Appendix U.3.4 – Finnish Studded Tyres

Generic Name of Test	*Rolling* Studded Tyres : Abrasion Test
Principle of Test	Loaded studded tyres orbiting
Historic Development of Test	This abrasion test uses the Technical Research Centre of Finland (VTT) testing apparatus. The test was developed to study the abrasion induced in concrete from studded tyres. Tests of this type have been made since the 1980's using testing machines in Finland, Norway and Sweden.
Apparatus and Abrasives	The apparatus consists of 4 studded tyres, which revolve about a central shaft. The track on which the wheels run varies from 3.1 to 3.7m in diameter and consists of six segments of concrete that are attached to a base. The base has a revolving eccentricity of 1cm (see figure U.3.4.1). [Komonen (1998)]

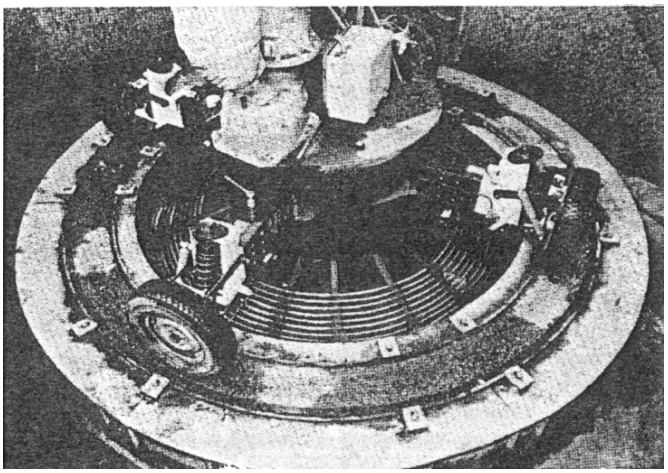

Figure U.3.4.1 The pavement-testing machine at the Technical Research Centre of Finland [Komonen (1998)]

Test Method	A 3.3kN wheel load was applied as the studded wheels ran on the track at 32 km/h. The base rotated at a speed of 1 rpm. The test environment alternated between wet and dry. 300 000 revolutions of the wheels constitutes a full test. [Komonen (1998)]
Abrasion Wear	This is measured as the abraded cross-sectional area of the concrete profile [Komonen (1998)]
References	Author — Comment Komonen (1998) — Source document

APPENDIX U.3.4

Wear Mechanisms according to Author

(i)Komonen (1998): The various concrete block pavements had different abrasion mechanisms; (1) aggregate crushing, (2) aggregate loosening, (3) nearly pure abrasion of the cement matrix.

(ii) Visual Effects: A groove with a width of 27cm is abraded into the test track due to the width of the large tyre and the eccentric rotation of the base.

Wear Mechanisms according to writer [R3 S2 I3]

(i) Rolling and Sliding: As the wheels rotate, their studs (made of steel) will be pressed into the face of the concrete and at the same time slip or slide somewhat relative to the surface. At the contact points there will therefore be both crushing and shearing effects from W and F respectively (See figure U.3.4.2) The corresponding abrasion wear may be expressed as $Q_{Crushing} \propto W$ and $Q_{Shearing} \propto F (=\mu W)$.

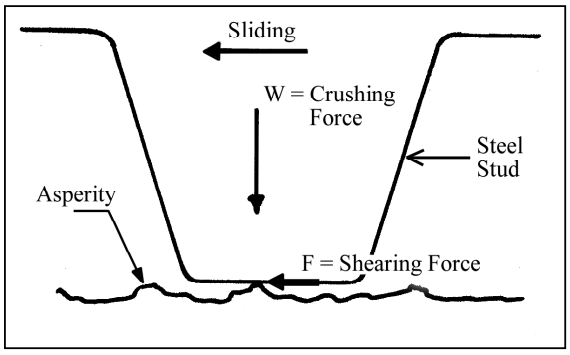

Figure U.3.4.2 Wear mechanisms beneath a stud of a tyre

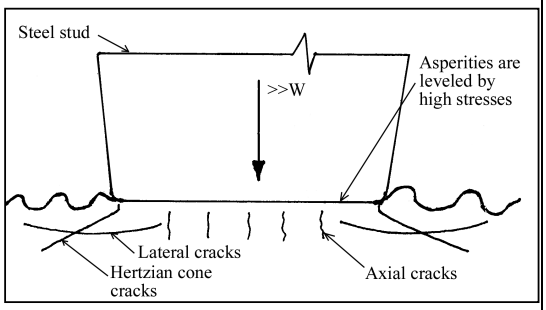

Figure U.3.4.3 Wear mechanism beneath a stud of a tyre - severe loading case

(ii) Impact: Vibration and bouncing effects occur as the wear path becomes rougher. The resultant impact has the effect of increasing W. If W is increased to a point where the asperities are levelled and the resulting stress beneath the stud exceeds a critical value, then various forms of sub-asperity cracking are possible including Hertzian cone cracks, lateral cracks, or axial cracks as indicated in figure U.3.4.3 (discussed in more detail in chapter 3). Cracks result in an accelerated wear process.

(iii) Adhesion and deformation: See note 1 in introduction to appendix U