



## **An Integrated Toolkit for the Conservation of Stone-Built Heritage**

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Rapid in situ diagnosis of damage is a key issue in the preservation of stone-built cultural heritage. This is evident in the increasing number of congresses, workshops and publications dealing with this issue. With this increased activity has come, however, the realisation that for many culturally significant artefacts it is not possible either to remove samples for analysis or to affix surface markers for measurement. It is for this reason that there has been a growth of interest in non-destructive and minimally invasive techniques for characterising internal and external stone condition. With this interest has come the realisation that no single technique can adequately encompass the wide variety of parameters to be assessed or provide the range of information required to identify appropriate conservation. In this paper we describe a strategy to address these problems through the development of an integrated 'tool kit' of measurement and analytical techniques aimed specifically at linking object-specific research to appropriate intervention. The strategy is based initially upon the acquisition of accurate three-dimensional models of stone-built heritage at different scales using a combination of millimetre accurate LiDAR and sub-millimetre accurate Object Scanning that can be exported into a GIS or directly into CAD. These are currently used to overlay information on stone characteristics obtained through a combination of Ground Penetrating Radar, Surface Permeametry, Colorimetry and X-ray Fluorescence, but the possibility exists for adding to this array of techniques as appropriate. In addition to the integrated three-dimensional data array provided by superimposition upon Digital Terrain Models, there is the capability of accurate re-measurement to show patterns of surface loss and changes in material condition over time. Thus it is possible to both record and base-line condition and to identify areas that require either preventive maintenance or more significant pre-emptive intervention. In pursuit of these goals the authors are developing, through a UK Government supported collaboration between University Researchers and Conservation Architects, commercially viable protocols for damage diagnosis, condition monitoring and eventually mechanisms for prioritizing repairs to stone-built heritage. The understanding is, however, that such strategies are not age-constrained and can ultimately be applied to structures of any age.