MATERIAL & TECHNOLOGY OF TARGETING AND RENDERED WALLSURFACES

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HISTORIC OVERVIEW

Neolithicum

Surfaces and mortars
- mud-mortar
- stone without mortar
**HISTORIC OVERVIEW**

**Ancient Egypt, Greece and Rome**

**Surfaces**
- brick
- stone
- plaster
- painted surfaces

**Mortars**
- lime mortar
- lime mortar + volcanic ash (pozzolanic ash)
- lime mortar + brick dust (Aegean area)
- gypsum mortar

**Middle Age**

**Surfaces**
- brick
- stone
- plaster
- painted surfaces

**Mortars**
- lime mortar
- cocciopesto in cellars (Venice)
- cocciopesto plasters in swimming pools (turkish bath)
### Renaissance

**Surfaces**
- brick / stone
- stone mouldings
- rendered surfaces

**Mortars**
- lime mortar
- cocciopesto

### Baroque

**Surfaces**
- brick / stone
- rendered mouldings (quoin and window frames) + rendered surfaces (= pargeting – „plaster architecture“)

**Mortars**
- lime mortar
- gypsum mortar
- 17th century - trass (Nette, Bohr) – Dutch Dam constructions
**HISTORIC OVERVIEW**

Classicism
19th century

**Surfaces**
- brick / stone
- stone quoins, window frames
- rendered surfaces

**Mortars**
- lime mortar
- all historic hydraulic mortar
- natural hydraulic lime (NHL)
- spread of cements

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1755-59  John Smeaton uses hydraulic lime mortars at the construction works of the Lighthouse at Eddystone

1796     James Parker – patent of Roman cement

1820     Directions for Engineers (Hungary) – prescriptions for the application of hydraulic limes (gozzolan, trass)

1824     Joseph Aspdin – patent of Portland cement

1840-42  Construction of the Chain Bridge in Budapest – on-site production of Roman cement (natural cement)

1844     Isaac Charles Johnson – clinker burnt over shrinkage temperature

1860     Lábatlan, Piszke – The first cement factories in Hungary

1860-89  Establishment of several cement factories all over the country (Beocsin, Nyergesújfalu, Mogyoróskla, Újlak/Obuda, Gurahonc, Lédec) + continuous cement import (mainly from Austria)

1897     Prescriptions of the Hungarian Association for Architects and Engineers (the first standard for cement)
COMPONENTS
- water
- aggregates
  - sand
  - rock flour
- binder
  - lime
  - gypsum
  - hydraulic materials
  - cement
- additives
  - pigments
  - etc.

AGGREGATES & AGENTS OF HISTORIC MORTARS

- aggregates
- gravel
- stone dust
- crushed stone
- fine stone dust

- pigments
- brick dust
- volcanic tuff, volcanic ash
- blast furnace slag
- fume

- characteristics amending additives
- increasing strength
- animal hair
- straw
- increasing porosity
- charcoal dust

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### Plastering Mortars

- **Mud Mortar**
- **Lime and Dolomitic Lime Mortars**
- **Gypsum Mortars**
- **Hydraulic Mortars**
  - Lime mortar + pozzolanic / latent hydraulic additives
  - Lime mortar + brick dust
  - Lime mortar + pozzolanic additives
  - Lime mortar + latent hydraulic additives
  - Natural hydraulic lime mortars
  - Roman cement mortar
  - Portland cement mortar

### Other Mortars
- **Roman Cement Mortar**
- **Portland Cement Mortar**

### MORTARS

- Lime mortar
- Hydraulic lime mortar
- Gypsum plaster (plaster of Paris)
- RC mortar
- PC mortar
- Cocciopesto (lime mortar with brick dust)
- Other mortars
The production of the cement fabric in Lábatlan (Hungary) between 1878 and 1900

<table>
<thead>
<tr>
<th>Year</th>
<th>Roman cement (t)</th>
<th>Portland cement (t)</th>
</tr>
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<tbody>
<tr>
<td>1878</td>
<td>1000</td>
<td>120</td>
</tr>
<tr>
<td>1880</td>
<td>1890</td>
<td>340</td>
</tr>
<tr>
<td>1885</td>
<td>3190</td>
<td>510</td>
</tr>
<tr>
<td>1890</td>
<td>7490</td>
<td>1090</td>
</tr>
<tr>
<td>1895</td>
<td>23950</td>
<td>7100</td>
</tr>
<tr>
<td>1900</td>
<td>8610</td>
<td>10980</td>
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The diagram illustrates the production of Roman cement and Portland cement from 1878 to 1900 in Lábatlan, Hungary.
DECORATIVE PLASTER COATINGS

• stukko-lustro
• tadelakt
• artificial marble types
• calce rasata

SURFACE DECORATION OF THE PLASTER COATINGS

• patterned plaster surfaces
• fresco
• pargeting
• sgraffito
• plaster inlay
• plaster relief
• etchwork in plaster

STUKKO-LUSTRO
work sequence:
1. course-grained lime plaster layer
2. smoothing
3. fine-grained lime plaster layer
4. smoothing
5. course-grained plaster with marble flour
6. smoothing
7. base of the painting
8. smoothing
9. painting
CALCE RASATA
work sequence:
1. wetting the wall
2. 2 coats of plaster
3. smoothing
4. rubbing (with a sponge)
5. drying (binding)
6. wetting the wall
7. 4-5 coat of smoothed, colored limewash
8. polish
9. making waterproof

TADELAKT
work sequence:
1. base coat of normal plaster
2. coat of Tadelakt mortar
3. rubbing (with a board)
4. smoothing
5. rubbing (with pebble)
6. polishing
**ARTIFICIAL MARBLE**

work sequence:
1. base coat of plaster
2. smoothing coat
3. preparing color rolls of the gypsum pulp
4. marble-like smear of the gypsum rolls on the surface
5. drying
6. 3x polishing + scraping
7. linseed oil + polishing

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PATTERNED PLASTER SURFACES

pattern types:
- rubbed
- broomed
- scratched
- raked
- pointed
- combed
- etc.

tools:
- plaster broom
- rake
- wire brush
- metal comb
- etc.

