

## Impact of climate changes on the service life and maintainability of buildings and components

### Summary

Climate change is happening at an accelerated pace and its effects on constructions must be properly acknowledged. Climate changes are expected to affect the durability of buildings and their external components, which are directly exposed to environmental loads. Constructions face new climate-related risks and hazards, which are likely to influence their degradation condition and, consequently, the expected service life. The extent to which the service life of a component could decrease or increase due to climate change induced degradation is difficult to estimate. Climate-induced degradation is a complex phenomenon, which depends on the variability, simultaneous actions and cumulative effects of several climate agents (e.g. temperature, solar radiation, precipitation and wind) over time. Additionally, the general degradation of buildings' components is influenced by non-climate-related factors, such as the (i) characteristics of the material, (ii) design and execution quality, and (iii) use conditions and maintenance activities during service life. Nevertheless, climate is determinant to the performance of buildings' external components and strongly affects their degradation process and natural aging over time.

The purpose of this research is to analyze the impacts of climate changes on the service life and maintainability of buildings and components, with a special focus on the envelope. External elements, such as façade claddings, are directly exposed to the action of climate agents and more vulnerable to the harmful outcomes of changing environmental exposure conditions. The study of (i) the influence of climate on mechanisms of degradation, (ii) the degradation evolution of components in service, (iii) the tendencies of historical climate data and (iv) the climate projections for the end of the 21<sup>st</sup> century is fundamental to define expectations on the future degradation of buildings' external components. The analysis of these subjects and of the connections between them is the base to the adaptation of an existing service life prediction model, in order to include the impact of climate changes on buildings' external components.

This research is relevant in the context of sustainability of constructions and adaptation to climate change. It provides useful information to support decision making at design and maintenance stages, with the objective of mitigating the vulnerability of buildings' external components to climate changes, delaying degradation, extending service life, lessening future maintenance needs and promoting durability.

### Keywords

Climate change impact, external building components, climate action, climate-induced degradation, service life prediction, durability, sustainability.



*Different types of defects observed on rendered façades during visual inspections: stains, cracks and loss of cohesion and adhesion (from left to right).*



### PhD student

Joana Alexandra Mirante Barrelas

### PhD program

Civil Engineering (FCT, Nova University of Lisbon; FCT, University of Coimbra; FEUP, University of Porto; EEUM, University of Minho and LNEC)

### Supervisor

Jorge de Brito (CERIS, IST, University of Lisbon)

### Co-supervisors

António Tadeu (FCT, University of Coimbra; CERIS, IST, University of Lisbon) and Ana Silva (CERIS, IST, University of Lisbon)

### Period

2019-2024

### Funding

FCT scholarship (PD/BD/150397/2019)