ABSTRAK

IDENTIFIKASI *VOID* DAN RETAKAN PADA *RIGID PAVEMENT* MENGGUNAKAN TERMOGRAFI INFRAMERAH DENGAN METODE *PRINCIPAL COMPONENT ANALYSIS*

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Rigid pavement rentan terhadap kerusakan internal berupa *void* dan retakan yang dapat menurunkan kapasitas dukung dan memperpendek umur layan struktur. Metode inspeksi konvensional memiliki keterbatasan dalam mendeteksi kerusakan bawah permukaan, sehingga diperlukan pendekatan *Non-Destructive Test* (NDT) yang lebih efektif. Penelitian ini bertujuan mengidentifikasi *void* dan retakan pada rigid pavement menggunakan termografi inframerah pasif berbasis *Principal Component Analysis* (PCA) serta menganalisis faktor yang memengaruhi tingkat kejelasan deteksinya. Pengujian dilakukan pada tiga sampel pelat beton K-300 berukuran 100 × 100 × 22 cm dengan *void* buatan berukuran 2–4 cm dan retakan buatan lebar 0,5–2 mm. Citra termal diambil menggunakan kamera FLIR E8-XT pada jarak 0,5–2,5 m dan diolah menggunakan *principal component analysis* (PCA). Hasil menunjukkan PCA mampu mendeteksi *void* dengan akurasi rata-rata di atas 90% pada jarak 0,5–1,5 m untuk sampel dengan kedalaman *void* 0,5 cm, namun tidak efektif pada jarak lebih jauh dan kedalaman *void* lebih besar. Deteksi retakan hanya berhasil pada kondisi lebar 2 mm kedalaman 3 cm di jarak 0,5 m, terbatas oleh resolusi spasial kamera. Tingkat kejelasan deteksi dipengaruhi oleh diameter, kedalaman *void*, ukuran retakan dan jarak kamera.

Kata kunci: R*igid pavement, termografi inframerah, Non-Destructive Test (NDT), Principal Component Analysis (PCA), void, retakan*

ABSTRACT

IDENTIFICATION OF VOIDS AND CRACKS IN RIGID PAVEMENT USING INFRARED THERMOGRAPHY WITH PRINCIPAL COMPONENT ANALYSIS METHOD

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Rigid pavement is prone to internal damage such as voids and cracks that can reduce its strength and shorten its service life. Common inspection methods are limited in detecting damage beneath the surface, so a more effective Non-Destructive Test (NDT) approach is needed. This study aims to identify voids and cracks in rigid pavement using passive infrared thermography combined with Principal Component Analysis (PCA), and to analyze factors that affect detection results. Tests were carried out on three concrete slab specimens (K-300, 100 × 100 × 22 cm) with artificial voids of 2–4 cm and artificial cracks of 0.5–2 mm width. Thermal images were taken using a FLIR E8-XT camera at distances of 0.5–2.5 m and processed using Empirical Orthogonal Functions (EOF). The results show that PCA was able to detect voids with an average accuracy above 90% at distances of 0.5–1.5 m for specimens with a void depth of 0.5 cm, but was less effective at greater distances and deeper voids. Crack detection was only successful for a 2 mm wide and 3 cm deep crack at 0.5 m distance, due to the camera's limited resolution. Detection clarity was affected by void size, void depth, size of the crack and camera distance.

Keywords: *Rigid pavement, infrared thermography, Non-Destructive Test (NDT), Principal Component Analysis (PCA), voids, cracks*