Petersen Aluminum Corporation

The Art of Metal Wall Panels: Corrugated and Concealed Fastener Attachments

Course Number S23AMWP (1 HSW | LU)

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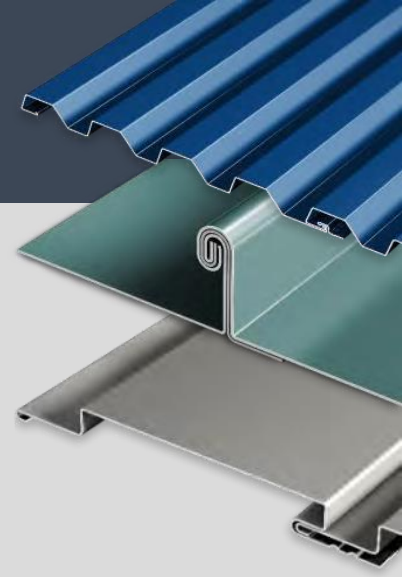

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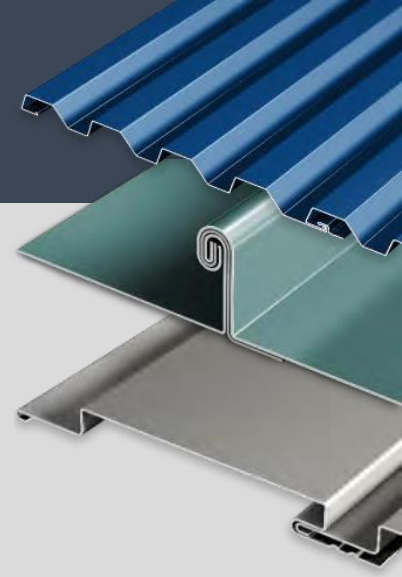

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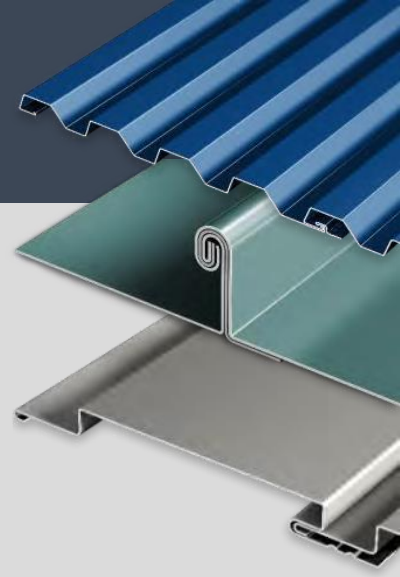
Course description



An advanced review of **metal wall panel** profiles, both exposed and concealed fastener, their proper application with field examples of flashing details “do’s and don’ts,” specific applications of these wall panel products and how they affect environmental efficiency, project sustainability and product performance.

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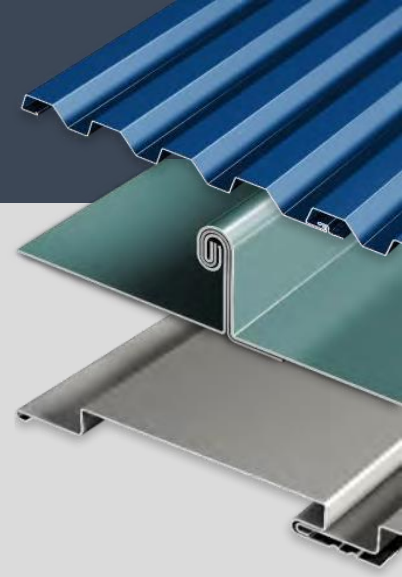
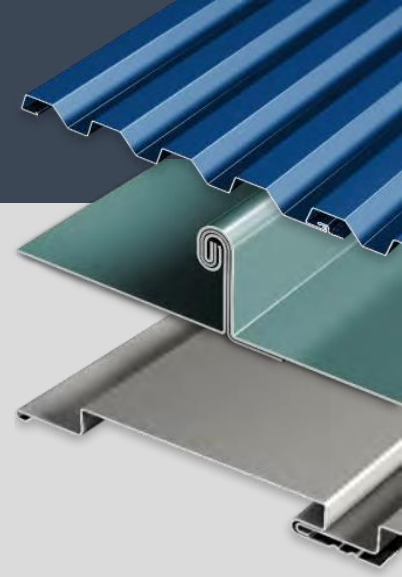
Learning objectives



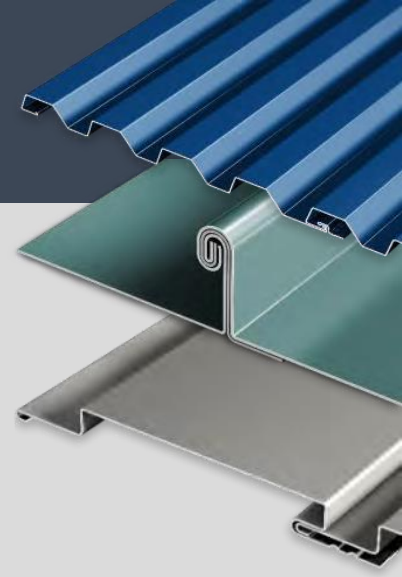
1. Identify **critical performance requirements and potential problem areas during the DD and CD stages**
2. Examine the importance of **incorporating the structural engineer-of-record wind loads with cladding and component negative loads early in the DD phase**
3. Examine basic metal wall panel and **sheet metal field flashing details and conditions (layouts) to design the proper installation** of these flashing details during DD
4. Understand the importance of **key basic details and layout of these field flashing details** to provide the owner the desired watertight and aesthetically attractive completed metal wall panel system

Overview

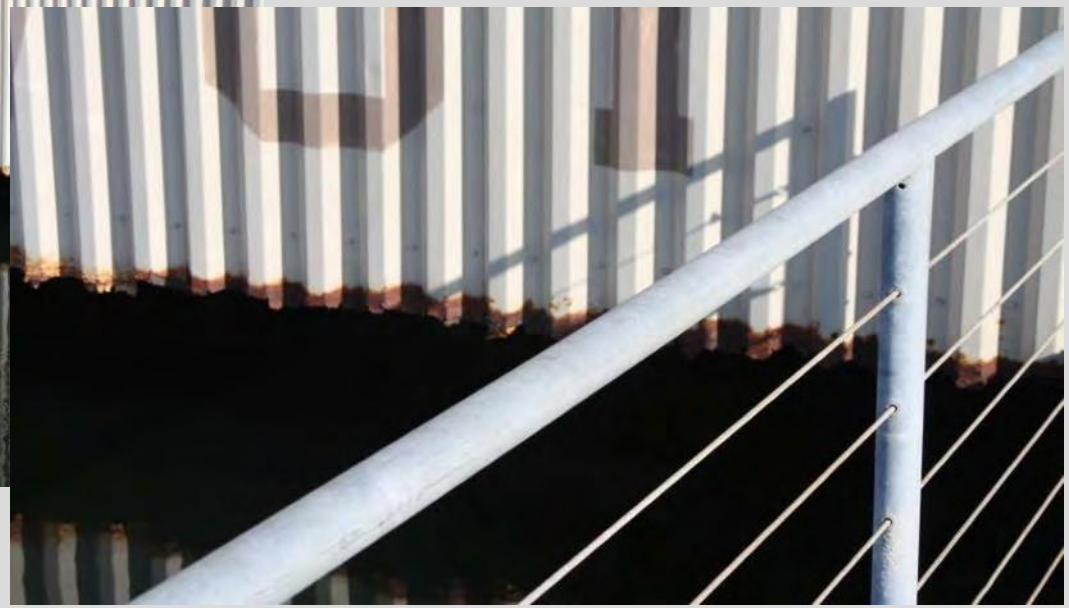


- Review of wall elevations and conditions during DD and CD stage.
- Apply S Notes from structural engineer of record prior to starting specification of wall panel system.
- Inspect basic framing issues PRIOR to installation.
- Layout of wall panels and flashings: ask questions.
- Identify early any problem areas: interface with other trades and wall penetrations.
- Identify “what else”

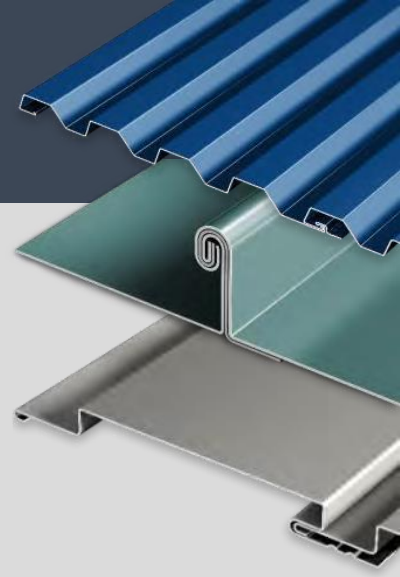
Design stage decisions gone wrong



Guantánamo Bay: coastal application designed with steel. Replaced with aluminum within 10 years

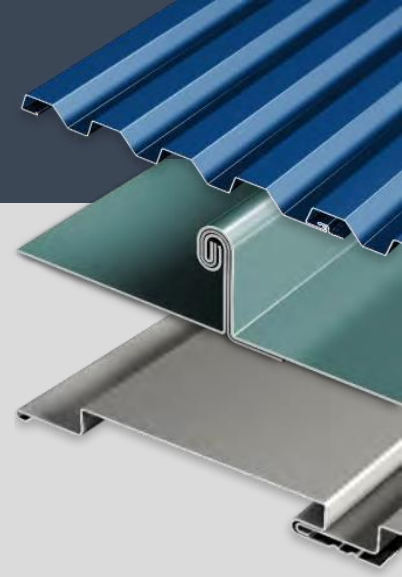


Field-applied finishes



Not only is this steel substrate on the coast, but field-applied (paint) finish does not perform the same as factory-applied

Where do we begin?

