Bicklaying – Brick facades

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historic overview

- round 10,000-7500 B.C.: the first known mud bricks
- round 3000 B.C.: the first known burnt ceramic bricks
- Roman Empire: burnt ceramic bricks and mobile kiln
- 12th century: brick gothic (Italy + North-West Europe)
- 19th century: Bull’s Trench Kiln (rotating procedure)
- early 20th century: the use of ceramic blocks
### Material

- mudbrick (claymud)
- ceramic brick
- ceramic block
- concrete block
- AAC block
- lime-sand brick & block
- insulating ceramic blocks

### Brick Modul Systems

**National standards – size, brick module**

- **British:** 21.5x11.25x6.5 cm
- **German:** 24x11.7x7.11 cm
- **Hungarian, Austrian:** 25x12x6.5 cm
- **French:** 22x10.5x6.5 cm

**German brick module system DIN**

![Brick sizes](image)

- **DF**
- **NF**
- **2DF**
- **3DF**

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Brick module systems

construction systems (ceramic)

load bearing exterior walls
load bearing interior walls
partition walls between functional units
partition walls
basement walls
hollow clay slab blocks
slab beams
bond beams
facade bricks
lintels
**construction systems (AAC)**

- roof panels
- slab panels

- lintels for load bearing walls
- lintels for partitions
- lintels
- bond beam
- hollow clay slab blocks
- hollow wall element
- isolating bedding mortar
- bedding mortar
- rendering mortar
- partition wall elements
- wall elements
- tenon & mortise wall elements
- tenon & mortise wall elements

**performance of brick walls**

- strength – load bearing capacity
- thermal insulation capacity
- acoustic requirements
- water uptake / frost resistance
- fire resistance
- vapour transport capacity
- durability
- accuracy
mortars

mortar material:
- mud mortar
- lime-mortar
- lime-cement mortars
- cement mortar

contents of mortars:
- binder (lime, cement, resin)
- aggregate (sand, stone dust)
- water
- admixtures and additives

performance of mortars:
- strength H4, H6...H20, H40
- durability
- frost resistance
- workability
- plasticity
- thermal insulation capacity

for restoration:
- compatibility
- color
- desalination
- porosity
- capilar activity
- etc.
mortars

application:

- traditional – prepared on-site

-pre-prepared – mixed only with water on-site

loadbearing walls: outer and inner walls with load-bearing role – calculated structures

non-loadbearing exterior walls: self supporting structures on the facades in a frame-structure building

facade covering walls: the outer layer of the wall structure – usually with a half-a brick width

partition walls: internal border wall in-between two adjoining units – between two flats acoustic rated as well

fire barrier walls: fire rated partition wall between fire sections
**thesaurus**

- cornice / string course
- projections
- arch
- horizontal joint
- vertical joint
- angel cuts
- normal courses
- soldier course

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**brick wall bonds**

- wall bond for half a brick (12cm) width
- stretched bond
### brick wall bonds

- **wall bond for whole brick (25cm) width**
- **heading bond**
- **crossbond**
- **Dutch bond**
- **English bond**
- **Flamish (Polnish) bond**

### bonds for wider walls

- **bond courses**
- **diagonal courses**

- **bonds for wall of 50cm width**
- **bonds for wall of more than 100cm width** (fortification walls)
arches

- segmental arch
- wedged arch
- flat arch
- semi circular arch
- gothic arch
- three-centered arch

brick joints - pointing

**flush joints**: finish is prepared by the trowel at the time of the bedding of the bricks

**half-round (bucket handle) joints**: finish is prepared with some delay (but within the time of hardening), with special tool

**recessed / raked joints**: finish joint is raked off – final pointing executed later with the same or different (finer, color, etc.) material

**weathered / french joints**: the joint finish is inclining into the direction to the lower brick edge
**work sequence of the activity**

1. set the corner bricks & string lines  
2. set the first course (dimensions, water level, etc.)  
3. laying the second, third, etc. courses  
4. place the lintels  
5. jointing / grouting  
6. surface treatment

brick walls  
block walls

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**design - execution**

**dimensions:** from wall surface to wall surface

**wall joints:** mortar bond / brick bond / bond with other material (e.g. steel wire, plate, etc.)

**vertical module:** the height of the brick/block

**horizontal alignment:** quarter of a brick/block have to be the smallest element
**Design Costs**

- High accuracy ceramic blocks, AAC blocks
  - thin plaster layer
  - + undercoat
  - + painting (coating)

- Clay blocks
  - 1.5 cm plaster
  - + undercoat
  - + painting (coating)

**Application of Modern Systems**

- Glued joints
- Tenon & mortise joints
- Block bond
- Joints with mortar „bag“
1. Transportation - tracks, trailers

Organizational questions:

• Unit: pallet – 300-600 bricks/ 50-150 blocks
• Transportation to the site: 7-12t truck (+ trailer)
• Moving at the site: with pallet jack / pallet track / fork-lift truck
1. Transportation - site logistic

arrangement of the palets

handtools

<table>
<thead>
<tr>
<th>Anglo-saxon</th>
<th>German</th>
<th>Asian</th>
<th>Hungarian</th>
</tr>
</thead>
<tbody>
<tr>
<td>moulding trowel</td>
<td>finishing trowel</td>
<td>+ mason's pan</td>
<td></td>
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</tbody>
</table>
handtools

- pointing trowels (round/square cross section)
- joint raker
- jointing trowels
- masons hammer
- levels
- string line

equipments

temporary structures:
- scaffolding (above 1.5m)

power tools:
- (electric) brick saw
- mortar mixer
String courses and cornices
**special shape bricks**

![Diagram of special shape bricks]

**special brick cuts**

![Diagram of special brick cuts]
Residential building, Horsens, Denmark

Fence pillar, Horsens, Denmark
Residential building, Horsens, Denmark

Custom-house, Copenhagen, Denmark
Central Railway Station, Copenhagen, Denmark

School building, Biberach, Germany
International competitions

new tendencies

bricklayer robots
new tendences

bricklayer robots

special architectural features
wiggled brick bond

special bond types

new tendencies
Brick facade, South Asian Human Rights Documentation Centre, India

Brick facade, Apartment building, New York, USA
Brick separation wall in a Villa in Bali, Indonesia

Thank you for your attention!
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http://www.diydoctor.org.uk/tips/tipsbrickwork.htm 13-04-2013
Bärtschi, Knauss, Bonwetsch, Gramatzio, Kohler: Wiggled Brick Bond, ETHZ
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