

## THE RELATIONSHIP BETWEEN TRAFFIC AND TRACK DAMAGE – THE EFFECT OF VERTICAL LOADS

Although there are clear financial incentives to operate vehicles with heavy axle loads at high speeds as intensively as possible, it is known that there is a financial penalty and possibly also a safety penalty due to the damage that the permanent way suffers. By proper design, inspection and maintenance practices, the problem of safety can be minimised, but the financial penalty remains. Although the total cost of track maintenance can be measured, it is usually impossible to identify and apportion the damage due to particular traffics or vehicle types. It is, therefore, difficult to determine the optimum operating speeds, axle loads etc., to minimise total costs.

Track damage is caused principally by wheel/rail forces and these forces are increased by irregularities in the wheel and rail profiles. The irregularities in rail level can be expressed as a spectrum of longitudinal variations in level with different wavelengths. These create a corresponding frequency spectrum of wheel/rail force variation. The amplitude of the force variations will usually be greatest when an excitation frequency coincides with a natural frequency of the vehicle/track system. Thus it is important to consider the principal modes of oscillation of this system.

This report commences with a description of the wheel/rail forces associated with the most important modes of oscillation and how they are affected by irregularities and then discusses the various forms of track damage. The problems of sudden fracture of rails and sleeper cracking are discussed first. This is followed by a description of cumulative damage mechanisms affecting either the rail profile or the integrity of the rail, the ballast and the formation. Work to quantify some of these damage mechanisms is described, and conclusions drawn. In some instances where work has yet to start, possible lines of analysis are suggested. Only vertical loads are considered in this report.