Anchorage Analysis
Cellular PVC Cladding

Report Q7761.01-117-14

Rendered to:

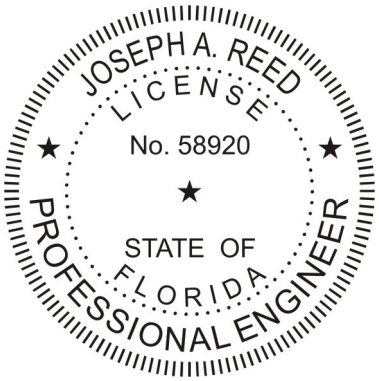
AZEK BUILDING PRODUCTS
894 Prairie Avenue
Wilmington, Ohio 45177

Prepared by:

Joseph A. Reed, P.E.
Craig H. Wagner, P.E.

Architectural Testing, Inc.
130 Derry Court
York, Pennsylvania 17406
(717) 764-7700
FL COA 29274

November 21, 2023



Joseph A. Reed, P.E.
Senior Project Engineer – Certification Services
FL PE 58920
2023.11.30 09:00:42 -05'00'

Craig H. Wagner, P.E.
Chief Engineer – Certification Services

This item has been digitally signed and sealed by Joseph A. Reed, PE on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Scope

Architectural Testing, Inc., an Intertek company, was contracted by AZEK Building Products to evaluate installation methods for their cellular PVC cladding. The following installation methods are evaluated for the cellular PVC claddings which are the subject of Code Compliance Research Report CCRR-0266:

- Attachment through a 3/8" drainage strip (Benjamin Obdyke or similar or 3/8" plywood strip) to 7/16" OSB or plywood sheathing and into stud.
- Attachment to 18 Ga. steel hat channel with FastenMaster Cortex Driller screws
- Attachment to 16 Ga. steel hat channel with FastenMaster Cortex Driller screws
- Attachment through a 3/8" drainage strip (Benjamin Obdyke or similar or 3/8" plywood strip) to 1/2" OSB or plywood sheathing only.
- Attachment through a 3/8" drainage strip (Benjamin Obdyke or similar or 3/8" plywood strip) to 3/4" OSB or plywood sheathing only.

Established anchorage capacities will be used to determine allowable design pressures for the cellular PVC siding product installed with these methods.

The analyses performed satisfy the methods and requirements of the following:

2021 International Building Code. International Code Council, 2020.

2021 International Residential Code. International Code Council, 2020.

Florida Building Code, Building, 8th Edition (2023). International Code Council, 2023.

ANSI/AWC NDS-2018 National Design Specification (NDS) for Wood Construction. American Wood Council, 2018.

AISI S100-16 North American Specification for the Design of Cold-Formed Steel Structural Members, 2016. American Iron and Steel Institute, 2016.

PDS – 2020 *Panel Design Specification.* APA - The Engineered Wood Association, 2020.

The calculations presented herein are for the integrity of the cladding anchorages based on wind load only. The weather tightness of the installation is not addressed by this report. The air/water/structural performance of the individual products is not proven by this report.

The supporting substrate is assumed to have the integrity to resist the anchor loads developed by the products. Furthermore, the results of the analyses present a solution that satisfies the scope of the project, but other feasible solutions may exist.

Anchorage Capacities

The individual capacities of each anchorage method were calculated using the methods of NDS 2018 or AISI S100-16. Pull-over values were established by test report J6771.01-119-19. Calculations are presented on page 6 to page 10 and summarized in Table 1.

Table 1 Calculated Anchorage Capacities

Substrate	Anchor	Anchor Capacity	Comments
7/16” Plywood or OSB and Stud	#10 x 2-1/2” Screw 2-3/4” Cortex Concealed	126 lb	Penetration adjusted for 3/8” drainage strip. Panel is C-D, Exposure 1, Species Group 1. S-P-F stud.
18 Ga. Hat Channel	Cortex Driller	104 lb	Min. F_y = 33,000 psi Steel
16 Ga. Hat Channel	Cortex Driller	131 lb	Min. F_y = 33,000 psi Steel
1/2" Plywood or OSB	#10 x 2-1/2” Screw 2” Cortex Concealed	62 lb	Penetration adjusted for 3/8” drainage strip. Panel is C-D, Exposure 1, Species Group 1.
3/4” Plywood or OSB	#10 x 2-1/2” Screw 2” Cortex Concealed	92 lb	Penetration adjusted for 3/8” drainage strip. Panel is C-D, Exposure 1, Species Group 1.

