Appendix U.4.7 – Wastlund's Steel Wheels

Generic Name of Test	*Rolling* Steel Wheels : Abrasion Test
Principle of Test	Loaded 305mm diameter wheels orbiting.
Historic Development of Test	Extensive abrasion resistance tests were carried out by the Swedish Cement and Concrete Research Institute in 1943 using the 'Road Testing Machine' of the Swedish road institute, described below. [Wastlund (1946)]
Apparatus and Abrasives	The road testing machine (figure U.4.7.1 and U.4.7.2) consists of a circular testing path with an inner diameter of 4.42m and an outer diameter of 6.1m divided into 7 sectors. 6 horizontal arms are attached to a central shaft. Two rubber tyred wheels, each driven by an electric motor are attached to two of the horizontal arms and in this way determine the speed of the central shaft. The wheel loading can be varied within wide limits. Solid rubber tyred wheels, steel wheels and leather covered wooden wheels may be fitted. [Wastlund (1946)]

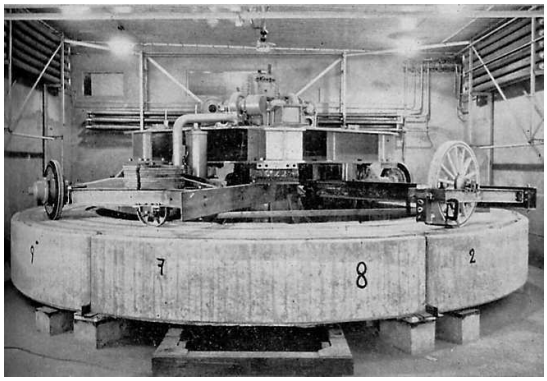

Figure U.4.7.1 Road testing machine [Wastlund (1946)]

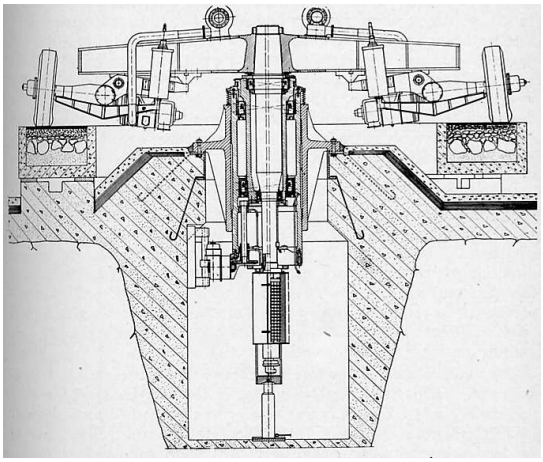

Figure U.4.7.2 Cross-section of the Road Testing Machine [Wastlund (1946)]

Test Method	Concrete test specimens were prepared and placed on the circular track. The 2 driven rubber tyred wheels ran in the middle of the testing track under a load of 800kg. A 400kg load was applied to the steel wheels, which were mounted at an angle of 4^0 to the tangent of the circumference, and ran on the inner track. The leather-covered wheels had a load of 100kg, were also offset by 4^0 and ran on the outer track. 3200 revolutions were made. [Wastlund (1946)]
Abrasion Wear	This was measured as the average depth of abrasion wear. [Wastlund (1946)]
References	Author — Comment Wastlund (1946) — Source document

Wear Mechanisms according to Author

(i) Wastlund (1946): No comments on the mechanism of wear.

(ii) Visual Effects:

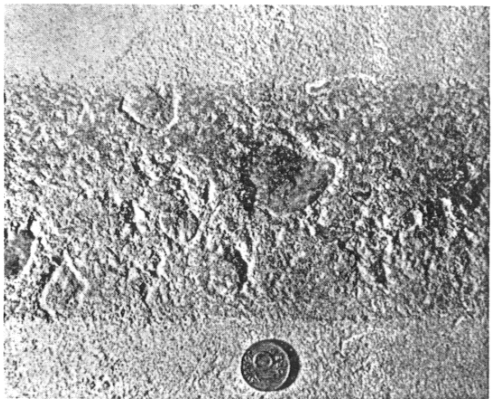

Figure U.4.7.3 Test specimen after 3200 revolutions [Wastlund (1946)]

Wear Mechanisms according to writer [R2 S1 I2]

(i) Rolling and Sliding: As the loaded wheels roll over the surface, the concrete asperities beneath the wheels will be subject to crushing effects, mainly in the case of the steel wheels. There is also significant tangential shear as a result of sliding from the offset wheel angles. The compressive force is shown as W in figure U.4.7.4, while the tangential skidding/slewing effect is shown as F, where $F = \mu.W$, and μ is the coefficient of friction between the slewing wheel and concrete. Figure U.4.7.3 confirms Wastlund's abrasion results, indicating that the abrasion wear was very superficial, with depth of wear varying between 0.2mm to 0.7mm (the very worst mix is excluded). Figure U.4.7.3 shows that only in a few isolated spots do there appear to be pockets of slightly deeper abrasion from the removal of a thin skin of mortar covering coarse aggregate particles close to the surface. (This failure, it seems, was initiated in the weaker 'transition zone' at the interface between aggregate and paste).

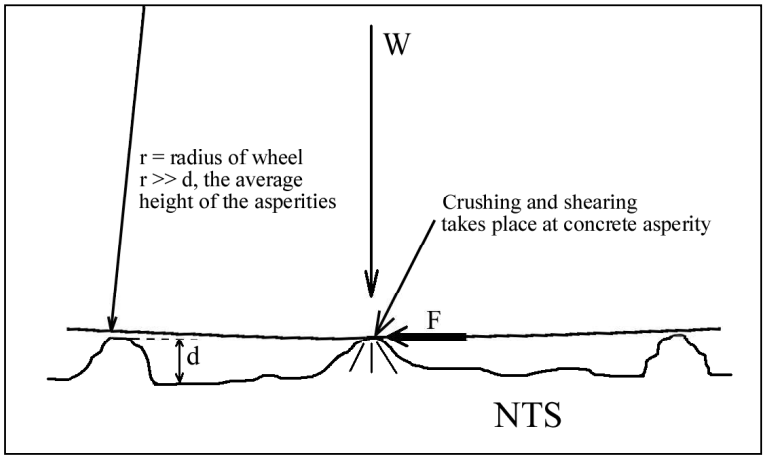

Figure U.4.7.4 Wear effects on the concrete induced by the steel wheel.

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