Geophysical Research Abstracts
Vol. 12, EGU2010-4870, 2010
EGU General Assembly 2010

Deformation Analysis on Ancient Structures Based on 3D Laserscanning

Stephan Schreiber and Klaus-G. Hinzen

Cologne University, Earthquake Geology Group, Vinzenz-Pallotti-Strasse 26, 51429 Bergisch-Gladbach, Germany (stephan.schreiber@uni-koeln.de)

Abstract:

During archaeological excavations in the new Archaeological Zone Cologne (AZC) in the historic city centre of Cologne (Germany), a Roman well and a medieval cesspit were analyzed. Both cylindrically shaped objects show deformations and structural damages. The damages and deformations are in line with previously described inclinations and damages of the foundations of the Cologne praetorium located 50 m to the North. The excavation is located in the eastern part of the Lower Rhine Embayment (LRE), a young sedimentary basin with typical intraplate seismicity and a seismogenic cause of theses damages is possible. In order to include both features in the current archaeoseismological study on the remains in the AZC, the structures were mapped using a phase-based 3D Laser scanner leading to two virtual models. The models of the well (238 Mio points) and the cesspit (78 Mio points) are the basis for a quantitative damage analysis. An ideal cylinder was fitted to the acquired points of the 6.5 m deep cesspit. The resulting cylinder has a diameter of 2.38 m. In order to evaluate the deformation of the entire object, the deviation of the point cloud to the cylinder was calculated. The analysis shows a damage zone between 44.5 to 47.5 m. a.s.l. corresponding to a depth of 3.5 to 6.5 m. This section includes eight rows of 384 tuff blocks. A least square procedure was used to fit planes to the front of each block, digitized out of the 3D model. The orientation of the normal vector of these fits defines the displacements and rotations of the blocks from their original position. The same technique was used on the virtual model of the 12.5 m deep Roman well for 338 blocks in 33 layers. In the well the main damage is found between 37.0 and 44 m a.s.l. The entire structure is displaced horizontally and vertically in this depth range. The individual blocks show cracking, rotation and displacement effects. Within the damage zone some of the block layers are separated from the structure and tilted up to 9° to the East. Both objects are located on the slope of a former sidearm of the Rhine River and the deformations indicate a downward movement of this slope.
Advantages of damage analysis based on virtual 3D models are: (1) high accuracy, (2) extensive measurements are possible independent from the accessibility of the object, (3) faster than classical measurements and less disruptive to the excavation.