An experimental study of the disc-jaw relative displacement along the contact length in a standardized Brazilian disc test using 3D DIC

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Introduction: A recently introduced theory [1] for the determination of frictional stresses developed at the disc-jaw interface during the standardized execution of the Brazilian disc test is here assessed experimentally using the 3D Digital Image Correlation technique. According to this theory the frictional stresses T(τ), at any point τ of the common contact length, are related to the mismatch U(τ) between the disc's and jaw's tangential displacements as T(τ)=*f*U(τ)P(τ). Here *f* is a constant related to the coefficient of friction and P(τ) is the distribution of radial pressure at point τ [2]. A typical variation of T(τ) along the contact arc is shown in Fig.1 for various *f*-values.

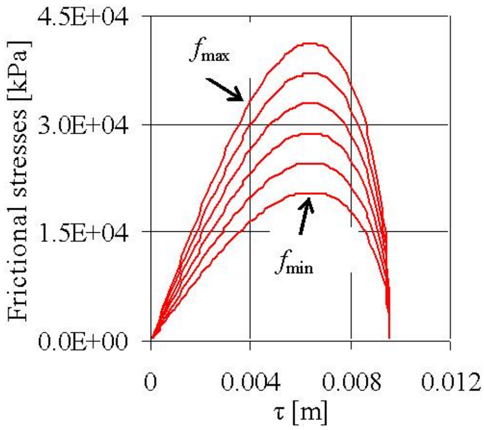

Fig.1 Frictional stresses at the disc-jaw interface [1]

Experimental procedure: Series of Brazilian disc-tests were carried out under quasi-static loading conditions. The tests were realized using the standardized apparatus suggested by ISRM (Fig.2) mounted to a 50 kN electro-mechanical INSTRON loading frame. The specimens (cylindrical discs of thickness w=10 mm and diameter D=100 mm) were made from PMMA. The choice of the specific material was dictated by its brittle nature and the fact that its constitutive behaviour approaches that of a linear elastic material (at least for loads not approaching the fracture load) as assumed in the theoretical analysis [1]. The displacement-field at the immediate vicinity of the disc-jaw contact arc was measured using a 3D-DIC system by LIMESS (Fig.2). One of the specimens' bases was covered with a speckle pattern providing the features for the matching process.

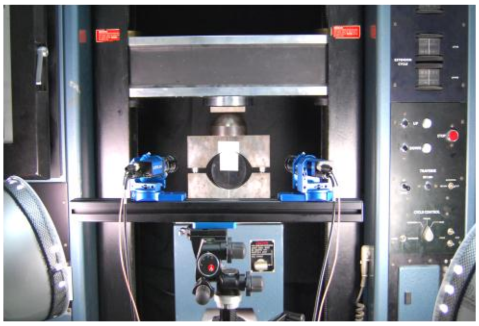

Fig.2 The experimental arrangement

Results and discussion: A characteristic distribution of the relative tangential displacement U(τ) along the contact length, experimentally obtained is shown in Fig.3 (continuous line). Point (270°, 0) corresponds to the initial contact generatrix (unloaded device) while point (277.5°, 0) corresponds to the end of the contact arc for an external load equal to 11 kN. In the same figure the theoretical predictions for U(τ) [1] are plotted (dotted line) for comparison. The agreement is satisfactory.

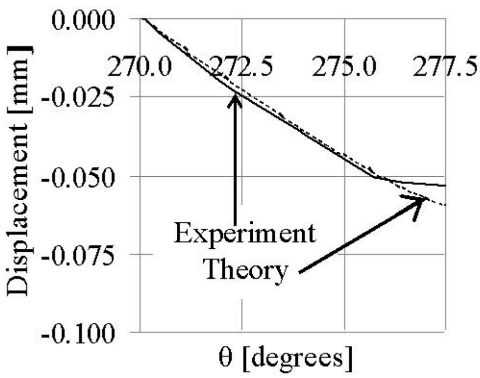

Fig.3 The relative displacement at the disc-jaw interface

References:

1. Kourkoulis S. K, Markides Ch. F. and Hemsley J. A., ECF19, Kazan, Russia (to appear).
2. Kourkoulis S. K, Markides Ch. F, *Rock. Mech. Rock. Eng.*, Online First, 25 Nov. 2011.