A General Introduction to Masonry Construction

Topics

- *Unit Types*
  - *Brick Concrete Masonry Units*
  - *Stone Glass Block*
- *Mortar*
- *Physical Properties & Technical Data*
- *Three Dimensional Masonry Structures*
- *Walls & Openings*
  - *Single & Multiple Wythe*
  - *Monolithic and Composite*
  - *Reinforced (Engineered) Masonry*

A Generic Definition for Masonry Construction

- **A variety of formations consisting of separate elements held together with a binder**
  - ***elements:***
    - ***stone, fired clay elements, concrete, glass, adobe***
  - ***binder:***
    - ***mud, lime mortar, cement mortar***

Potential Advantages of Masonry Construction:

- simple
- materials at hand
- less bracing & formwork than concrete.

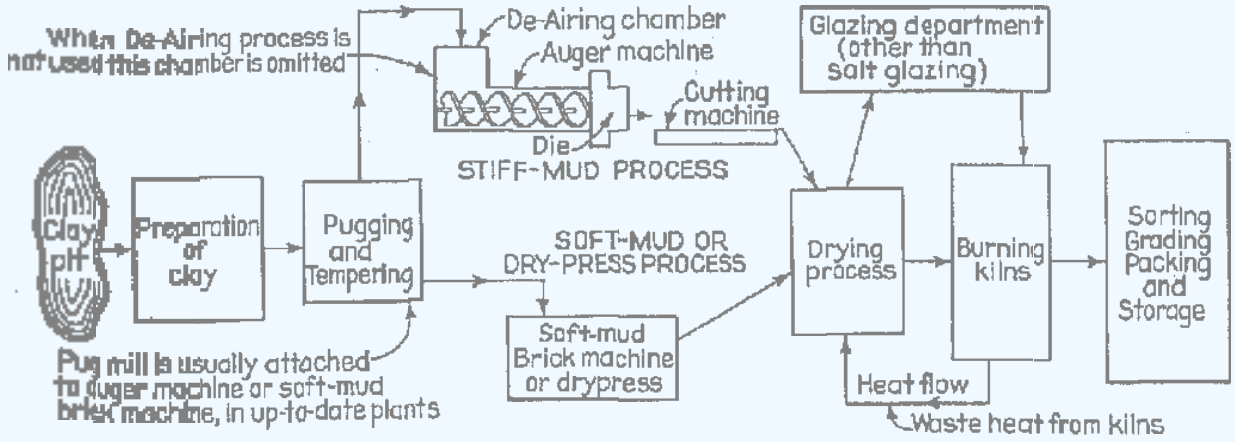
Potential Disadvantages of Masonry Construction:

- labor intensive
- compressive capacity only
- skilled labor
- mortar shrinkage
- thermal exp/contr

Bricks

Brick Manufacturing

- Stiff Mud - Extrusion Process
- Soft Mud - Molding Process



Brick Classification

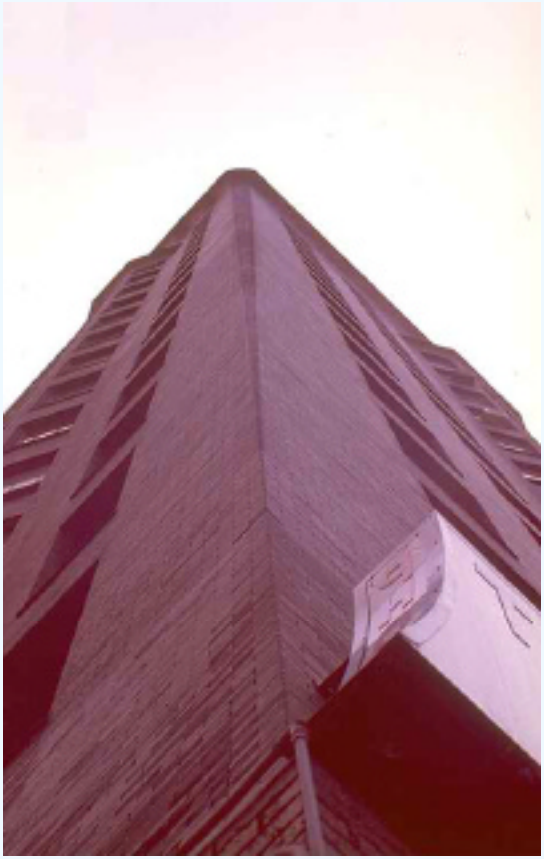
- **ASTM C216 • Facing Brick**
- **Other Classifications Exist for:**
  - ***Building Brick***
  - ***Hollow Brick***
  - ***Paving Brick***
  - ***Glazed Ceramic Brick***
  - ***Thin Brick Veneer Units***
  - ***Sewer Brick***
  - ***Chemical Resistant and Industrial Floor Bricks***