Cladding Design Pressures

The allowable design pressure is based on the capacity of the fastener, the spacing of the anchors, and the number of anchors per location. The allowable design pressure may also be limited by the design pressure established for the siding board by testing. The least of these design pressures shall be designated as the siding design pressure.

Calculations are presented on page 11 to page 13 and summarized in the following tables.

Table 2 Allowable Design Pressures for 3.5" Solid Board

Substrate	Fastener	Number of Fasteners	Fastener Spacing	Allowable Design Pressure
7/16" Plywood or OSB Over 2x Stud	#10 x 2-1/2" screw 2-3/4" Cortex Concealed	2	16"	631 psf
1/2" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	319 psf
3/4" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	473 psf
18 Ga. Hat Channel	Cortex Driller	2	16"	535 psf
16 Ga. Hat Channel	Cortex Driller	2	16"	631 psf

Table 3 Allowable Design Pressures for 5.5" Solid Board

Substrate	Fastener	Number of Fasteners	Fastener Spacing	Allowable Design Pressure
7/16" Plywood or OSB Over 2x Stud	#10 x 2-1/2" screw 2-3/4" Cortex Concealed	2	16"	351 psf
1/2" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	203 psf
3/4" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	301 psf
18 Ga. Hat Channel	Cortex Driller	2	16"	340 psf
16 Ga. Hat Channel	Cortex Driller	2	16"	351 psf

Table 4 Allowable Design Pressures for 7.25" Solid Board

Substrate	Fastener	Number of Fasteners	Fastener Spacing	Allowable Design Pressure
7/16" Plywood or OSB Over 2x Stud	#10 x 2-1/2" screw 2-3/4" Cortex Concealed	2	16"	313 psf
1/2" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	154 psf
3/4" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	228 psf
18 Ga. Hat Channel	Cortex Driller	2	16"	258 psf
16 Ga. Hat Channel	Cortex Driller	2	16"	325 psf

Table 5 Allowable Design Pressures for 3.2" Tongue and Groove Board

Substrate	Fastener	Number of Fasteners	Fastener Spacing	Allowable Design Pressure
7/16" Plywood or OSB Over 2x Stud	#10 x 2-1/2" screw 2-3/4" Cortex Concealed	2	16"	382 psf
1/2" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	349 psf
3/4" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	382 psf
18 Ga. Hat Channel	Cortex Driller	2	16"	382 psf
16 Ga. Hat Channel	Cortex Driller	2	16"	382 psf

Table 6 Allowable Design Pressures for 5.5" Tongue and Groove Board

Substrate	Fastener	Number of Fasteners	Fastener Spacing	Allowable Design Pressure
7/16" Plywood or OSB Over 2x Stud	#10 x 2-1/2" screw 2-3/4" Cortex Concealed	2	16"	294 psf
1/2" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	203 psf
3/4" Plywood or OSB No Stud	#10 x 2-1/2" screw 2" Cortex Concealed	2	16"	294 psf
18 Ga. Hat Channel	Cortex Driller	2	16"	294 psf
16 Ga. Hat Channel	Cortex Driller	2	16"	294 psf

Anchor Capacities

Attachment Through 3/8" Drainage Strip to 7/16" OSB and Stud

Spruce-Pine-Fir 2x Wood Stud Minimum (G=0.42)

OSB, (G_{equiv} = 0.45)

G' = ((0.45)(7/16")+(0.42)(11/16"))/(1.125") = 0.43 (weighted average G)

#10 x 2-1/2" Wood Screw (D = 0.190"); qualifies #10 x 2" Cortex

$W = 2850G^2D = 2850(0.43)^2(0.190) = 100$ lb/inch

p = 2-1/2" - 1" - 3/8" = 1-1/8"

C_D = 1.6 for Wind Load

C_M = 0.7 for any moisture condition at time of install

C_t = 1.0 for T ≤ 100 °F (at time of maximum wind load)

$W' = C_DC_MC_tWp = (1.6)(0.7)(1.0)(100 \text{ lb/inch})(1.125") = 126$ lb

Pull-Though Capacity of Cortex Screw:

From J6771.01-119-19 pull through capacity is 155 lb.

