ABSTRACT

Limited research exists on the loading mechanism of a brake disc. The need to determine the mechanical stresses in typical brake disc set-up has never been necessary as these stresses are well below the strength of typical brake disc materials. A recently developed wire-woven bulk diamond (WBD) ventilated brake disc with superior thermal performance has initiated a need to understand how the mechanical stresses within a brake disc are developed. The loading mechanism was separated into the resultant compressive stresses due to the clamping load and the shear stresses due to the applied braking torque. These stresses were measured experimentally using strain gauges mounted on a solid brake disc tested on a custom-built test rig. For the clamping load test, the compressive stresses were concentrated at the disc/pad contact interface. For the applied torque load test, the disc face shear stresses were found to be distributed throughout the circumference of the disc. These results were applied to design the required reinforcement of a WBD brake disc. The analysis was based on the maximum possible deceleration conditions of a medium sized truck. While the WBD material was strong enough to withstand the shearing of the braking torque, the clamping load was determined to cause failure. Consequently, straight radial ribs were designed to reinforce the ventilated core. The final dimensions of the designed rib were 74 x 14 x 2.5 mm, manufactured from mild steel (SAE1006). The core will be reinforced with 10 ribs orientated radially and equispaced at 36° intervals. The 10 ribs adds 0.20 kg to the weight of the WBD disc. Thus, the newly reinforced WBD brake disc remains lighter than a commercially available pin-finned disc, has superior thermal performance and is strong enough to withstand the required mechanical stresses.