Brick Selection

- **Aesthetics**
  - ***Size***
  - ***Color***
  - ***Texture***
  - ***Shapes***
- **Cost**
- **Availability**

Physical Properties

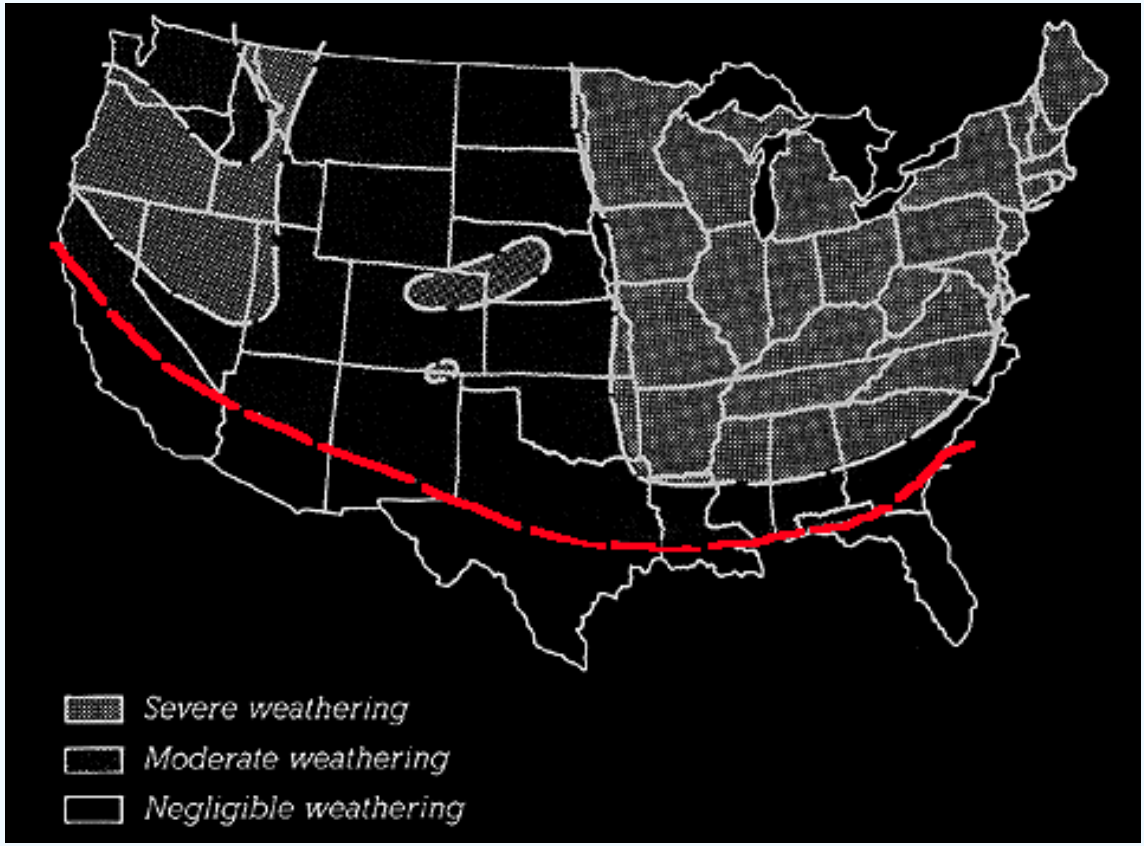
- Compressive Strength
- Durability
- Absorption
- Abrasion Resistance



