

## Attachment -- Solid Concrete Block Stopping Design

Mine operators can use any alternative to the approach described in this attachment that satisfies the requirements of Section 75.1507(b)(2). However, this attachment details a solid concrete block stopping design that can be used to construct a refuge alternative that reliably will withstand a pressure wave of 15 psi overpressure for 0.2 seconds. The attachment also describes installation, quality control, certification, examination, and training provisions that may be developed to assure the initial and continued integrity of the solid concrete block stopping, such that the stopping reliably will provide effective protection during an emergency.

### **Solid Concrete Block Stopping Design Criteria:**

This solid concrete block stopping design may be used in mine entries up to 8 feet high and up to 20 feet wide if constructed of solid concrete blocks with a compressive strength of at least 1800 psi that are 6 inches by 8 inches by 16 inches or 8 inches by 8 inches by 16 inches.<sup>1</sup> Shorter blocks may be used for the top course. The blocks must be laid in a transverse pattern with a nominal  $\frac{3}{8}$  inch  $\pm\frac{1}{8}$  inch joint. The stopping must be at least 16 inches thick. A pilaster at least 16 inches by 32 inches must be interlocked near the center of the stopping.<sup>2</sup> Type M or stronger mortar (minimum 2,500 psi compressive strength) must be used between all joints. The stopping must be hitched into solid ribs to a depth of at least 4 inches and hitched at least 4 inches into the floor. The hitch may be no wider than needed to allow the first course of block to be laid and any gaps filled with Type M mortar or equivalent. The stopping and pilaster must be fully mortared at the roof. A 6 x 6 x  $\frac{1}{2}$ -inch metal angle iron must be secured against the roof at the inby top of the stopping with at least 1-inch diameter Grade 36 bolts on 12 inch centers that are fully resin anchored into the roof to a depth of at least 24 inches. The metal angle iron must be in continuous contact with this inby top of the stopping and extend the full width of the stopping, except across the pilaster. The entire stopping must be coated with an MSHA-approved, flame-retardant sealant that will minimize air leakage and have a flame-spread index of 25 or less, as tested under

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<sup>1</sup> For entry sizes greater than 8 feet in height and/or greater than 20 feet wide, the District Manager may consider the design to be an alternative design and may follow the criteria outlined in the Alternative Materials – 15-psi Stopping Design Guide Book (available from Technical Support).

<sup>2</sup> Refer to Figure 1 for a schematic of the block pattern layout.

ASTM E162-87. If a door is used, it must be 32 inches high by 32 inches wide or less.<sup>3</sup> The door and door frame must be constructed of at least ½ inch thick Grade 60 steel and must be flush with the outby side of the stopping. The door, frame, hinges, flanges, and latching mechanism for the door, as well as any welded components, must be capable of withstanding a 15 psi pressure as described in the regulation and be certified by a registered professional engineer.

### **Assurance of Solid Concrete Block Stopping's Capability:**

The Solid Concrete Block Stopping submission should include complete, stand-alone, step-by-step installation procedures. The installation procedures should be as detailed as possible in order to avoid any confusion during the construction and quality control process. Quality control procedures, which include material quality verification along with post-construction test sampling, should also be developed and certified by a registered professional engineer. All procedures and calculations for this certification should be submitted to and approved by the District Manager. Post-construction test procedures should be adopted and follow a reputable standards organization criterion, such as ASTM.

Use of MSHA's solid concrete block design in a particular mine should be certified by a professional engineer to assure that the design is appropriate for the conditions in that particular underground coal mine. The submission should specify that a professional engineer will conduct or oversee the installation and will certify that all of the design provisions have been followed during the installation. The submission should state that the professional engineer will inspect the stopping and door during construction as part of the oversight and certification provided in the submission. The submission should state that the professional engineer will: (1) verify that the stopping is suitable for the specific conditions and the door appropriate for use with the stopping design, (2) confirm that the site preparation is adequate, (3) confirm that the workforce is adequately trained to properly build the stopping and door, (4) verify that the correct materials and procedures are being used to construct the stopping and door, and (5) confirm that adequate quality controls are in place and are being followed. The professional engineer should provide a certification that may be submitted to the District Manager upon completion of the stopping.

