# Abstract

Self-healing of microcracks has been recognized to play an important role in the overall behavior of bituminous binders. It has been widely observed that the microdamage restoration happening in the field leads to an increase in the lifespan of bituminous pavements. However, self-healing is still debated, and the overall phenomenon requires a more comprehensive understanding. In fact, the evaluation of self-healing of bituminous binders still lacks a universal testing protocol. Several approaches have been proposed by the scientific community, which stems from different ways of studying and modeling the phenomenon. In this background, the present dissertation arises from the comparison of three diverse methods to quantify healing of neat and polymer-modified bituminous binders. Based on the results, the research was furtherly developed by adopting a single testing protocol which included two oscillatory shear loading intervals separated by a single rest period. The methodological approach was focused on the effect of rest time and rest temperature with the purpose of providing simple and effective tools to predict the healing response of the binders. The analysis involved a quantitative assessment of self-healing based on the magnitude of stiffness and fatigue endurance gain, in which biasing time-dependent artefacts were properly quantified and removed. Obtained results were found to be consistent with the kinetics of self-healing phenomena and underscored the importance of multiple testing conditions for a reliable evaluation of true self-healing properties. This is mostly important when the performances of different binders need to be compared. In fact, a single parameter cannot be capable of conveying a reliable ranking between materials, since it is found to be valid only for the specific conditions adopted during testing. Therefore, a new model relying on the generalized logistic function was proposed to describe the self-healing performance of bituminous binders. However, it must be underlined that a comprehensive approach needs to include the evaluation of the overall fatigue performance, not only exclusively based on the relative assessment of self-healing. Advanced modeling also included the application of non-linear viscoelastic constitutive theory which was successfully implemented on the self-healing phenomenon. This allowed the construction of self-healing master curves in the reduced rest time domain which proved the applicability of rest time-rest temperature superposition principle. Such self-healing master curves were found to properly predict the self-healing potentials of bituminous materials.