Factors to Consider in Application

- Moisture Penetration
- Temperature Variation
- Structural Loading

Weathering Grades • ASTM C216



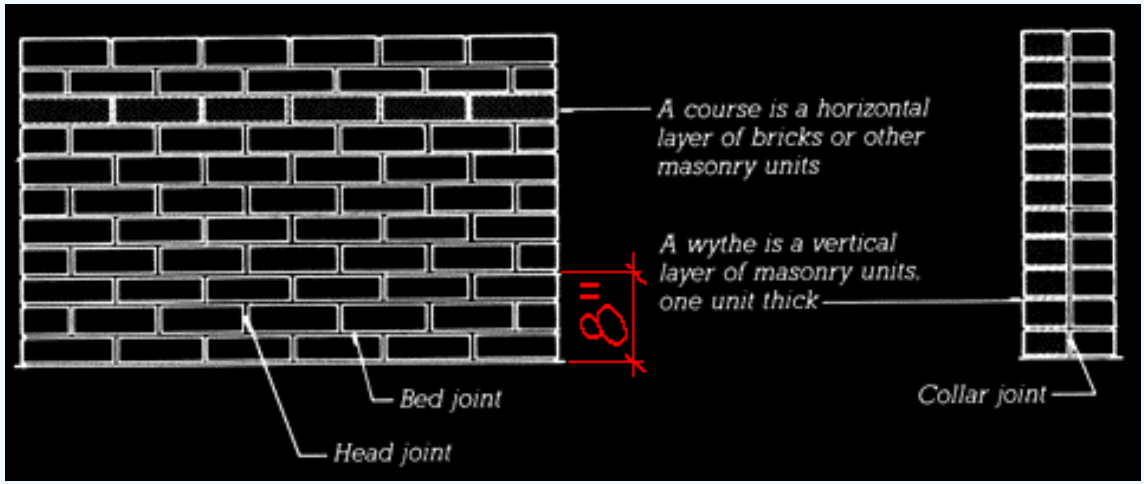
Face Brick Grades • ASTM C216

- FBX • tightest tolerance, ±5/32"
- FBS • less tolerance, ±1/4"
- FBA • loosest tolerance, not specified

Basic Terminology

- **Course • continuous horizontal layer of masonry units**
- **Wythe • continuous vertical section of masonry one unit in thickness**

Brick Course, Wythe & Joints



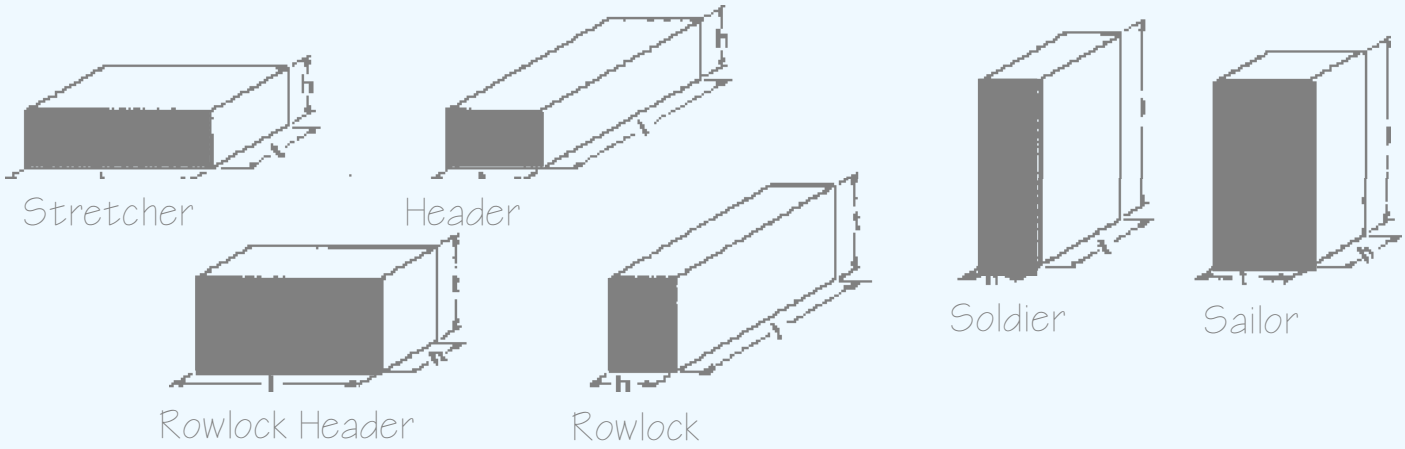
Brick Dimensional Data

- Standard Modular
- Face Dimension • 2 2/3" x 8" nominal
- Thickness • 4" nominal
- Mortar Joint • 3/8"

