

# The geopolymer composition for restoration, construction and substitution

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# Punned geopolymer parts

1. Sandstone  
( 85 wt. % of sand).



2. Decorative part of architecture use of  
silicon mould.  
(used additive material – natural shale)



# The terracotta sculpture restoration

## 17.century

- The author G.M. Mazza – Bologna, property of National Gallery of Art, Prague, Czech Republic,
- restoration was a part of final examination in the school of professor P. Siegl,
- geopolymer chosen for stabilization and reinforcement of the sculpture after exclusion of previously mentioned possibilities as:
  - a) Use of metallic construction,
  - b) Repair with calcareous binding agents.

# Guiseeppe Mario Mazza (1653-1741)

- The front view „Virgin Maria with child Jesus and John Baptist“
- High 1.42 m
- Material - terracotta
- Support – sandstone



## State before restoration

- Rear view with large damage all over the sculpture – visible cracks and fissures missing parts, etc.
- The stabilization previously saturated by calcareous binding agent inside the statue. Damage also on robe and its gathering and two eagles in lower rear part were partially destroyed.





# Possibility to use geopolymer binder

- Joint of two original pieces of terracotta by geopolymer composite with calculated amount of non plastic additives.
- Outside coloration repeating the color of terracotta and done by combination of colored clays (content of natural iron oxides in used clays).

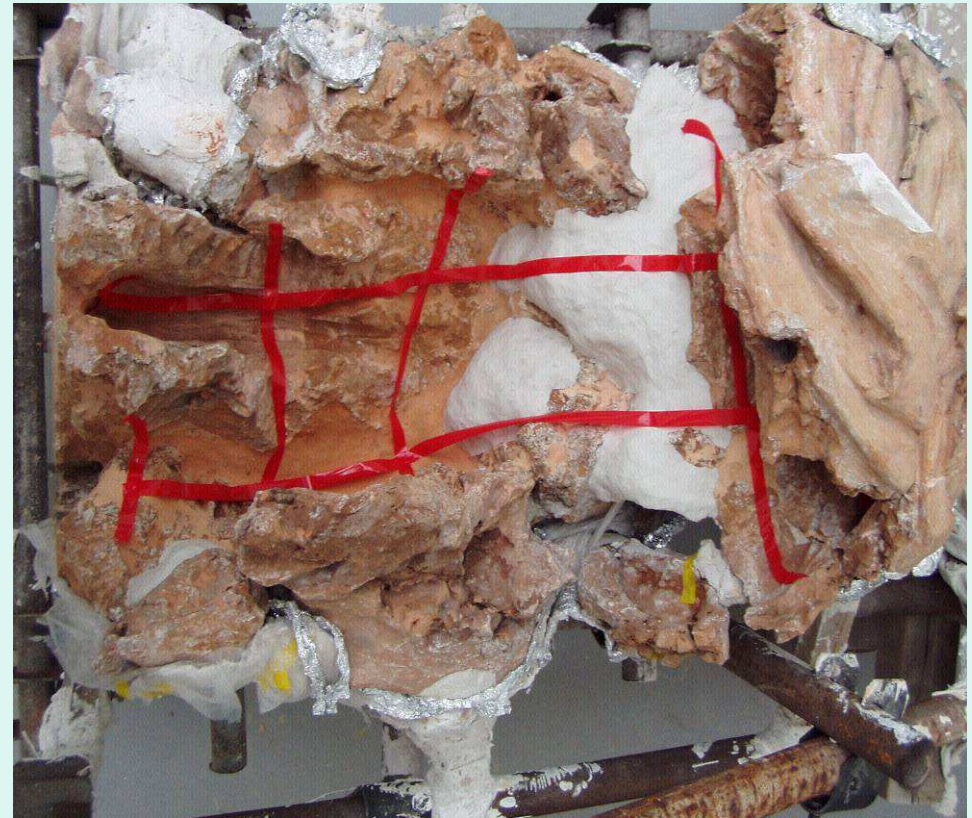


# Steps of restoration work

- The statue was laid face down to the plaster support fixing the original modulation,
- Special iron frame of the plaster support permitted the manipulation in inclined position,
- Gradually was dismantled all rear part of the statue and extracted all kind of cementing matter used in past, which filled all inner volume.
- All missing parts affecting the face modulation were substituted by plasticine – the geopolymer composite was fixed only the terracotta inner parts of the statue.
- By the plastic bands were planed the system of future geopolymer ribs.

# View from the open rear

- All damaged rear parts and all kind of cementitious agents were removed.
- Red strips mark the reinforcement plan of geopolymer ribs.
- The white parts are made from plasticine to avoid the penetration of geopolymer on the front modulation.





