Appendix U.6.4 – Diamond Tip Scratcher

Generic Name of Test	*Sliding* Diamond Scratcher : Abrasion Test
Principle of Test	Loaded diamond tip slides over specimen
Historic Development of Test	In 1824 Mohs, a German mineralogist numbered a range of minerals of increasing hardness from 1 to 10 such that the harder material was a minimum of 1.2 times harder than the preceding soft mineral on the scale and thereby able to scratch it [Hutchings (1992)]. This proposed test assumes that the softer the surface, the deeper will be the penetration of the diamond tip.
Apparatus and Abrasives	The apparatus consists of a 5mm diameter steel rod with a diamond tip

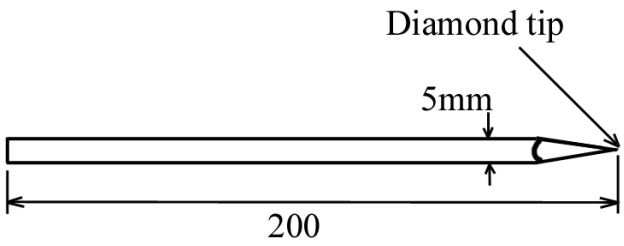

Figure U.6.4.1 Steel scratch tester with pointed diamond tip

Test Method	The test specimen is placed on a firm surface and applying constant pressure, the sharp diamond tip on the steel rod is drawn by hand over the surface at a constant angle θ.
Abrasion Wear	The depth of the scratch in the concrete specimen is compared to scratch depths in other parts of the test site, as well as that of a surface of known and acceptable abrasion resistance.
References	Author — Comment v.d. Klugt (1989) — Source document Hutchings (1992) — Source document

APPENDIX U.6.4

Wear Mechanisms according to Author

(i) Not applicable – the 'author' is also the 'writer'

(ii) Visual Effects: This will vary from a faint scratch mark for very hard concrete surfaces to relatively deep grooves for concretes with inferior surfaces.

Wear Mechanisms according to writer [R3 S3 I0]

(i) Sliding: As the steel scratcher moves across the surface, the concrete asperities beneath the diamond tip will be subject to shearing and crushing effects. The compressive force is shown as W in figure U.6.4.2, while the tangential sliding force is shown as F. The depth of abrasion and failure mechanism will depend on the applied normal load W, the angle of attack θ, and the hardness of the surface. Hard surfaces will experience a mild loss of the asperities as shown in figure U.6.4.2, whereas soft surfaces will experience deep penetration of the diamond tip coupled with lateral cracks as shown in figure U.6.4.3. A sharp diamond tip is unlikely to cause Hertzian cone cracks or axial cracks, since it will cut into the surface rather than set up the tensile stresses associated with the depression into the surface of a relatively blunt object. Similarly the high compressive stresses required for axial cracks are not readily generated by hand.

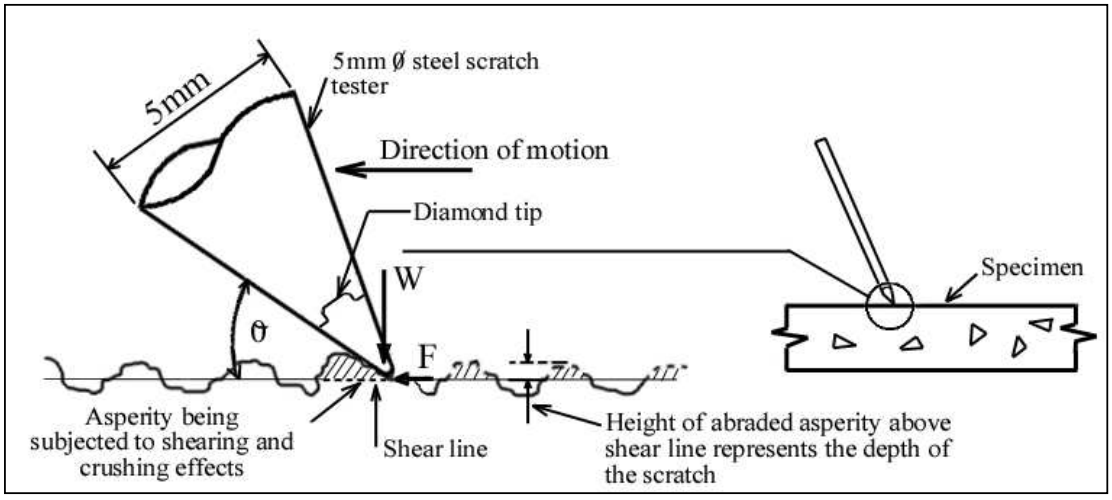

Figure U.6.4.2 Magnification of the abrasive actions of the scratch-tester

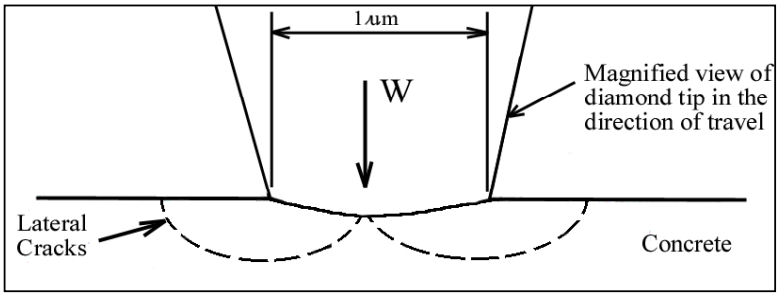

Figure U.6.4.3 Lateral cracking from high contact pressures is possible for large values of W in relatively soft surfaces.

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