

Shape Optimization of an Ultra Light-Weight CMU

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Abstract:

The optimized shape for an 8- by 8- by 16-in. (203- by 203- by 406-mm) concrete masonry unit (CMU) has been developed for partially grouted reinforced masonry wall construction. The optimization was conducted on an open-end (A-shape) unit to facilitate placement around vertical reinforcement. A 7/8-in. (22 mm) minimum thickness was adopted for both cross-webs and face shells to allow for production using the vibro-press blockmaking technology prevailing in North America. The middle web was positioned for vertical alignment (indexing) in running bond construction so that only grouted cells can be easily filled without grout leakage into adjacent cells. Material properties, production efficiency, placement of horizontal reinforcement, handling, transportation, and laying of the unit were taken into consideration during the optimization process. Analytical studies using finite element analysis were conducted to determine the critical level of stresses. Experimental studies including laboratory testing and construction of full size retaining walls were performed. The new unit weighs 18 lb (8.2 kg), 50 percent lighter than the 38-pound (17.2-kg) standard unit. It also has a compressive strength of 3,800 psi (26.2 MPa) double the minimum strength required by the American Society for Testing and Materials (ASTM).

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