

ABRI Design Guide

2020 Edition





Introduction

The ABRI masonry veneer system allows designers to explore a variety of aesthetic options that redefine expectations for what concrete masonry can achieve. This brief guide is not meant to be a comprehensive guide to designing anchored veneer walls, it simply highlights considerations that are unique to ABRI veneers. For suggestions on aesthetic options with ABRI, please see our Pattern Portfolio (www.resources.concreteproductsgroup.com)

ABRI is an anchored veneer system. Designers should consult the following references for more information for how to build their project in compliance with Code and best practices:

Technical Guidance:

NCMA TEK 3-6c, Concrete Masonry Veneers, National Concrete Masonry Association (www.ncma.org)

Concrete Products Group, Anchored Veneer Design Manual and accompanying veneer spacing calculation spreadsheet (www.resources.concreteproductsgroup.com).

Code Requirements:

TMS 402 sets out the following prescriptive requirements for anchored veneers:

- Backing system
- Weeps / Flashings
- Adjustable Anchors
- Movement Joints
- Veneer Height based on framing type or structure.
- Bond Patterns not laid in Running Bond
- Seismic Design Requirements

TMS 402/602-13, "Building Code Requirements and Specifications for Masonry Structures", The Masonry Society. While this document refers to TMS 402, the referenced masonry standard in the International Building Code (IBC) as "Code", the user needs to consider and include any local or state amendments to the IBC.



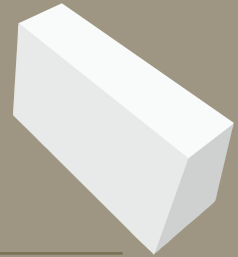
ABRI
MASONRY
VENEERS

ABRI Shapes

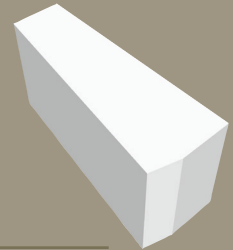
Kit of Parts

ABRI has five shapes for 2020

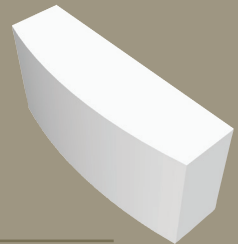
Shingle



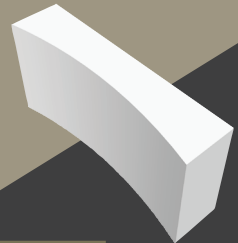
Wedge



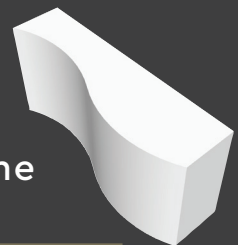
Convex



Concave

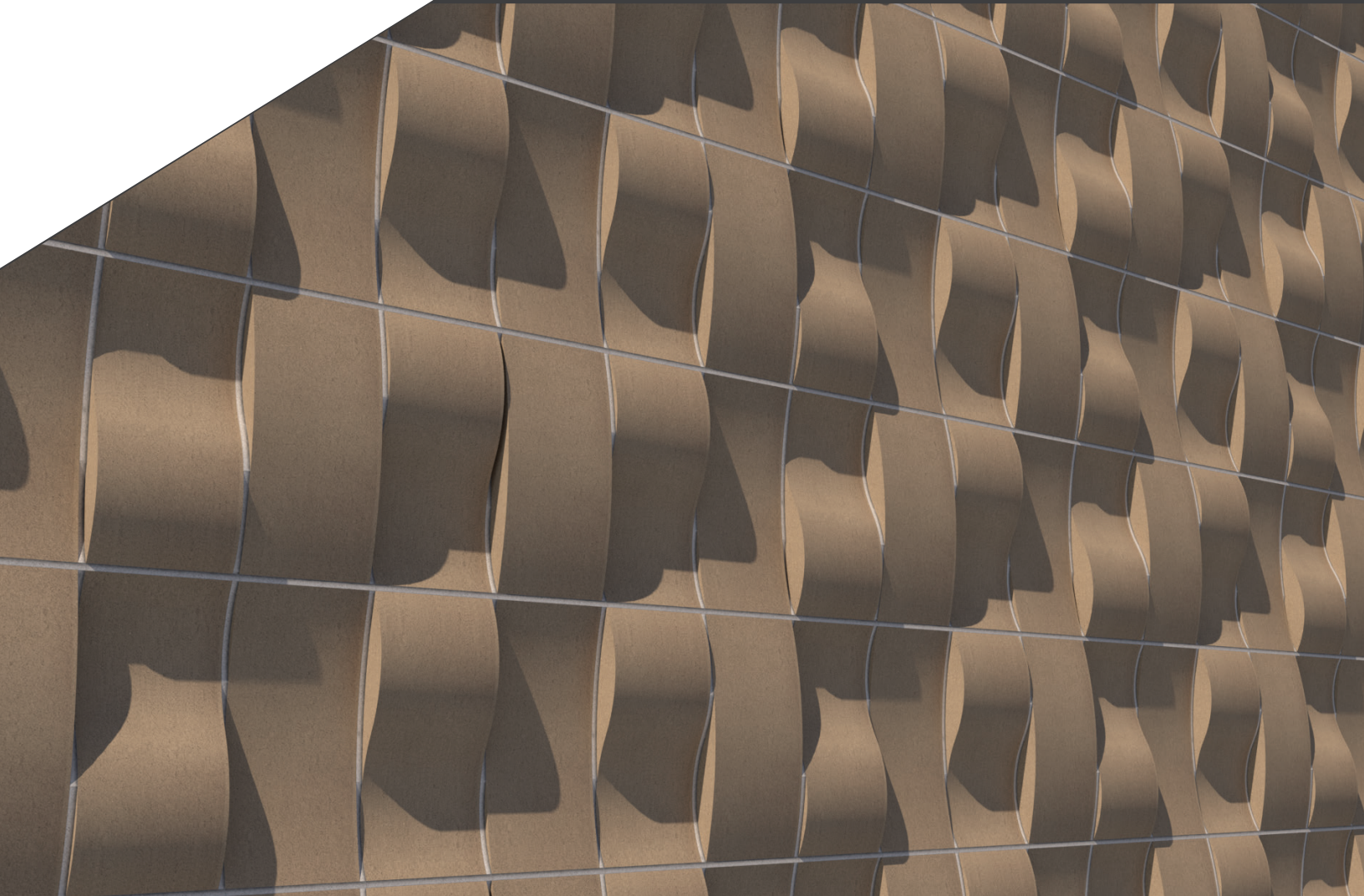


Serpentine



Five Shapes and Countless Possibilities

ABRI units are available in five shapes. The Convex, Concave and Serpentine units have a curved face profile, while the Wedge and Shingle are Angular. All ABRI Units are suitable for vertical or horizontal placement. This opens up a world of possibilities to create unique and fresh designs with unexpected profiles and combinations. We offer a Pattern Portfolio (available at www.concreteproductsgroup.com) that demonstrates more than 70 wall panel, column and accent band patterns.



Bond Patterns

Bond pattern selection is a key element of creating the full array of possible looks with an ABRI wall. A masonry craftsman is not even limited to vertical or horizontal coursing of the units. As a result, there is a large family of traditional brick bonding patterns with historical usage and naming.

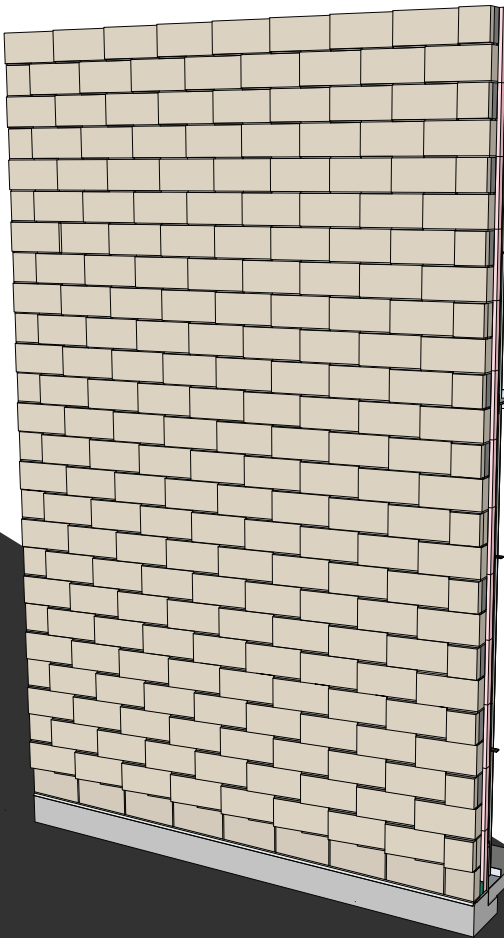
While the possibilities for custom bonding are extensive, we recommend starting with a more limited subset of bond patterns that are compatible with recommendations for horizontal joint reinforcement and anchorage spacing. Please refer to the section below that discusses horizontal joint reinforcement and anchorage spacing considerations. It is possible to use other bond patterns beyond those presented for smaller features or where crack control is addressed through special design steps such as tight spacing of movement joints.

Here are examples of these bond patterns that work readily with anchorage and horizontal joint reinforcement and allow a wide range of aesthetic options:

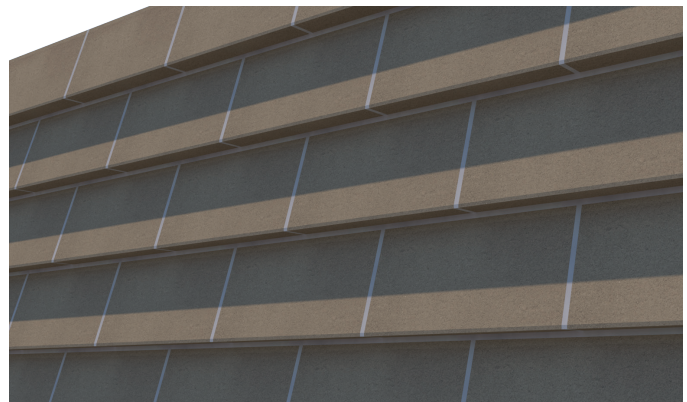
Running Bond

For a running bond, the ABRI units are placed with an offset from course to course. The most familiar running bond configuration is half bond, but quarter bonding or other offsets are options.

A consideration regarding running bond patterns with ABRI is that it may produce frequent horizontal ledges with some ABRI shapes. For some applications, this may be very desirable, because the frequent projections and differences in profile depth will produce dramatic shadowing effects. However, such ledges may collect moisture and allow climbing of the veneer panel using the ledges for hand and foot holds. If these issues are not concerns for an application, then use of running bond can produce beautiful results.