Tension Capacity of Connection is 126 lb/screw

Anchor Capacities (Continued)

Attachment Through 3/8" Drainage Strip to 1/2" Plywood

Species Group 1 Panel, (G_{equiv} = 0.45)

p = 2-1/2" - 1" - 3/8" = 1-1/8"; Full penetration of 1/2" panel

#10 x 2-1/2" Wood Screw (D = 0.190"); qualifies #10 x 2" Cortex

$W = 2850G^2D = 2850(0.45)^2(0.190) = 110$ lb/inch

p = 1/2"

C_D = 1.6 for Wind Load

C_M = 0.7 for any moisture condition at time of install

C_t = 1.0 for T ≤ 100 °F (at time of maximum wind load)

$W' = C_DC_MC_tWp = (1.6)(0.7)(1.0)(110 \text{ lb/inch})(0.50") = 62$ lb

Pull-Though Capacity of Cortex Screw:

From J6771.01-119-19 pull through capacity is 155 lb.

Tension Capacity of Connection is 62 lb/screw

Anchor Capacities (Continued)

Attachment Through 3/8" Drainage Strip to 3/4" Plywood

Species Group 1 Panel, (G_{equiv} = 0.45)

p = 2-1/2" - 1" - 3/8" = 1-1/8"; Full penetration of 3/4" panel

#10 x 2-1/2" Wood Screw (D = 0.190"); qualifies #10 x 2" Cortex

$W = 2850G^2D = 2850(0.45)^2(0.190) = 110$ lb/inch

p = 3/4"

C_D = 1.6 for Wind Load

C_M = 0.7 for any moisture condition at time of install

C_t = 1.0 for T ≤ 100 °F (at time of maximum wind load)

$W' = C_DC_MC_tWp = (1.6)(0.7)(1.0)(110 \text{ lb/inch})(0.75") = 92$ lb

Pull-Though Capacity of Cortex Screw:

From J6771.01-119-19 pull through capacity is 155 lb.

Tension Capacity of Connection is 92 lb/screw

Anchor Capacities (Continued)

Attachment to 18 Gauge Hat Channel

Cortex Driller

18 Gauge 33 KSI Steel Hat Channel

Allowable Tension of Cortex Driller:

P_{ss}/Ω = (1,936 lb)/3.0 = 645 lb (TEKS 410 Stainless Steel Data)

Pull-Out of Cortex Driller:

$P_{not}/\Omega = 0.85t_c dF_{u2}/\Omega$
$P_{not}/\Omega = 0.85(0.0428")(0.190")(45{,}000\ psi)/3.0$
P_{not}/Ω = 104 lb

Pull-Though Capacity of Cortex Screw:

From J6771.01-119-19 pull through capacity is 155 lb.

Tension Capacity of Connection is 104 lb/screw

Anchor Capacities (Continued)

Attachment to 16 Gauge Hat Channel

Cortex Driller

16 Gauge 33 KSI Steel Hat Channel

Allowable Tension of Cortex Driller:

P_{ss}/Ω = (1,936 lb)/3.0 = 645 lb (TEKS 410 Stainless Steel Data)

Pull-Out of Cortex Driller:

$P_{not}/\Omega = 0.85t_c dF_{u2}/\Omega$
$P_{not}/\Omega = 0.85(0.054")(0.190")(45{,}000\ psi)/3.0$
$P_{not}/\Omega = 131$ lb

Pull-Though Capacity of Cortex Screw:

From J6771.01-119-19 pull through capacity is 155 lb.

Tension Capacity of Connection is 131 lb/screw

Cladding Design Pressures

Sample Calculation

3.5” Solid Board Installed to 18 Ga. Hat Channel

Substrate: 18 Ga. Hat Channel
Fasteners: 2x Cortex Driller
Fastener Capacity: 104 lb
Fastener Spacing: 16”
Board Capacity: 631 psf per J6771.01

Load Area: (16”)(3.5”)/144 = 0.3889 ft^2

(DP)(Load Area) = Total Fastener Capacity

(DP)(0.3889 ft^2) = (2)(104 lb)

