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# Elaboration of an Analytical Formula for the Calculation of the Surface Temperature

Abdelhamid Mammeri [a*], Mostefa Lallam [b]

[a] *Laboratory Mechanics of Structures, University of Tahri Mohamed, Béchar 08000, Algeria.*

[b] *Laboratory of Sciences and Water Technical, University of Mustapha Stambouli, Mascara 29000, Algeria.*

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**Abstract**

Pavement structures are sometimes subject to repeated dimensional variations of thermal origin generating mechanical stresses that may be detrimental to their durability. Among the most frequently observed degradations, by these stress, are the transverse cracks whose frequency, depth, and variable openings reduce the ride comfort. In this context, where such solicitations are preponderant and the strong variation is noticed on the surface, an analytical approach for calculating the surface temperature of a flexible pavement has been proposed. This approach is able to deal with the transient thermal problem including the phenomenon of ambient temperature and the influx of solar flux specifically for arid regions where the sky is often clear. This approach is adopted because it proposes a simplified calculation of the surface temperature. The model was built on a database measured on the experimental pavement of the laboratory of Egletons GEMH (France), using the calculation code Eureqa formulate. Although neglected in the domain's literature, the meteorological parameters (air temperature and solar flux) are taken into consideration in the analytic function because they give good prediction. The model has practical meanings to predicting the maximum, minimum, and amplitude of the pavement surface temperature. Hence, a good surface temperature assessment provides a key factor for further thermal cracking modeling.

*Keywords:* Pavement; Temperature; Solar Flux; Monitoring; Analytical Model.

## 1. Introduction

Although pavement structures are sensitive to temperature, there are not considered as an indispensable factor in asphalt pavement design in areas with large temperature differences, which may be detrimental to their durability [1]. Cracks in pavements are commonly observed in areas that experience low temperatures and large temperature differences [2]. The sizing methods around the 45th parallel (in France in particular) neglect this type of solicitations as regard the traffic.

On the other hand, there are regions where thermal stresses are predominant [3, 4], arid regions with a desert climate are part of it [5]. Pavements structures have in common cracking mechanisms of various origins. The thermal stresses and the traffic are at the origin of these disorders [6], but the nature of these will vary according to each type of structure. This variation of daily and seasonal temperature in such regions has a peculiarity, sometimes the temperature easily exceeds 45 °C in the shade in summer [7].

The influence of temperature on pavement structures remains a subject of much research in one-dimensional studies [8], two-dimensional [9], or three-dimensional [2].The amplitude and maximum of the surface temperature of pavements

* Corresponding author: mammeri_ab@yahoo.fr

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