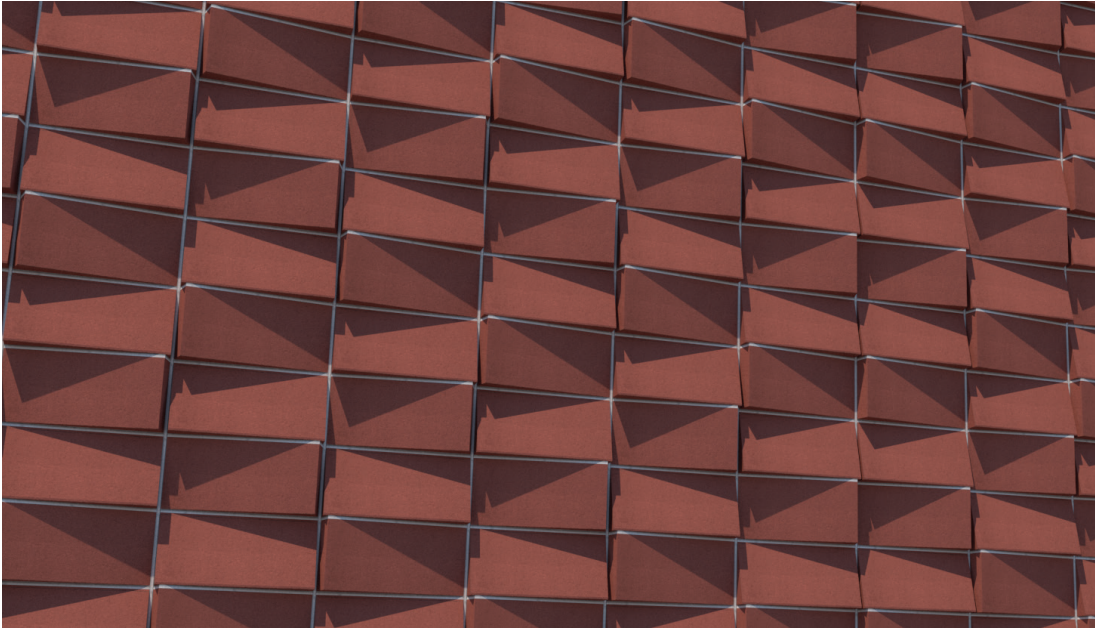
Abri Wedge Units in Running Bond
Frequent ledging



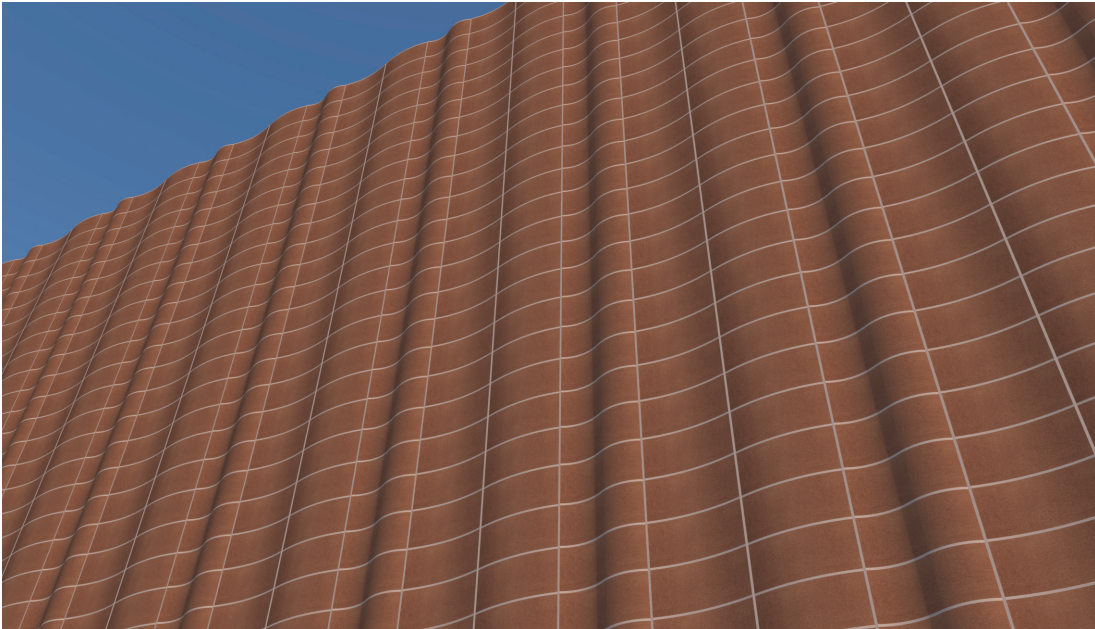
Abri Shingle Units in Running Bond
No ledging

Stack Bond

Stack bond is exactly what the name suggests: the units are stacked in vertical columns. With ABRI, stack bonding can be used either with a single shape, or with interesting combinations.



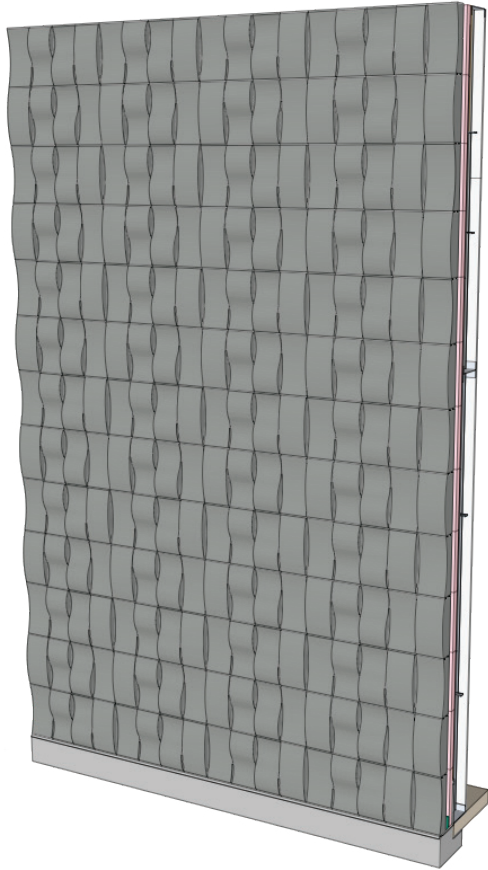
ABRI Concave, Convex and Serpentine in Stack Bond



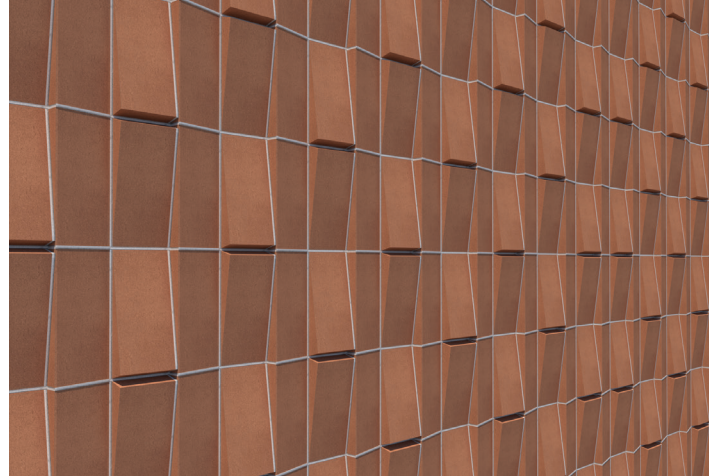
ABRI Shingle and Wedge in Stack Bond

Soldier Course

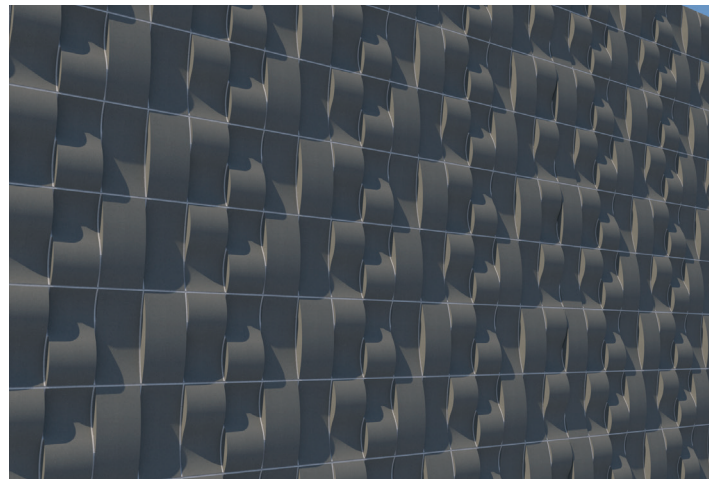
Soldier Course bonding also stacks the units in vertical columns but their orientation is switched so that the longer side of the unit is vertical. Soldier coursing allows significant profile relief and shadowing without creating horizontal ledges.



ABRI in Stack Bond on Metal Frame



ABRI Wedge and Shingle in Soldier Courses



ABRI Concave, Convex and Serpentine in Soldier Courses

Crack Control

The physical characteristics of masonry materials need to be taken into account when designing veneer panels. Concrete masonry tends to shrink for a variety of reasons. Brick tends to expand. There are movement (expansion or shrinkage) coefficients that have been developed to assist designers in anticipating the movement that will occur. It is instructive to apply these coefficients to a typical wall section; the amount of expected movement typically is significant.

There are two simple measures that are used to address movement issues to control cracking of veneer panels: Movement joints and horizontal joint reinforcement.