Modular Brick • Coursing Dimensions

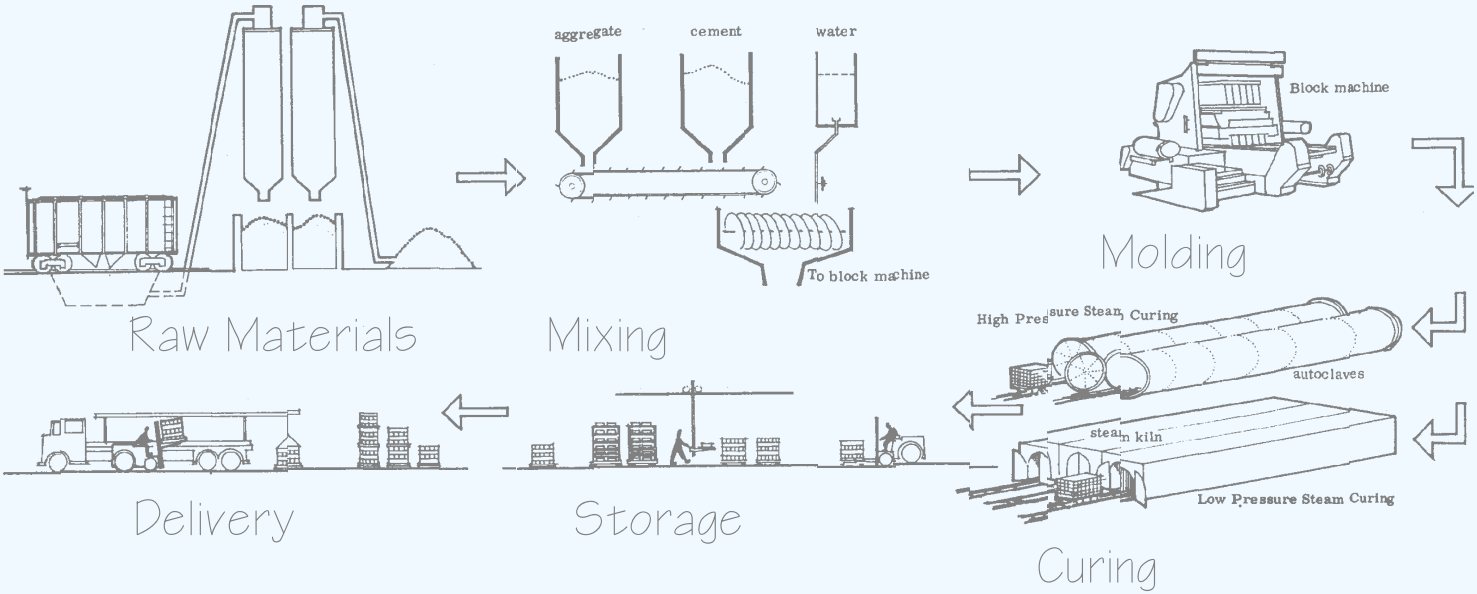
Unit Designation	t	h	l	Modular Coursing
Standard Modular	4"	2 2/3"	8"	3C = 8"
Economy 8	4"	4"	8"	1C = 4"
Economy 12 (Jumbo Utility)	4"	4"	12"	1C = 4"
Norwegian	4"	3 1/5"	12"	5C = 16"

Brick Positions in a Wall



Concrete Masonry Units

Concrete Masonry Unit Manufacturing



Concrete Masonry Unit Classification

- ASTM C90 • Load-Bearing Concrete Masonry Units
- ASTM C129 • Non-Load-Bearing Concrete Masonry Units
- ASTM C55 • Concrete Building Brick

Concrete Masonry Unit Selection

- **Aesthetics**
  - ***Color***
  - ***Texture***
  - ***Shapes***
- **Function**
- **Strength**
- **Shape**

