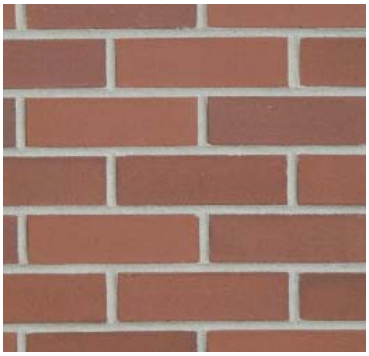
T3 02 Materials Case Study

BRICK

Mary Beth Robbins, 1/22/2018

Synopsis



Ballpark - General Shale Brick

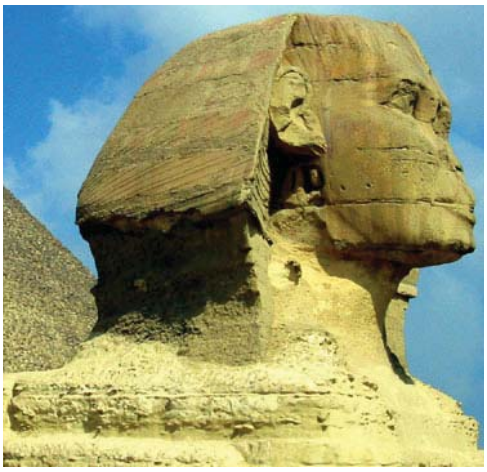
BRICK: a masonry unit of clay, formed into a rectangular prism and hardened by drying in the sun or firing in a kiln.

Why would an architect select this material? Because brick is timeless.

The use of brick masonry has been seen in even the first known architecture. Imhotep, an Egyptian architect uses brick masonry in the Pyramid of Djoser (2667-2648 BC), and it became a common way of building Egyptian pyramids and landmarks like the infamous Great Sphinx (pictured below). The style quickly became common throughout the world and throughout centuries, as it is seen at Monticello (1772, pictured), Louis Kahn's Phillips Exeter Library (1972, pictured), and to the present day John W. Oliver Transit Center (2012, pictured). All these structures span over 4,500 years apart, yet, why haven't we gotten sick of it?

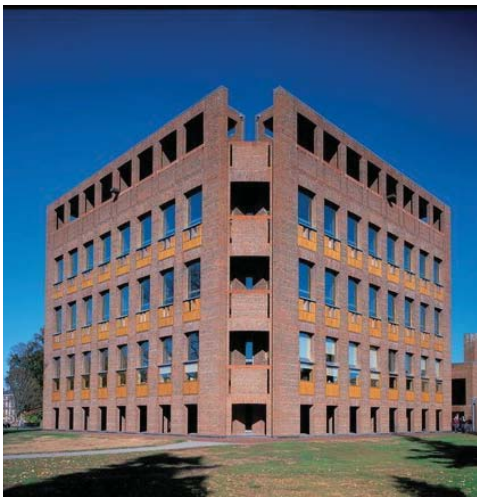
Brick is very efficient to make, with just clay, a mold, and a source of drying heat (kiln or sun). Because of this simplicity, brick is very easy to manufacture,. General Shale, a brick manufacturing company located throughout the US, has over 200 types of brick you can choose from. These vary on color, cut and size. People also comment that brick is a module. Used repeatedly, it creates a familiar pattern. Brick can also be cut or shaped a certain way to create curved brick walls or interesting architectural statements.

Because of brick's wide range of variety, it has become the one most timeless architectural materials.

