6.3 Architectural Components

6.3.2 Interior Partitions

6.3.2.1 Interior Partition Walls, Heavy

Heavy partitions may be full or partial height and may be constructed of reinforced or unreinforced masonry. Older office buildings were often built with hollow clay tile partitions throughout much of the interior. These elements are found as infill along column lines or located away from the structural framing or walls. In modern construction, these types of partitions may be found where an area separation for fire safety is required. Although "nonstructural" in their intended function, masonry partitions often become "structural" in the sense that they affect the overall response of the building to earthquakes and thus require the expertise of a structural engineer to properly assess. Unless rigid partitions are located in a stiff building with very small inter-story drifts, they should be isolated from the structural system or be explicitly included in the lateral force design of the building.

Provisions

BUILDING CODE PROVISIONS

ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures*, (ASCE, 2010) focuses on providing adequate strength for out-of-plane forces and providing details that isolate the partition from building deformations.

- All heavy partitions greater than 6 feet in height must be laterally braced to the structure, independent of any ceiling lateral bracing.
- Partitions must be designed for wind and seismic forces acting out-of-plane on the wall.
- The partition must be detailed so that it does not interact with the structural system or other nonstructural elements when the building displaces laterally under wind or seismic loading.

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings*, (ASCE, 2007) classifies heavy interior partitions as both acceleration and deformation sensitive.

- Heavy interior partitions are subject to the requirements of ASCE/SEI 41-06 when:
    - The performance level is Immediate Occupancy or Life Safety in high or moderate seismicity areas.

  - The performance level is Hazards Reduced in high or moderate seismicity areas and heavy interior partitions are located over areas of public access or egress.
- Acceptance criteria focus on verifying that the partitions have sufficient strength to resist out-of-plane forces, and verifying that the partitions can accommodate in-plane story drift. If the building drift exceeds certain limits, the connection conditions at the edges of the partition require retrofit to accommodate the building movements.

Typical Causes of Damage

- Heavy partitions are both acceleration and deformation sensitive and may fail either in-plane or out-of-plane if not properly detailed. Partial height partitions may fail unless they are laterally braced to the structure above or engineered to cantilever from below. Full height partitions may fail unless they are isolated from the building deformations and provided with out-of-plane restraint.
- Masonry may crack and spall, walls may collapse creating falling hazards and blocking corridors and exits with debris. Masonry debris may be particularly hazardous in stairwells and elevator shafts.
- Where partitions are used as lateral support for piping, electrical cabinets, storage shelves, or other nonstructural items, the failure of the partition wall may result in damage to these other components.

Where partitions are built tight against structural columns, there is a potential for the masonry wall to unintentionally create a “captive column” thereby changing the intended earthquake response of the building. A structural engineer is needed to evaluate the implications of such conditions.

DAMAGE EXAMPLES

Figure 6.3.2.1-1 Damage along the top of a reinforced concrete masonry unit partition built flush with soffit of metal deck at an industrial facility in the 2001 magnitude-8.4 Peru Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.3.2.1-2 Damage to reinforced concrete masonry partition used to support fire protection cabinet and piping in the 2001 Peru Earthquake; loose stucco and masonry were removed prior to photo (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.3.2.1-3 Damage to structural column ("captive column") due to restraint caused by partial height masonry wall in the 2001 Peru Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.3.2.1-4 View of stairway in the Banco Central Building, Managua, Nicaragua after the 1972 magnitude 6.2 Managua Earthquake. Most of the stairs were covered with debris that resulted from the failure of the hollow tile partitions surrounding the stairs (Photo courtesy of PEER Godden Collection, No. J94).

Figure 6.3.2.1-5 Damage to unreinforced brick partitions in patient rooms, and other mostly nonstructural damage, resulted in the evacuation of the Felix Bulnes Hospital in Santiago in the 2010 magnitude-8.8 Chile Earthquake (Photo courtesy of Gilberto Mosqueda, University of Buffalo, SUNY).

Figure 6.3.2.1-6 An infill masonry wall collapsed onto the distilled water equipment spilling two 150 gallon containers; water leaked past the perimeter edge of the floor slab into the operating room suite below resulting in the closure of 3 of 6 the operating rooms. Replacement gypsum board partition seen in photo. Hospital built in 2005 in Los Angeles, Chile. Damage from the 2010 Chile Earthquake (Photo courtesy of Bill Holmes, Rutherford & Chekene).

