

The CSMU bricks manufactured at Arriscraft are in accordance with ASTM C73 – Standard Specification for Calcium Silicate Brick (Sand-Lime Brick) and are fully solid masonry bricks with a 100% net cross-sectional area. Due to their fully solid configuration, CSMU bricks exhibit higher unit weights than masonry products that rely on internal voids to reduce mass. On-site installation often fails due to improper assumptions and failure to follow best practices and industry recommendations. Failures may increase if solid bricks are installed using these assumed details; the extra weight may cause cracking, movement, or moisture problems to show up and in some cases even before project completion.

1. BRICK WEIGHT AND FIELD ASSUMPTIONS

CSMU bricks manufactured in accordance with **ASTM C73** are **solid bricks with no core holes**. As a result, these bricks are heavier than typical cored masonry products like clay brick. In general, CSMU can be installed and detailed using the details used by clay brick industry and rainscreen detail is highly recommended. Due to this additional weight, it becomes more important to stick to best industry practices and recommendations. It has been observed that over time, construction sites may develop wrong techniques, which may not be immediately evident in lighter masonry façade material. However, when these translate to heavier masonry such as CSMU, the additional weight can cause cracking and distress to appear almost immediately.

2. LINTEL SUPPORT AT OPENINGS

CSMU bricks are intended for **non-load-bearing veneer applications**. Although CSMU have very high compressive strength, they are not designed to take structural loads. Loads due to self weight of masonry above window and door openings must be supported by properly designed steel lintels or angles. Undersized or inadequately bearing supported lintels may lead to cracking at openings, particularly when supporting heavier solid brick veneers. Lintels should be designed to carry the full weight of the masonry above the opening. In general residential practice, a **minimum lintel bearing or overhang of 6” inches** at each support is recommended to reduce localized stress and cracking for solid masonry. Final lintel sizing and support may be confirmed by the project structural engineer.

3. HOT WEATHER INSTALLATION PRACTICES

As intended, CSMU bricks draw some moisture from fresh mortar to form a strong bond. However, during hot weather when evaporation is higher than normal, mortar may lose moisture quickly. Due to this additional moisture loss, the mortar may become dry and shrinkage cracks may appear. Pre-wetting masonry skids before installation is recommended to reduce excessive moisture loss through mortar and prevent mortar from being dry.

4. LINTEL MOVEMENT AND THERMAL EFFECTS

Steel lintels undergo normal thermal expansion and contraction when exposed to heat for longer durations. This movement can transfer stress into the surrounding masonry veneer, both side of the angle. This condition may be more apparent on elevations exposed to direct sunlight. Providing proper flashing and soft joints (backer rod and sealant) at lintel ends allows for differential movement and helps reduce cracking. Further, flashing should be provided between Lintel and Masonry to provide a slip plain to avoid any frictional stresses in case of any movements.

5. MORTAR SELECTION

For residential CSMU brick applications, **Type N mortar** is recommended. Type N mortar is typically proportioned as:

- 1 part Portland cement
- 1 part lime
- 6 parts sand

This mortar provides adequate strength while maintaining flexibility to accommodate minor movement. Overly stiff mortars can increase the likelihood of cracking in rigid masonry systems.

6. DRAINAGE PLANE

Although calcium silicate masonry bricks are dimensionally stable, unregulated moisture intrusion would remain as a primary contributor to veneer deterioration. Moisture management is critical for the masonry façade systems. In 1962 a Norwegian researcher, Birkeland, identified six major sources of moisture leakage:

- wind-induced air pressure differences,
- pressure-assisted capillary,
- gravity,
- kinetic Energy,
- air currents, and
- updrafts.

Conventional means of managing moisture resist most of the major causes of moisture leakage, but wind-induced air pressure is not quite so easily counteracted. This research was further developed by the Canadian National Research Council, which published Canadian Building Digest 40, Rain Penetration and Its Control. This publication remains one of the primary reference sources on the topic. It states that, “...through wall penetration of rain can be prevented by incorporating an air chamber into the joint or wall where the air pressure is always equal to that on the outside.” This remains the basic principle of a rain screen wall.

