

# **MONITORING OF MARBLE SURFACES OF THE ARCHITECTURAL HERITAGE IN A CHANGING ENVIRONMENT**

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## **Abstract**

The preservation of stone surfaces of the architectural heritage exposed outdoor in urban environment is challenging. The combined action of anthropogenic and environmental factors has been a primary and highly effective source of damage. The resulting mechanical and chemical erosion mechanisms of surfaces exposed to precipitations, as well as deposition and soiling leading to chemical alteration of the stone substrates have been extensively studied in the past. The results of environmental regulations on national and European scale for the reduction of pollutants emissions are responsible for significant variations of the overall air quality. At the same time, global climate change is altering the environmental pressure to exposed materials. The current situation therefore requires proper monitoring of the long term-behaviour of stone surfaces subjected to a changing environment. The present work reports on the diagnostic and monitoring activity conducted on the Milan Cathedral (Italy). An extensive restoration was conducted due to the precarious state of conservation of the marble surfaces of the façade. Starting from 2012, few years after the completion the restoration project, measurements of the actual stone surfaces of the Cathedral and of stone specimens exposed on the façade were performed in order to monitor the evolution of the damage mechanisms and related deterioration patterns. The monitoring approach is mainly focused on soiling and erosion phenomena. The characterization of the potential harmfulness of deposits, the evaluation of the soiling rate and the study of the effects of precipitation with respect to erosion was conducted by means of a multi-analytical strategy based on in situ and laboratory measurements.