

Appendix U.4.5 – Fruchtbaum’s Steel Wheels

Generic Name of Test	<i>Rolling</i> Steel Wheels : Abrasion Test
Principle of Test	Loaded 76mm diameter wheels orbiting
Historic Development of Test	This apparatus was first reported by Fairchild in 1934.
Apparatus and Abrasives	The apparatus (see figure U.4.5.1) consists of horizontal arms attached to a driven vertical shaft. 2 loaded trolleys were attached to the arms with each trolley having a load of 143kg added to it. Each trolley ran on 3 swivel casters with a wheel diameter of 76mm and a width of 38mm. The apparatus describes a circular path (1.67m radius) over 7 differently mixed concrete sectors. [Fruchtbaum (1938)]

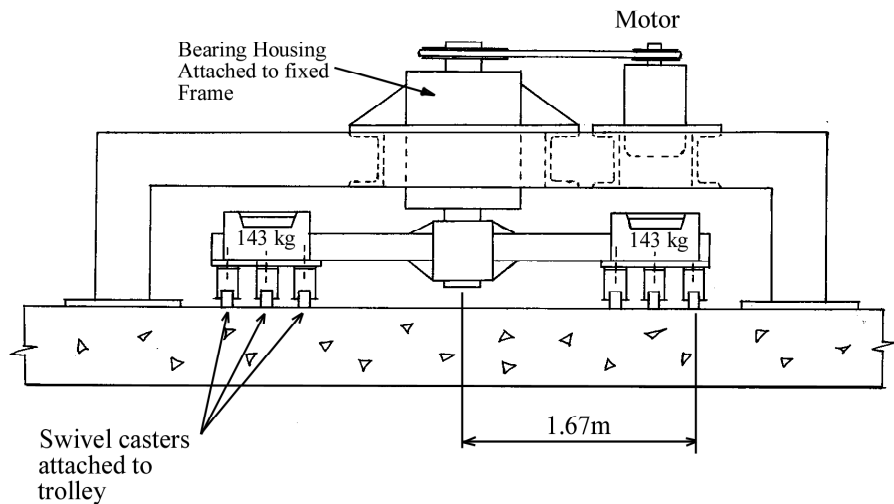


Figure U.4.5.1 Envisaged reconstruction of apparatus according to description given in text

Test Method	The apparatus was rotated at 8 rpm until a definite comparison between the different concrete mixes could be made. The exact duration of the test is unknown. [Fruchtbaum (1938)]				
Abrasion Wear	This is measured with a micrometer and is reported as the average depth of abrasion wear. [Fruchtbaum (1938)]				
References	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;"><u>Author</u></td> <td style="width: 50%;"><u>Comment</u></td> </tr> <tr> <td>Fruchtbaum (1938)</td> <td>Source document</td> </tr> </table>	<u>Author</u>	<u>Comment</u>	Fruchtbaum (1938)	Source document
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Fruchtbaum (1938)	Source document				

APPENDIX U.4.5

Wear Mechanisms according to Author

- (i) No comment by Fruchtbaum
- (ii) Visual Effects: None Available

Wear Mechanisms according to writer [R2 S2 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. There is also tangential shear as a result of sliding caused by a continuous change in direction of the wheels. The degree of slip is related to the width of the wheels and the circumference of the circular track, since the outside edge of the wheel will have a proportionally greater path to travel around the circle than the inside edge of the wheel.

The compressive force is shown as W in figure U.4.5.2, while the tangential sliding/slewing effect is shown as F , where $F = \mu.W$, and μ is the coefficient of friction between the sliding wheel and concrete.

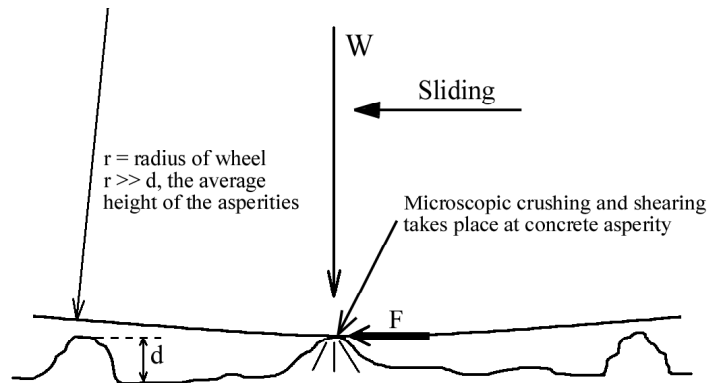


Figure U.4.5.2 Microscopic wear effects on the concrete induced by the steel wheel.

Fruchtbaum's results show that for different surface toppings and dry shakes the abrasion wear ranged between 0.63mm to 1.44mm for 50 000 'impacts' (equivalent to 25 000 revolutions). It therefore appears that very gradual attrition of asperities as indicated in fig U.4.5.2 is the correct presentation of the microscopic abrasion process, and that W and F did not induce sufficiently large tensile stresses for the onset of Hertzian cone cracks (or lateral cracking or axial cracking).

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