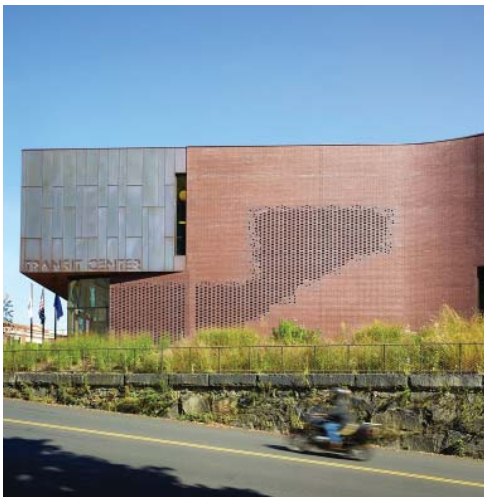


The Great Sphinx of Giza

Monticello, Thomas Jefferson



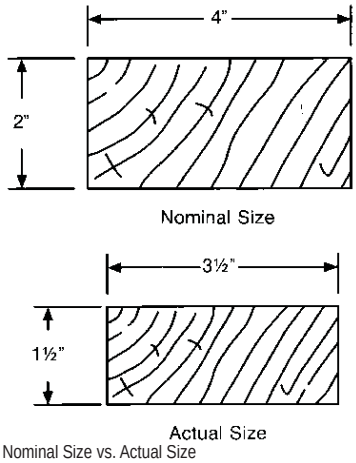
Louis Kahn's Phillips Exeter Library



John W. Olver Transit Center, Charles Rose Architects

Properties

What are the basic types or properties of this material?
Because of brick's ability to be shaped or formed in many different ways, there has to be a set system that identifies certain types of brick, based on dimension, grade, and type.



Nominal Size vs. Actual Size

BRICK DIMENSION: the measurements of a single brick
- Norminal Dimension: dimension larger than the brick to account for thickness of the mortar joint.
- Modular Brick: 4 in x 2-2/3 in x 8 in brick
- Norman Brick: 4 in x 2-2/3 in x 12 in
- SCR Brick: stands for Structural Clay Research. 6 in x 2-2/3 in x 12 in
- Engineered Brick: 4 in x 3-1/5 in x 8 in
- Norwegian Brick: 4 in x 3-1/5 in x 12 in
- Roman Brick: 4 in x 2 in x 12 in
- Economy Brick: 4 in x 4 in x 8 in


Absorption test of a brick

BRICK GRADE: the durability of brick when exposed to weathering . There are 3 US weathering regions - Severe, Moderate, and Negligible. According to annual winter rainfall and number of freezing days. Brick is graded for use in each region according to compressive strength, maximum water absorption, and maximum saturation coefficient.
- Absorption: the weight of water absorbed by a clay masonry unit when immersed in either cold or boiling water for a stated length of time, expressed as a percentage of the weight of the dry unit.
- Saturation coefficient: the ratio of the weight of water absorbed by a clay masonry unit immersed in cold water to the weight absorbed when immersed in boiling water, indicating the probable resistance of the brick to the action of freezing and thawing.
- SW: Brick suitable for exposure to severe weathering as when in contact with the ground or used on surfaces likely permeated with water or subfreezing temperatures.
- MW: Brick suitable for exposure to moderate weathering, as when used above grade on surfaces unlikely to be permeated with water in subfreezing temperatures.
- NW: Brick suitable for exposure to negligible weathering as when used as a back up or in interior masonry.

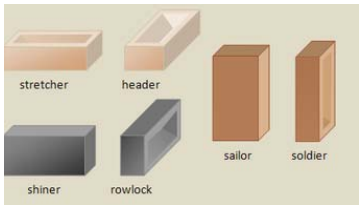

FBS vs FBX vsd FBA brick

BRICK TYPE: A designation indicating the permissible variation in size, color, chippage, and distortion allowed in a facing brick unit.
- FBX: facing brick suitable for use where a minimum variation in size, narrow color range, and high degree of mechanical perfection are required.
- FBS: facing brick suitable for use where a wider color range and greater variation in size are permitted than for type FBX
- FBA: facing brick suitable for use where particular effects are desired resulting from nonuniformity in size, color, and texture of the individual units.

- Cull: a brick rejected for being under quality.

Design Principles

What are some basic design principles when using this material? How is this material often used?



Brick Orientation Examples

Bricks have a certain class system as what they are used for (distinction), and how they are laid in an assembly (orientation).

DISTINCTION
- Common Brick: made for general building purposes and not specifically treated for color and texture. Also called a building brick.
- Facing Brick: made of special clays for facing a wall, often treated to produce the desired color and surface texture.

BRICK ORIENTATION: the different ways a brick is laid or customized to fit in an assembly
- Soap: brick having normal face dimensions but a nominal thickness of 2 in
- Bat: brick cut transversely so as to leave one end whole
- Gauge: to chip or rub bricks to a certain size or shape.
- Stretcher: brick laid horizontally with the longer edge exposed.
- Header: brick laid horizontally with the short end exposed
- Rowlock: brick laid horizontally on longer edge with the shorter end exposed.
- Soldier: brick laid vertically with the longer face edge exposed
- Sailor: brick laid vertically with the longer face edge exposed.
- Shiner: brick laid horizontally on longer edge with the broad face exposed.

