Geophysical Research Abstracts
Vol. 19, EGU2017-17236, 2017
EGU General Assembly 2017

Non-Destructive Approaches for the Validation of Visually Observed Spatial Patterns of Decay

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Historical structures are regarded as a built legacy that is passed down through the generations and as such the conservation and restoration of these buildings is of great importance to governmental, religious and charitable organisations. As these groups play the role of custodians of this built heritage, they are therefore keen that the approaches employed in these studies of stone condition are non-destructive in nature.
Determining sections of facades requiring repair work is often achieved through a visual conditional inspection of the stonework by a specialist. However, these reports focus upon the need to identify blocks requiring restorative action rather than the determination of spatial trends that lead to the identification of causes. This fixation on decay occurring at the block scale results in the spatial distribution of weathering present at the larger 'wall' scale appearing to have developed chaotically. Recent work has shown the importance of adopting a geomorphological focus when undertaking visual inspection of the facades of historical buildings to overcome this issue. Once trends have been ascertained, they can be used to bolster remedial strategies that target the sources of decay rather than just undertaking an aesthetic treatment of symptoms.
Visual inspection of the study site, Fitzroy Presbyterian Church in Belfast, using the geomorphologically driven approach revealed three features suggestive of decay extending beyond the block scale. Firstly, the influence of architectural features on the susceptibility of blocks to decay. Secondly, the impact of the fluctuation in groundwater rise over the seasons and the influence of aspect upon this process. And finally, the interconnectivity of blocks, due to deteriorating mortar and poor repointing, providing conduits for the passage of moisture. Once these patterns were identified, it has proven necessary to validate the outcome of the visual inspection using other techniques. In this study, three complimentary approaches were employed, ground penetrating radar (GPR), probe permeametry and 3D modelling. Each of these strategies were selected as they were both capable of substantiating the suggested causes of visible decay trends and non-destructive in nature.
GPR was employed to detect variations in the wall corresponding to the presence of hollows or moisture within the wall sections. The returns support the conclusions that empty spaces, created through the deterioration of mortar exist within the wall, allowing the passage of moisture. Using probe permeametry, the surface permeability of the wall surface was measured, analysis of which was carried out using kriging. The variograms created for this purpose suggest a significant directional element. 3D Models created by scanning the wall sections was used to calculate a measurement of roughness for the surfaces of the study area. Due to the stonework at the church being hammer dressed, the effectiveness of the determination of changing roughness was restricted, however some variation was identified. Through the combined use of these techniques, the wall scale trends suggested by the results of the visual inspection were validated. Thus, the apparent potential of these techniques, in particular the use of GPR, in supporting future studies of decay is promising.