Weld deformation of hydraulic support measurements by using FBG sensors

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Abstract

The welding deformation and cracking of hydraulic support structural parts have always been an important issue that impacts product quality and performance in the industry. In order to quantify the deformation of the welding seam of the reverse four-bar linkage hydraulic support under loading conditions, a real-time weld monitoring system based on sensitive Fiber Bragg Grating sensors is designed, which contains a hydraulic pressure measurement unit based on a NI DAQ-USB 6002 and an optical fiber data acquisition unit mainly composed by a SM125-500 demodulator, meanwhile they are synchronized by the timestamp of the host computer. Four typical eccentric load experiments were performed on a top coal caving reverse four-link support in the test bench of Safety Access Analysis and Verification Laboratory for Mine Support Equipment. The results prove that the Fiber Bragg Grating sensor is accurate enough to measure weld deformation of hydraulic support, measurement resolution reaches 0.1 mm and the eccentric load experiment makes the reverse four-bar torsion force, especially when the top beam at a low position, the maximum deformation of the weld reaches 100 mm.

Full Text

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Figures

Figure 1

Deformation sensor.

Figure 2

The layout of measuring points and 3D model of ZFG10000/23/38.

Figure 3

The synchronized measurement system for hydraulic pressure and welding seam.

Figure 4

Loading diagram and block position. (a) Top beam at the low position; (b) Top beam at the high position; (c) The block at the left side of the top beam; (d) The block at the right side of the top beam.

Figure 5

Hydraulic pressure waveform. (a) Top beam at the high position; (b) Top beam at the low position.

Figure 6

Weld deformation of eccentric loading of the top beam at a high position. (a) The block on the left side; (b) The block on the right side.

Figure 7

Weld deformation of eccentric loading of the top beam at a low position. (a): The block on the left side; (b): The block on the right side.

Figure 8

Cycle loading test with the top beam at a low position. (a) block on the left side; (b) block on the right side.