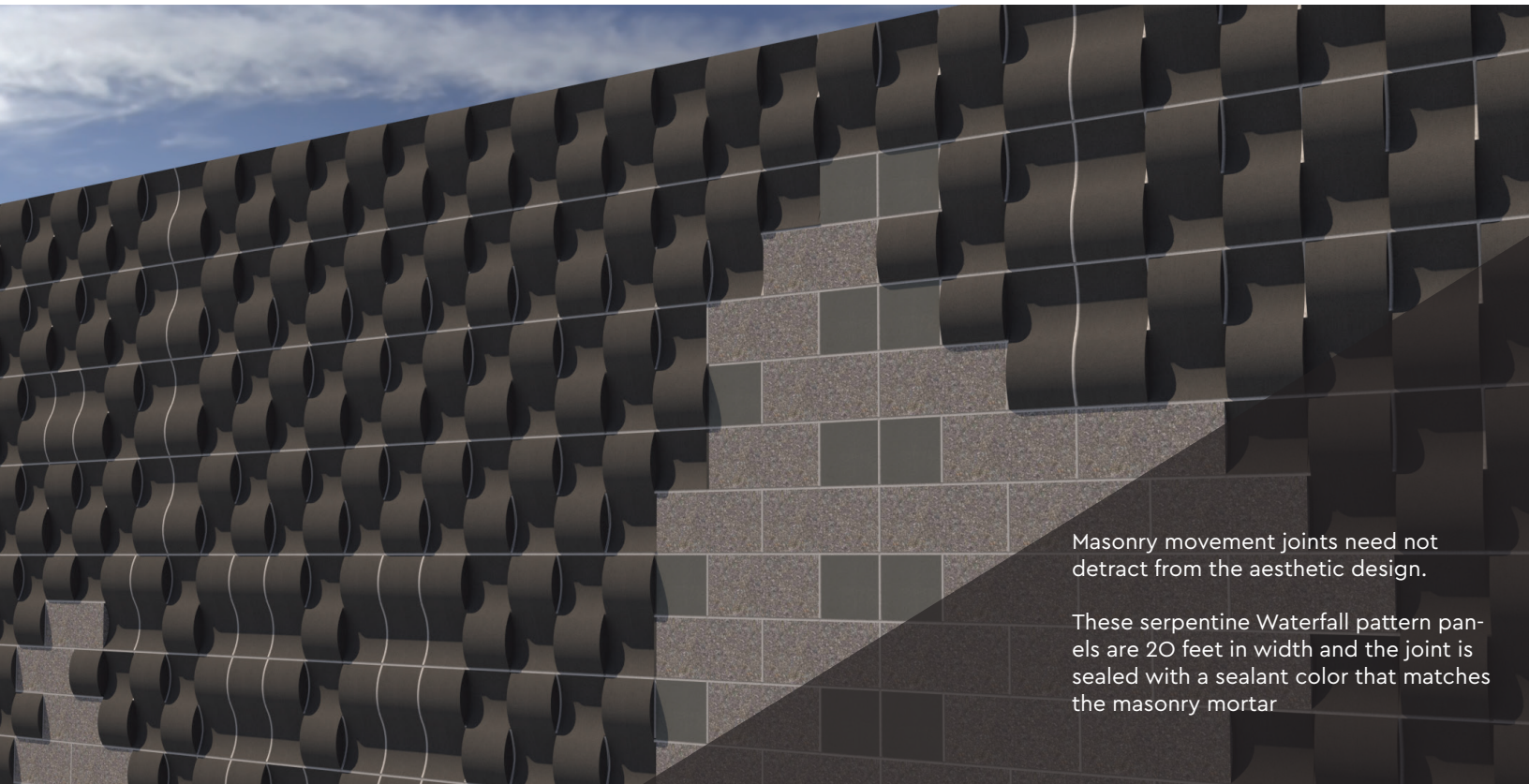
Masonry Movement Joints

A masonry movement joint is simply a vertical joint that separates panels. When using running bond, this will require half units at the joint location. For stack bond or soldier coursing, no special units are required.

The addition of movement joints divides the total veneer surface into smaller panels to reduce the amount of movement, and allow space for it to occur. Movement joints should be placed at intervals along the length of the wall, and at areas of stress concentration. There is extensive industry technical guidance relating to movement joint spacing considerations and design methodology, including NCMA TEK 10-4 CRACK CONTROL FOR CONCRETE BRICK AND OTHER MASONRY VENEERS. This is an issue that should be specifically addressed by the project designer.

As a general approximation, spacing of the movement joints should be no greater a multiple of 1.5 of the wall height, not to exceed maximum spacing of 20 feet (NCMA TEK 10.4). The general recommendation for spacing from corners of the building is that the joint should be spaced at $\frac{1}{2}$ the maximum spacing for the wall as whole.

For weather protection, the movement joint is sealed with backer rod and a bead sealant, which typically can be color matched to the mortar or veneer.



Masonry movement joints need not detract from the aesthetic design.

These serpentine Waterfall pattern panels are 20 feet in width and the joint is sealed with a sealant color that matches the masonry mortar

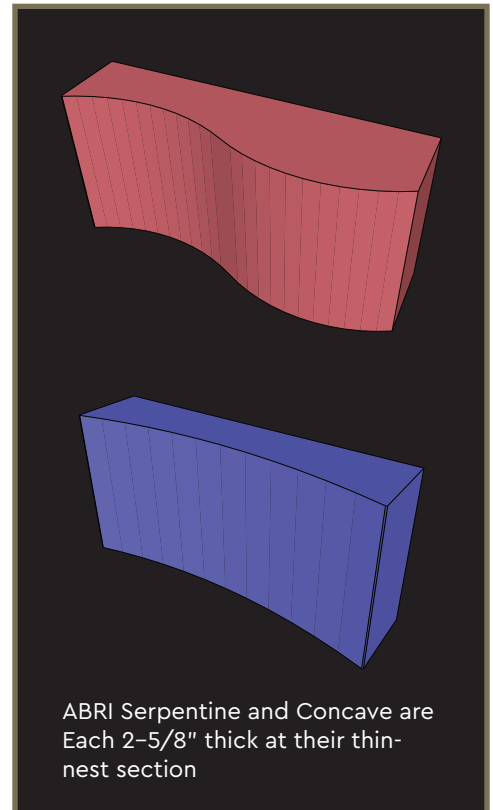
Horizontal Joint Reinforcement

Horizontal joint reinforcement is used along with movement joint placement to control cracking. ABRI veneers are either nominal 8" in stack or running bond or nominal 16" in height when soldier coursing is used. For both of these, horizontal joint spacing at 16" is recommended. Code also requires the use of horizontal joint reinforcement with at least one wire (Section 12.2.2.9) for stack bond and soldier coursed veneer.

Code requires that horizontal joint reinforcement be placed such that it has at least 5/8" cover in the mortar from the exterior of the veneer panel to resist corrosion (Section 12.2.2.5). Stainless steel horizontal joint reinforcement may be used without this restriction, though it costs more.

The ABRI Concave and Serpentine Shapes, when placed in running or stack bond, have a minimum thickness of 2 5/8" at their thinnest section along the bed joint, which may require a custom horizontal joint reinforcement thickness of less than the standard 2" width that is typically used with 4" (3 5/8" actual) CMU veneers. When placed in soldier courses, all of the ABRI units have at least 3 5/8" thick bed joints where the horizontal joint reinforcement will be placed.

The following table shows the types and spacing of joint reinforcement that are recommended for ABRI products in Running, Stack or Soldier Course Bond Patterns.



ABRI UNIT	Minimum Thickness	Bond Pattern	Single or Double Wire?	Anchor placement	Wire Size (Double Wire)	Vertical Spacing
Wedge Shingle Convex	3 5/8"	Running	Both	Alternate Course	2"	16"
		Stack	Double	Alternate Course	2"	16"
		Soldier	Double	Same Course	2"	16"
Serpentine Concave	2 5/8"	Running	Both	Alternate Course	<2" or single wire	16"
		Stack	Double	Alternate Course	<2"	16"
		Soldier	Double	Same Course	2"	16"

Double wire: ladder style, standard dimension is 2" thick for use with 3 5/8" veneer.
Double Wire <2" may require custom fabrication.

Veneer Anchorage

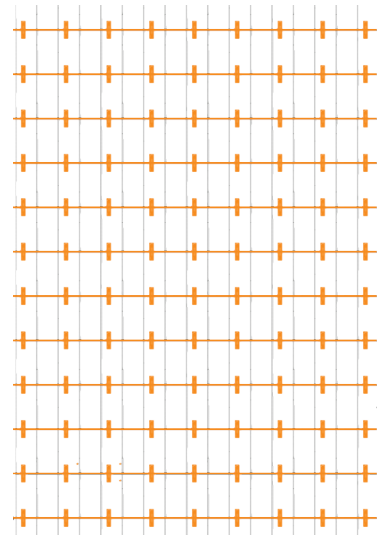
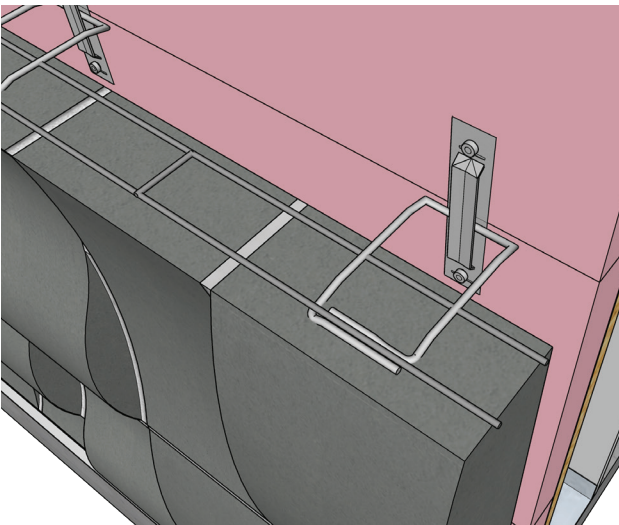
The design should address how veneer anchors can be placed in the joints of the veneer panel in a compatible way with the selected horizontal joint reinforcement.

Anchorage Embedment. Code requires that the veneer anchor be embedded at least 1 ½ inches into the mortar joint for ABRI veneers (Section 12.2.2.5). Anchorage sizing should take into account the thickness of the airspace and insulation. For CMU backup walls the anchor will be secured to the CMU. For framing, the anchor should be secured to the frame elements and not just the sheathing. Consult the anchorage manufacturer for recommended sizing, unit type selection, and installation instructions.

Anchor Spacing. There are Code based prescriptive requirements for anchor spacing that take into account expected wind or seismic loadings on the building. Please consult the Anchored Veneer Design Manual for recommended spacing, including the accompanying Anchor Spacing Spreadsheet. For frame walls, the placement of shelf angles will also need to be addressed. For ABRI veneers, anchor spacing of 16" x 16" works well with the unit dimensions, but a project specific anchor spacing design should be performed.

Interaction with Horizontal Joint Reinforcement. Depending on the bond pattern selected, different combinations of horizontal joint reinforcement and anchors will be optimal. The examples on the next three pages show how the anchors and horizontal joint reinforcement can be deployed for veneer walls built with running bond, stack bond and soldier coursing.