Factors to Consider in Application

- **Exposure Condition**
  - ***Moisture Penetration***
  - ***Temperature Variation***
- **Structural Loading**

Physical Properties

- Moisture Content
- Absorption
- Face and Web Thickness
- Compressive Strength

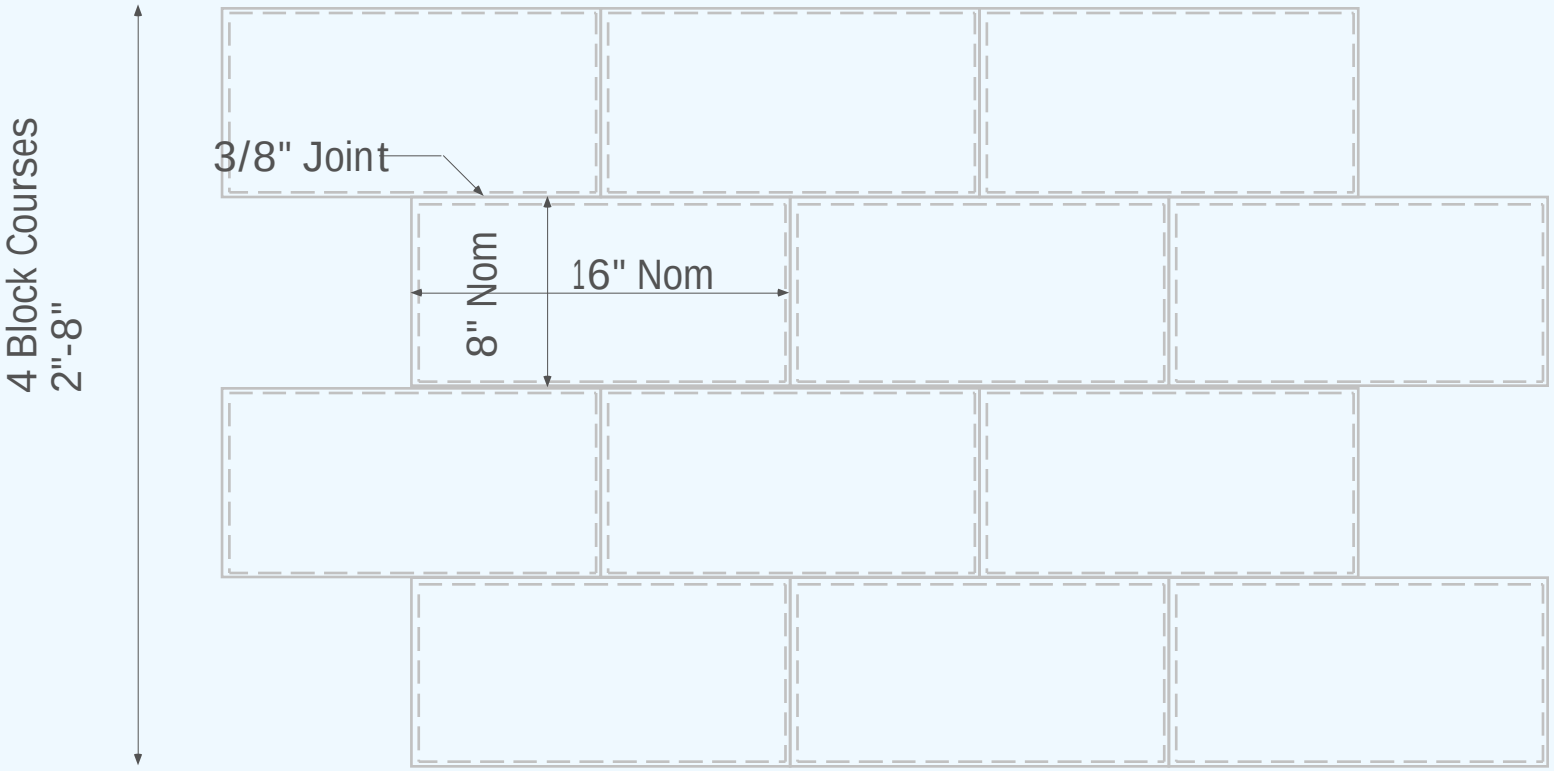
Concrete Masonry Unit Classifications

- ASTM C90
  - Type I • Moisture Controlled
  - Type II • Non-Moisture Controlled

