

The geopolymer composition for restoration, construction and substitution

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Tampered geopolymer parts

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



2. Decorative part of architecture
formed into the silicon moulds.
(used additive material – sand and
natural shale)



The restoration of terracotta sculpture 17.century

- The author G.M. Mazza – Bologna, property of National Gallery of Art, Prague, Czech Republic,
- restoration was a part of the student final examination on the Academy of Plastic Art, School of professor P. Siegl,
- geopolymer was chosen for stabilization and reinforcement of the sculpture after exclusion of previously discussed possibilities as:
 - a) Use of inner metallic construction,
 - b) Filling the statue by the calcareous binding agents.

Giuseppe Mario Mazza (1653-1741)

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



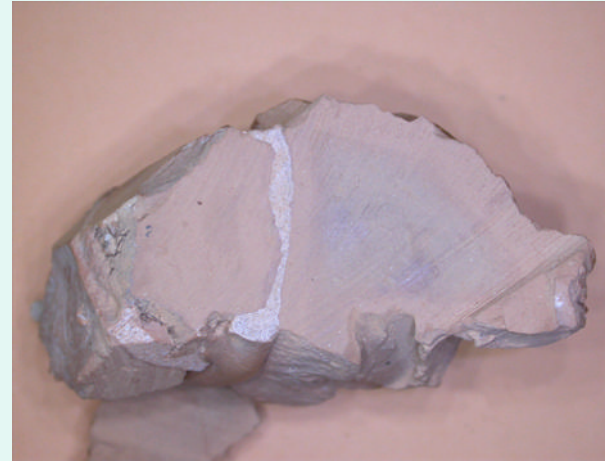
State before restoration

- Rear view with large damages all over the sculpture – visible cracks and fissures missing parts, etc.
- The stabilization previously saturated by calcareous binding agents 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 its inclined position,
- Gradually was dismantled rear part of the statue and extracted all kind of cementing matters 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 to 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 the 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“ identifies 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.

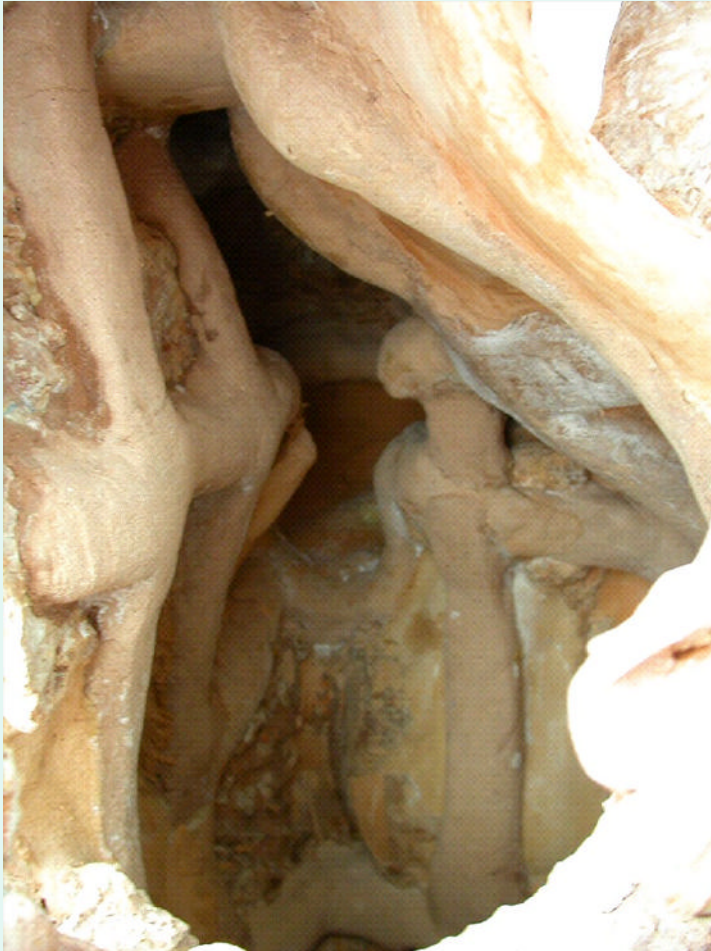


Detailed view – inner ribs

- 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



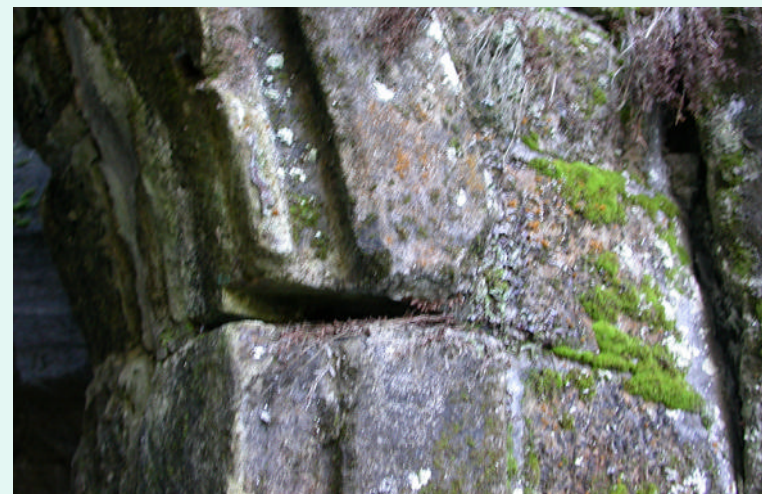
- Side view on the reinforcement inner construction before replacement of the last part of right shoulder.
- The lengthways strips are ending in the statue neck supporting the Virgin head.
- Geopolymer construction fully stabilized the statue and any filling material was not necessary.

Repair of entrance gate

- The city of Aderšpach is famous for its sandstone domes and specifically shaped needle like rocks.
- The ancient owner constructed pseudo-gothic main gate entrance to underscore the fairytale surrounding of the bizarrely formed rocks.

Repair of Adršpach Gate

- Upper picture shows state of the sandstone gate (19.cetury) - 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 based on kaolinitic clay was filled by local sand and prepared a dense paste was applied between the sandstone blocks. The same material was used for fixing the lateral gate blocks to the massive rock.
- Geopolymer was chosen as a 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