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## Time-dependent reliability analysis of B70 pre-stressed concrete sleeper subject to deterioration

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### ABSTRACT

Railway sleepers are amongst the vital components of the rail track superstructure and play significant role in providing integrity and safe operation of the tracks. Such sleepers are manufactured with different composition among them pre-stressed concrete sleepers are more common. From the durability and the track resistance point of view, the sleepers that originate from the same factory possess almost the same mechanical properties. However, they may end up in different working conditions. Similar to all other types of structures, an initial reliability index can be assigned to pre-stressed concrete sleepers in the beginning of their service life. Naturally, this index decreases over the time according to the environmental conditions. The authors of this article have investigated the impact of penetration of chloride ion on reliability index of B70 pre-stressed concrete sleeper. It is the purpose of this paper to present the correlation between the corrosion due to chloride ion and the reliability index of the concrete sleepers. UIC713 code is used to provide for the loading conditions and the analysis of concrete sleepers. The limit state function that is used for the pre-stressed concrete reliability analysis is based on the allowable stress criteria. The simulation procedures that are used in this article are based on a computational reliability model and the Monte Carlo technique. The change in the reliability index is calculated in points with significant tensile stresses, such as the top fiber of the sleeper, the mid-span and the bottom fiber of the rail seat. The sensitivity analyses indicate that the sleeper reliability is considerably sensitive to the variations of dimension, the strength and the loading of the sleeper. It is concluded that the sleeper mid-span is more vulnerable than the rail seat and the failure at this point is more likely to occur.

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### 1. Introduction

Railway sleepers are amongst the important railway superstructures that lie between the rail and the ballast. Sleepers are composed of several materials. The most common type of the sleepers are made of the pre-stressed concrete [1]. Determination of the health and the performance of the sleepers is a key factor in maintaining railways [2]. Performance of the pre-stressed concrete sleeper is the same as a pre-cast beam in withstanding the rail forces and the compression stresses exerted by the underlying ballast layer. Fig. 1 shows a typical railway track.

Over the past two decades, durability and longevity of concrete structures have been the focus of many researches [3]. There are several good reasons for such interests. The environmental conditions that cause deterioration and corrosion in concrete structures are amongst them. The time and the intensity of the failure are dependent on the type of concrete

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