Anchorage Type. There are adjustable anchors available that will work well with ABRI masonry veneers. The following discussion shows which generic types of anchors are best suited for each bond pattern of the ABRI panel.



- (1) Anchor must be embedded at least 1.5 in. into mortar joint.
- (2) Provide at least 5/8" mortar cover to the exterior.

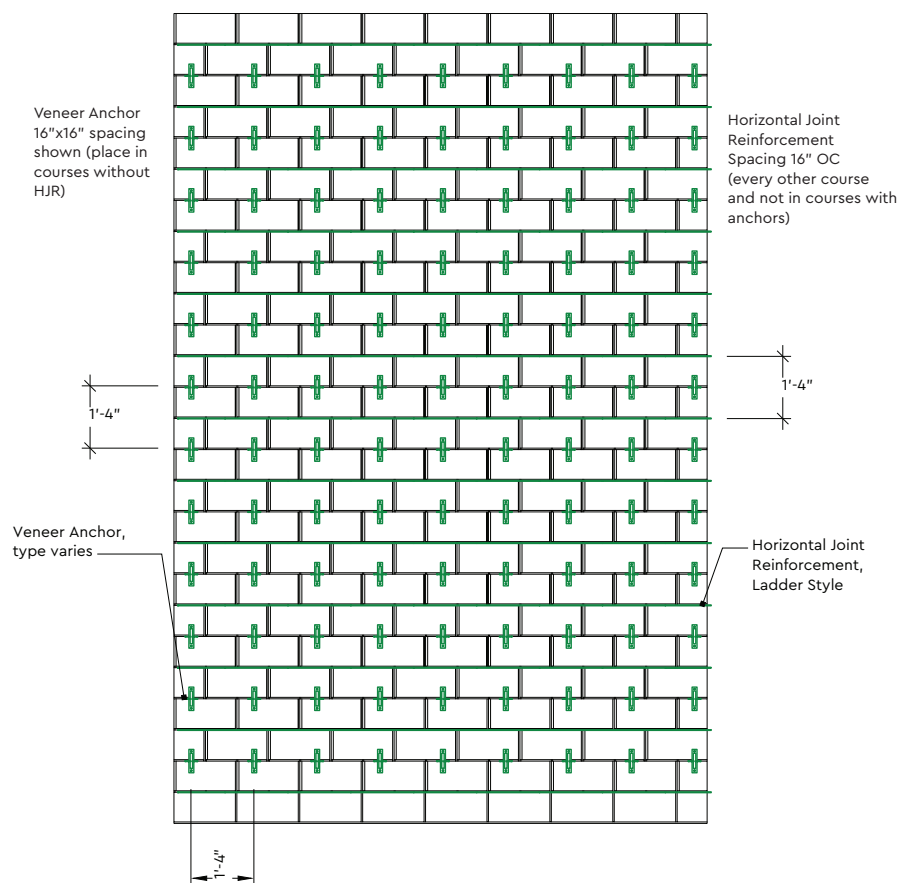
Soldier course patterns require anchors that attach to the HJR in the same joint at 16" spacing (see example at left)

Anchor and Joint Reinforcement Placement for ABRI Walls In Running Bond Using 16"x16" Anchor Spacing

Spacing requirements should be evaluated for each project. If 16" horizontal joint reinforcement and 16"x16" Anchor spacing are selected, then the following recommendations apply. Anchor spacing surrounding openings should also be considered.

Component	Horizontal Joint Reinforcement	Veneer Anchor
Type	2 wire, Ladder Style 1 Wire (running bond only)	Adjustable, specific model based on anchor manufacturer's recommendations
Dimension	Wedge Shingle and Convex: 2" (for 4" CMU) Concave and Serpentine: sized to fit 2 5/8" veneer Option: 1 Wire HJR	At least 1.5 inch embedment; sizing based on Anchor manufacturer's recommendation for specific wall condition
Placement	16" Spacing in Alternate Courses	16" by 16" spacing in courses not used for horizontal joint reinforcement

Typical Layout Elevation for Running Bond Field of Wall

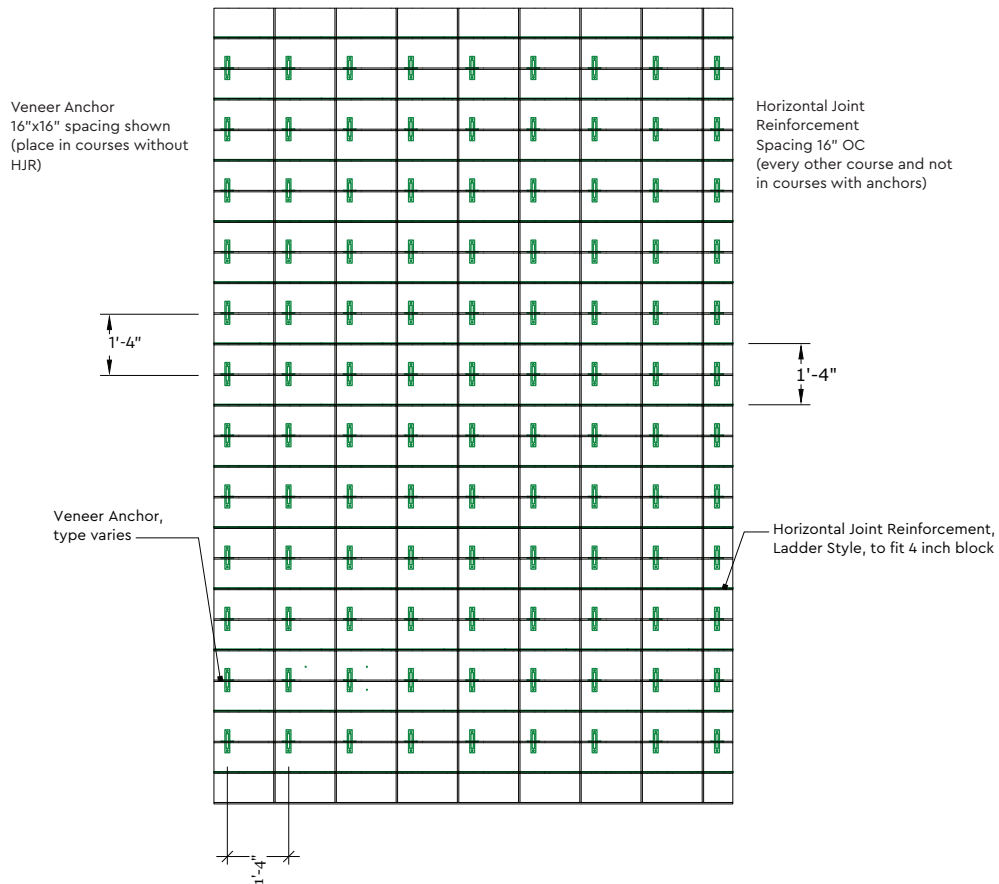


Anchor and Joint Reinforcement Placement for ABRI Walls In Stack Bond Using 16"x16" Anchor Spacing

Spacing requirements should be evaluated for each project. If 16" horizontal joint reinforcement and 16"x16" Anchor spacing are selected, then the following recommendations apply. Anchor spacing surrounding openings should also be considered.

Component	Horizontal Joint Reinforcement	Veneer Anchor
Type	2 wire, Ladder Style	Adjustable, specific model based on anchor manufacturer's recommendations
Dimension	Wedge Shingle and Convex: 2" (for 4" CMU) Concave and Serpentine: sized to fit 2 5/8" veneer	At least 1.5 inch embedment; sizing based on Anchor manufacturer's recommendation for specific wall condition
Placement	16" Spacing in Alternate Courses	16" by 16" spacing in courses not used for horizontal joint reinforcement

Typical Layout Elevation for Stack Bond Field of Wall

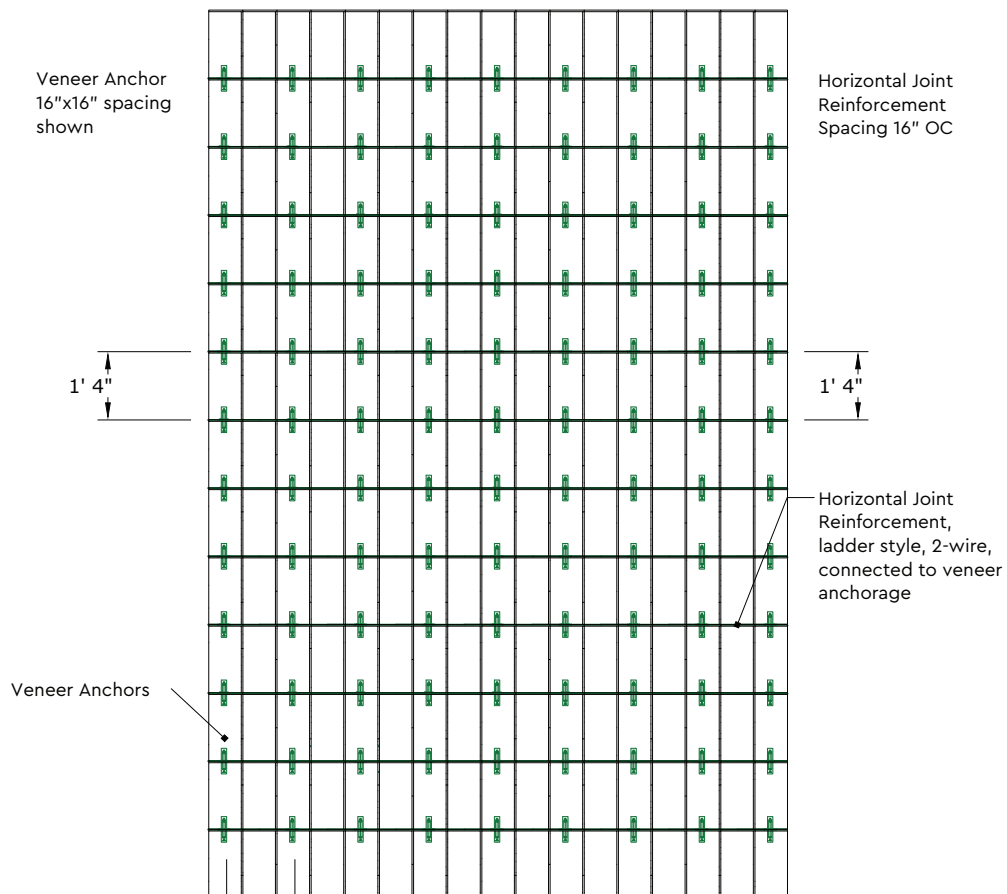


Anchor and Joint Reinforcement Placement for ABRI Walls In Soldier Course Bond Using 16"x16" Anchor Spacing

Spacing requirements should be evaluated for each project. If 16" horizontal joint reinforcement and 16"x16" Anchor spacing are selected, then the following recommendations apply. Anchor spacing surrounding openings should also be considered.