# State after the first geopolymer application

- The lengthways and cross ribs fixing the terracotta front parts.
- The specific singularity in masters technology was in picking the terracotta material from the inner part of the statue – irregularity in thickness of the body caused cracks and fissures during the drying and later firing of the statue the formation of „black core“ also identify the irregularity in firing process.
- White parts on the left is the plasticine support of the ribs, this will be finally replaced by ceramic.



## Replacement of rear parts

- Every returned rear part of the statue means extension of the ribs, fixing them on geopolymer reinforcement.
- The main advantage is possibility of perfect joint between previous and new part of inner ribs.
- The picture shows the whole range of damages on the rear side and necessity of reinforcement.



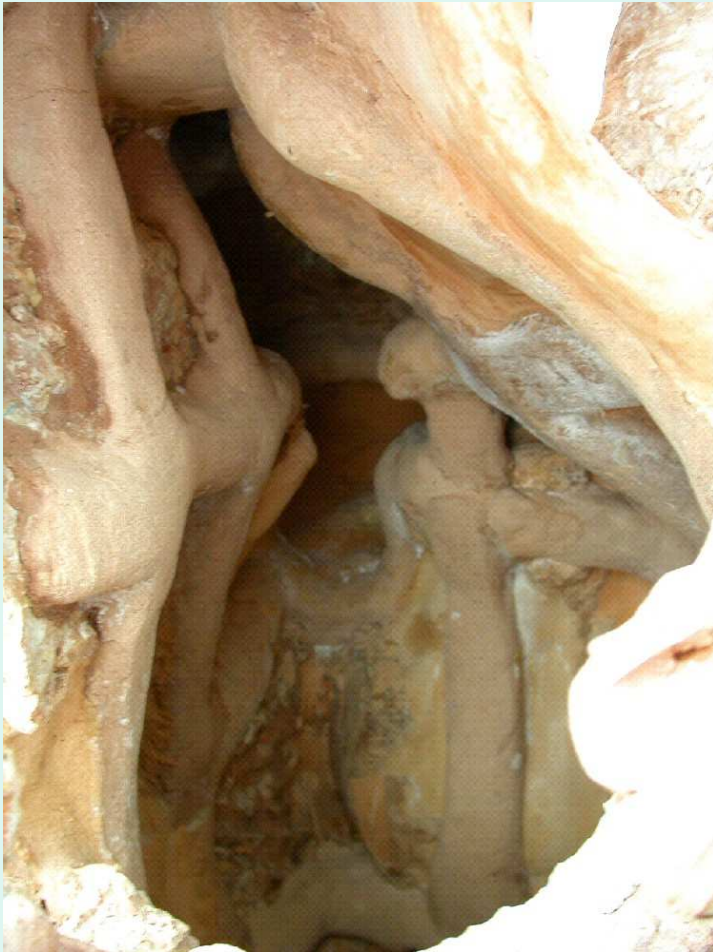
## Detailed view – inner ribs

- Each part of terracotta was fixed by new portion of geopolymer rib,
- Between the eagles could be seen white strip of plasticine substituting temporary missing part of out viewed modulation.
- The fixed parts were in many cases temporary secured by plastic bands or ropes and also by wooden spars, etc.





# The final stage



- Side view on the reinforcement inner construction before replacement of the last part of right shoulder.
- The lengthways strips are ending in the statue neck supporting the Virgin head.
- Geopolymer construction fully stabilized the statue and any filling material was not necessary.

# Repair of Adršpach Gate

- Upper picture shows state of sandstone gate (19.cetury) the main entry to the National Park of Adršpach Rocks. The upper cornice is inclined, the sandstone is hardly damaged in joints between the stones and also between the rock and stones.
- Lower picture shows detailed damage with pronounced erosion by the vegetation.





# Geopolymer composition using local sand and its application

- Geopolymer matrix (kaolinitic clay) with local sand as additive was prepared as dense paste and applied between the sandstone blocks. The same material was used as fixing the blocks to the massive rock where previous joining material was disturbed.
- Geopolymer was chosen as material non containing calcareous matters, which was excluded by the Union of natural conservators.
- The detailed view on geopolymer binder applied in between blocks of the gate.



## View on reconstructed gate

- New cornice stones were placed on the top substituting the most damaged ones. Well could be seen the joints between natural sandstone rocks and blocks of gate.
- The control after two years application constants perfect linkage on both sides and any destructions or damages even the gate is in shade and in wet surroundings.





# Geopolymer substitute of original Delft Faïence Sphinx



General view on pedestal

Delft Faïence: step-like vase for flowers in  
shape of multilevel pagoda carried by four  
sphinxes



Top of pedestal with missing sphinx

# Creation of a copy: Geopolymer with porcelain dust



Original piece



Mould fabrication – proportion 1 : 1



Remolding



View on the copy

# Result

Decorated replica



Side view on pedestal



Top view on pedestal



Thank you for your attention