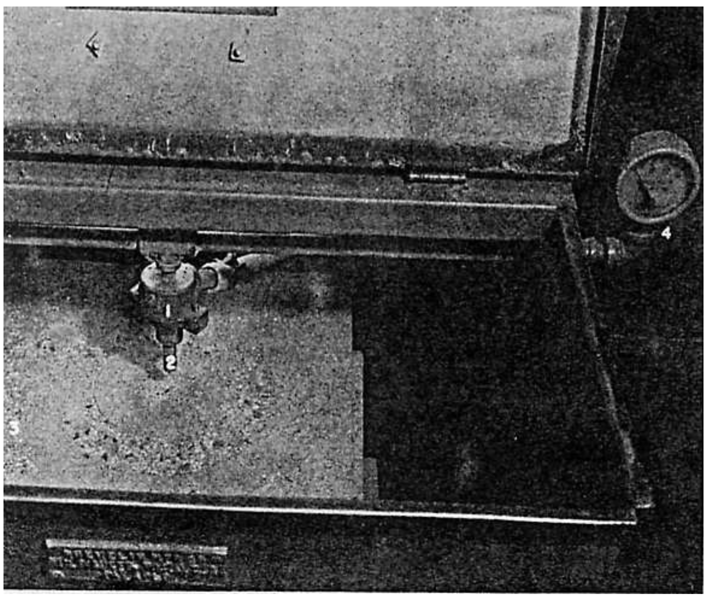
Appendix U.5.20 – Ruemelin's Shotblast

Generic Name of Test	*Impact* Fine Abrasive : Abrasion Test
Principle of Test	Steel shot is pneumatically propelled against the surface
Historic Development of Test	This test is described by Ruemelin in 1958. It is the forerunner of the ASTM C418 test, which used the same blast cabinet described by Ruemelin, but differs in other ways such as substituting sand abrasive for broken steel shot. (The ASTM C418 test became the standard in 1958). [Lane (1978)]
Apparatus and Abrasives	The apparatus shown in figure U.5.20.1 consists of a blast cabinet equipped with a blast nozzle with an aperture of 6mm. 2000 pieces of No. 20 broken steel shot are used. A suitable clamping mechanism is provided to secure the test specimen [Smith (1958)]
 **Figure U.5.20.1** Ruemelin shotblast apparatus [Smith (1958)]	1) Air and steel shot mixing chamber 2) 6mm nozzle 3) Test specimen 4) Air pressure gauge
Test Method	The test specimens are weighed dry and clamped in the blast cabinet 102mm from the blast nozzle. The steel shot is ejected at 620 kPa at a rate of 500g per minute. 8 tests are performed on each specimen after which it is again weighed. It is not known if a shield plate is used to concentrate the abrasive in a focused area (as done in ASTM C418). From the picture of the apparatus, it seems that it is not. [Smith (1958)]
Abrasion Wear	This is measured as the loss in mass of the test specimen. [Smith (1958)]
References	<u>Author</u> <u>Comment</u> Smith (1958) Source document Lane (1978) Source document

Wear Mechanisms according to Author
(i) Smith (1958): No comments on the mechanism of wear are made
(ii) Visual Effects

Wear Mechanisms according to writer [R0 S2 I2]

(i) Impact: A steel shot particle of mass m, and considerable initial velocity U , strikes a surface at angle θ . This results in impact wear Q_{impact} (mm^3) such that $Q_{impact} \propto \frac{m.U^2}{H}.f(\theta)$ where H is the indentation hardness of the surface material, and $f(\theta)$ is a function of the angle of impact, generally a maximum at 90^0 in brittle materials [Hutchings (1992)]. On impact, crushing and shearing (in the form of cutting, scraping and scratching) of asperities will take place, as indicated in figures U.5.20.2 and U.5.20.3 while sub-asperity cracking (in the form of Hertzian cone cracks or axial cracks) will only occur superficially given the low mass of the steel shot particles.

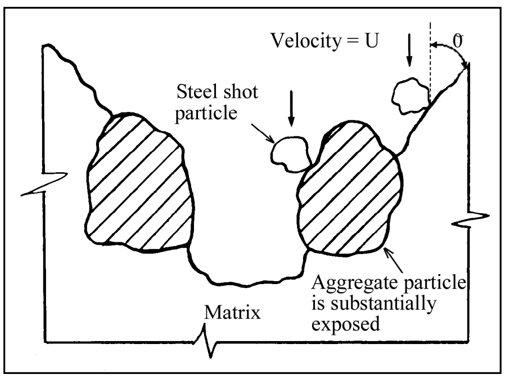


Figure U.5.20.2 Cross section of a typical crater. Abrasion wear of the matrix of paste and fine aggregate occurs at a far greater rate than for the course aggregate. The course aggregate becomes progressively more exposed until it is eventually dislodged and blown out.

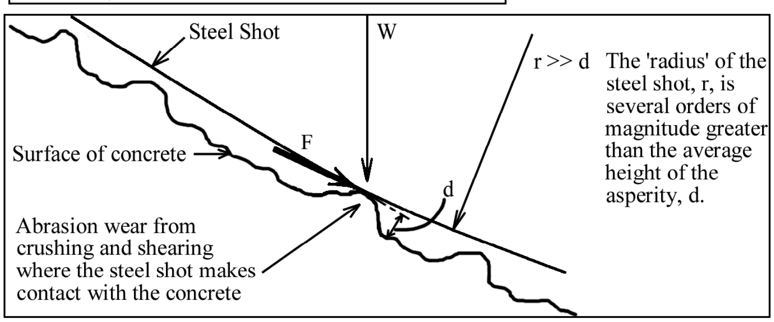


Figure U.5.20.3 Microscopic wear mechanism of a shotblast test. W and F are respectively the crushing and shearing forces from the impact of the steel shot against the concrete's surface

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