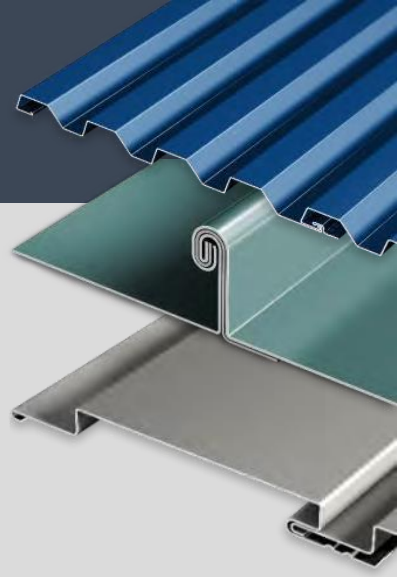


1. **Hat channel too far apart**

2. Wrong size hat channel face, resulting in clip not properly fastened in both spots

P.S. Not all mechanicals have been installed, so final panel installation is on “Hold”

Oil canning is NOT a cause for rejection



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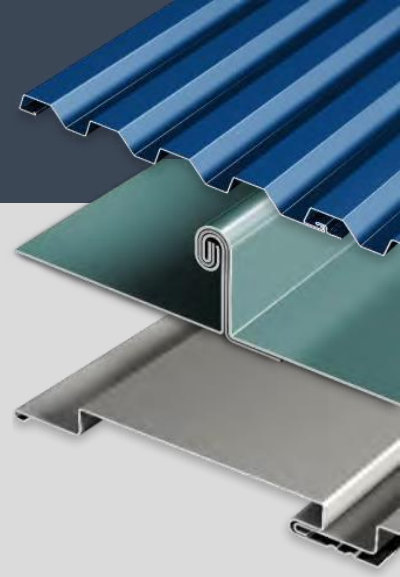
Seek advice from the experts … early

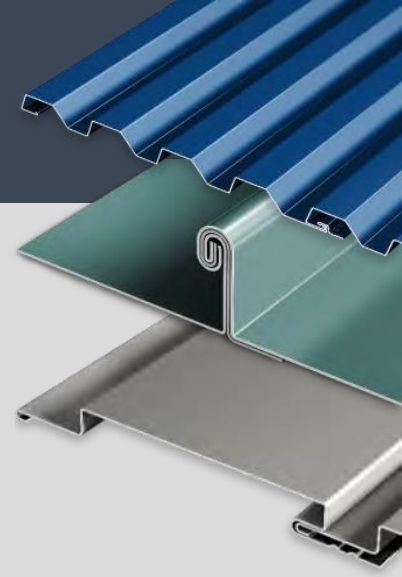


Panel at or exceeded recommended length, resulting in **oil canning**

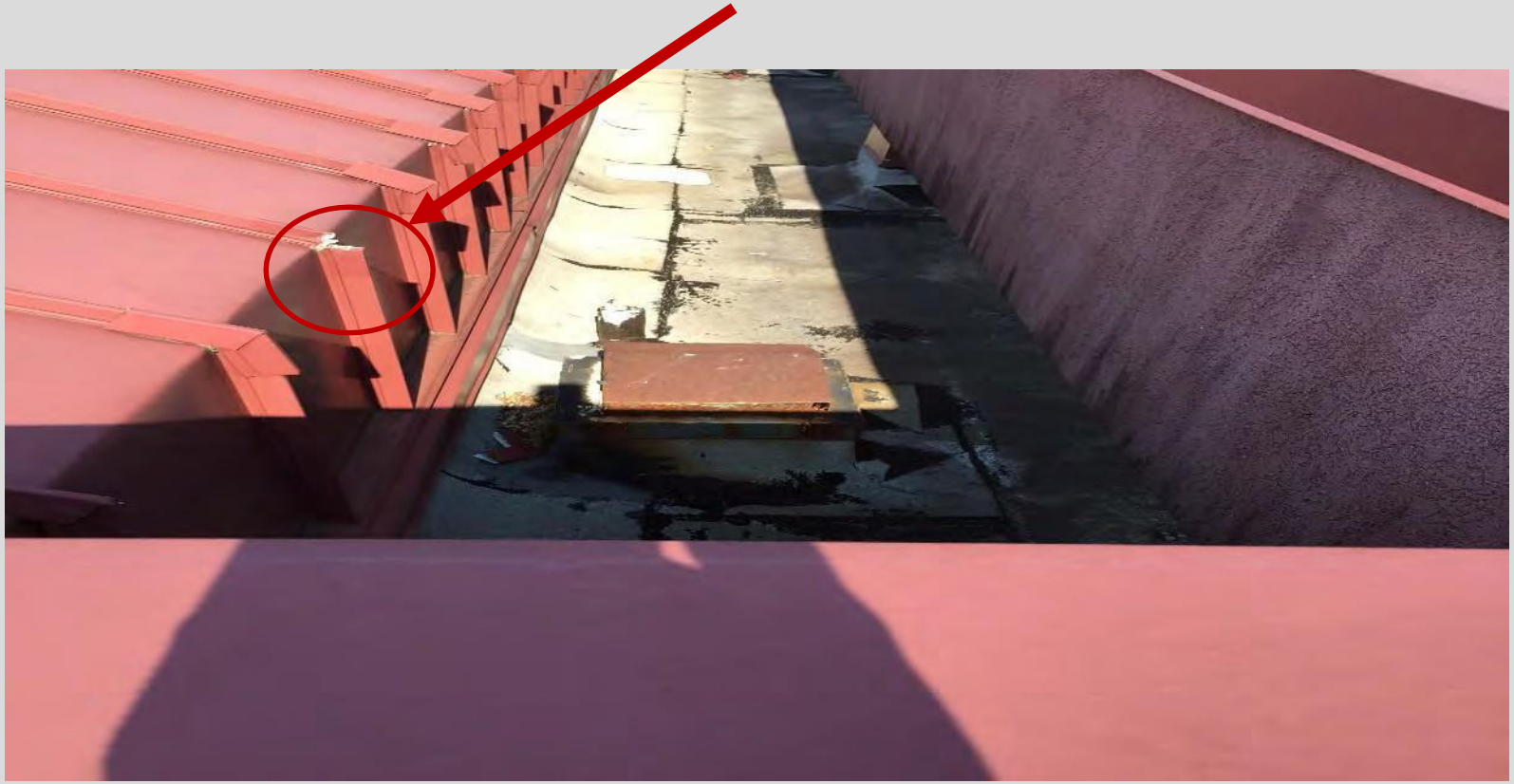
→ Design flashing breaks to shorten panels

→ Increase gauge and add panel conditions (i.e. pencil ribs)

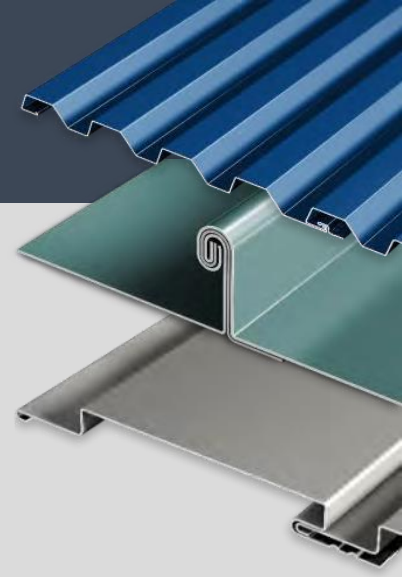
Updated details



Avoid relying on sealants (the “old” details) and consult your panel manufacturer early in the design phase (missing knuckles)



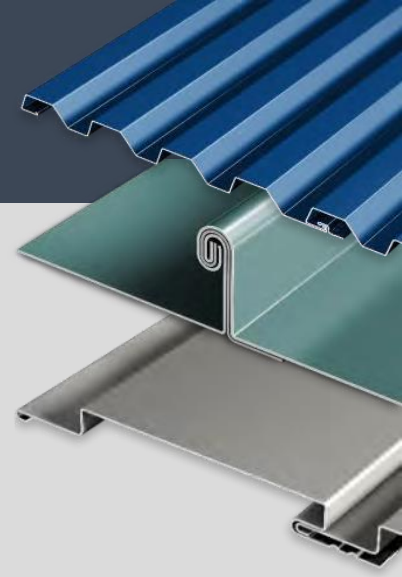
But some things are out of your control



DMV entrance: inexperienced drivers pull up to the front.

Unable to design for every human factor.

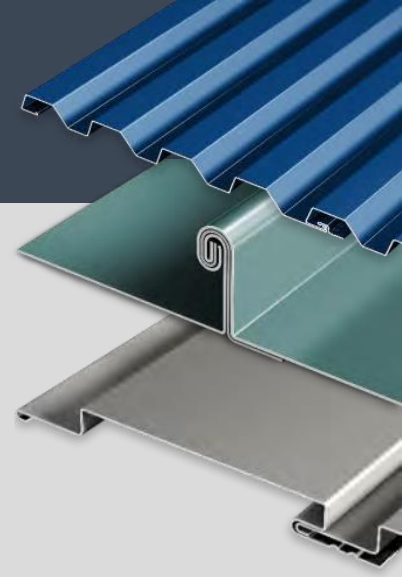
Learning objective 1



Identify **critical performance requirements and key criteria that are important to the owner during the DD and CD stages.**

Contact *the manufacturer and an expert contractor* ***early***.

Decisions made early in design

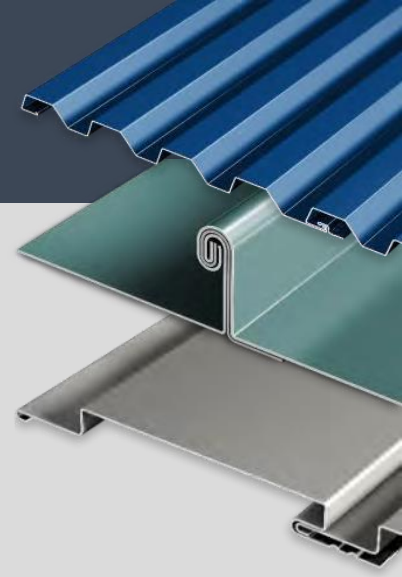


Assess the big picture: coastal application or high wind area, use (such as high traffic), feature elevation (signage)

Consider performance requirements, such as:

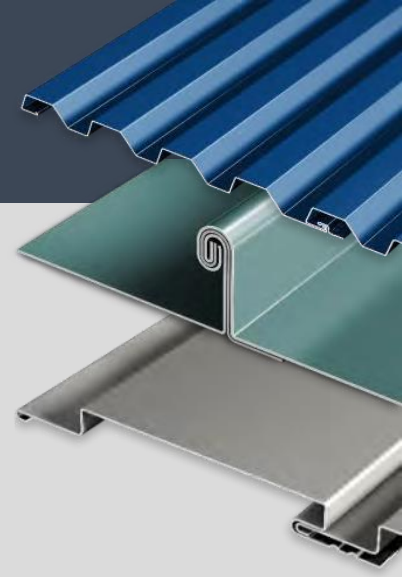
- Building height and other performance criteria
- Material: single skin, composite panels, insulated
- Aluminum vs. steel
- Maximum panel length – they all have limitations
- Trade integration and collaboration (i.e. mechanical or plumbing with cladding sub-contractor)

Identifying potential issues early



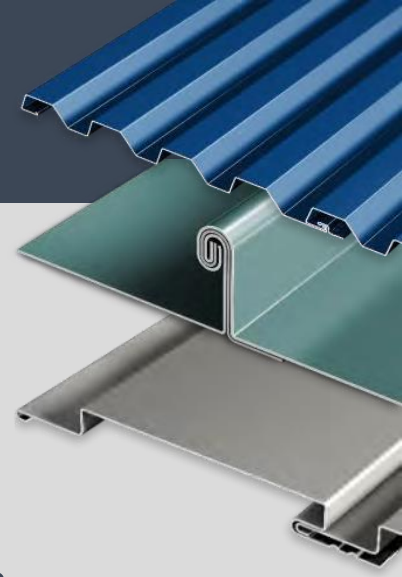
- Where is my building **located** and am I specifying the **correct metal substrate** for this location?
  - **Aluminum** is required for any coastal, salt water or otherwise corrosive or aggressive environments.
  - Corrosive environments require all **attachment components** to be **stainless steel or aluminum**, including clips, screws, cleats, flashings

Identify issues in DD and CD stages



- Does my **budget** for this wall fit/meet the client's expectation for this elevation?
  - How **visible** will this wall be in the overall elevation of the finished building?
  - Is this wall area or entire wall **important** to the client?
- Does the wall assembly on each elevation have **suitable framing and sub-structure for a metal panel** attachment?

