

Concrete Masonry Unit (CMU) Wall Design & Detailing

Introduction

Concrete Masonry Units (CMU) are modular units made from various mixtures of Portland cement and aggregates. The units can come in a variety of sizes, however; the most common have a face dimension of 8 inches high by 16 inches wide. These are the nominal dimensions as the actual dimension will be 3/8" shorter to allow for mortar joints.

CMU can be used to construct a wide variety of wall types and accommodate many functions. Their inherent mass and stability lend themselves to walls which perform well for sound dampening, fire partitions, areas requiring a strong substrate with little deflection, areas where abuse resistance is a concern, and areas requiring a high thermal mass.

Use at NIH Facilities

CMU walls are frequently used within NIH Facilities where a high level of abuse resistance is needed or areas subjected to frequent wet conditions. These situations often occur within animal facilities, such as at cage wash areas and large animal holding rooms. Additionally, similar needs for abuse resistance can often be found at loading docks, switchgear rooms, or other utility areas.

In order to obtain an appropriately smooth finish for CMU, NIH requires that CMU used in Animal Research Facilities utilize fine sand aggregate or ground face block. This requirement provides for a substrate which can then meet the needs of a high-performance finish system. One other major concern with detailing CMU construction in Animal Facilities is the need to prevent pest infiltration and harborage. In addition to sealing all penetrations and voids, all CMU walls require a solid top soap course, fully grouted bond beam, or otherwise completely sealed to structure without voids or gaps.

Detailing

In order to perform properly, a CMU wall needs to be installed on a solid, rigid base. Deflections of the support system need to be minimized in order to prevent cracking of the masonry. In retrofit areas where a new CMU wall is to be installed, the supporting structure should be inspected and the design strength confirmed that it will support the new CMU dead load. Details must be drawn up to appropriately connect the floor and CMU. If the wall is placed on a concrete slab, the CMU is often connected through cast or drilled dowels which are then grouted in place to form a single structural unit. The top of a CMU wall often has to be additionally braced (See Figure 1). The anchorage at the top of a CMU wall is often done through the use of steel angles. Consideration should also be provided for deflection of the slab or structure above. At some point all masonry walls will also need to be supported laterally. The maximum height to slenderness of the wall can be

determined by rules of thumb which state a single wythe solid masonry wall should not exceed a height to thickness ratio of 20 and a hollow masonry wall should not exceed a ratio of 18. It should be noted that even if not reinforced vertically, all CMU walls must be reinforced horizontally.

Another important design consideration which is often overlooked is the layout and detailing of coursings. When improperly designed a CMU wall will have numerous non-modular pieces and require labor intensive cuts and prove difficult when placing grout. Locations of openings also need close attention and coordination. A

standard 7'-0" door

within a CMU wall will require an 86" opening. Eleven courses of CMU is 88" in height resulting in a 2" discrepancy between the opening and coursings. One method to resolve this issue is to specify a frame with a 4" head which is intended to be used for this condition and will fill the 2" discrepancy.

One final consideration when placing CMU is the use and location of control joints. CMU typically shrinks after it leaves manufacturing. This change must be accommodated in order to prevent cracking, spalling, and displacement of masonry. Joints are typically needed:

- Adjacent to openings
- At changes in wall height or thickness
- Between main and intersecting walls
- At maximum one half control joint spacing from corner

CMU is a versatile structural material but requires careful consideration and design to prove effective.

References

1. International Masonry Institute. <http://imiweb.org/>
2. Weber, Richard A. "Masonry Wall Systems." Whole Building Design Guide. <https://www.wbdg.org/guides-specifications/building-envelope-design-guide/wall-systems/masonry-wall-systems>
3. National Concrete Masonry Association. <http://ncma-br.org/member.asp>

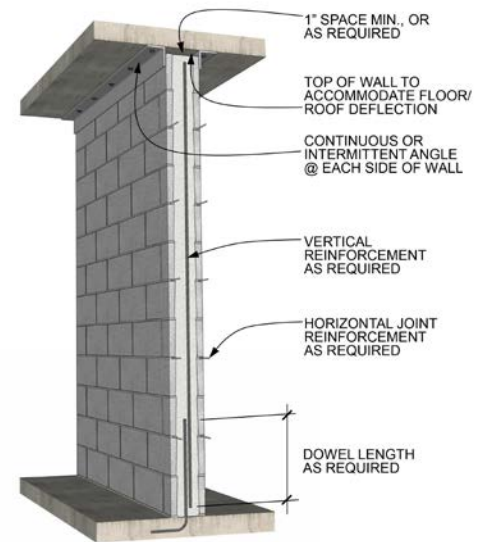


Figure 1: CMU Wall Section