Measurement Apparatus for Residual Stress of rock core with Laser Interference FringEs - at South African Gold Mine

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The stress state in a basement rock is one of the most important control parameters to unstable phenomena like earthquakes including mining earthquakes. Measuring the stress acting on a basement rock prior to excavation is important for safe mining. Especially, it is useful to know the direction of the maximum principal stress and the extent of the differential stress. Thus, we developed a new apparatus to measure the deformation of rock core samples from a borehole due to the residual stress. Differing from the traditional ASR method, this apparatus intends to determine circumference profile of rock core, so that it can identify the direction of major principal stress more accurately. Also, this apparatus was designed to run on dry-cell battery and motorbike battery, which are versatile and portable. This makes it possible to transport the apparatus and perform measurement in the field. All batteries will be removed during transportation, so that the apparatus will not be activated for safety.

We used the laser interference fringes to determine the circumferential profile of rock core sample. Distance between neighboring dark interference fringes in the laser beam transmitting through a slit, can be calculated with function of a path length, wavelength of laser beam, and slit width. Therefore, a slit width can be estimated by measuring width of dark interference fringes. The apparatus applies this principle to identify circumference profile of a rock core as follows: Hold a rock core on a rotation table, and make a slit with a knife-edge. Measure the position of knife-edge using a dial meter. Transmit laser beam through the slit and estimate the slit width. Rotate the core and repeat the above procedure at each given angle. Profiles of the position of knife-edge and the slit width recorded in a notebook PC give the circumference profile of rock core sample.

The specification of this apparatus is followings:

Model / Type : MARS-LIFE1
Component : Core Radial Component
Measurement Accuracy : 10micron max.
Power Supply : DC3V(Laser beam source), DC6V(Support light), DC12V
Electric Power Consumption : 100VA max.
Permissible Temperature Range / Temperature Tolerance Range : 0-40degreesC
Outside Diminution : W600mm x D400mm x H392mm (without legs)

We measured the deformation of rock core samples drilled from the borehole at the Tau Tona mine in South Africa (Ogasawara et al., this meeting). Since a drilling site was the severe environment of 2.9km below ground, it became indoor measurement at the office of ISSI ltd. Due to the lack of the accuracy (about strain of 10**-3 for the present version of our apparatus) for such a hard rock (the site mainly consisted of quartzite) and the highly crushed condition around the borehole, we could not detect any residual strain. Now, we are developing the second version to improve the accuracy problem and the weight problem.

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