Identifying potential issues early



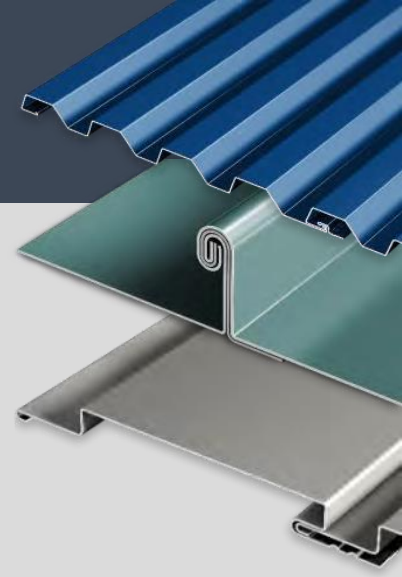
- Is there a significant number of wall penetrations on this building? If so, are metal wall panels the right cladding?
- Have we discussed the BUDGET of this wall cladding with the owner? Can we afford the cost of the wall cladding that we currently have in mind?

Successful project profile

Before and after

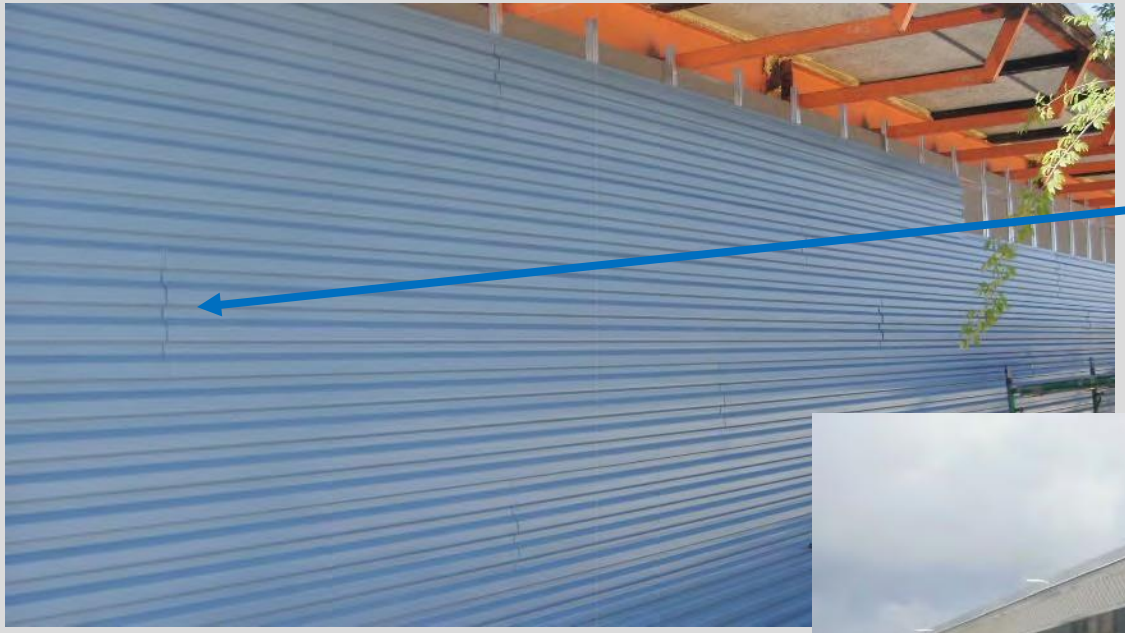
- Proper framing and attachment
  - Horizontal and vertical
  - Zee channel for insulation
- Intentional panel breaks

Project profile

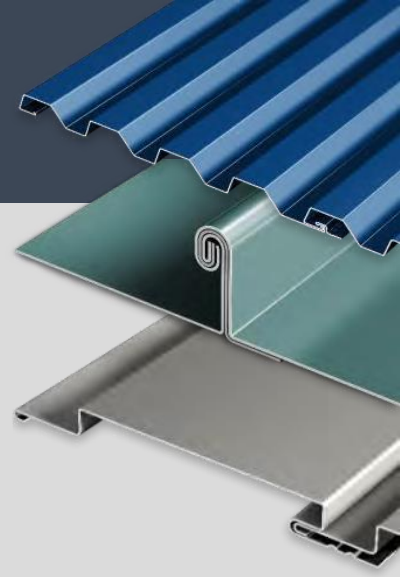


Adequate attachment spacing because **wind load requirements determined up front by structural engineer**

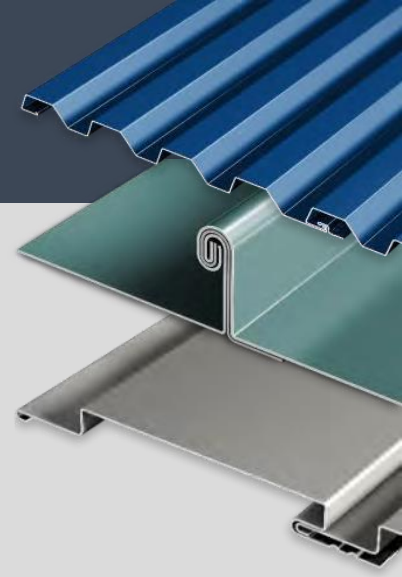
Project profile



Different panel splice details determined prior to construction phase.



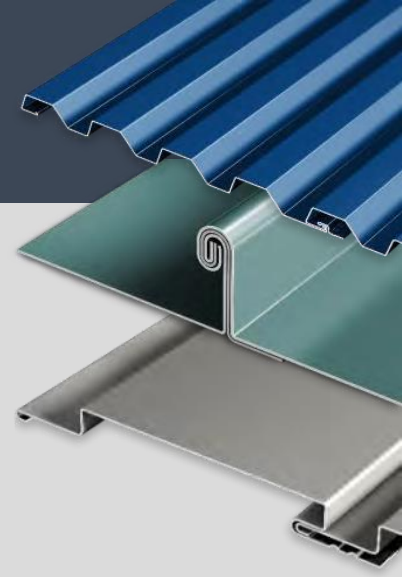
Project profile: Ashville, NC



Three different profiles on wall, monitor roofing, and monitor walls

- Suitable for each application
- Economical (labor)
- Visually interesting

Learning objective 2

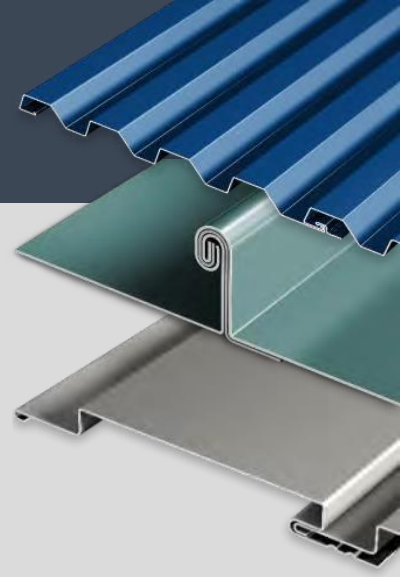


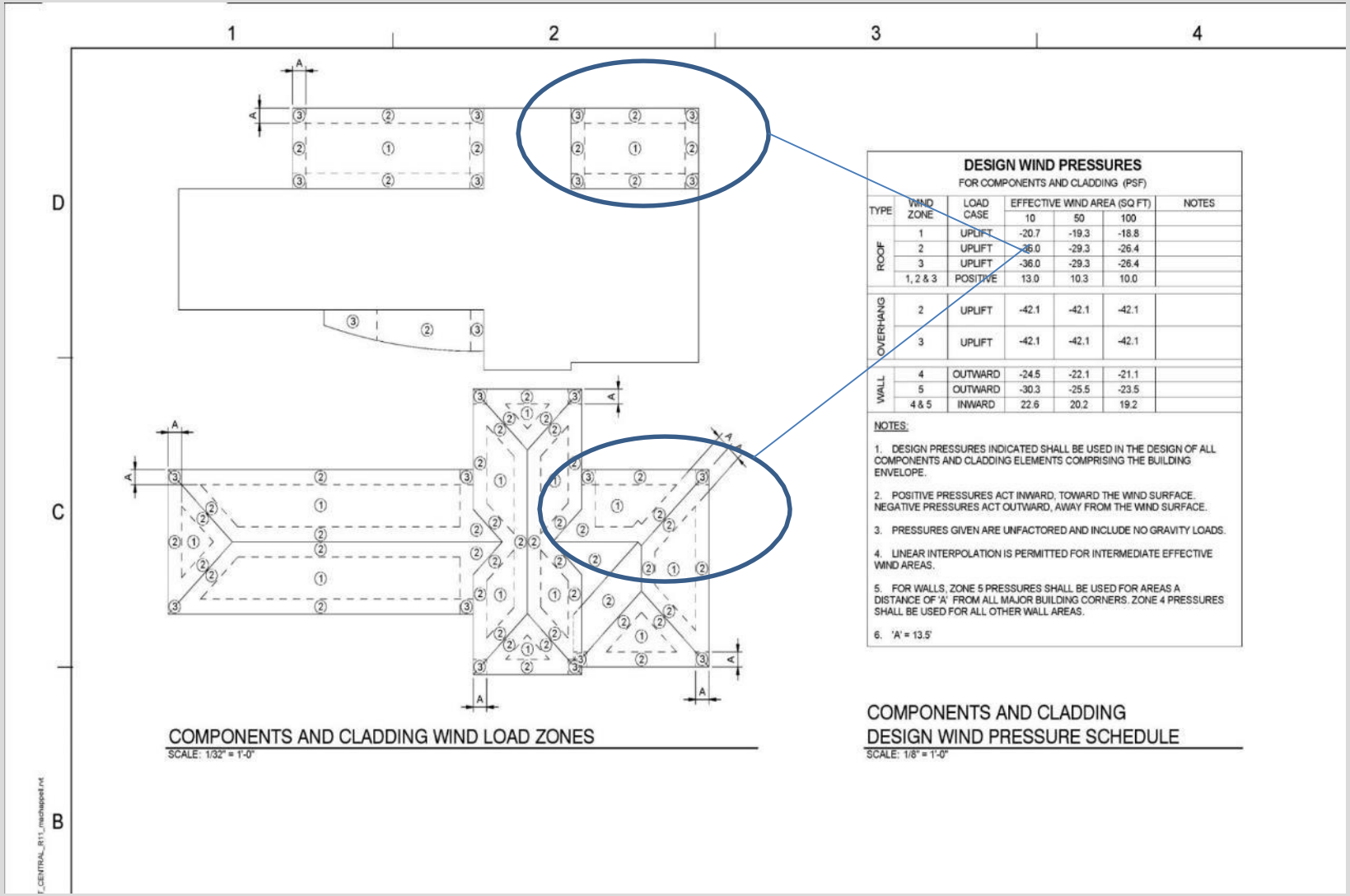
Structural engineer-of-record MUST BE brought into the equation much earlier than in past years.