Clinker bricks being used for paving.

- Clinker: a dense, hard-burned brick used for paving.

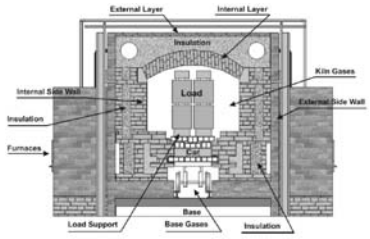
- Mortar: the workable pasted used to bind building blocks together in masonry.

Fabrication

Where does the material come from and how is it made?

PROCESS: These processes give different characteristics to the final form of the brick, distinctively making it look a certain way. This is usually characterised by the type of mold used to shape the brick, and the moisture content of the clay.
- Soft-Mud Process: the process of forming brick my molding wet clay with a moisture content of 20% - 30%.
- Sand-Struck brick: a soft-mud process with a mold line with sand to prevent sticking. Produces a matte textured surface.
- Water-Struck brick: a soft-mud process with a mold lubricated with water to prevent stick. Produces a smooth, dense surface.
- Stiff-Mud Process: process of forming brick by molding dry clay with a 5% - 7% moisture content. Under high pressure, resulting in a sharp-edged, smooth surface brick.
- Kiln: a furnace for burning, baking, or drying things like bricks, pottery, or timber.

Commercially, bricks are dried in a tunnel kiln, and are fired between 10-40 hours, depending on kiln type and brick variables.



Cross-section of a tunnel kiln

Sourcing / Vendors

Who would you contact for using the material in the design?

1. General Shale Brick - One of the largest brick manufacturers in the United States. Offers 200+ types of brick for residential and commercial purposes, as well as other building materials like stone, concrete block, sand, mortar, and more.

2. Triangle Brick - Located in Durham, North Carolina and serves the east coast, most of the midwest, and as far south west as Texas. Triangle Brick has been recognized as “Best of Houzz 2015” for Design and Service. Triangle Brick offers a wide selection of over 80 brick types in 7 distinctive collections.

3. Glen-Gery Brick - Based mainly in the midwest, Glen-Gery is a superior choice of brick among architects, builders, and homeowners. They offer a variety of bricks including face brick, thin brick, and paving brick, as well as stone and other masonry supplies.

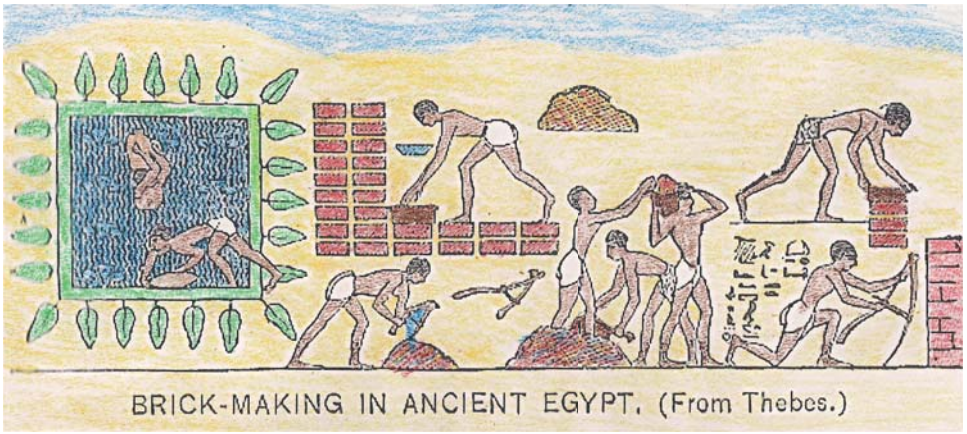
These are just 3 of many brick manufacturers in the United States. Great architects and home builders always will keep a catalog of material types and manufacturers for reference to clients and themselves throughout the designing process.

Contemporary Research

Since the beginnings of time, the process of curating bricks has evolved. Before, clay was mixed with water, shaped, and dried in the sun. Now bricks are studied closely with specific molds and linings (wood molds, sand lining, water lining), and dried in different types of kilns at different temperatures. Moisture content and capacity become an important factor into which what type of brick to use and how well it holds up to weathering. There is even a science of what type of clay to use to produce a certain color and finish of the processed brick.

