Small sized monuments: Development of non-destructive methods for consolidation

Problem

Different methods of the consolidation of stone monuments exist, leading to a general higher rock strength.

After a consolidation stone monuments often show an abritrary fracture system, damaging sometimes the whole statue or architectonical element (see photographs).

The cause and mechanism are unkown.

The geomechanical simulation is used for the prediction of fractures so that the consolidation method can be adjusted in the future before the consolidation is carried out.

Study case for full consolidation

Study case:

The baroque tombstone was erected in 1763 in Elbesandstone material of Cotta-type.

Two putti, three cartouches for inscriptions and two heads of angels within a gloriole are shown.

Location:

Cemetery of the ‚Innerer Neustädter Friedhof' in Dresden. It was founded in 1731 as a compensation for the former cemetery of the Dreikönigskirche which was removed by the Saxonian King August the Strong.

Damage pattern:

All elements undergo heavy soiling and sanding. Green algae and black crust formation are visible on the remaining original surface while rain shielded areas suffer beginning alveolisation.

Consolidation:

Innovative consolidation media of the full consolidation are the mineral consolidant Xilan S, consisting of a mixture of functional Silanes in an alcoholic solution.

In the consolidation process, the object is conditioned to a certain moisture degree. It is then coated and completely flooded with the consolidant in a tank.

Under vacuum and pressure, the consolidant fully penetrates the pore system of the object. Preferentially the solid matter of the consolidant will stabilise the outer deteriorated areas more, than the pristine inner material parts.

Topics:

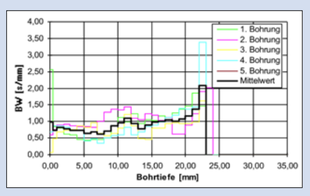
- mapping damage pattern
- microdrilling resistance measurement
- water uptake by Karsten tubes, brush test and salt analysis
- 3d-Laserscan and geomechanical simulation

Algae growth underlain by black patina.

Black patina in sheltered zone.

Crumbling

Crumbling



microdilling resistance measurement: Lowest hardness in observed near to the surface up to a depth of about 6 mm. After this zone the hardness profile tends to increase until the sound material is reached in about 23 mm depth.

water uptake measurement: reduced water uptake because of the closed pores due to soot.

Generation of a 3D-surface by means of a handheld laserscanner and the software Geomagic®

tombstone after consolidation: Relocation to a new appropriate place. The surface became more darkly and lost its original yellowish colour due to the consolidant. After the exhalation it hopefully turns into a brighter more yellowish appearance.

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