DP = (2)(104 lb)/(0.3889 ft^2) = 535 psf < Board Capacity

3.5” Solid Board Installed to 18 Ga. Hat Channel DP = 535 psf

Spread Sheet Calculations

Product: 3.5" Solid Board
Width: 3.500 inch
Test Report(s): J6771.01, L4008.01
Design Pressure per Test: 631 psf

Fastener	Substrate	Fastener Capacity (lb)	Fastener Spacing (in)	Fasteners	Design Pressure[2] (psf)
#10 x 2-1/2" Screw	7/16" Plywood Sheathing and Stud[1]	126	16	2	631
#10 x 2-1/2" Screw	1/2" Plywood Sheathing[1]	62	16	2	319
#10 x 2-1/2" Screw	3/4" Plywood Sheathing[1]	92	16	2	473
Cortex Driller	18 GA. Hat Channel	104	16	2	535
Cortex Driller	16 GA Hat Channel	131	16	2	631

Notes: [1]with 3/8" Drainage Strip
[2]Red indicates governed by test

Product: 5.5" Solid Board
Width: 5.500 inch
Test Report(s): E7507.01
Design Pressure per Test: 351 psf

Fastener	Substrate	Fastener Capacity (lb)	Fastener Spacing (in)	Fasteners	Design Pressure[2] (psf)
#10 x 2-1/2" Screw	7/16" Plywood Sheathing and Stud[1]	126	16	2	351
#10 x 2-1/2" Screw	1/2" Plywood Sheathing[1]	62	16	2	203
#10 x 2-1/2" Screw	3/4" Plywood Sheathing[1]	92	16	2	301
Cortex Driller	18 GA. Hat Channel	104	16	2	340
Cortex Driller	16 GA Hat Channel	131	16	2	351

Notes: [1]with 3/8" Drainage Strip
[2]Red indicates governed by test

Product: 7.25" Solid Board
Width: 7.250 inch
Test Report(s): J6771.01, L4008.01
Design Pressure per Test: 372 psf

Fastener	Substrate	Fastener Capacity (lb)	Fastener Spacing (in)	Fasteners	Design Pressure[2] (psf)
#10 x 2-1/2" Screw	7/16" Plywood Sheathing and Stud[1]	126	16	2	313
#10 x 2-1/2" Screw	1/2" Plywood Sheathing[1]	62	16	2	154
#10 x 2-1/2" Screw	3/4" Plywood Sheathing[1]	92	16	2	228
Cortex Driller	18 GA. Hat Channel	104	16	2	258
Cortex Driller	16 GA Hat Channel	131	16	2	325

Notes: [1]with 3/8" Drainage Strip
[2]Red indicates governed by test

Cladding Design Pressures (Continued)

Product: 3.2" Tounge and Groove
Width: 3.200 inch
Test Report(s): F6955.01, L4008.01
Design Pressure per Test: 382 psf

Fastener	Substrate	Fastener Capacity (lb)	Fastener Spacing (in)	Fasteners	Design Pressure[2] (psf)
#10 x 2-1/2" Screw	7/16" Plywood Sheathing and Stud[1]	126	16	2	382
#10 x 2-1/2" Screw	1/2" Plywood Sheathing[1]	62	16	2	349
#10 x 2-1/2" Screw	3/4" Plywood Sheathing[1]	92	16	2	382
Cortex Driller	18 GA. Hat Channel	104	16	2	382
Cortex Driller	16 GA Hat Channel	131	16	2	382

Notes: [1]with 3/8" Drainage Strip
[2]Red indicates governed by test

Product: 5.5" Tounge and Groove
Width: 5.500 inch
Test Report(s): J6771.01, L4008.01
Design Pressure per Test: 294 psf

Fastener	Substrate	Fastener Capacity (lb)	Fastener Spacing (in)	Fasteners	Design Pressure[2] (psf)
#10 x 2-1/2" Screw	7/16" Plywood Sheathing and Stud[1]	126	16	2	294
#10 x 2-1/2" Screw	1/2" Plywood Sheathing[1]	62	16	2	203
#10 x 2-1/2" Screw	3/4" Plywood Sheathing[1]	92	16	2	294
Cortex Driller	18 GA. Hat Channel	104	16	2	294
Cortex Driller	16 GA Hat Channel	131	16	2	294

Notes: [1]with 3/8" Drainage Strip
[2]Red indicates governed by test

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	11/21/23	N/A	Original report issue