Machine laying out bricks

bricks drying in a kiln



Historical Summary

Brick Masonry is nothing new. In fact, it is the oldest manufactured product. Sun-baked clay bricks were used in construction more than 6,000 years ago. Brick masonry was used in the Egyptian pyramids and other historical BC buildings, and it began the revolution of other masonry materials, such as stone masonry, concrete masonry, and even marble based masonry. This inspires some of the worlds most notable buildings like the Colosseum (Stone masonry), the Great Wall of China (stone masonry), and the Taj Mahal (marble masonry). Brick also paved the way for other building strategies and decorations like terra-cotta (slower baked earth).

Our studies on brick masonry have evolved immensely over the years. One major jump for the production of the brick was the invention of the kiln. The kiln allows the brick to dry faster than in the sun. Brick manufacturers mass produce bricks of all shapes and sizes using a large array of molds and enormous kilns that reach high temperatures.

Like said before, brick is timeless, because of its module form, and ability to be customized in many ways. It has evolved from the roughness of Egyptian Pyramids to modern-day curved brick that have the ability to look like thin, light curtain walls. Bricks are widely admired for its uniformity. Even though a brick may be slightly different in cut or color, it is so easy to identify that reddish cast on a building. Look at the images here on this page, as brick is featured in so many different architectural styles.

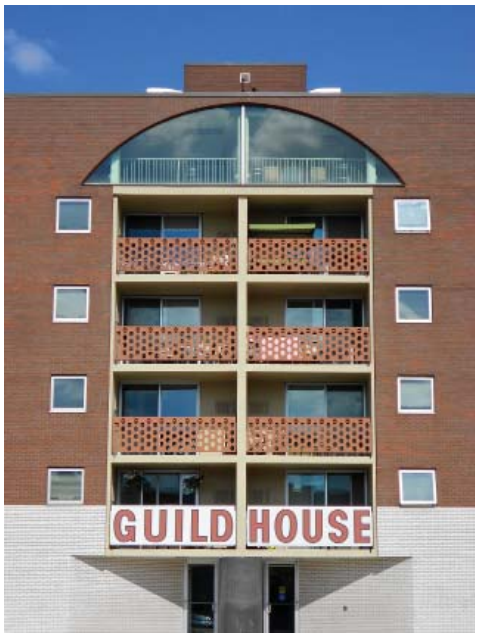
Great Mosque of Samarra, Abbasid Architecture

St. Mary's Church of Lubeck, Gothic Architecture

Ontario Farmhouse, Victorian Architecture

Robie House, Frank Lloyd Wright, Prarie Style

Folly Farm, Sir Edwin Lutyens, Queen Anne Revival Style



The Guild House, Robert Venturi, Postmodernism

Bibliography

"2017 Brick in Architecture Award Winners Announced." ArchDaily, 10 Aug. 2017, www.archdaily.com/877519/2017-brick-in-architecture-award-winners-announced.

"About Us." General Shale, generalshale.com/company/.

Ching, Francis D. K. "Brick." A Visual Dictionary of Architecture, Wiley, 2012, pp. M6–M8.

Editor, TMG, et al. "New Technology for Making Clay Bricks." HeraldLIVE, 29 Oct. 2014, www.heraldlive.co.za/business/2014/10/29/new-technology-making-clay-bricks/.

"Glen-Gery." Glen-Gery - Glen-Gery Brick, www.glengery.com/about-us.

"History of Masonry." Mason Contractors Association of America, www.masoncontractors.org/history/.

"Manufacturing of Brick." TECHNICAL NOTES on Brick Construction, 9 Dec. 2006

Ochshorn, Jonathan. "ARCH 2615/5615 Lecture Notes." Building Technology II: Structural Elements, Cornell University, courses.cit.cornell.edu/arch264/notes/masonry-systems.html.

O'Connor, William. "Brick Buildings That Are Actually Cool (PHOTOS)." The Daily Beast, The Daily Beast Company, 25 Apr. 2015, www.thedailybeast.com/brick-buildings-that-are-actually-cool-photos

"Our Story: History of Triangle Brick Company." Triangle Brick, www.trianglebrick.com/why-triangle-brick/our-story.