During each construction shift, a person designated by the operator with requisite authority and capability should examine each stopping and door under construction to ensure that the stopping and door are being constructed in accordance with the

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<sup>3</sup> When a door larger than 32 inches wide by 32 inches high is used, the District Manager may consider the design to be an alternative design and may follow the criteria outlined in the Alternative Materials - 15-psi Stopping Design Guide Book (available from Technical Support).

approved engineering design. The submission should state that the designated person will take actions necessary to identify any deficiency and to assure that appropriate corrective actions are taken.

Training should be provided to miners constructing stoppings and doors and to designated persons. This training should be conducted prior to constructing a stopping and door and as appropriate thereafter.

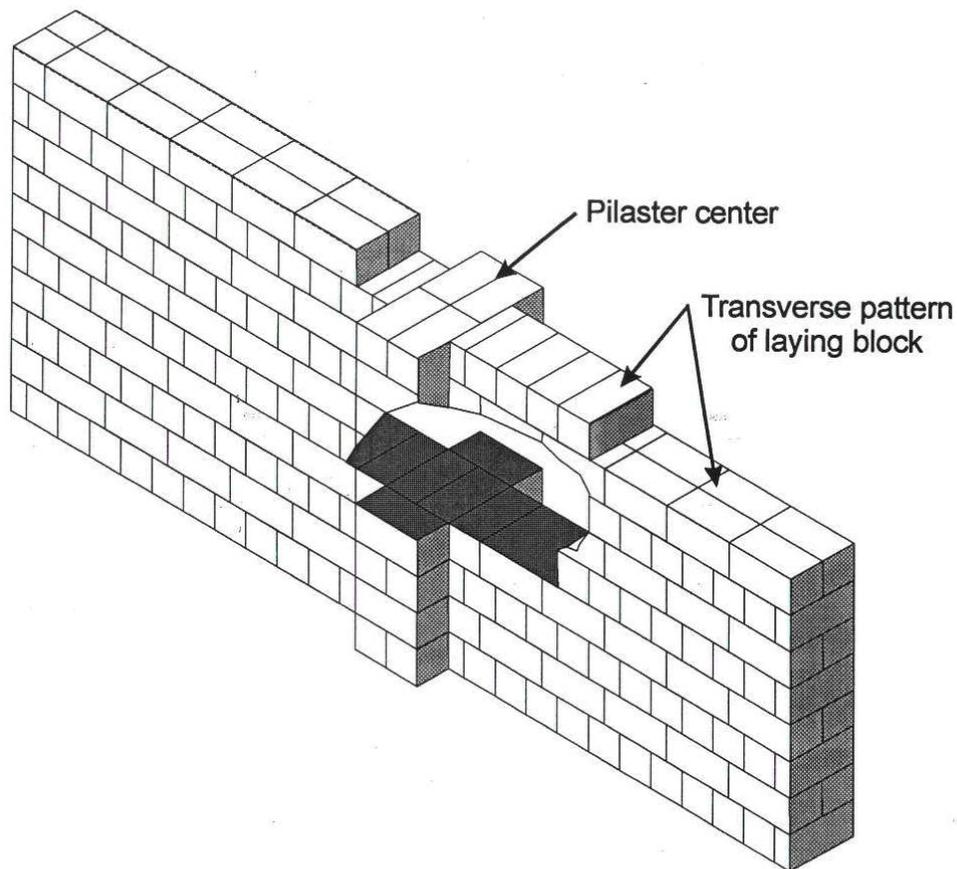


Figure 1: General Schematic of Concrete Block Stopping with Pilaster (Schematic shown does not include a door and is not to scale)