- S-E-O-R should provide the cladding and component negative loads for the roof and walls.

- Ensure that you have the **correct loads (by zone)** for the building from which to start your design and specification for the roof and the walls.

Example of cladding loads





COMPONENTS AND CLADDING WIND LOAD ZONES
SCALE: 1/32" = 1'-0"

DESIGN WIND PRESSURES
FOR COMPONENTS AND CLADDING (PSF)

TYPE	WIND ZONE	LOAD CASE	EFFECTIVE WIND AREA (SQ FT) 10	50	100	NOTES
ROOF	1	UPLIFT	-20.7	-19.3	-18.8	
	2	UPLIFT	-36.0	-29.3	-26.4	
	3	UPLIFT	-36.0	-29.3	-26.4	
	1, 2 & 3	POSITIVE	13.0	10.3	10.0	
OVERHANG	2	UPLIFT	-42.1	-42.1	-42.1	
	3	UPLIFT	-42.1	-42.1	-42.1	
WALL	4	OUTWARD	-24.5	-22.1	-21.1	
	5	OUTWARD	-30.3	-25.5	-23.5	
	4 & 5	INWARD	22.6	20.2	19.2	

NOTES:

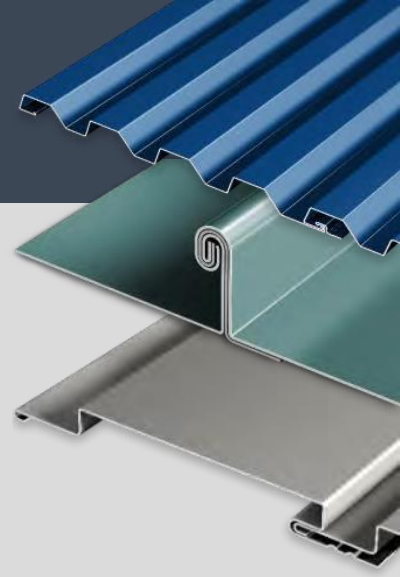
1. DESIGN PRESSURES INDICATED SHALL BE USED IN THE DESIGN OF ALL COMPONENTS AND CLADDING ELEMENTS COMPRISING THE BUILDING ENVELOPE.
2. POSITIVE PRESSURES ACT INWARD, TOWARD THE WIND SURFACE. NEGATIVE PRESSURES ACT OUTWARD, AWAY FROM THE WIND SURFACE.
3. PRESSURES GIVEN ARE UNFACTORED AND INCLUDE NO GRAVITY LOADS.
4. LINEAR INTERPOLATION IS PERMITTED FOR INTERMEDIATE EFFECTIVE WIND AREAS.
5. FOR WALLS, ZONE 5 PRESSURES SHALL BE USED FOR AREAS A DISTANCE OF 'A' FROM ALL MAJOR BUILDING CORNERS. ZONE 4 PRESSURES SHALL BE USED FOR ALL OTHER WALL AREAS.
6. 'A' = 13.5'

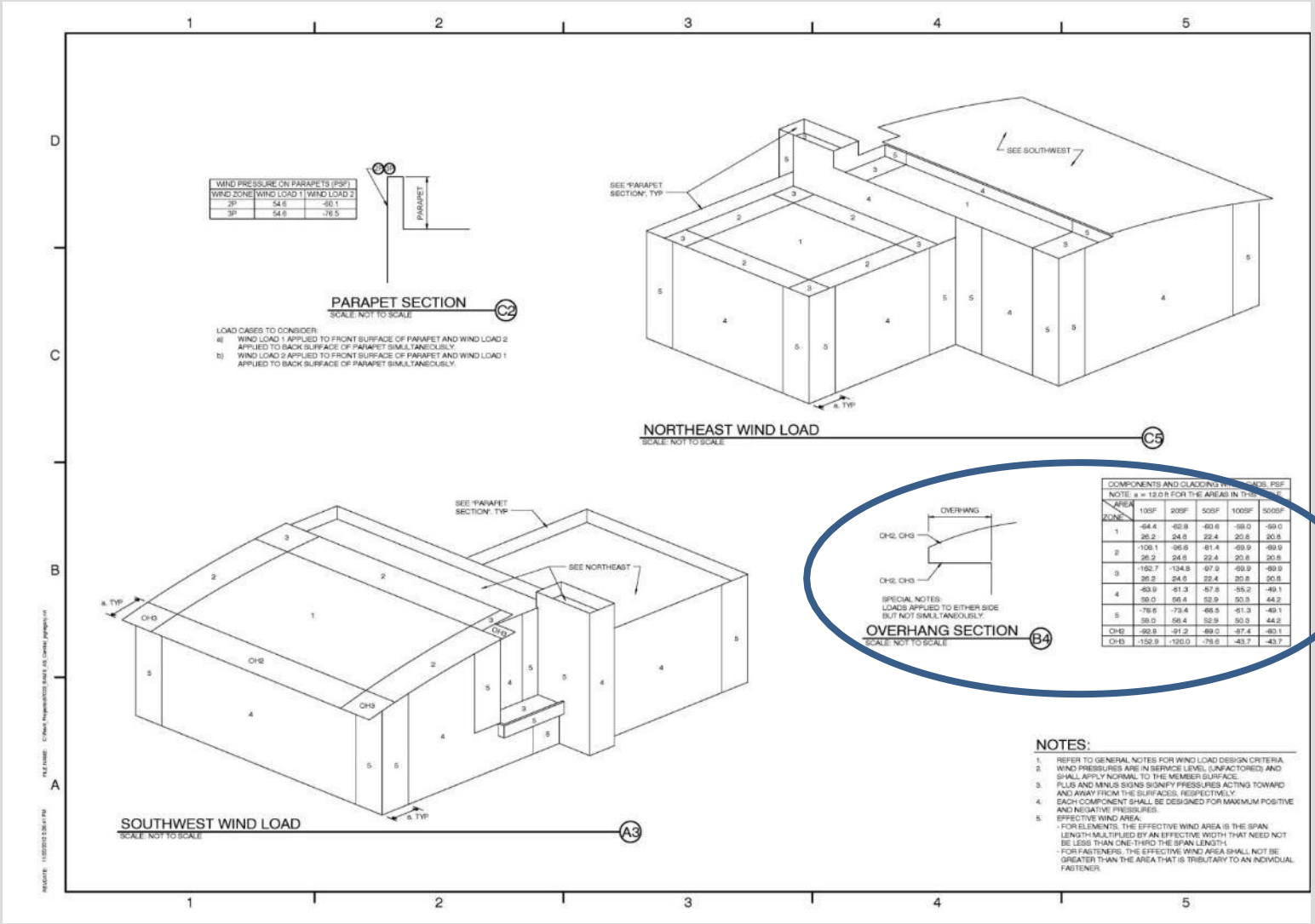
COMPONENTS AND CLADDING
DESIGN WIND PRESSURE SCHEDULE
SCALE: 1/8" = 1'-0"

Tables based upon ASCE 10, but ASCE 16 coming soon.

ASCE-16 changes the “rule of thumb” to specific perimeter and corner zones BY elevation (e.g. prevailing winds, openings, etc.)

Example of cladding loads (2)





WIND PRESSURE ON PARAPETS (PSF)

WIND ZONE	WIND LOAD 1	WIND LOAD 2
2P	54.6	-60.1
3P	54.6	-76.5

PARAPET SECTION (C2)
SCALE: NOT TO SCALE

LOAD CASES TO CONSIDER:
a) WIND LOAD 1 APPLIED TO FRONT SURFACE OF PARAPET AND WIND LOAD 2 APPLIED TO BACK SURFACE OF PARAPET SIMULTANEOUSLY.
b) WIND LOAD 2 APPLIED TO FRONT SURFACE OF PARAPET AND WIND LOAD 1 APPLIED TO BACK SURFACE OF PARAPET SIMULTANEOUSLY.

NORTHEAST WIND LOAD (C5)
SCALE: NOT TO SCALE

SOUTHWEST WIND LOAD (A3)
SCALE: NOT TO SCALE

OVERHANG SECTION (B4)
SCALE: NOT TO SCALE

SPECIAL NOTES:
LOADS APPLIED TO EITHER SIDE BUT NOT SIMULTANEOUSLY.

COMPONENTS AND CLADDING WIND LOADS, PSF
NOTE: a = 12.0 ft FOR THE AREAS IN THIS TABLE

AREA / ZONE	10SF	20SF	50SF	100SF	500SF
1	-64.4	-62.8	-60.6	-59.0	-59.0
	26.2	24.6	22.4	20.8	20.8
2	-108.1	-96.6	-81.4	-69.9	-69.9
	26.2	24.6	22.4	20.8	20.8
3	-162.7	-134.8	-97.9	-69.9	-69.9
	26.2	24.6	22.4	20.8	20.8
4	-63.9	-61.3	-57.8	-55.2	-49.1
	59.0	56.4	52.9	50.3	44.2
5	-76.6	-73.4	-66.5	-61.3	-49.1
	59.0	56.4	52.9	50.3	44.2
OH2	-92.8	-91.2	-89.0	-87.4	-80.1
OH3	-152.9	-120.0	-76.6	-43.7	-43.7

NOTES:
1. REFER TO GENERAL NOTES FOR WIND LOAD DESIGN CRITERIA.
2. WIND PRESSURES ARE IN SERVICE LEVEL (UNFACTORED) AND SHALL APPLY NORMAL TO THE MEMBER SURFACE.
3. PLUS AND MINUS SIGNS SIGNIFY PRESSURES ACTING TOWARD AND AWAY FROM THE SURFACES, RESPECTIVELY.
4. EACH COMPONENT SHALL BE DESIGNED FOR MAXIMUM POSITIVE AND NEGATIVE PRESSURES.
5. EFFECTIVE WIND AREA:
   - FOR ELEMENTS, THE EFFECTIVE WIND AREA IS THE SPAN LENGTH MULTIPLIED BY AN EFFECTIVE WIDTH THAT NEED NOT BE LESS THAN ONE-THIRD THE SPAN LENGTH.
   - FOR FASTENERS, THE EFFECTIVE WIND AREA SHALL NOT BE GREATER THAN THE AREA THAT IS TRIBUTARY TO AN INDIVIDUAL FASTENER.