The basic premise of the rain screen principle is to control all forces that can drive moisture through the wall system. Its primary function is to restrict the passage of moisture through the wall caused by wind-induced pressures. The critical components of a rain screen wall are exterior barrier containing protected openings that permit the passage of air but not water, a confined cavity behind the rain screen in which air pressure is essentially equalized with the exterior, insulation securely fastened to the outer face of the interior wall system, and an interior wall system, incorporating an air and vapour barrier capable of resisting the passage of air and water vapour, and capable of withstanding all required design loads. Most important components for moisture management are discussed below:

- **Wall Cavity:** ensure that a clear draining cavity at least 1in. (25 mm) in width exists between the masonry veneer and the other wall components. The cavity must be kept clear of debris, protrusions and mortar fins and droppings. Hence a proper drainage mechanism is required to drain any moisture entering the masonry wall
- **Weep-Vent System:** Installing weep vents at the base of the wall and vents at the top of the wall cavities is recommended to assist in drying the drainage cavity of the masonry wall and to create a pocket for air pressure equalization. Also, ensure that the masonry veneer is not installed at or below grade, as below grade masonry may come in continuous contact with moisture and deicing compounds during winters which may cause deterioration and spalling. Weep vents installed in head joints of masonry units below grade may act as a passage for moisture to enter the wall cavity, such as when snow is piled up against the wall during snow clearing activities. Weep vents must be installed at a maximum spacing of **24 inches on center** to facilitate drainage and pressure equalization within the cavity.

To prevent mortar blockages in the cavity behind the veneer, a product such as MortarNet can be used inside the cavity. Additionally, wire mesh covers can be installed over the weeps and vents to prevent insects from entering the system without obstructing the openings.

- **Flashing:** Without continuous flashing and proper airspace, the weep holes cannot function effectively. Flashing should be installed below the overhang to protect the wall from moisture that may penetrate through the mortar joints. The ends of the flashing sticking out should be turned up into the head joint a

minimum of 1 in. (25.4 mm) to form end dams, past the face of brickwork. This acts as a drip system, allowing moisture to drain away from the face of the brick veneer. It is also recommended that the flashing consist of continuous, lapped pieces with a minimum overlap of 6 in. (152 mm) and that it be properly sealed.

- Any penetrations through the flashing membrane should be addressed for both moisture and thermal bridging. This can be done through overlapping materials, such as by lapping the building paper over the vertical leg of the flashing to maintain the flow of moisture. Flashing membranes should be provided in the cavity above openings, shelf angles, and at the foundation level to drain any water that enters the cavity, ultimately connecting to the weep vents. Ensure that the vertical leg of flashing is installed behind the water-resistive barrier layer.
- **Sills:** A properly constructed sill must be installed directly below wall openings such as windows and vents. Sills help in protecting the veneer from moisture. When using masonry sills, we suggest you consider the addition of a continuous flashing membrane immediately below the sill, turned up at its ends to form an end dam. This will serve to protect the masonry below from any moisture that may penetrate the sill units. Make sure the sills have a gradient and are tilted away from the brick. A proper drip edge is required. This acts as a mechanism to break down the surface tension flow of moisture back to the wall surface. They are installed underneath the surface of the sill.
- **Masonry Ties or Connectors:** Masonry ties play an important role in designing a proficient masonry façade that will last for years. Wall ties generally transfer lateral loads to the structural backing, while also permitting in-plane movement to accommodate differential movements. Thus, wall ties must be installed at recommended spacing and be securely attached or embedded to the backing.

There are many design variables that must be considered when selecting masonry connectors. Local conditions such as wind and seismic design loads, exposure to moisture, cavity width, ease of installation, and the nature of the surrounding or adjacent wall materials all affect the selection of the masonry connectors. Due to the many design variables that must be considered we suggest determining this information prior to the start of

construction. Refer to ARRISCRAFT•NOTE (Vol. 1, No. 3), titled Connectors - Part I, Masonry Ties, which describes the various types of masonry connectors and the important criteria to be considered when specifying connectors. Further, while designing the tie spacing, we recommend considering TMS 402 - C216 13.2.2.5 which states that ties should be located within 16 in. (406 mm) of supported edges and within 12 in. (305 mm) of unsupported edge, opening, and movement joints. The exact horizontal and vertical tie spacing could be calculated using basic criteria in Table 13.2.2.5, which gives Maximum tributary area per tie (2.67 ft² or 0.248 m²) and maximum spacing allowed (24 in. or 610 mm). Additional information and recommendations should be sought from the masonry connector manufacturers.

