

Pavement damaging effects from dual tyre configurations of heavy vehicles with tyre inflation pressure differentials

Morris De Beer and Yvette van Rensburg

Abstract

Recently, analyses on Stress-in-Motion (SIM) data of heavy vehicles (HVs) from National Road 3 (N3) indicated that there are un-equal loading on dual tyre configurations. It was shown that the mass of approximately 70 percent of the *outside* tyres in a dual pair are *lower* than the average mass on the dual pair, and only 30 percent *higher*. In South Africa the majority of HVs do incorporate dual tyre configurations, especially on drive axles. Analysis of consolidated tyre contact stress and tyre inflation pressure data in addition to tyre loading resulted in a rough empirical estimate of tyre inflation pressure *directly* from SIM contact stress measurements. In an ideal world, an instrument such as the SIM could be invaluable in not only capturing the tyre loading and contact stresses, but also estimate the tyre inflation pressure of individual tyres on the fly. With this in mind, SIM experiments were completed where dual truck tyre configurations with *different tyre inflation pressures* were used under the Heavy Vehicle Simulator (HVS). General assumptions in road pavement design of equal load sharing between all tyres, axles and axles groups for heavy vehicles are challenged, including damaging effects from dual tyre pairs with *differential tyre pressures*. The aim of this paper is to present data with associated pavement analysis where dual pair truck tyre configurations with *tyre inflation pressures differentials (TIPD)* were used as input. Preliminary investigations indicated that over a total load range of 30 kN to 100 kN on a dual truck tyre pair with a rigid axle, and *tyre inflation pressure differences* ranging between 19 percent and 83 percent, the resultant *individual tyre load differences* ranged from 13 percent to 52 percent. The difference in resultant tyre loading as a direct result of TIPDs is investigated in this paper with respect to the structural response and associated behaviour of typical thinly surfaced flexible asphalt pavements. It is recommended that design factors be developed to incorporate the damaging effect of a typical dual pair of truck tyres with TIPD in structural road pavement design. The wider extent, degree and impact, however, of TIPD in dual tyres on a range of typical flexible pavements need to be further quantified in future.