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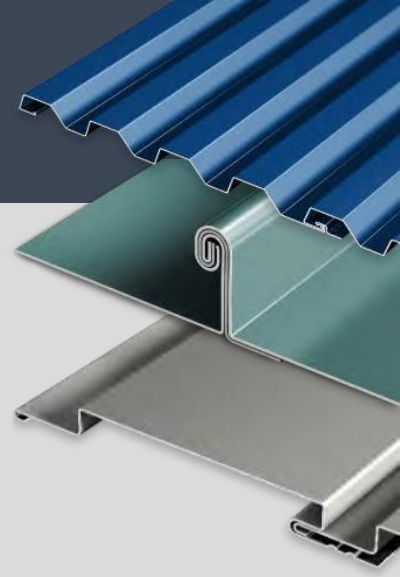
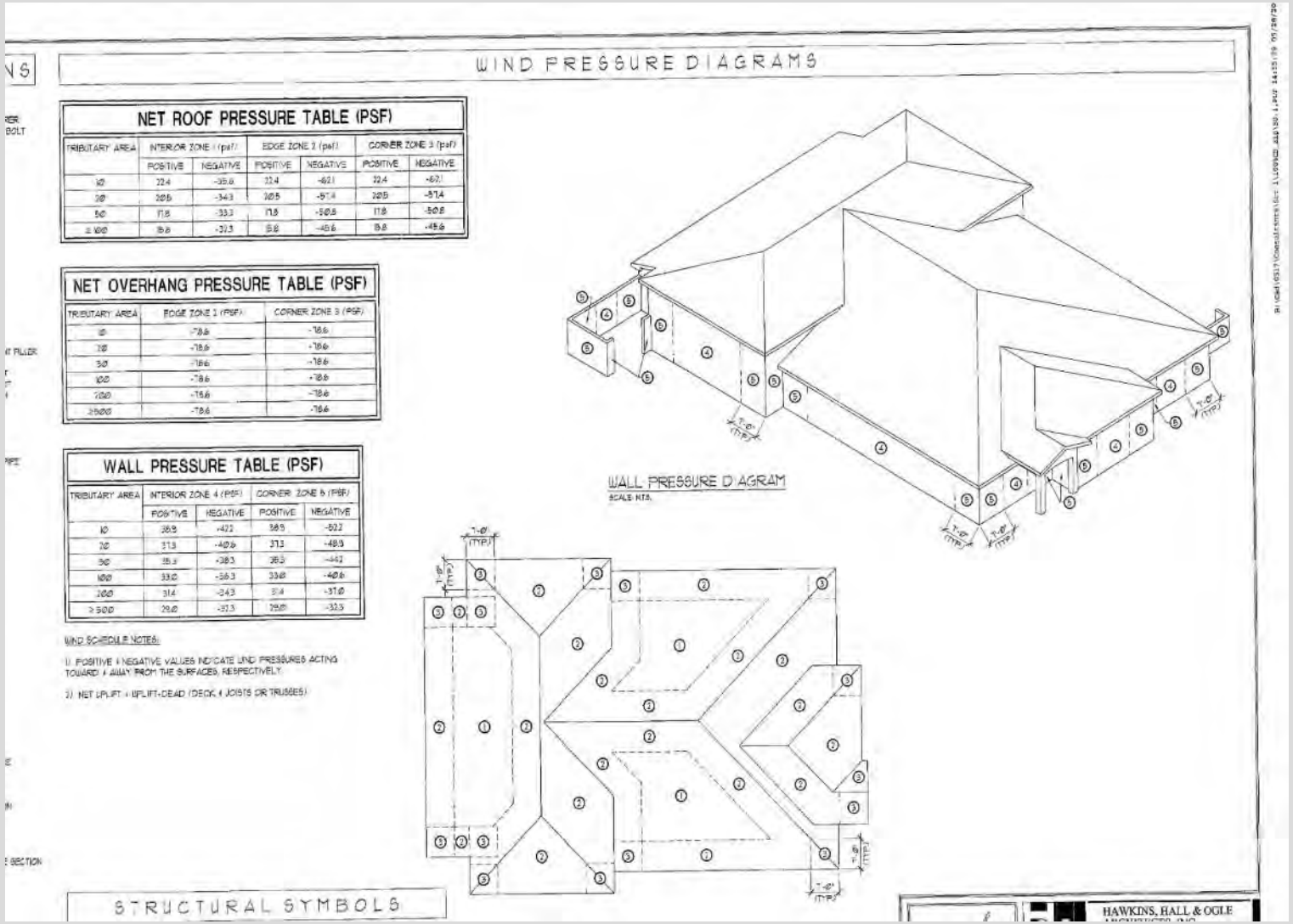
Example of cladding loads (3)





WIND PRESSURE DIAGRAMS

NET ROOF PRESSURE TABLE (PSF)

TRIBUTARY AREA	INTERIOR ZONE 1 (psf)		EDGE ZONE 2 (psf)		CORNER ZONE 3 (psf)	
	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
10	22.4	-35.6	22.4	-62.1	22.4	-62.1
20	20.5	-34.3	20.5	-57.4	20.5	-57.4
50	17.8	-33.3	17.8	-50.8	17.8	-50.8
≥ 100	15.8	-32.3	15.8	-45.6	15.8	-45.6

NET OVERHANG PRESSURE TABLE (PSF)

TRIBUTARY AREA	EDGE ZONE 2 (PSF)	CORNER ZONE 3 (PSF)
10	-78.6	-78.6
20	-78.6	-78.6
50	-78.6	-78.6
100	-78.6	-78.6
200	-78.6	-78.6
≥500	-78.6	-78.6

WALL PRESSURE TABLE (PSF)

TRIBUTARY AREA	INTERIOR ZONE 4 (PSF)		CORNER ZONE 5 (PSF)	
	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
10	38.9	-42.2	38.9	-52.2
20	37.3	-40.6	37.3	-48.3
50	35.3	-38.3	35.3	-44.2
100	33.8	-36.3	33.8	-40.6
200	31.4	-34.3	31.4	-37.8
≥ 500	29.8	-32.3	29.8	-32.3

WIND SCHEDULE NOTES:

1) POSITIVE & NEGATIVE VALUES INDICATE WIND PRESSURES ACTING TOWARD & AWAY FROM THE SURFACES, RESPECTIVELY.

2) NET UPLIFT = UPLIFT-DEAD (DECK & JOISTS OR TRUSSES)

WALL PRESSURE DIAGRAM

SCALE: NTS.

STRUCTURAL SYMBOLS

HAWKINS, HALL & OGLE

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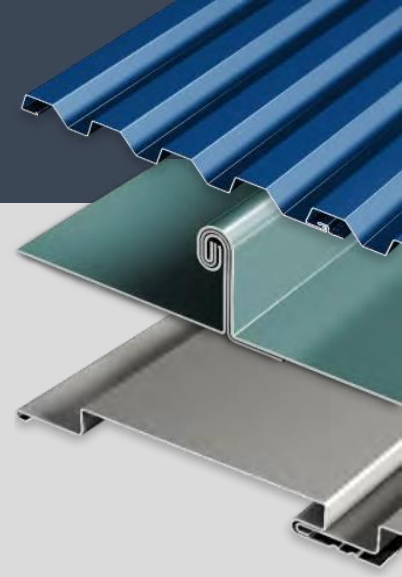
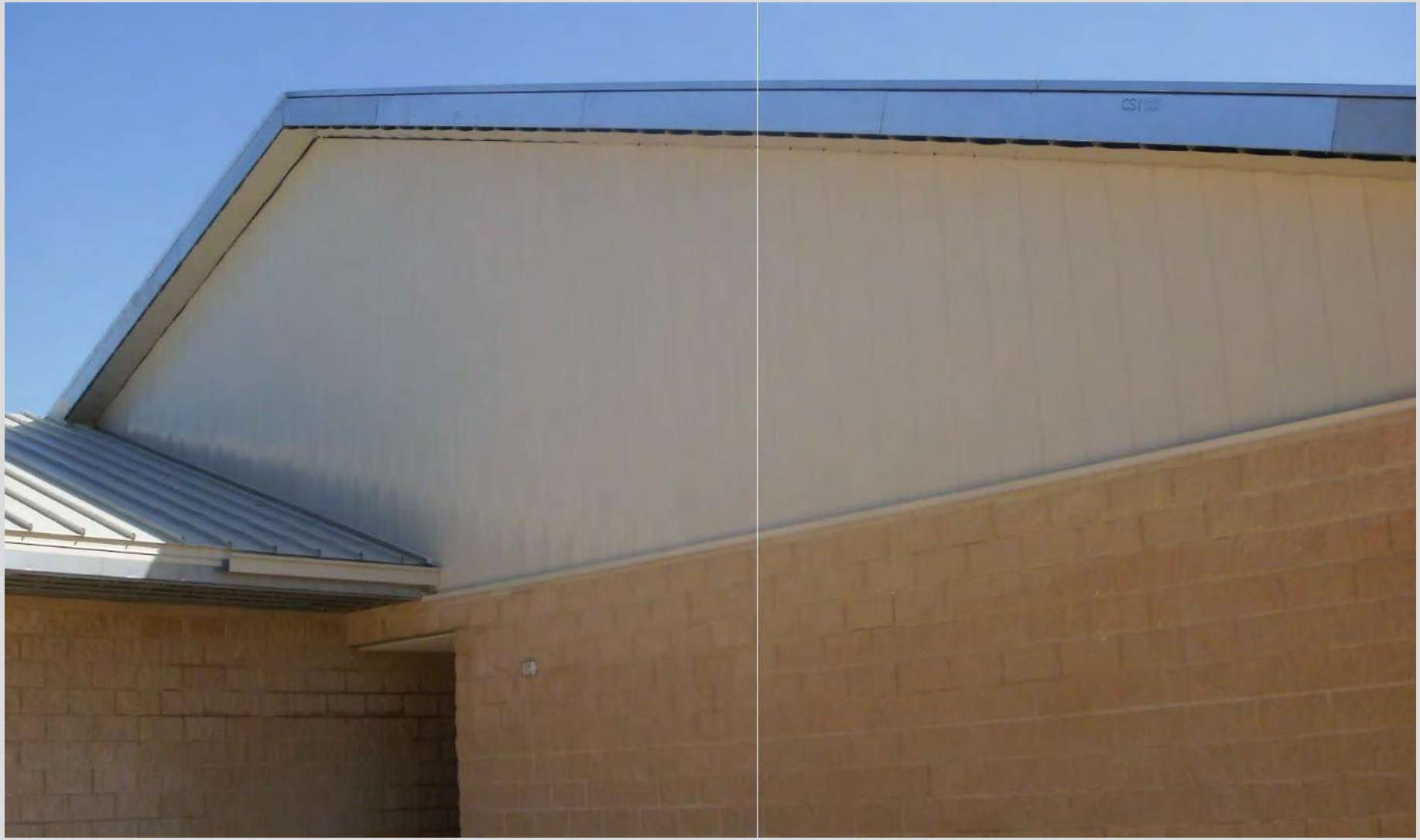
Enhanced attachment in specific building zone