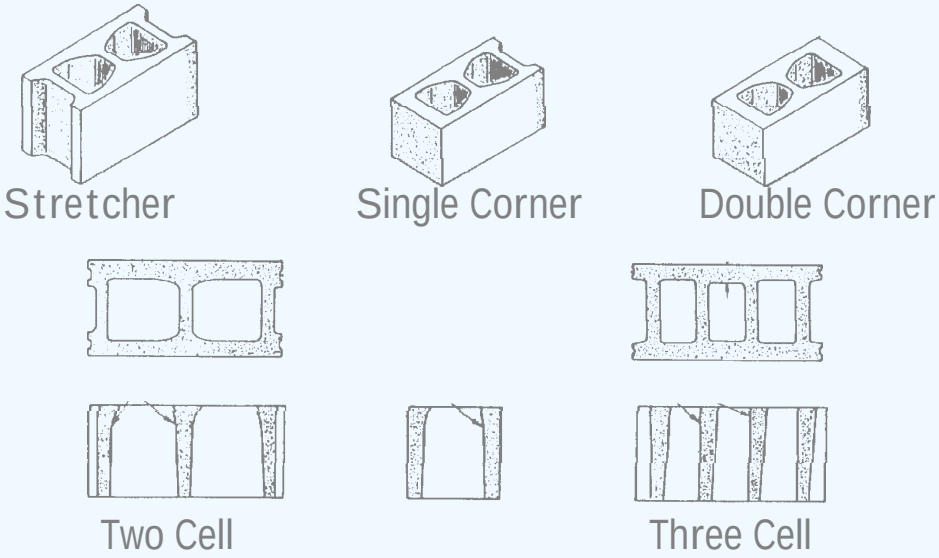
Strength and Absorption Requirements • ASTM C90

Type Weight of concrete (PCF)	Wt of One 8x8x16 Unit	Compressive Strength (Gross area) PSI	Max Water Absorption, PCF of Concrete
Normalweight (>125)	40	1200-1800	13#
Mediumweight (<125)	35	1100-1500	15#
Lightweight (<105)	25	700-1500	18#

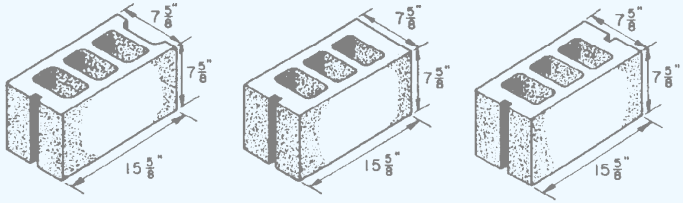
Concrete Masonry Unit • Modular Coordination



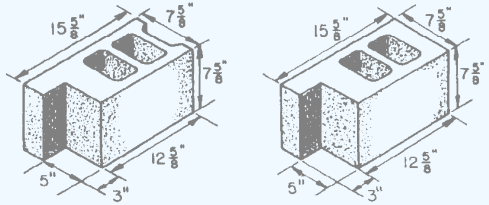
Concrete Masonry Unit Basic Shapes



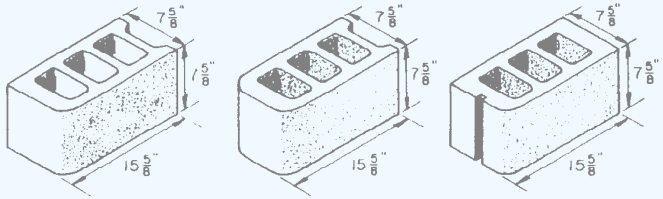
More Basic Shapes I



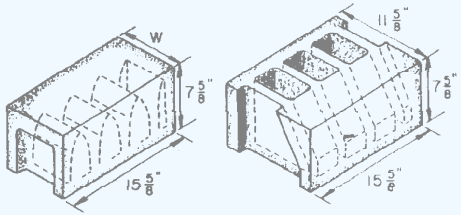
Steel Sash Units



Wood Sash Units



Bullnose Units



Capping Units

Stone

Stone Types:

- Primary
- Secondary
- Metamorphic

Primary

- Igneous
  - *granite*
  - *hard / no cleavage*

Secondary

- **Sedimentary**
  - ***disintegration - sandstone***
  - ***reconsolidation - limestone***
  - ***easy to saw or split***

Limestone

- First quarried in South Indiana in 1827
- Demand coincided with growth of the RR
- Gang saws were introduced to slice slabs
- Fires in Chicago (1871) Boston (1872)
- Indiana Statehouse/ Chicago City Hall
- High-rise Empire State/Tribune Tower

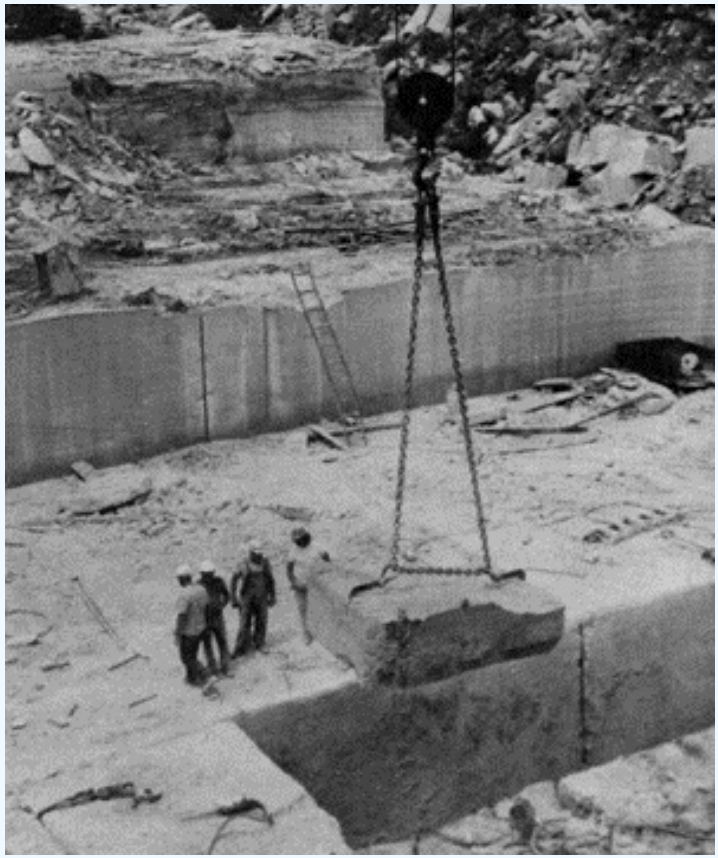
Seasoning:

- Contains water known as quarry sap.
- Minimum 6-month seasoning.
- Difficult to finish after seasoning.

Metamorphic

- **Sedimentary converted by heat & pressure**
  - ***marble***
  - ***high compressive strength***
  - ***low tensile strength.***

Quarrying Techniques for Stone



Production sizes & shapes:

- floor to floor panels
- blocks
- sills
- copings
- entrance features

Compressive Strength & Density

Brick	2500 psi	100-140 pcf
CMU	1900 psi	75-135 pcf
Limestone	3000 psi	130-170 pcf
Sandstone	4000 psi	140-165 psf
Marble	9000 psi	165-170 pcf
Granite	15,600 psi	165-170 pcf

Mortar

Mortar Functions

- Bonding
- Sealing against Air and Water
- Accommodating Small Movements
- Leveling
- Securing Reinforcement

Properties of Plastic Mortar

- **Workability**
  - ***Spreads Easily***
  - ***Adheres to Vertical Surfaces***
  - ***Supports the Weight of the Units***
  - ***Maintains Position***
- **Water Retention**
- **Re– tempering is Permissible to Maintain Workability**

Mortar

- ASTM C270
- Four Types • M, S, N, O
- Cement, Lime, Fine Aggregate (sand), Water

Proportion & Strength Specifications

Mortar	Portland Cement	Hydrated Lime	Aggregate	Strength
M	1	1/4	2 1/4 ~ 3	2500 psi
S	1	1/4 ~ 1/2	2 1/4 ~ 3	1800 psi
N	1	1/2 ~ 1 1/4	2 1/4 ~ 3	750 psi
O	1	1 1/4 ~ 2 1/2	2 1/4 ~ 3	350 psi