Component	Horizontal Joint Reinforcement	Veneer Anchor
Type	2 wire, Ladder Style	Veneer Anchor designed to attach to horizontal joint reinforcement with proper mortar cover and embedment
Dimension	All ABRI unit types: 2" wire to fit 3 5/8" veneer unit	At least 1.5 inch embedment; sizing based on anchor manufacturer's recommendation for specific wall condition
Placement	16" Spacing in each course	16" by 16" spacing in courses also used for horizontal joint reinforcement

Typical Layout Elevation for Field Stack Bond Field of Wall:



Considerations for Detailing ABRI Masonry Veneer Walls

ABRI Masonry Veneers are built using standard design methods for anchored concrete masonry veneers. We highlight some matters in this section that address specific characteristics of ABRI veneer panels.

Ledges

A virtually unlimited number of patterns can be constructed with the ABRI kit of parts. The designer should also consider both the benefits and potential issues posed by using patterns that have ledging based on the requirements of the application. Ledges create beautiful shadows, but they may also have other consequences that the designer should consider.

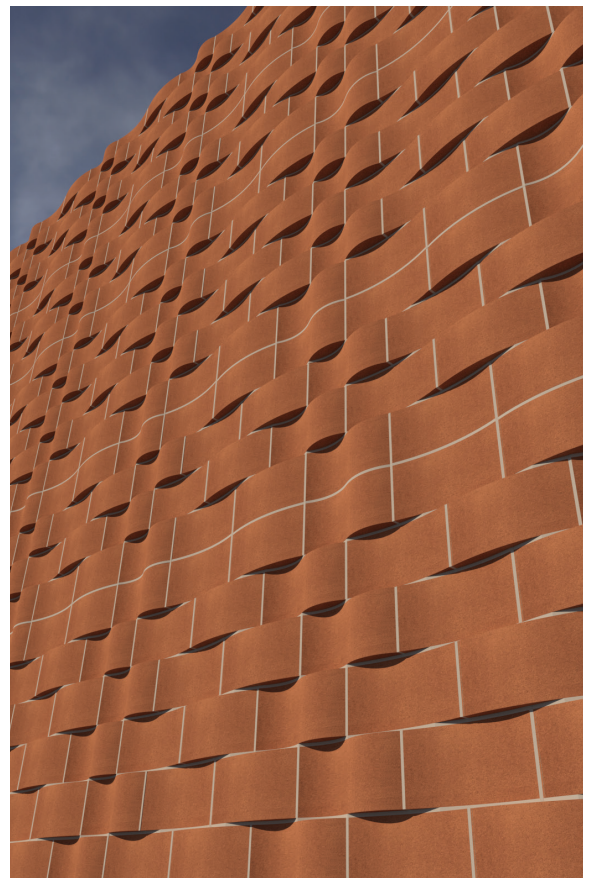
Exterior Applications: Ledges

For exterior applications that are exposed to the elements, selecting patterns that do not form horizontal ledges is the safest course of action optimal weather resistance and avoidance of staining. Anchored veneer walls will be highly resistant to moisture penetration due to the veneer, the presence of the weather protective barrier, the air space cavity and the flashing system. Assembly patterns that produce horizontal ledges may, however, have a higher risk of water related staining and/or efflorescence in exterior applications.

There are several steps that can be taken to minimize this risk. Select patterns that either eliminate or protect ledges from water accumulation – these types of patterns are highlighted in this portfolio. Abri units for exterior applications should include compatible integral water repellent in the Abri units and mortar. Use a breathable post-applied sealant/stain to provide additional protection.

For some patterns with limited ledges, it may be practical to install flashing above them.

The mortar may also be installed with a slight wash at ledge locations. Though a wash helps, it may not be a long-term solution since mortar is itself vulnerable to water penetration.



Interior or Exterior Applications: Ledges as Climb Hazard

For interior or exterior applications that are readily accessible, the veneer panel should be designed so that it does not present a climbing hazard by providing access to hand and foot holds that would allow a climber to ascend to a height that presents a risk of injury. Avoid ledges in accessible portions of the wall, or only have them to a limited height so that climb hazard is limited.

Alternative Patterns For Dramatic Appearance

Soldier course bonding allows considerable profile depth changes and will not create any ledges. To see examples, please review the ABRI Pattern Portfolio.

Backup Walls

ABRI veneers are compatible with all typical backup walls used for anchored veneer construction, including CMU backup walls, lightweight framing, and precast or poured in place panels. In the following section on weather protection, we will highlight both frame and CMU backup walls.

Height Considerations

CMU Backup: Due to the rigidity of CMU backup walls, there is no Code height limitation on a concrete masonry veneer with CMU backup, and shelf angles are not required (Section 12.2.2.3.1)

Frame Backup: Due to the deflection that occurs in lightweight framing, the height of an anchored masonry veneer panel built with that method without additional structural support is limited to 30 feet, or 38 feet from foundation to gable. Use of shelf angles is necessary to exceed these limits, and will serve to independently support segments of the veneer panel.

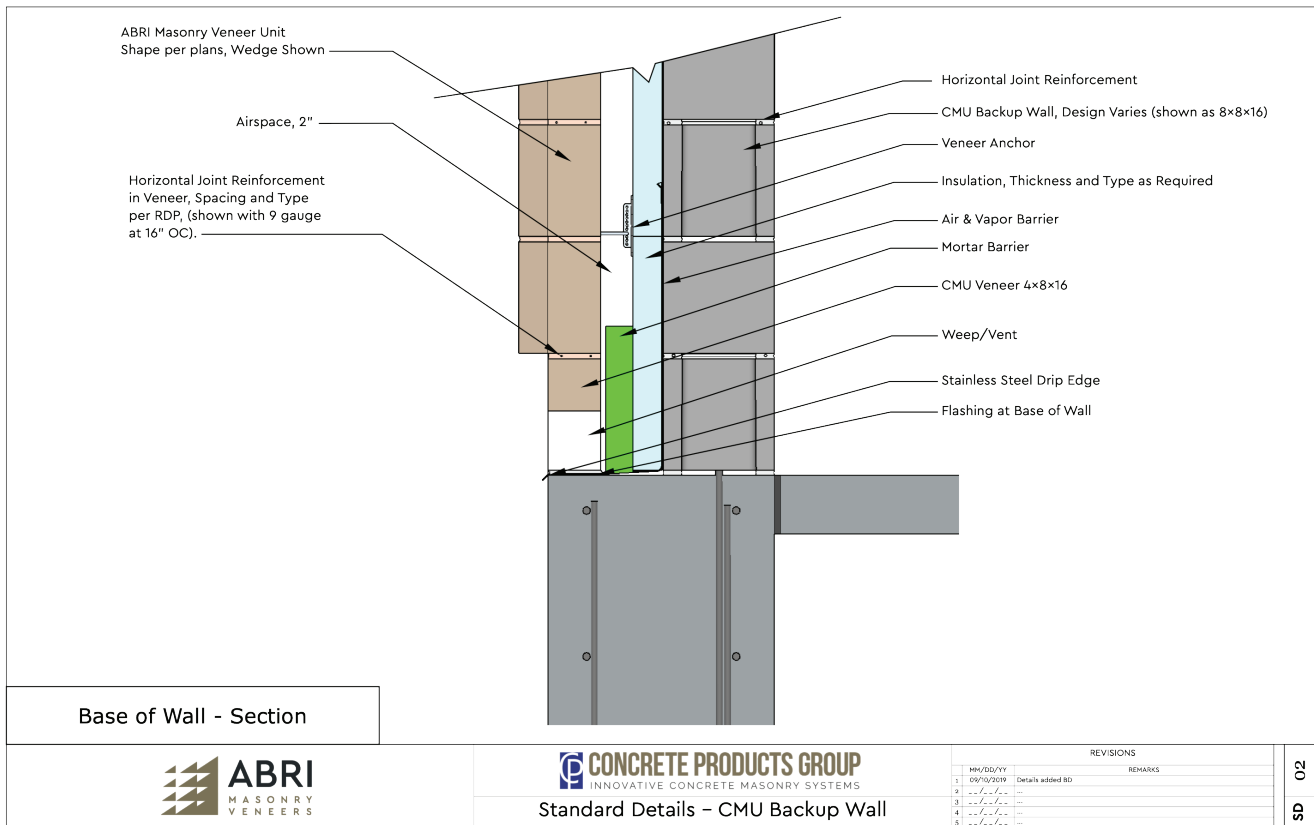
Detailing for Weather Protection

For exterior applications, ABRI veneers should be designed using the design methods that have been well proven over the years for anchored veneer walls. Anchored veneer wall systems are designed to resist moisture penetration by relying on multiple layers of protection and an air space that serves as a drainage plane in the cavity of the wall.

As the construction sequence below shows, there are multiple layers of thermal and moisture protection built into the wall system, including the installation of insulation and a water resistive barrier on the exterior side of the backup wall that is integrated with the wall's flashing and weep system.

Base of Wall - Sequence

	<p>CONCRETE PRODUCTS GROUP INNOVATIVE CONCRETE MASONRY SYSTEMS</p> <p>Abri Detail 8001</p>	REVISIONS		<p>SP 03</p>		
		1	09/10/2019		Details added RD	
		2				
		3				
		4				



Veneer Thermal and Moisture Protection relies on multiple layers of protection:

- The first level of defense is the veneer along with a fluid applied sealer, which also provides egress for moisture via the flashing and weep system
- The wall cavity has an airspace to provide drainage for any moisture that enters the cavity.
- Thermal protection is provided by the insulation in the cavity
- A water resistive membrane is placed at exterior of backup wall to prevent moisture penetration and integrates with the flashing and weep system to provide a path for moisture to exit the wall.
- An air and vapor retarder barrier is placed (location depending on climate) at the backup wall. If the backup wall is solid concrete or fully grouted concrete masonry, then a separate air barrier is not required.

