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Extended Abstract

Effect of Extreme Climate on Long-term Performance of Railway Prestressed Concrete Sleepers †

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Prestressed concrete is currently the most used material for railway sleepers because of its superior advantages in structural performance, low maintenance, sustainability, and construction. In practice, many prestressed concrete sleepers are applied in harsh environments subject to various changes of climate uncertainties. Therefore, environmental conditions are a considerably influential factor to the time-dependent behaviour of prestressed concrete sleepers. Climate uncertainty has become a significant issue around the world which has been raised as a global political problem. The reasons resulting in climate change could be human activities, biotic processes, variations in solar radiation received by Earth, and volcanic eruptions. In recent years, the climate change caused the frequency of severe weather patterns increasing (IPCC 2007). Therefore, the railway infrastructure exposed to various extreme climates, the performance can be directly influenced by climate change. 'Extreme climate' is defined as unusual, unexpected or unpredicted severe weather based on the historical record in the most unusual ten percent [1–18].

The time-dependent behaviour of concrete has been investigated over a century ago. The gradual development of concrete deformation with time is due to creep and shrinkage. Creep strain is that the strain increases with time under the constant stress. Shrinkage is not relevant to stress and results primarily from the several factors such as loss of water. Creep and shrinkage can cause unduly axial deformation, excessive pre-camber, and loss of prestress. The excessive deflection and excessive shortening are often caused by creep and shrinkage. The unsightly cracking could occur that results in impaired serviceability and durability issues. Environmental factors can largely influence creep and shrinkage. For example, temperature rise increases the deformability of cement paste and accelerates drying [19,20].

This study aims at investigating the effects of extreme climatic conditions on the performance and time-dependent behaviour of prestressed concrete sleepers using contemporary design approaches. The study into the effects of climate uncertainties on creep and shrinkage has been investigated on the basis of both environmental temperature and relative humidity. The outcomes indicate that environmental conditions play a vital role in the time-dependent behaviour of prestressed concrete sleepers. The insight of this research can be used to evaluate the serviceability of prestressed concrete sleepers installed in extreme natural climate regions. The effect of extreme climate on long-term performance of prestressed concrete sleepers is shown as Figure 1.

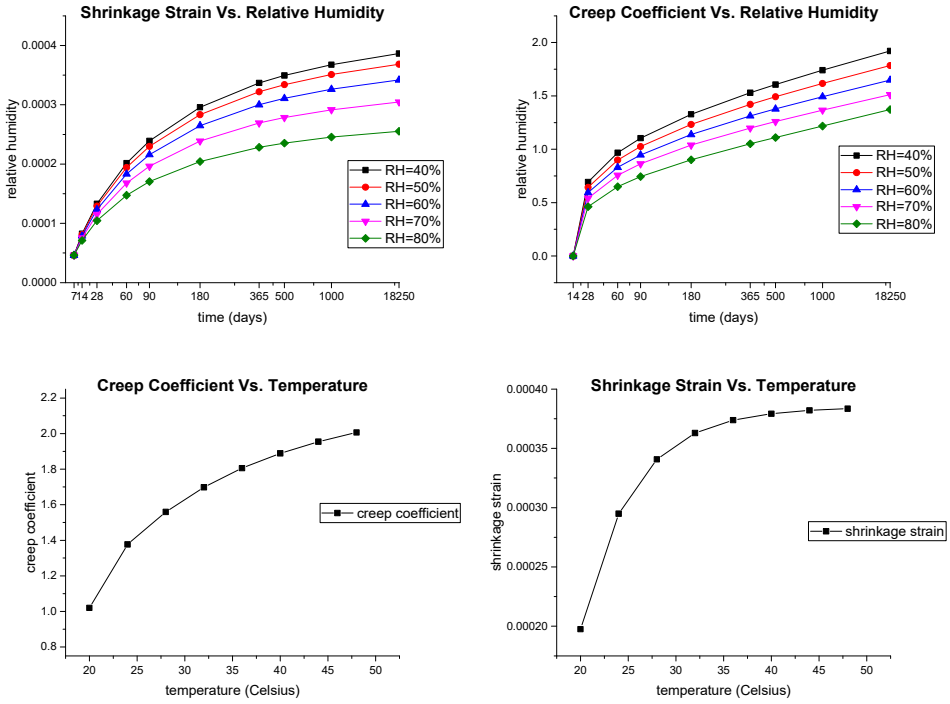

Figure 1. The effect of extreme climate on long-term performance of prestressed concrete sleepers.

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