



Abrasion Wear on Granite Stairs due to Anthropogenic Action

David Martin Freire-Lista (1,2,3), Rafael Fort (3), and María Ángeles García-del-Cura (3)

(1) Centro de Geociências da Universidade de Coimbra (CGeo). Rua Silvino Lima. Universidade de Coimbra - Polo II, 3030-790. Coimbra, Portugal., (2) Universidade de Trás-os-Montes e Alto Douro (UTAD). Quinta de Prados, 5001-801. Vila Real, Portugal., (3) Instituto de Geociencias IGEO (CSIC, UCM) Spanish Research Council CSIC – Complutense University of Madrid UCM. Madrid, Spain.

Granite has been used in important World Heritage monuments as a building stone. However, the knowledge of many aspects of this material is still rather limited. Many historic buildings have granite stairs, and in many of them abrasive anti-slip tapes are installed to prevent pedestrians from slipping. The surface roughness of pavements is related to their adhesion capacity, and the abrasion resistance determines the wear of the granite surface, and therefore its polish and abrasion resistance values. The abrasion resistance of granite depends mainly on its mineralogy. Hard minerals such as quartz increase the resistance to abrasion. In addition, anti-slip tapes incorporate abrasive grains that, when released, accelerate stone wear.

A study of interactions and compatibility between Alpedrete granite of Madrid (Spain), anti-slip tapes and pedestrians was carried out to determine the abrasion wear of granite stairs.

Surface optical micro-roughness of Alpedrete granite was measured with a portable TRACEiT micro-rugosimeter to quantify the amount of abrasion wear experienced by granite in the main entrance stairs of the Geological Sciences Faculty at Complutense University of Madrid. Forty micro-roughness measurements were performed on the surface of the stairs. The average of micro-roughness parameters (R_a , R_q and R_z) was calculated by the TRACEiT software as stipulated in DIN EN ISO 4287. The measurements have been made before the installation of the anti-slip tapes and in the following two years.

Three-body abrasion wear resistance values of two Alpedrete granite samples were determined using the Wide Wheel Abrasion test, according to UNE-EN 14157:2018.

The micro-roughness parameter values have decreased in the first two years after the anti-slip tape installation: 46% for R_a , 45% for R_q and 35% for R_z .

The average Wide Wheel Abrasion values of Alpedrete granite samples was 13.2 ± 0.9 mm.

The abrasion wear and the micro-roughness reduction observed in the granite stairs have been produced by pedestrian traffic, and they were accelerated by the detachment of abrasive grains from the anti-slip tapes.

Stairs in buildings subject to heavy foot traffic are particularly susceptible to abrasion wear. The stairs of historic and modern buildings must be monitored to minimize wear to their granite steps. Polishing of rough surface granite due to abrasion wear causes physical and aesthetic variations. Improperly selected anti-slip systems with respect to abrasion wear resistance may result in high replacement costs because the original stones of the stairs are not always easy to replace.

Acknowledgements: This work was funded by the Regional Government of Madrid, Spain, within the framework of the GEOMATERIALS 2-CM and TOP HERITAGE-CM [S2013/MIT-2914 and S2018/NMT-4372] programme.