Weather Protection Detailing Checklist

Veneer

- Select ABRI Pattern appropriate for building requirements
- ABRI veneer units include integral water repellent
- Mortar with integral water repellent compatible with that used in the ABRI units
- Post-applied clear or pigmented breathable or suitable film forming pigmented sealant suitable for exterior masonry applications
- Horizontal Joint Reinforcement at 16" o.c. for ABRI veneers.
- Movement Joints, spaced per design requirements
- Proper detailing of mortar joints: concave joints recommended
- Flashing and weep/drip edge provided at base of wall and at any interruptions of drainage plane
- Use of suitable bead sealant at movement joints and as otherwise required for openings, drip edge attachments, caps, etc.

Air Space

- 2" minimum span recommended
- Use means to prevent collected mortar droppings during construction from blocking flashing and weep systems (mortar barriers).

Cavity Insulation

- Insulation selected based on Code requirements for applicable climate zone
- Flashing detailing compatible with continuous insulation.

Water Resistive Membrane

- For all wall types, a water resistive membrane should provide continuous protection all the way down the backup wall at the cavity to the flashing system.
- For frame/sheathing, either seal joints of weather resistive sheathing, or use a separate weather resistive barrier applied to the sheathing.

Air and Vapor Barrers

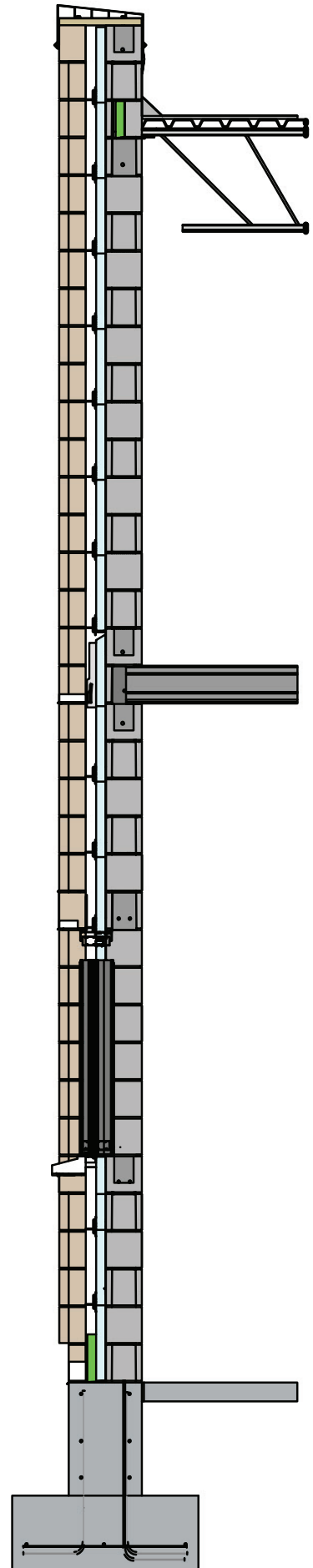
- Placement depends on Climate Zone considerations. For colder climates the vapor barrier needs to be placed toward the interior of the structure. For hot, humid climates, the opposite is required.



Detailing Considerations for Certain Wall Features

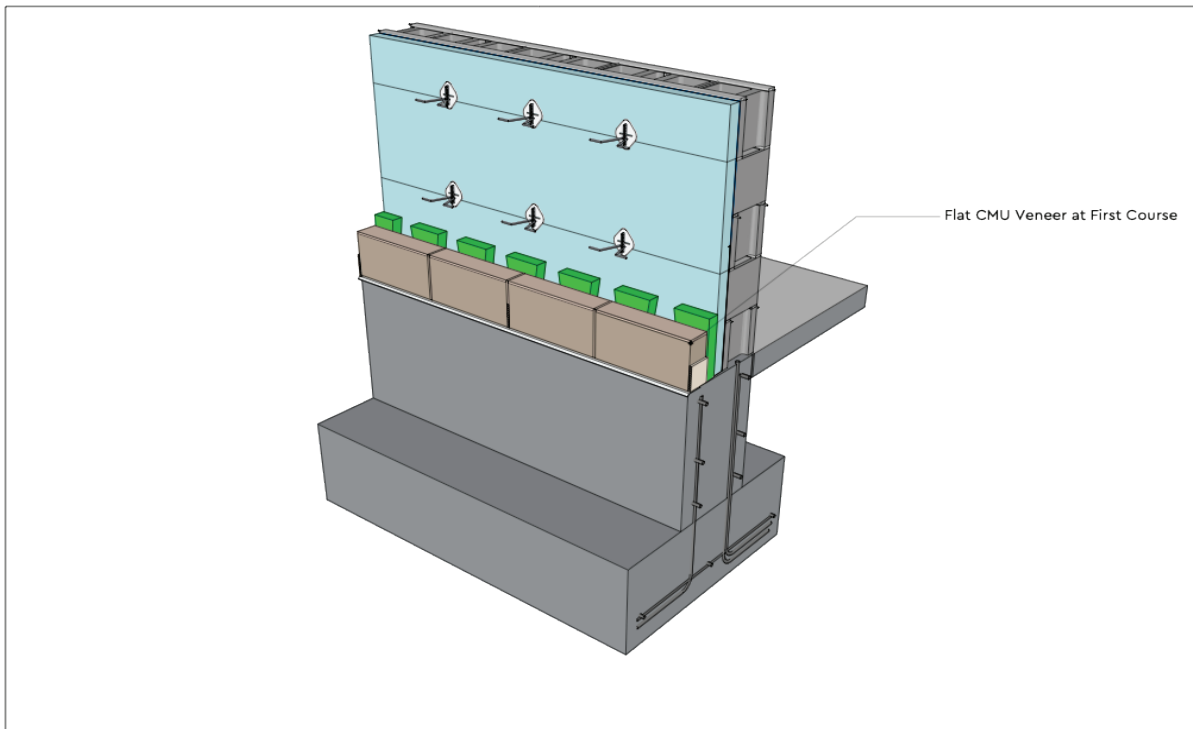
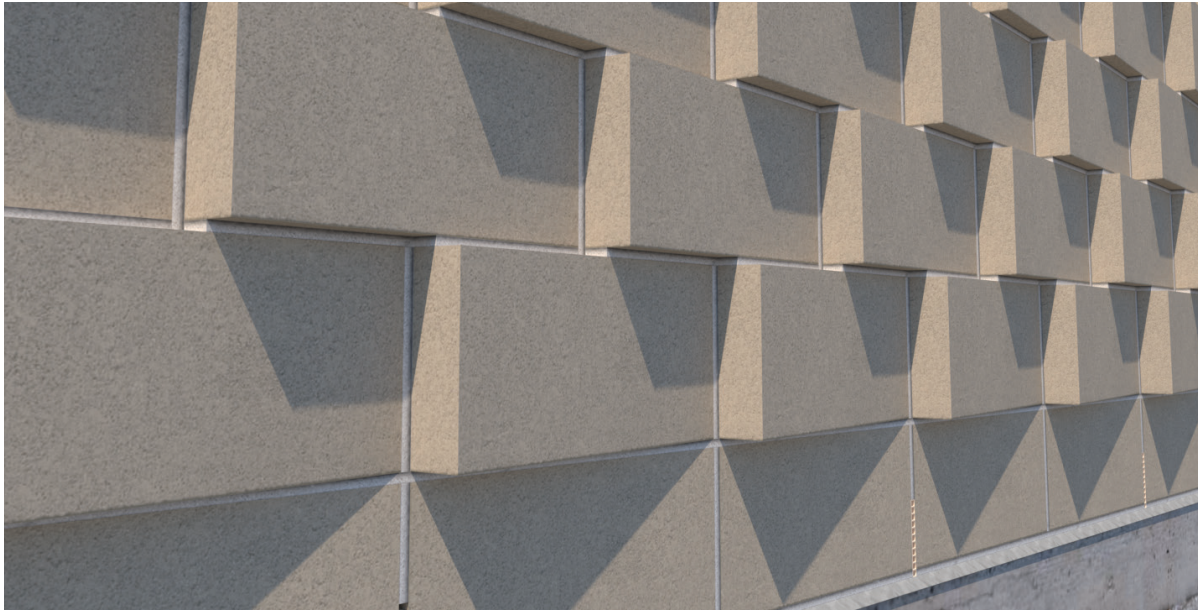
Parapet and top of wall A flat surface may be required to seat the parapet cap properly – See suggestions on following pages

Drip edge locations See the following pages for suggestions on using drip edges with the various face profiles at shelf angles, heads of openings, sills and at the base of the wall.