FRESCO

work sequence:
1. cleaning the wall
2. wetting the wall
3. two base coats of plaster
4. coarse-grained base coat of the painting
5. fine base coat of the painting
6. whitewash
7. painting

tools:
- paintbrushes
- templates
- etc.
PARGETING

technology:
• gypsum- or cement plaster
• rough structure or precast elements

the base:
• cast cement
• cast metal (zinc or tin)
• terracotta
• gypsum

tools:
• plastering tools
• moulding template
• scraper
• other templates

RESTORING OF MOULDINGS

- cleaning the surface, revealing the original forms
- selecting material
- to mould the negative form (e.g. with gypsum)
- preparing the moulding template, fastening the laths
- moulding:
  - base coat
    - first coat
    - rough coat
    - sharp coat
  - finishing coat
SGRAFITTO technology:
1. base coat of plaster
2. colored layers of plaster
3. finish coat
4. manufacturing the pattern

tools:
• chisels
• rulers
• spoons
• blades

ETCHWORK IN PLASTER technology:
1. plastering
2. making the etching
3. paint the lines

PLASTER INLAY technology:
1. plastering
2. scraping according to the patterns
3. fill with color mortar
4. smoothing
5. polishing

PLASTER REILEF
1. diagnostics, investigation of the structures – analysing the technical needs
   - moisture
   - salt load
   - mechanical properties

2. suggested method (in case of no confronting technical needs)
   - use of the original (historic material)
   - preserving the original fabric of the building
   - equal technology to the original one

The treads of restoring with altering material / improper technology:
- removing the original facture /material the building losing historical character/value
- material incompatibilities - improper (self-destroying) solutions
- aesthetic failures
FREQUENTLY OCCURRING FAILURES OF RESTORING

- thick mortar coating covers the fine details of the surface (disfiguration)
- the color of the used new material can be different from the host one
- restoring the building with different material – the vapor transport capacity is also will be likely to differ

RESTORING LIME AND HYDRAULIC LIME MORTARS

Re-pointing, re-grouting
- re-pointing, re-grouting with the original material
- in case of lime mortar - removing cement pointing if the wall was re-grouted with cement earlier – and it can be removed without damaging the bricks/stones

- in case of 19th century and early 20th century buildings, where originally Portland cement was used – it should not be changed unless it is technically inevitable
Restoring material for lime mortars

- every effort should be taken to match with the composition of the original material

- similar vapor-transport capacity needed as the original material has

- no higher strength recommended than the original material has

- complex investigation of the structural system (vapor stream, frost hazard etc.) have to be proceeded

- for fine work - 2-3 years lime putty should be used

Suggested compositions for Roman cement mortars (ROCEM)

<table>
<thead>
<tr>
<th>Application</th>
<th>Aggregate</th>
<th>Cement-aggregate ratio</th>
<th>w/c</th>
</tr>
</thead>
<tbody>
<tr>
<td>for cast elements</td>
<td>∅ &lt; 10mm (round)</td>
<td>1 : 2 (1 : 3)</td>
<td>0.65</td>
</tr>
<tr>
<td>for targeting (base coat)</td>
<td>∅ &lt; 4mm (main fraction: 0.25mm)</td>
<td>1 : 1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>for targeting (finish coat)</td>
<td>∅ &lt; 2.5 (1.25mm)</td>
<td>1 : 1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Remarks:

- time of binding - 30 min
- citric acid can be used as retarder
- 1 hour follow up time within two layers
- the thickness of a coat is 3-60 mm
- cleaning the surface – removal of paints (techniques depending on the material)
- treating the cracks
- completion with mortar defined by composition analyses of the original material
- surface coatings – with the same material if possible

- analyzing the ingredients (aggregates, lime, cement)

- the early Portland cements are some way similar to Roman cement

- plastering work – depending on the ingredients’ ratio

- post treatment

- fiber or mesh reinforcement – depending on the wall (base) structure, etc.
Special mortars for evaporation

Use of mortars with high microporosity and capillarity.

**Traditional method**
- lime mortar mixed with charcoal dust

**Modern materials**
- modern mortar with microporous additives
- pre-fabricated traditional mortar officially tested, with CE marking
- renovation plaster
- multi-layered plaster system (WTA)
Special mortars for desalination

in case of high salt load in the wall

1. Use of mortars with high micorporosity and capillarity that “pulls out” the salts from the wall (building a sacrificial coat)

2. If this sacrificial coat is full of salt, it should be changed depending on the state of the wall:
   - with a new desalinating coat
   - with an evaporating coat

RESTORING PAINTS ON PLASTERING

1. If the original painting at least partially exists – it should be analyzed (color, pigments, ingredient materials, etc.)

2. If a new paint is to be chosen – it should have at least the same vapor-transport capacity as the wall’s capacity is (e.g. lime-paints, silicate paints)
1. How do we know what kind of material do we have on the walls?

2. Certification (ETA, CE)

3. Guarantee and lasting

4. Budget

THANK YOU FOR YOUR ATTENTION!
REFERENCES

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