Linear viscoelastic response of semi-circular asphalt sample based on digital image correlation and XFEM

Hasanain Radhi Radeef[a,b], Norhidayah Abdul Hassan[a], Mohd Zul Hanif Mahmud[a], Ahmad Razin Zainal Abidin[a], Ramadhansyah Putra Jaya[c], Che Ros Ismail[a], Hind Fadhil Abbas[a]

[a] School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[b] Department of Civil Engineering, College of Engineering, University of Kufa, Najaf Governorate, Iraq
[c] Department of Civil Engineering, College of Engineering, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia

ABSTRACT

Asphalt mixtures behave as linear viscoelastic materials when subjected to loading conditions that are similar to pavement operating conditions. Thus, this study proposed a novel method for extracting the linear viscoelastic properties of asphalt mixture at 25 °C using digital image correlation and repeated-load semi-circular bending (SCB) test. Digital image correlation was utilised successfully for extracting creep compliance using semi-circular samples under repeated loading conditions. A fractional time-dependent viscoelastic element converted the creep compliance data into relaxation modulus. The extracted relaxation modulus data were verified by simulating the viscoelastic response of control and modified asphalt mixtures using the extended finite element model (XFEM). The findings presented in this paper showed that digital image correlation has a high potential for bridging the gap between experimental and simulation work. The strain map provided by the prediction model was compatible with the DIC strain.

KEYWORDS

Viscoelastic; Digital image correlation; Semi-circular bending test; Extended finite element model