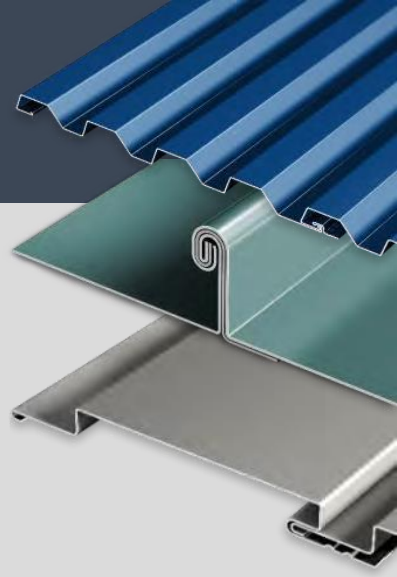


Panel loads: use
2.0 Safety Factor (PSF)

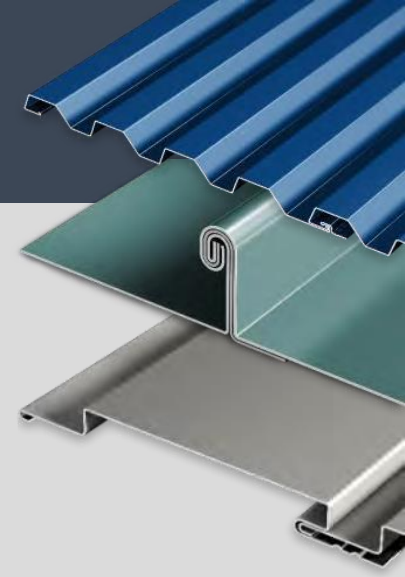
Note the additional framing for the soffit panels

Panel installed





Horizontal wall panel installation



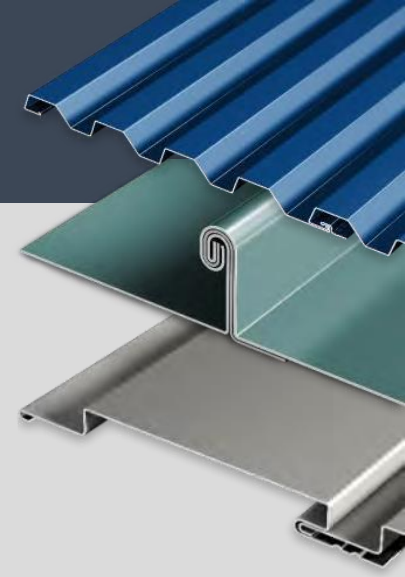
During construction

- Zee channels installed **perpendicular** to panel
- Foil-faced insulation

Completed installation

- Architect edict was no flashing breaks
- Elevation exceeded maximum panel length
- Selected a wall panel that allowed for panel splice/overlap (as opposed to flashing breaks)

Horizontal wall panel installation



Proper orientation of zee channels for horizontal wall installation

Pre-determined flashing breaks incorporated into design

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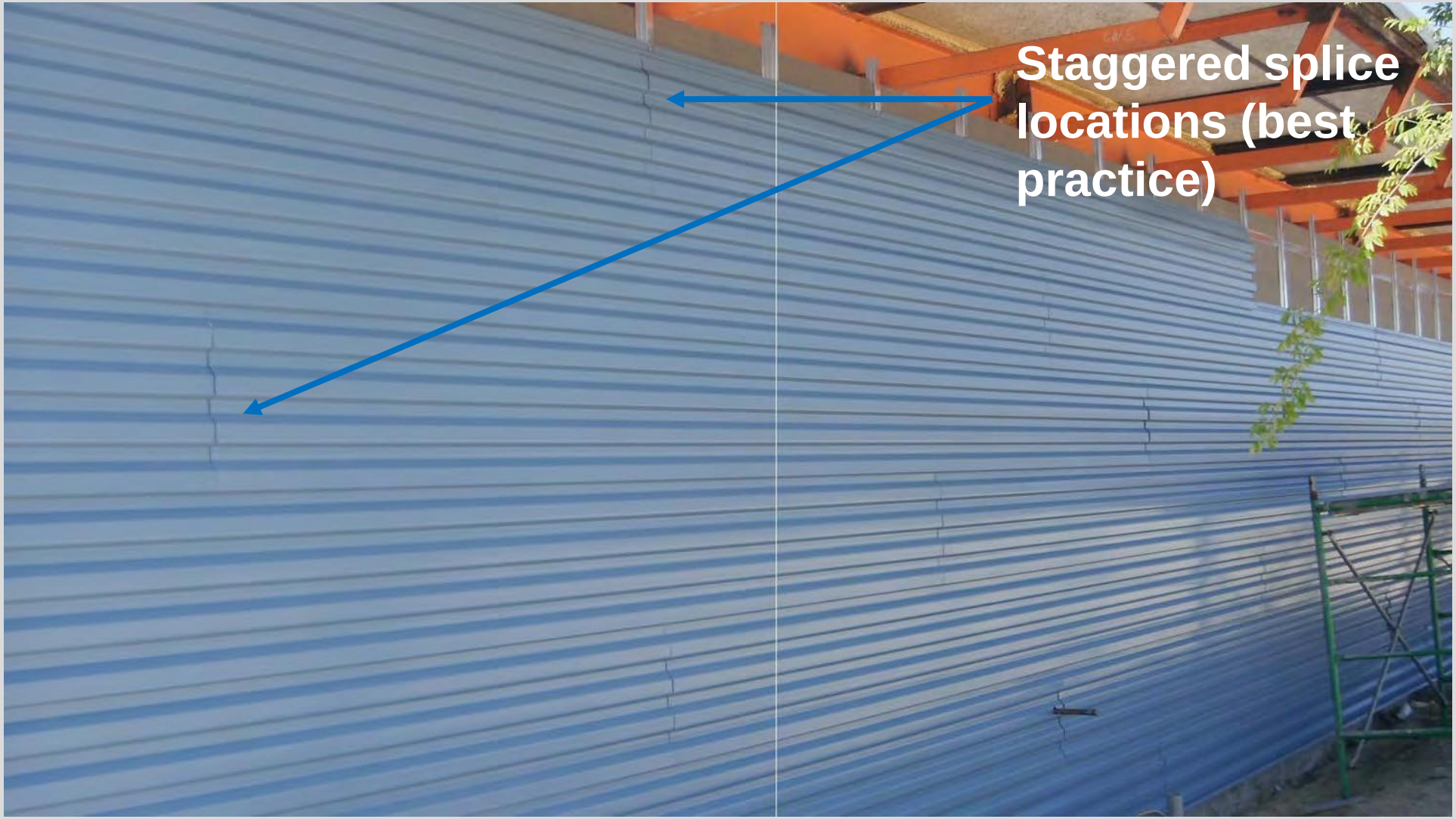
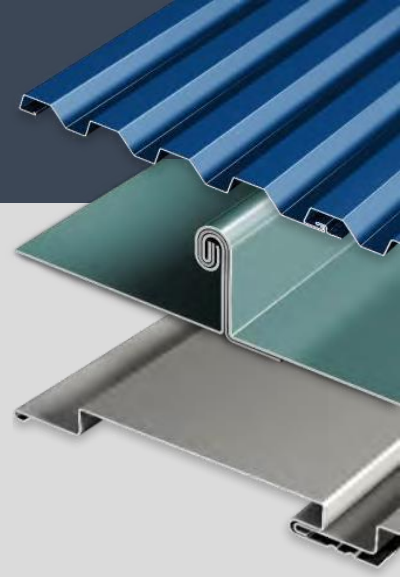
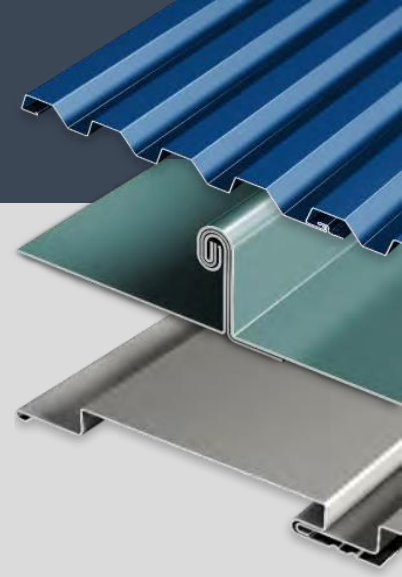
Horizontal wall panel installation





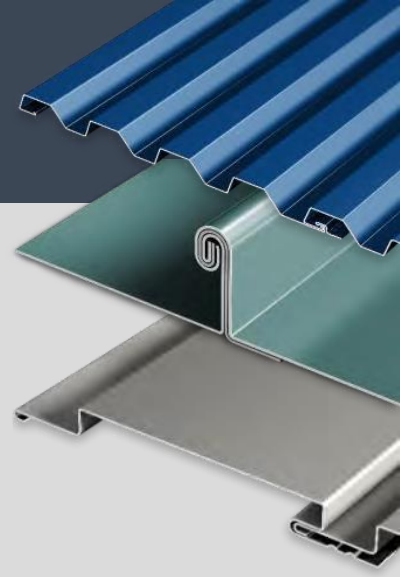
Learning objective 3



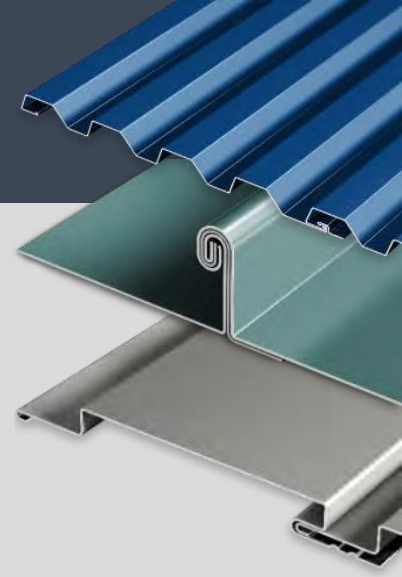
- “If something doesn’t look right, it probably isn’t.”
  - Investigate and find out why, then direct this to be corrected.
- Examine basic framing issues.
- Examine basic metal wall panel flashing conditions in the field and recognize the proper installation of these details.

