

Field-Use Round Determinate Panel Test System

Objective

To develop a portable field-use testing system for conducting ASTM-1550-05 round determinate panel tests. The test system can be used at the mine site to obtain shotcrete toughness strengths that are required for determining the support requirements for mine openings, minimizing falls of ground, and reducing mine roof-fall incidents (Figures 1 and 4).



Figure 1. Portable round determinate panel test system.

Background

When shotcrete is used as part of a ground support system in mining, it is important to know the placed strength of the shotcrete. The round determinate panel test (RDPT) was developed to quantify the resistance to tensile failure and toughness of fiber-reinforced shotcrete. The tension cracks produced by the RDPT represent the failure type observed in underground tunneling and mining. There are two design values obtained from the RDPT, the load profile and the energy. Both of these values are used when designing ground control for underground openings. While many methods have been tested for measuring strengths, RDPT is the preferred method for directly measuring determinate breaks and providing resultant toughness.

Operating the Portable Round Determinate Panel Test System

Round panel samples are formed by spraying shotcrete into 75 x 800-mm (3 x 31.5-in) mold rings. The upper surface of each panel is leveled with a screed to a flatness tolerance of within 5 mm (0.2 in). Each sample must measure between 70 to 90-mm (2.75 to 3.5-in) high and 750 to 850-mm (29.5 to 33.5-in) in diameter, with correction factors available for variances. Three samples are usually made for each test interval, and tests are typically conducted after the shotcrete has cured for 7, 14, and 28 days.

The portable RDPT system is a self-contained, closed-loop, servo-controlled, stiff-frame press. To conduct a test, a cured sample is positioned on three support pins centered below the test system's ram. After the ram is lowered to a position just above the sample, an automated test cycle is initiated by depressing the green start button, which initiates the test and also starts the data acquisition system. The ram is set at a

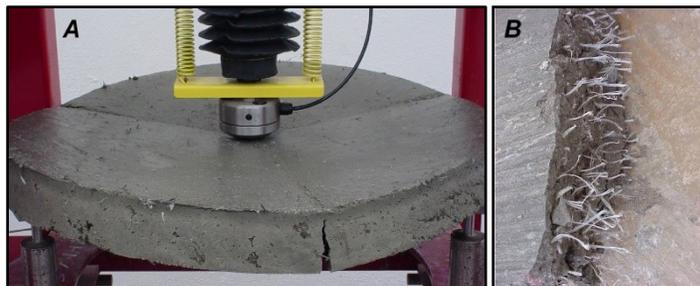


Figure 2. Shotcrete test specimen. (A) Three determinate tension cracks as produced during a test. (B) A typical panel cross section showing fibers.

stroke rate of 4.00 mm/min (0.16 in/min) as per ASTM specifications; a full test stroke is 45 mm (1.77 in). During the test, the operator observes the sample for the development of three tension cracks (Figure 2). The cracks usually develop at less than 5 mm (0.2 in) of ram displacement. After a full test stroke, the press head automatically retracts to unload the sample. The test specimen is then measured in 10 spots for thickness, and a relative fiber count is conducted on the broken face of the sample (Figure 2).

Data for load and displacement is gathered using an Eaton data logger. Typical round determinate panel test results comparing shotcrete load and energy versus displacement are shown in Figure 3.

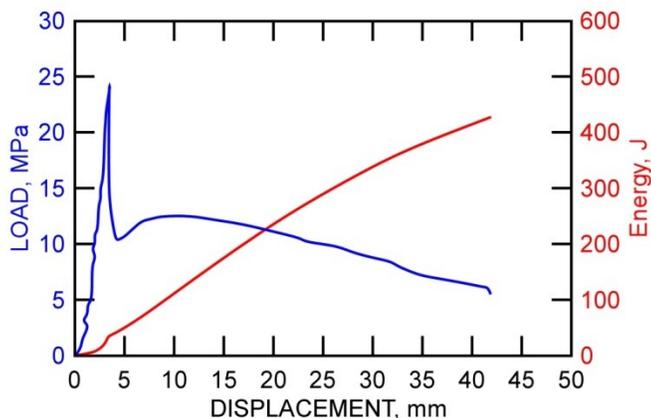


Figure 3. Typical round determinate panel test results.

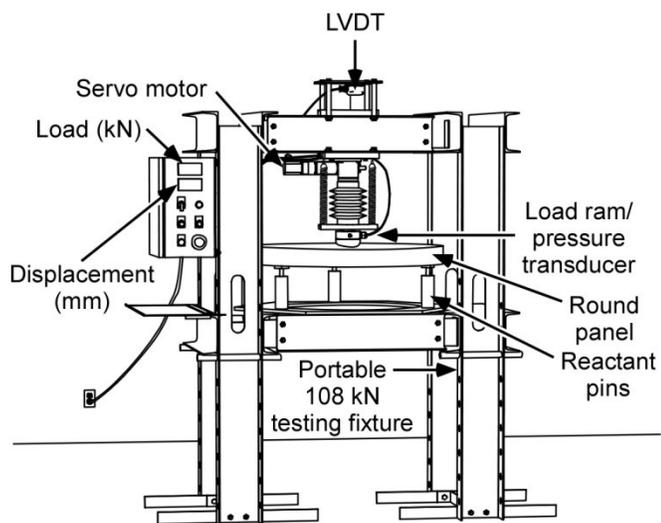


Figure 4. Schematic of field-use RDPT system.

Design Features

- Mobile with built-in controller
- Compact and easy to stow or transport underground
- Full range of motion
- Operator located at the test site location
- Fully automated test cycles
- Power choices: 110 V or DC→AC inverter at site

Specifications

Specifications		
Press		
Capacity	108 kN	24,000 lbf
Height	185 cm	73 in
Width	150 cm	59 in
Depth	84 cm	33 in
Speed – test	4.0 mm/min	0.16 in/min
Speed – jog	45.7 mm/min	1.8 in/min
Drive system	Ball screw	
Control	Closed-loop servo	
Data System		
Eaton Controls		
Control Box		
Height	41 cm	16 in
Width	23 cm	9 in
Depth	41 cm	16 in
Power	110 VAC	
Operating system	Eaton Controls	
Output	± 0–5 Volt signal	

For More Information

For more information on the RDPT system, contact Lewis Martin at LMartin@cdc.gov 509-354-8077, or the Health Communications Coordinator (OMSHR@cdc.gov), NIOSH Office of Mine Safety and Health Research, P.O. Box 18070, Pittsburgh, PA 15236-0070.

To receive NIOSH documents or for more information about occupational safety and health topics, contact: 1-800-CDC-INFO (1-800-232-4636), 1-888-232-6348 (TTY), e-mail: cdcinfo@cdc.gov, or visit the NIOSH Web site at <http://www.cdc.gov/niosh>

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