7. MOVEMENT AND EXPANSION JOINTS

Movement joints are not commonly incorporated in residential construction and are often overlooked in typical practice. However, their use should be encouraged, and they should be provided wherever required to properly accommodate building movement and reduce the risk of cracking and distress. They are used to segment the veneer to prevent cracking due to changes in temperature, moisture expansion, elastic deformation due to loads, and creep. They may be horizontal or vertical. Although primarily used to accommodate movement, building movement joints must also resist moisture penetration and air infiltration. They can be constructed in a variety of different ways to fulfill these requirements.

A good quality backer rod and joint sealant should be used to seal the exterior of the movement joint against moisture and air penetration. The sealant material should be selected by the designer to be highly elastic, resistant to weathering and ultraviolet radiation, and compatible with the masonry materials. These filler materials must be highly compressible and elastic in nature in order to accommodate the expansion and contraction of the veneer materials. As such, the use of fiberboard or other similar materials is not recommended for use in movement joints. Materials such as mortar or joint reinforcement should not bridge the expansion joint as they would restrict movement and not allow the movement joint to perform its intended function.

As a general rule of thumb, movement joints should be located at the following locations:

- at changes in wall direction, such as building corners;
- at wall openings, such as windows and doors;
- at changes in building height, such as building junctions;
- at major changes in thickness of wall, such as pilasters;
- at periodic lengths of continuous wall;
- at changes of building materials; and
- below shelf angles.

Horizontal movement joints are required wherever the masonry veneer has been supported on a shelf angle outside the frame. They are typically created by providing a space beneath the angle for differential movement to occur. Differential movements of the veneer materials and the structural frame should both be considered.

Movement joints are used in masonry construction to allow for the differential movement generated by materials as they react to their own properties, environmental conditions and loads. In general, vertical movement joints should be used to break the masonry into rectangular elements that have the same support conditions, the same climatic exposure and the same through wall construction. Horizontal movement joints should be placed below shelf angles supporting masonry

For in-depth details on movement joints please refer to *Arriscraft•NOTE Vol. 1 No1., BUILDING MOVEMENT, which discusses the proper placement and construction of building movement joints in masonry veneer walls.

SUMMARY

CSMU bricks can perform very well in residential applications when detailed and installed as per recommendations. However, their fully solid construction results in increased weight and reduced tolerance for common detailing deficiencies. A lightweight construction may take longer to reflect construction or design deficiencies, whereas there is almost instant result due to added load of solid CSMU brick. Thus, conditions such as limited lintel bearing, restrained lintel movement, improper mortar selection, and inadequate hot weather practices can cause cracking to appear earlier than expected. Inadequate accommodation of differential movement, particularly at shelf angles and other restraint locations, can further contribute to localized cracking in masonry veneers. Cracking around openings is typically localized and does not indicate a systemic material issue. Once appropriate support and movement detailing is in place,

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repointing affected joints can restore both appearance and performance. The information and suggestions contained herein are based upon the available data and the experience of Arriscraft architectural and engineering staff. Final decisions regarding material selection, detailing, and structural design are not within the purview of Arriscraft and must rest with the project designer or owner.

It remains the sole responsibility of the designer to properly design the project and ensure all architectural and engineering principles are properly applied.

ARRISCRAFT•CADD, our comprehensive sample detail library, can be found at [https://caddlibrary.arriscraft.com/..](https://caddlibrary.arriscraft.com/) The details highlight Arriscraft masonry products with several different types of structural back-up, such as steel studs, structural concrete block, concrete block infill with steel superstructure, wood studs, and site wall construction. The masonry connectors illustrated on our details are representative and do not specify a specific masonry connector.

RELATED REFERENCES

1. ASTM C73 – Standard Specification for Calcium Silicate Brick (Sand-Lime Brick)
2. ASTM C216 – Standard Specification for Facing Brick (Clay Masonry Units)
3. ASTM C270 – Standard Specification for Mortar for Unit Masonry
4. BIA Technical Notes on Brick Construction
5. CSA S304 – Design of Masonry Structures