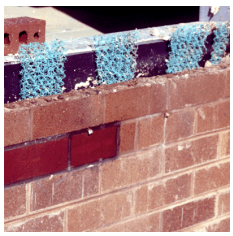


Note mortar droppings on tie



- The brick is held to the wall with the brick tie.
- This tie is adjustable, allowing the mason to slide the tie up or down to meet the bed joint.

This wall has a proprietary product made of an expanded mesh of recycled plastic. This mesh is supposed to catch mortar droppings from the backside joint trim and prevent the cavity from being clogged up with mortar. (disrupting it's ability to prevent water penetration)



Cavity cover.

- With the ties in place and the joints trimmed, the mason will tool (or rod) the face joint to achieve the specified joint profile
- When done for the day, the mason will cover the cavity to prevent moisture from accumulating in the cavity