Seismic Mitigation Considerations

- Heavy full height partitions need out-of-plane restraint with an in-plane slip joint. This can be provided with steel angles on either side attached to the structural slab above as shown. Steel angles may be continuous or intermittent; check code requirements. Note that special details may be required to meet fireproofing, sound proofing, weatherproofing or insulation requirements.
- Care must be used in detailing slip joints for a series of interconnected perpendicular walls since the out-of-plane restraints for one wall will prevent in-plane slip along the perpendicular wall; vertical isolation joints may be required. Similarly, special details are required where the soffit of the structure above has an irregular profile that would prevent slip such as the metal deck in Figure 6.3.2.1-1, or a sloping profile such as a ramp.

- If the partition will be used to provide lateral restraint for other nonstructural items, check that the wall and the lateral restraints at the top are adequate to resist the additional loading.
- Heavy partial height partitions are often used in exterior walls with glazing above or used as guardrails along exterior corridors. In buildings with structural frames, these walls should be self supporting and isolated from the structural framing at both ends. Failure to provide appropriate seismic isolation for these partial height walls has resulted in thousands of structural "captive column" failures in past earthquakes.

MITIGATION EXAMPLES

Figure 6.3.2.1-7 Detail of isolation joint to prevent creation of "captive column" condition (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.3.2.1-8 Full-height concrete masonry unit walls detailed with steel clip angles (3 angles visible in photo). Configuration shown includes perpendicular walls, sloping ramp above, and column with column capital. Although wall detailed with sealant joints along edges of column and column capital, it is not clear that the concrete frame can move independently of these CMU walls (Photo courtesy of Cynthia Perry, BFP Engineers).

