Appendix U.5.13 – Schuman's Revolving Discs

Generic Name of Test	*Sliding* Fine Abrasive : Abrasion Test
Principle of Test	Loaded rotating steel discs moving in planetary circuit cause abrasive to slide/roll over specimen
Historic Development of Test	This test was developed by Schuman and Tucker for the National Bureau of Standards in order to investigate the wear of concrete surfaces up to depths of 2.5mm. The test results were reported in 1939. This test was a forerunner of the ASTM C779 Procedure A. [Schuman and Tucker (1939)]
Apparatus and Abrasives	Three abrading disks of 76mm diameter are each attached to a vertical shaft by means of a universal joint, which in turn is attached to a rotating plate. This allows the discs to rotate as well as move in a planetary circuit, resulting in a circular abrasion track. Each abrading disk carries a load of 11 kg and No.60 silicon carbide abrasive sand is used. [Schuman and Tucker (1939)] (See figure U.5.13.1)

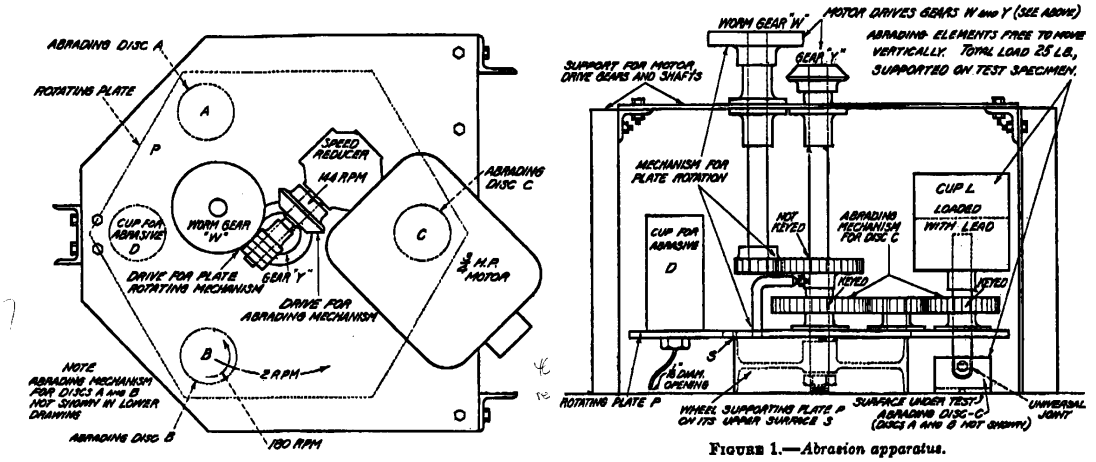

Figure U.5.13.1 The Schuman and Tucker abrasion machine [Schuman and Tucker (1939)]

Test Method	The apparatus is secured to the concrete test specimen or floor and the apparatus run for approximately 20 minutes. The main planetary disk turns at 2 rpm while the smaller revolving disks are rotated at 180 rpm. [Schuman and Tucker (1939)]
Abrasion Wear	The depth of wear is measured at 8 points around the abraded area and the average depth of wear reported. [Schuman and Tucker (1939)]
References	Author — Comment Schuman and Tucker (1939) — Source document

APPENDIX U.5.13

Wear Mechanisms according to Author

(i) Schuman and Tucker (1939): Pitting may be due to exposure of voids in the mortar or concrete, or to actual loosening of particles of aggregate.

(ii) Visual Effects:

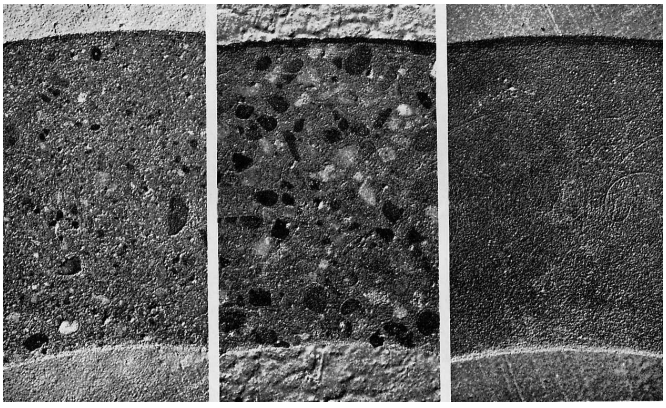

Figure U.5.13.2 The appearance of 3 different concrete slabs showing varying degrees of pitting after testing with the Schuman and Tucker apparatus [Schuman and Tucker (1939)]

Wear Mechanisms according to writer [R2 S2 I0]

General comment on the pitting effects in figure U.5.13.2: The combination of disk rotation and planetary motion means that any loosened aggregate particles can be spun out at the rear end of the rotating disks as they move forwards along their planetary circuit. This is discussed in greater detail in U.5.15

(i) Rolling and Sliding:

The mechanism of wear is one of microscopic crushing and/or shearing at the contact points, as the sand is made to move laterally beneath the specimen. The sand will both slide and roll. The predominant action in the case of sliding will be shearing in the form of scratching, scraping and cutting of the asperities. In the case of rolling, sharp points are likely to generate high compressive stress, resulting in microscopic crushing in very localised areas. These wear mechanisms are illustrated in figure U.5.13.3

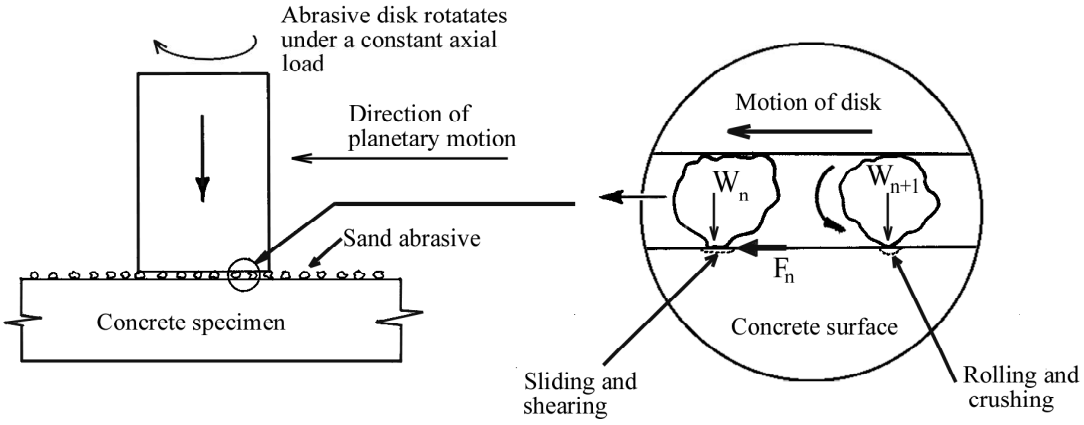

Figure U.5.13.3 Rolling and sliding wear mechanisms

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