

DEGRADATION OF MECHANICAL PROPERTIES OF FRP COMPOSITES UNDER HYGROTHERMAL EXPOSURE: PREDICTIVE MODELLING USING MACHINE LEARNING TOOLS

Tarikul HASAN^{1a}, Pedro PEREIRA^{1b}, José P. MATOS^{1c}, João CORREIA^{1d}, Mário GARRIDO^{1e}, Susana CABRAL-FONSECA²

¹ Universidade de Lisboa, Instituto Superior Técnico, CERIS, Portugal
email: ^a tarikul.hasan@tecnico.ulisboa.pt, ^b pedro.alves.pereira@tecnico.ulisboa.pt,
^c jose.matos@tecnico.ulisboa.pt, ^d joao.ramoa.correia@tecnico.ulisboa.pt,
^e mario.garrido@tecnico.ulisboa.pt

² Nacional Laboratory for Civil Engineering, Portugal
email: sbravo@lnec.pt

ABSTRACT

Understanding the durability of FRP composites under moisture exposure is important for civil engineering structures, as they are often used in wet environments and usually designed for relatively long service lives. Having validated degradation models can be extremely helpful in developing reliable durability design provisions. Currently, robust and comprehensive degradation models, validated by extensive experimental data sets, do not exist. In this context, the study presented in this paper is a preliminary contribution to developing such degradation models for FRP composites exposed to moisture. Data were collected from the literature on the impact of moisture exposure on different mechanical properties of FRP composites. The collected data encompasses mechanical property retention, characteristics of the composites and ageing protocols, such as constituent materials (type of fibre and resin), production method, thickness, fibre-volume ratio, shape, preconditioning, immersion temperature, ageing duration and loading condition. Degradation models were developed using different machine learning algorithms and optimized by tuning the hyperparameters. The Gradient Boosting algorithm provided the best performance ($R^2=0.96$) in predicting the degradation of tensile strength, interlaminar shear strength, and flexural strength of FRPs exposed to hygrothermal ageing.

KEYWORDS

Fibre Reinforced Polymer (FRP) composites; hygrothermal ageing; mechanical properties; degradation modelling; machine learning.