Base of Wall with Running or Stack Bond

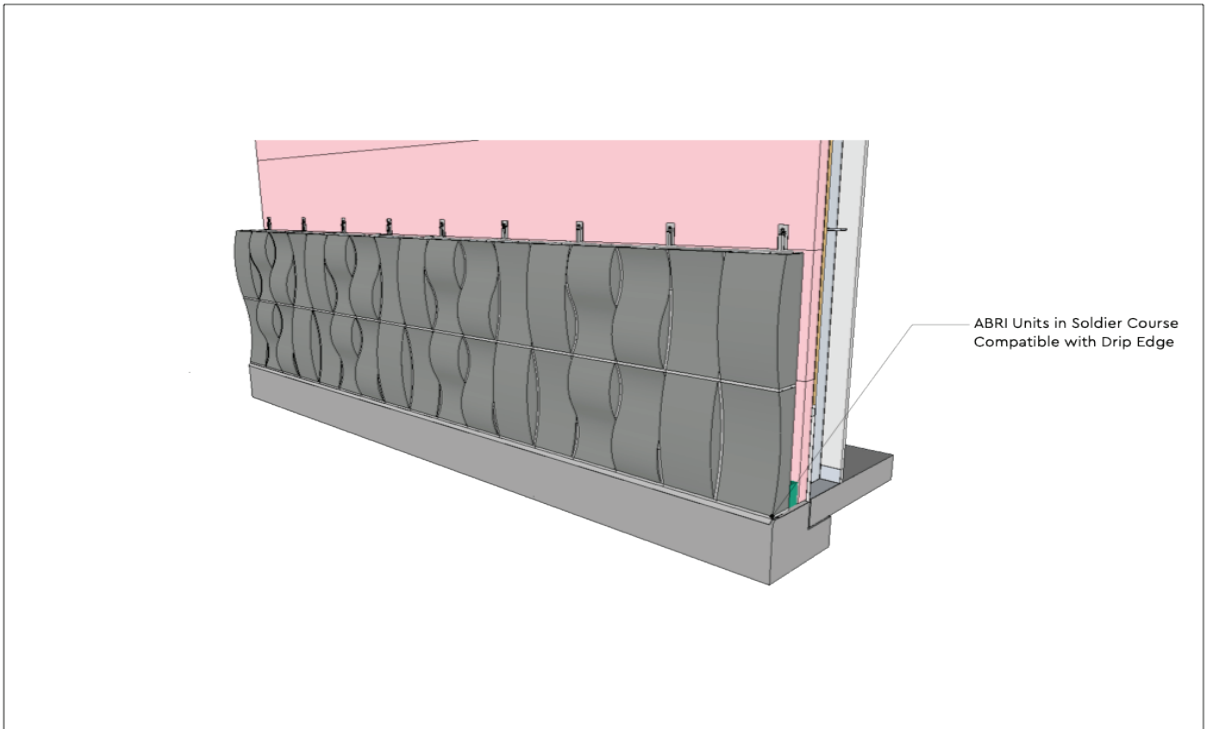
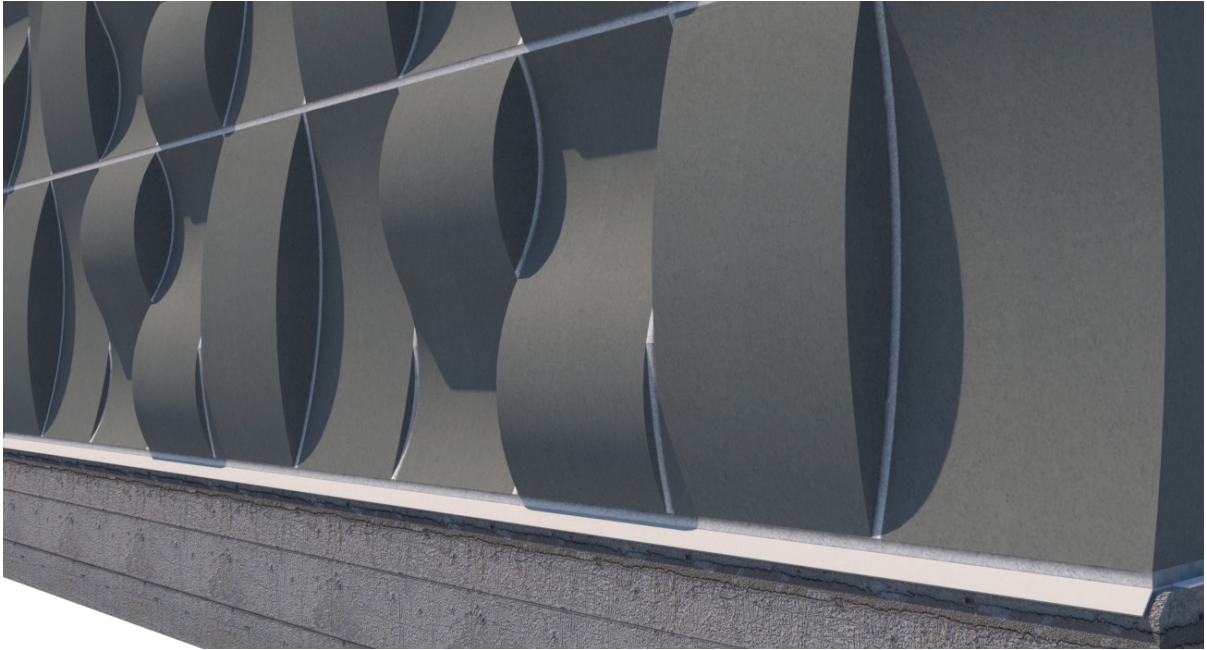
It may be desirable to use a flat veneer course at the base of the wall both for aesthetic and practical reasons when building an ABRI veneer panel that has the units in stack or running bond, to provide a straight interface with the drip edge as it exits the wall. This also provides a framing effect for the look of the veneer, and creates an accent shadow band.



CMU Backup Wall Base of Wall	 CONCRETE PRODUCTS GROUP INNOVATIVE CONCRETE MASONRY SYSTEMS	REVISIONS		A 06
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Base of Wall with Soldier Course Bond Pattern

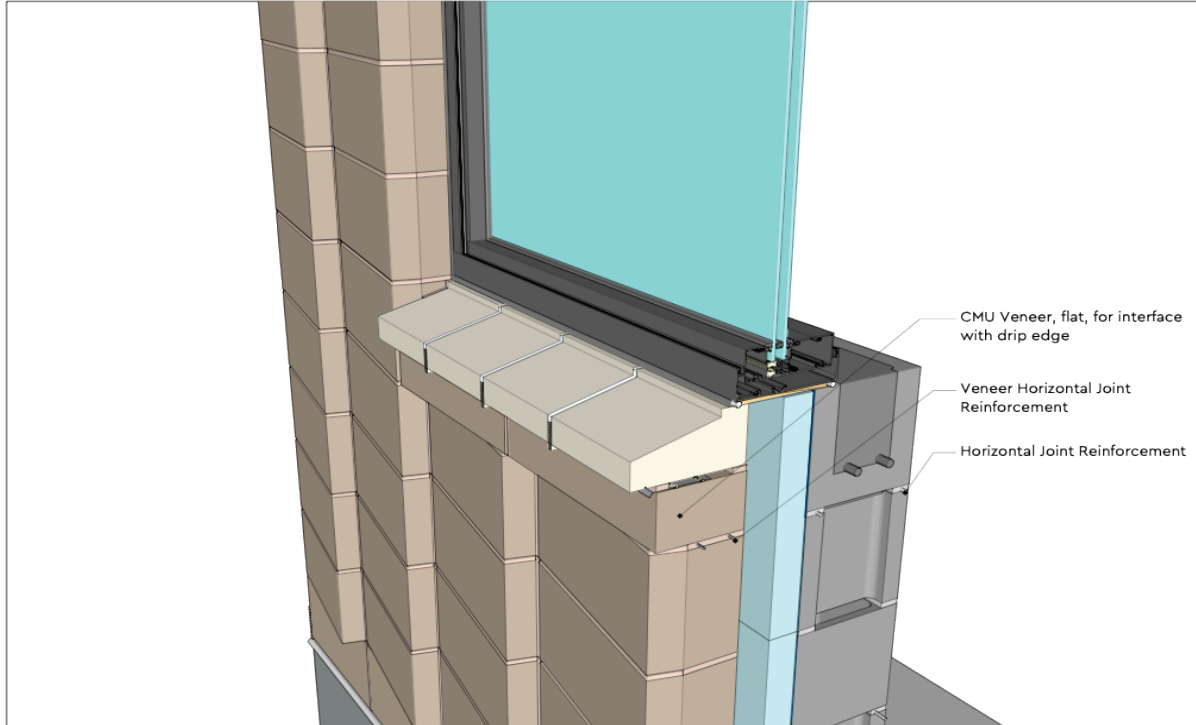
Where soldier course bonding is used, there is no need to use flat veneer units at the base of the wall because all ABRI units have the same depth along their 8" end (they all are 3 5/8" deep at that position) so there is no issue with the drip edge interface.



Frame Backup Wall Base of Wall Soldier Course	ABRI Detail 8102 - Frame Backup Base of Wall	REVISIONS		A 09
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Window Sill

The window sill is an additional location where the designer may prefer to use an accent band of flat veneer units for the same reason of compatibility with the flashing weep and drip edge.



ABRI/CMU Backup Wall
Window Sill



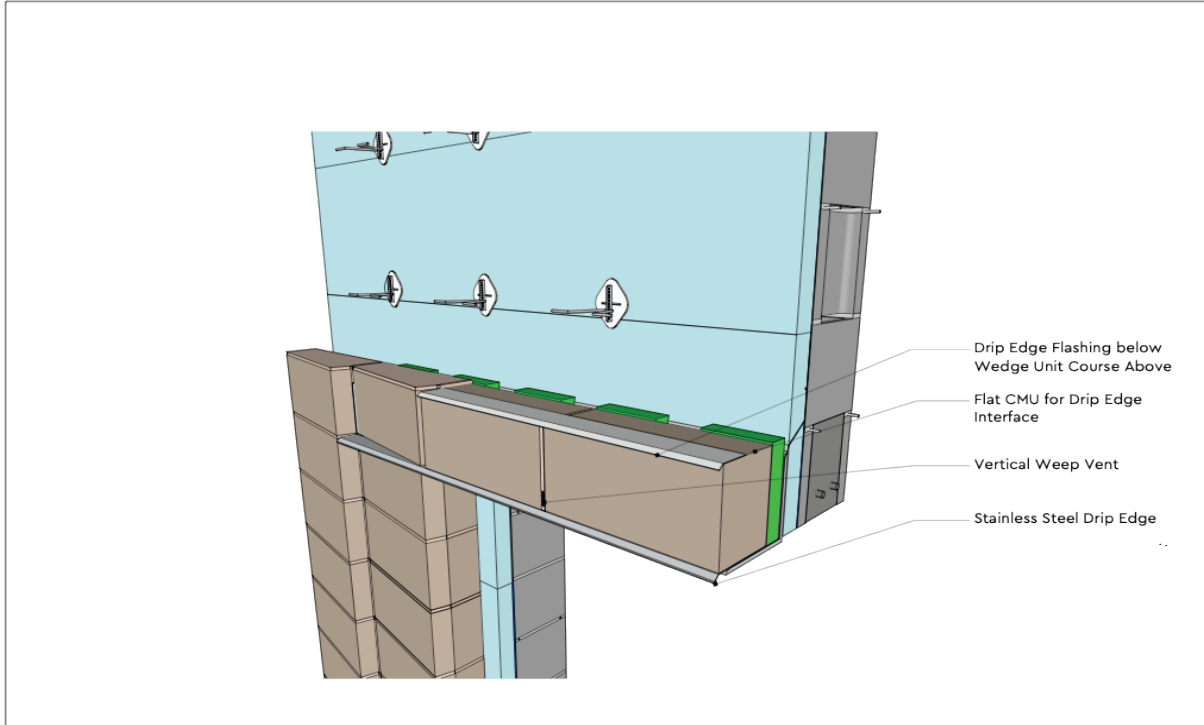
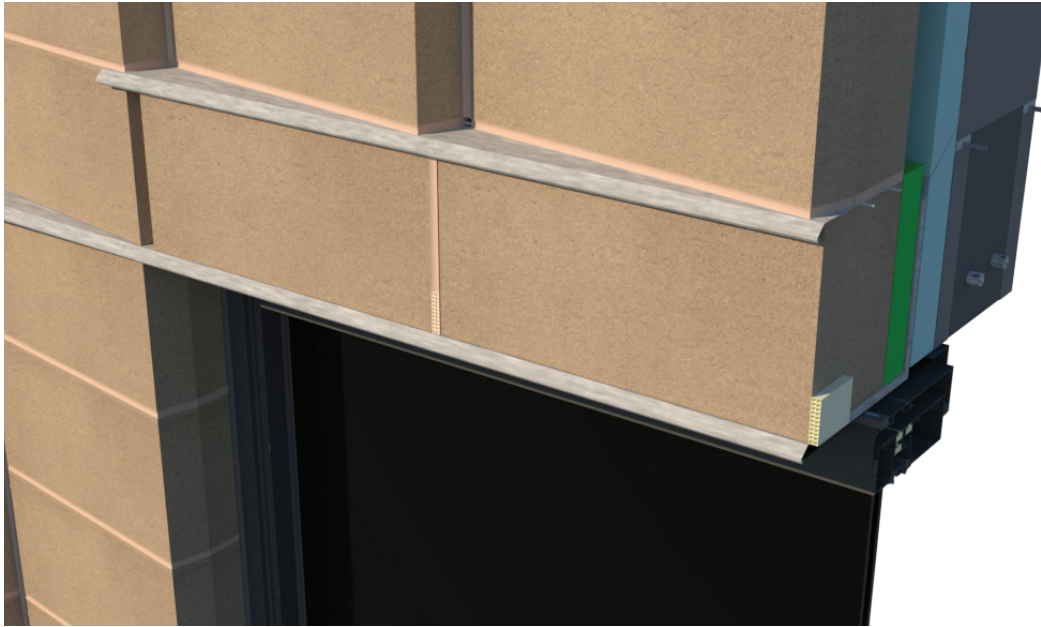
ABRI DETAIL 8003