MITIGATION DETAILS

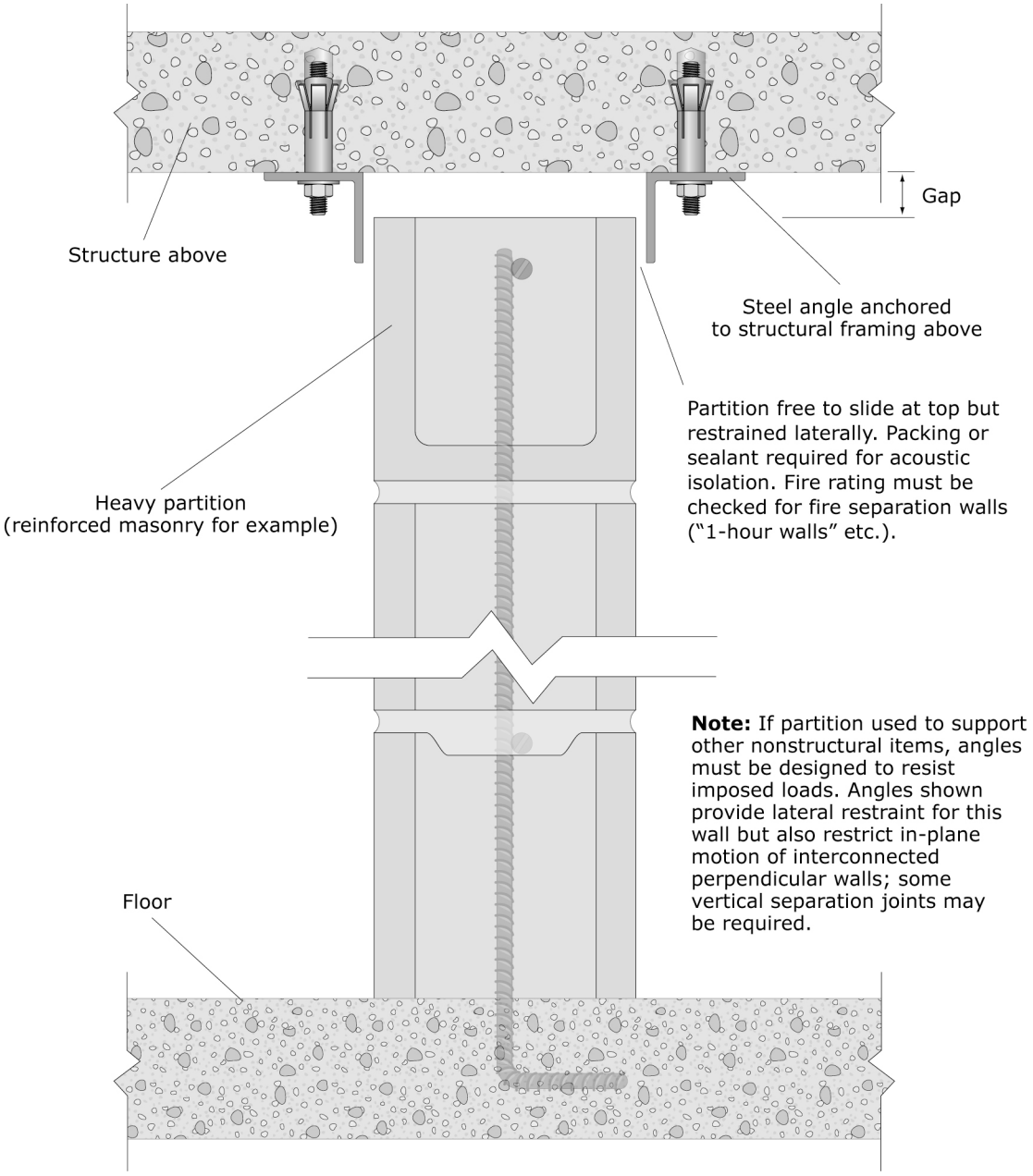
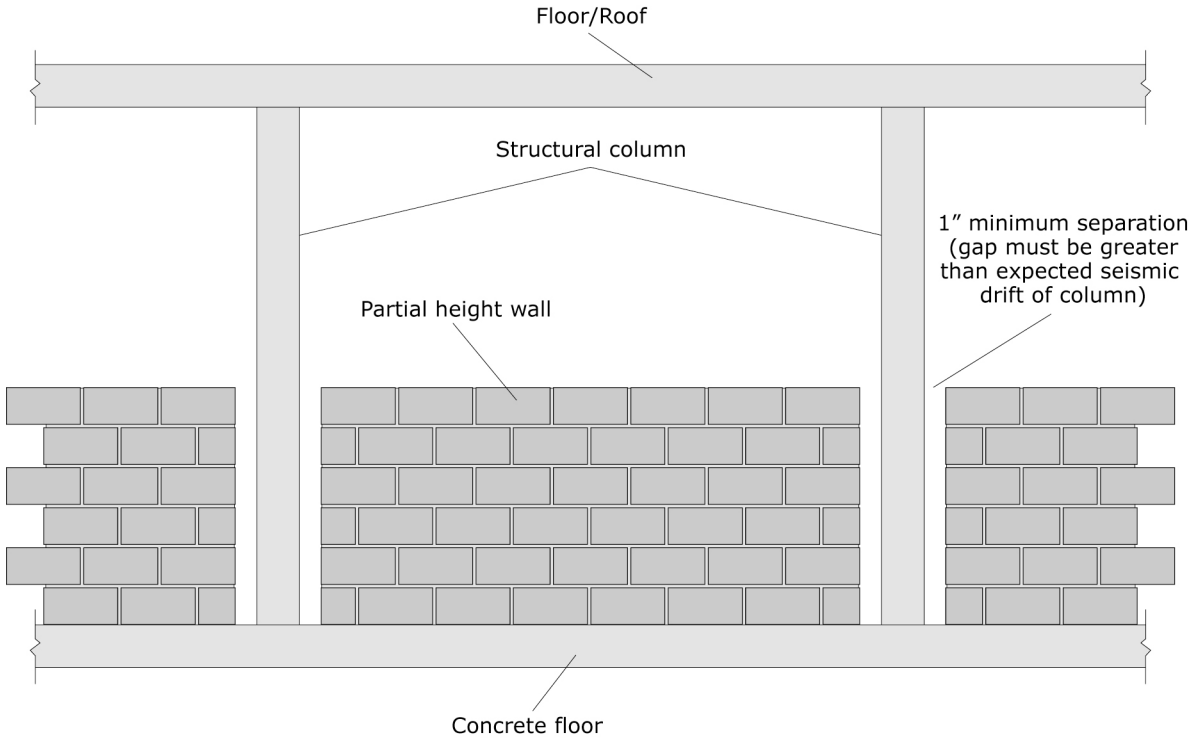


Figure 6.3.2.1-9 Full height heavy partition (ER).



Note: If wall is not designed to cantilever from the base, either remove and replace with properly designed wall, or light partition. Alternatively, reinforce in place.

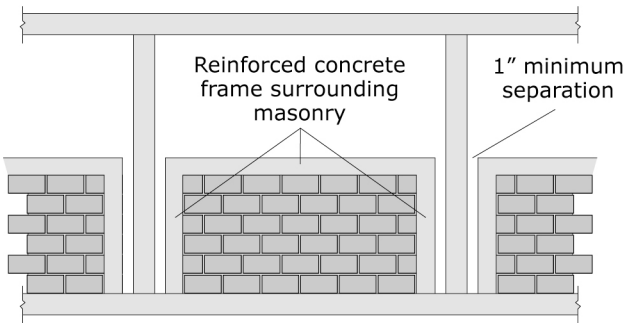


Figure 6.3.2.1-10 Partial height heavy partition (ER).