Appendix U.4.6 –C&CA Steel Wheels

Generic Name of Test	*Rolling* Steel Wheels : Abrasion Test
Principle of Test	Loaded 75mm diameter wheels orbiting.
Historic Development of Test	The test apparatus was developed in the 1980s at the Cement and Concrete Association (C&CA), now British Cement Association, in collaboration with Aston University to study in-situ abrasion resistance. [Kettle (2000)] The test has recently been adopted into the standard *BS 8204: Part 2: 1999 Screeds, Bases and Insitu Floorings – Part2: Concrete wearing surfaces – code of practice*.
Apparatus and Abrasives	Three 75mm diameter steel wheels mounted tangentially on a circular plate rotate on fixed individual axles each axle being radially orientated. The loading on the wheels is 65kg. The wheels wear an annular groove with a mean diameter of 225mm and a width of approximately 25mm. (See figure U.4.6.1 and figure U.4.6.2). [BS 8204:Part2: (1999)]

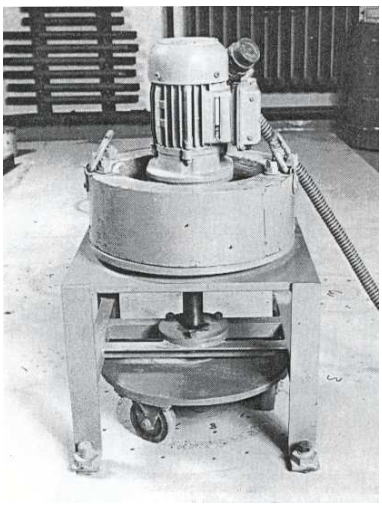

Figure U.4.6.1 The original C&CA accelerated abrasion apparatus [Chaplin (1991)]

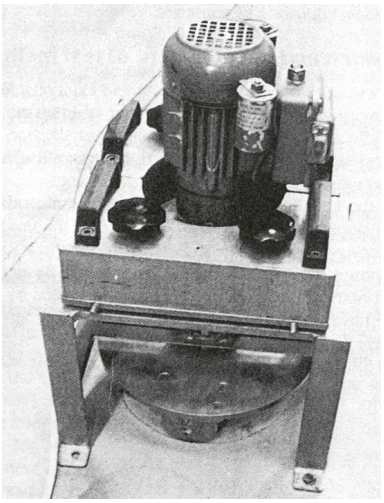

Figure U.4.6.2 Concrete Abrasion Tester (CAT) – a commercial version of the C&CA tester. The weights are easier to handle [Chaplin (1991)]

Test Method	The test apparatus is attached to the concrete being tested with a frame that is held to the floor with pins. The wheels are mounted on a disk that can follow the surface profile of the concrete thus ensuring full contact pressure between the wheels and floor. The duration of the test is 2850 revolutions at approximately 180 rpm, which takes approximately 15 minutes. [BS 8204:Part2: (1999)]
Abrasion Wear	The depth of wear is measured with a bridge micrometer at 8 locations around the wear track (see figure U.4.6.3) and the mean is used to express the abrasion resistance of the surface. [BS 8204:Part2: (1999)]
References	<u>Author</u> <u>Comment</u> BS8204: Part2: (1999) Source document Kettle (2000) Source document Chaplin (1991) Source document

APPENDIX U.4.6

Wear Mechanisms according to Author

(i) Chaplin (1972): The wear mechanism corresponding to heavily loaded steel wheels may be a combination of scratching or scuffing, friction and localised crushing of the aggregate or matrix.

(ii) Visual Effects:(See figure U.4.6.3)

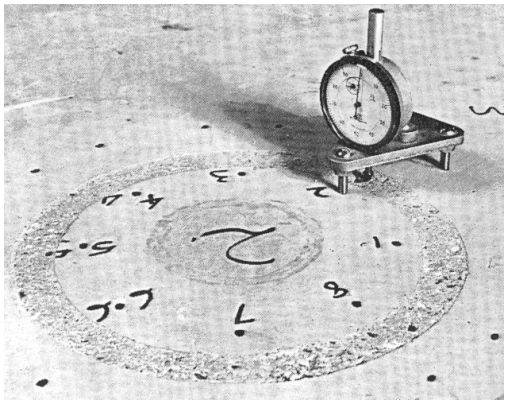

Figure U.4.6.3 Visual impression of abrasion wear and measurement of wear depth [Chaplin (1991)]

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.4.6.4, while the tangential slip effect is shown as F , where $F = \mu.W$, and μ is the coefficient of friction between the slewing wheel and concrete.

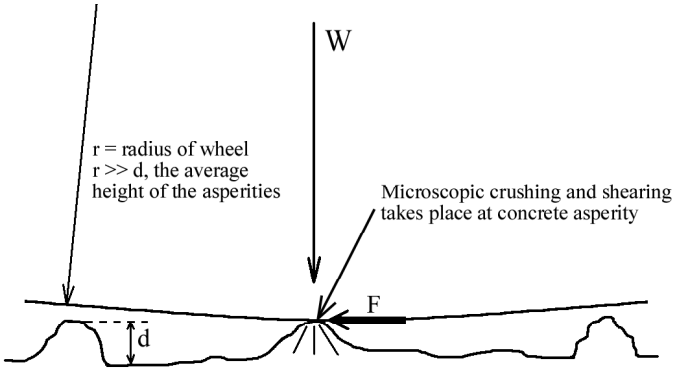

Figure U.4.6.4 Microscopic wear effects on the concrete induced by the steel wheel

(ii) Impact: This test may be classified as a 'mild' abrasion test with only limited impact, restricting abrasion effects to asperity crushing as shown in figure U.4.6.4. Proof of the mild nature of the test is that BS 8204 requires that the depth of wear should not exceed 0.4mm after 15 minutes of operation on a class AR3 floor (made from a grade C40 concrete). Note that for classes AR1 & AR2 the limitations are 0.1mm & 0.2mm)

However, it is conceivable that greater depth of wear will be obtained for poorly finished or weak concrete mixes. If the coarse aggregate is hard relative to the mortar and becomes exposed, then a degree of bouncing/vibration / impact will result, with accelerated penetration rates.

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