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A 03

Window Head

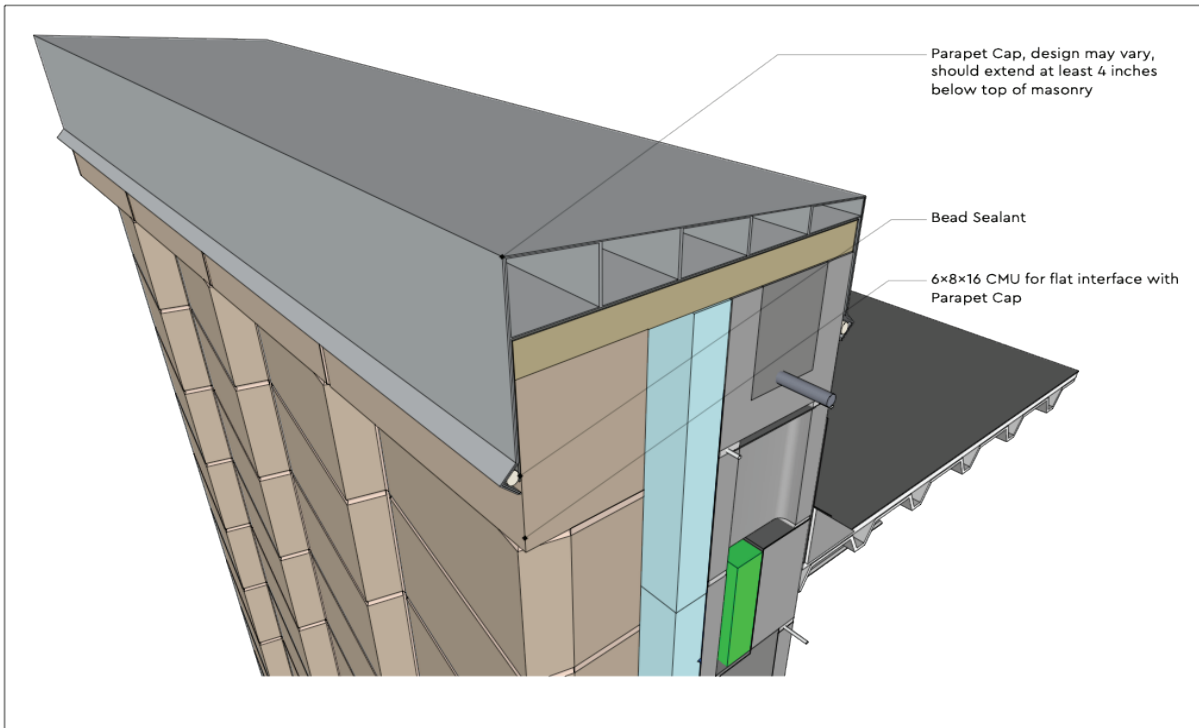
The window head will likely have an lintel angle supporting the veneer that will have flashing and a drip edge so it may be desirable to provide flat units at this position as well. Note the drip edge above the flat veneer units. Flashing occasional ledges such as this is recommended.



ABRI/CMU Backup Window Head	 CONCRETE PRODUCTS GROUP <small>INNOVATIVE CONCRETE MASONRY SYSTEMS</small>	REVISIONS	A 05																
	ABRI Detail 8005	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">MM/DD/YY</th> <th style="width: 10%;">New</th> <th style="width: 80%;">REMARKS</th> </tr> </thead> <tbody> <tr> <td>12/28/19</td> <td>New</td> <td></td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		MM/DD/YY	New	REMARKS	12/28/19	New											
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12/28/19	New																		

Parapet/Wall Top

If a metallic parapet cap is selected, it will require a flat profile for the top course of the masonry to provide weather protection against wind driven rain. The designer may want to explore precast or masonry caps (with proper flashing and weather protection) as an aesthetic option.



ABRI/CMU Backup Wall
Parapet



ABRI DETAIL 8008

REVISIONS	
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Keys to Success: Construction

Even though ABRI veneers offer a multitude of new design opportunities, the basics of construction of an ABRI veneer wall are not different than more conventional masonry veneers.

Here are some considerations to take into account during construction:

Unit Alignment

Even though the faces differ depths and contours, All ABRI shapes are designed so that the mason simply aligns the flat back side of the units.

Mortar Joints

When different ABRI shapes are used in a pattern together, the mortar joints may be less linear than masons encounter on traditional products. The mason should fully mortar each head and bed joint at the area where the two shapes intersect

Mortar Joint Tooling

As with all architectural masonry, mortar joints should be consistently tooled when they reach thumbprint hardness, so that they have consistent color. Joints should be tooled with a concave joint for weather protection.

Sample Panel

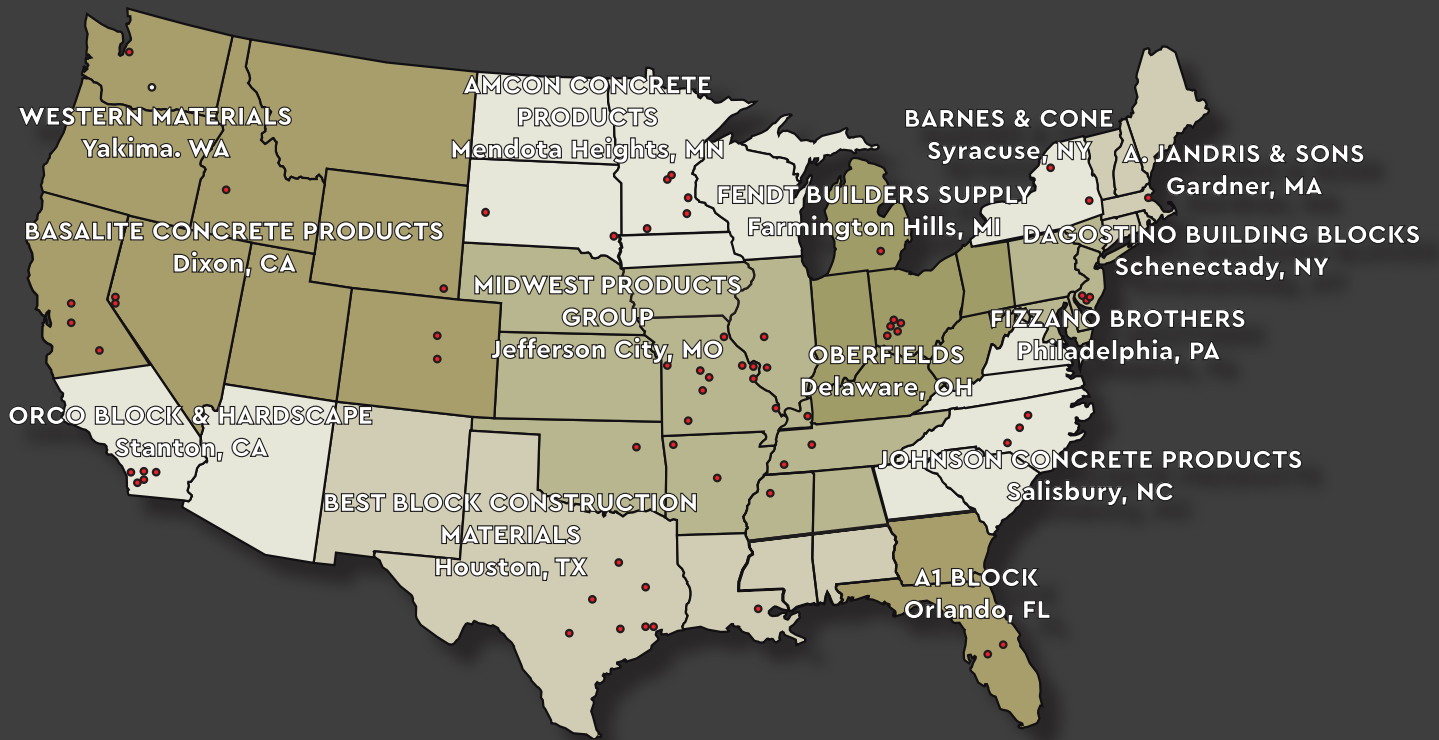
The sample panel is the most important tool for the architect, owner and contractor to communicate the standard for acceptance of the finished work. With ABRI walls, a sample panel is particularly important to demonstrate the desired laying pattern, along with all of the usual criteria that are evaluated.

Visualizing Pattern Layouts

We offer a library of 3D models of many ABRI patterns, and welcome requests for assistance. Please contact info@concreteproductsgroup.com for more information

Cleaning

Cleaning is a key step in the delivery of a successful architectural masonry project. The means and methods for cleaning should be reviewed via a test on the sample panel prior to beginning cleaning of the walls. For more recommendations regarding cleaning, please see the Design Note on Cleaning Architectural Masonry on www.concreteproductsgroup.com



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