Inspection of jobsite details

The roof cladding
will reflect the deck

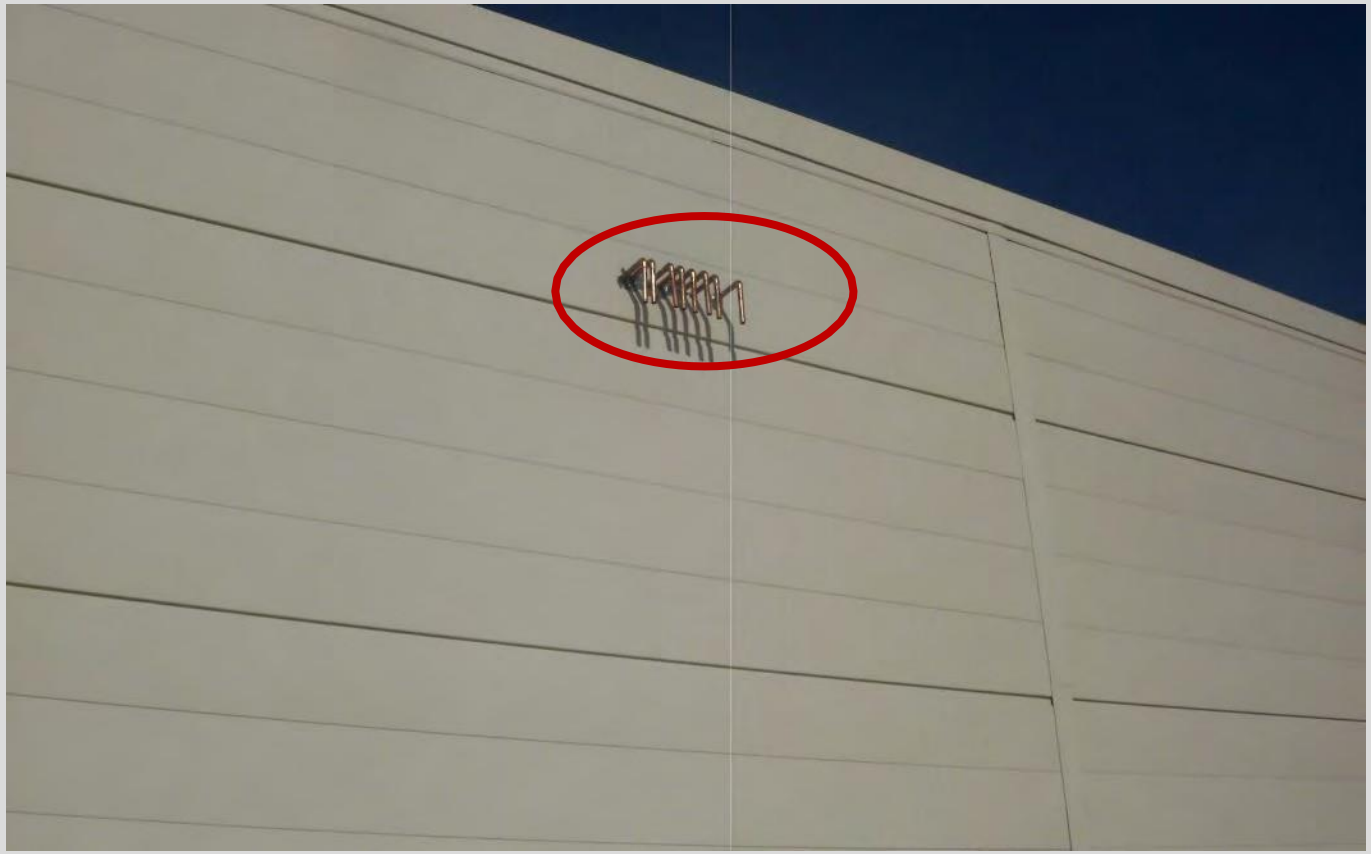


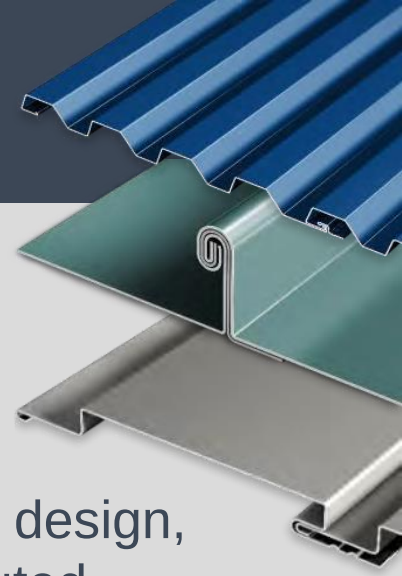
Result of jobsite details NOT inspected



- Uneven substrate
- Clips too tight
- No expansion for longer-length panels

Unsightly jobsite details

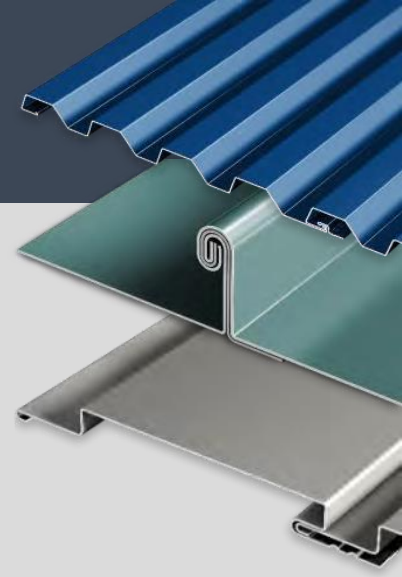




Extensive flashing detail design, followed by poorly executed penetration details

- **Dissimilar metals** (copper) draining onto wall panel will erode finish
- Suggest **flashing around the cluster** of pipes

Inspection of project details before panel installation



Trade collaboration during construction (before panels were installed)

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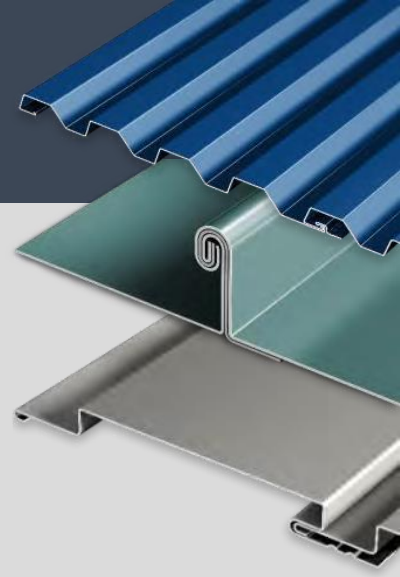
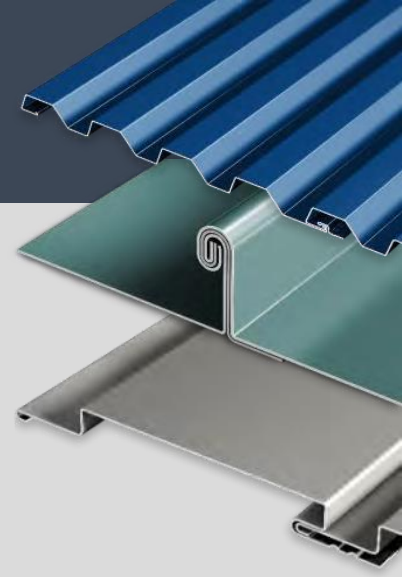
Temporary details during installation

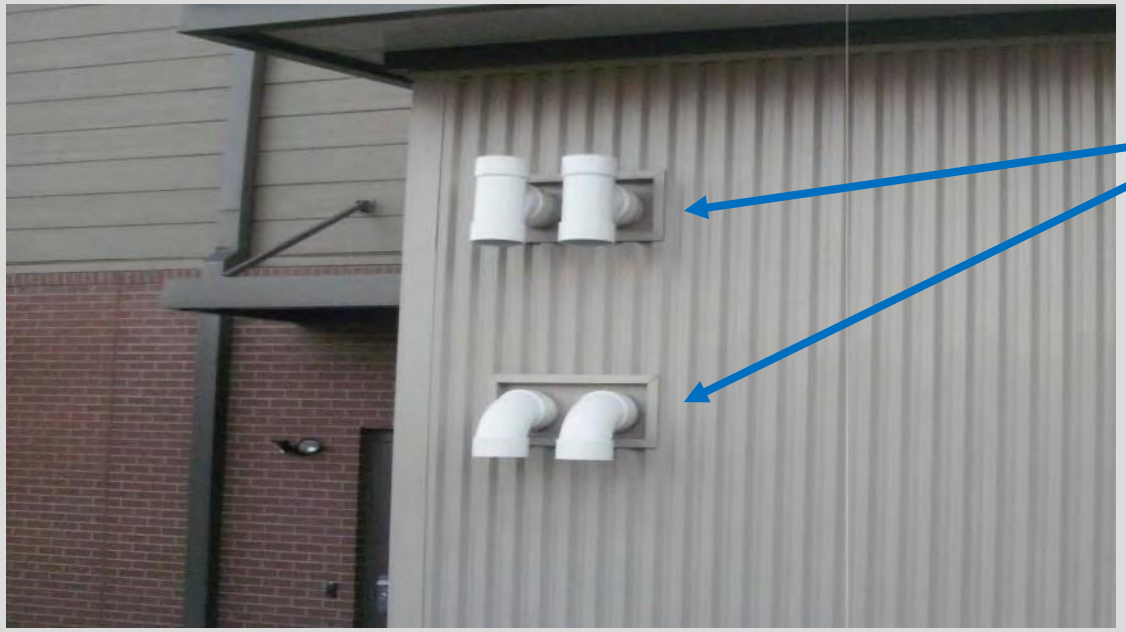


During construction

- Intermediate pipes are temporarily caulked

Final details – completed installation

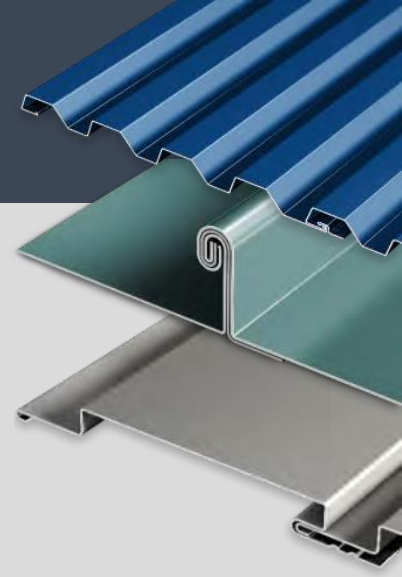




Flashing details
should look like this

Clean, neat and weathertight
flashing details on penetrations

Clean details: louvers, flashings, soffit



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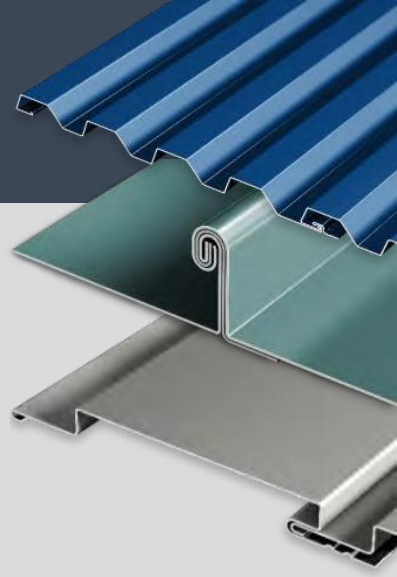
Profile project: retrofit metal building



