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Determination of ground structures of the Suleymaniye complex and the Selimiye madrasa with GPR in Damaskus-Syria

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Suleymaniye complex located on the banks of the Barada River was built by Sultan Suleyman I of the Ottoman Empire or Suleiman the Magnificent (1520-1566) between 1554 and 1560, locally known as the Takiyya. This complex represents a direct implantation of architectural style of the Ottoman capital, Istanbul, in the plan of its buildings with their exterior configurations and decorative features. Its main part composes of a mosque, caravanserai, public kitchen and hospice, was designed by Sinan (the 'Great Architect Sinan'), In 1566 a madrasa including a mosque called Selimiye Madrasa was added to the East of the group of buildings by Selim II (1566-1574) of the Ottoman Empire and was linked to the Suleymaniye complex by a souk (arasta). Basic elements of architectural iconography of the complex and the madrasa are hemispherical lead-covered dome, cylindrical minaret, domed portico, courtyard, a large regtangular pool in the courtyard.

First restoration was done in the mosque during French occupation in Syria. But then the dome was inclined about 56 cm in 1920. The second restoration was done and the colons were fastened by hawsers to avoid collapsing of the dome in 1928. The network of the drainage around the complex has been changed 25 years ago. After 5 years passed, according to the Syrian engineers saying, the first subsidence deformations have started on the courtyards and the porticos surface and some fractures have been occupied on the wall of the buildings of the madrasa and the Suleymaniye complex. Now these subsidences threaten the madrasa.

The aim of the study was to determine the reason of the subsidences in the courtyards especially in the madrasa. Therefore ground penetrating radar (GPR) method was used to reveal ground structure of the whole complex, to determine buried drainage locations, and In addition to research basement of the Suleymaniye mosque. Two dimensional (2D) GPR data were acquired on the parallel GPR profiles on the courtyards around of the pools in the Selimiye madrasa and Suleymaniye complex, arasta, and some special areas around the complex using 500 MHz shielded antennas. Secondly, the GPR data measurements were also carried out on spaced 1 m parallel profiles in the Suleymaniye mosque.

The results showed that the first very shallow ductile layer was approximately 1 m thick and included some water pipes or drain pipes. The second layer was until 2.5 m depth and included buried human made structures in the Suleymaniye courtyard. They could be restoration traces in the early time or could be archaeological remains. The third layer was a more compact layer seen until the end of profile sections. However, it was seen on the profile section that third layer included more effective vertical fracture groups and some of them reached to the surface in the courtyard and the portico of the Selimiye madrasa. This result could be the reason of the deformation in the courtyard and the portico. There was no important anomaly in the profile sections of the Suleymaniye mosque to find the reason of the fractures on its dome.

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