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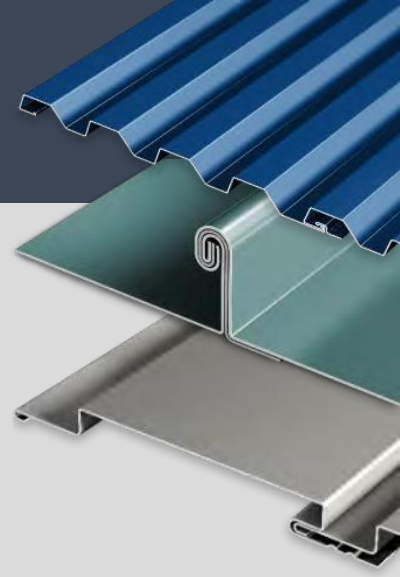
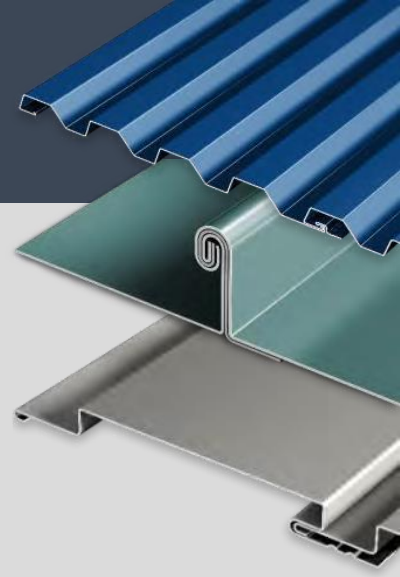
Project profile



- .032 aluminum to endure scratched paint from a thrown tennis racket!
- Economical aesthetic enhancement
  - 7/8″ Corrugated
  - Plywood stud wall
  - Fluid-applied weather barrier

Project profile 2



Adjacent panel splice details placed behind downspouts

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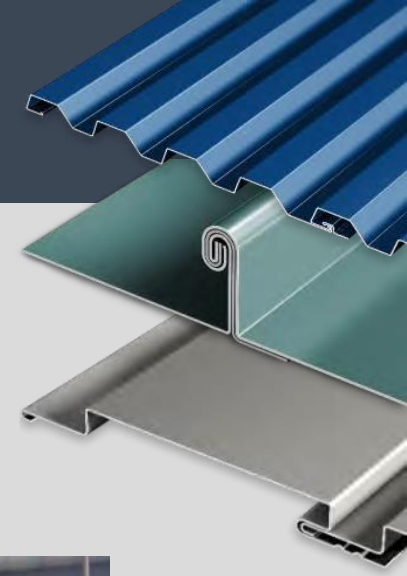
Project profile 3



Jacksonville, Fla., Humane Society

- Horizontal panels continued into interior

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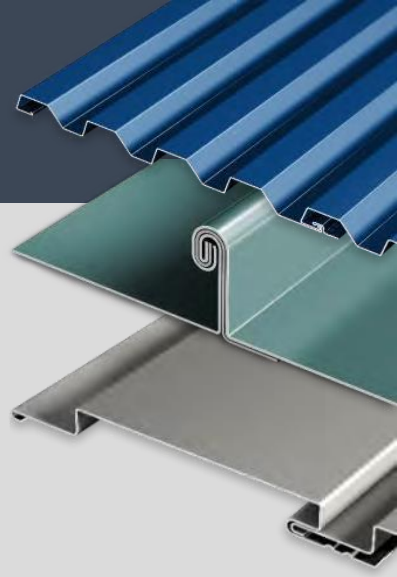
Clean flashing details



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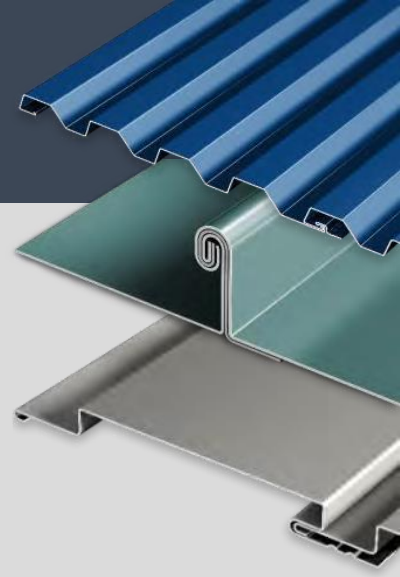
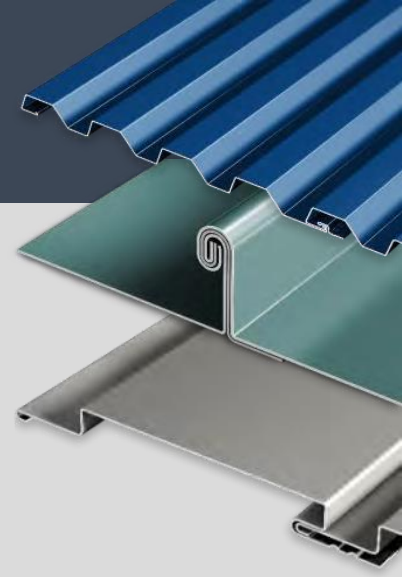
Learning objective 4



Understand the importance of **key basic details and layout of these field flashing details** to provide the owner the desired watertight and aesthetically attractive completed metal wall panel system.

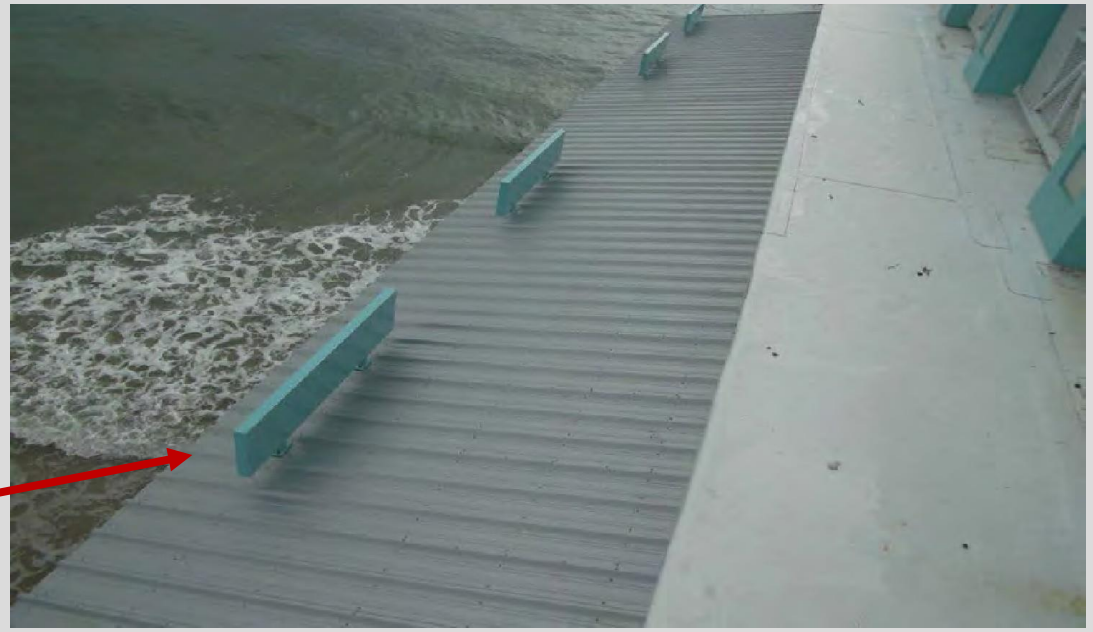
Learning objective 4



- Tie all these basic details together with this simple summary:
  - “Do I have positive drainage flow of all water that hits my wall cladding?”
- Look at additional items that can be placed sparingly on the walls:
  - Lights, louvers, vents, signage or similar and remind your owner, “how will this be maintained?”
- Remember: a metal panel wall system is 100% RECYCLABLE at the end of its lifecycle and will easily last 20 years and longer with simple care and maintenance.

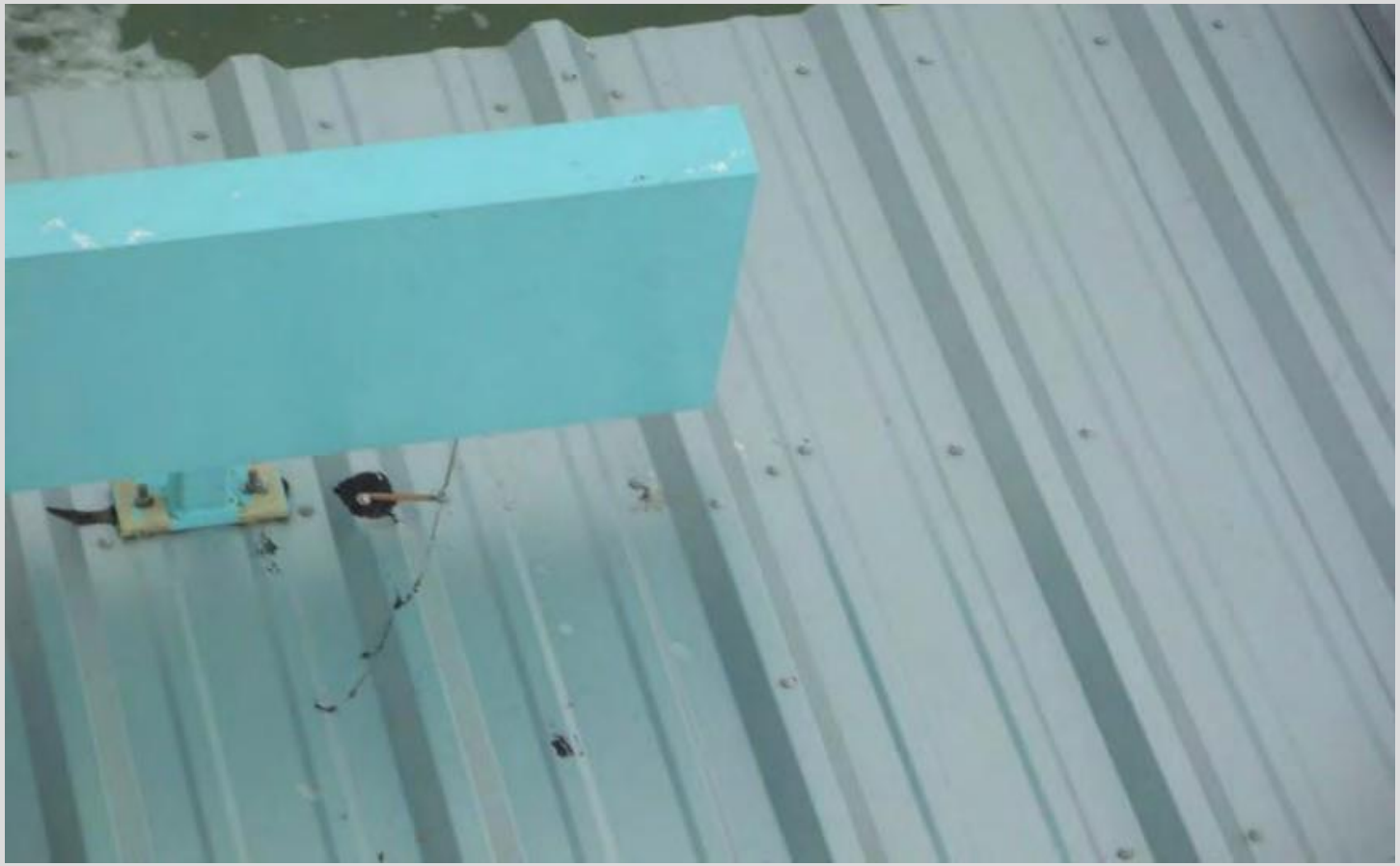
Effects of late-addition details

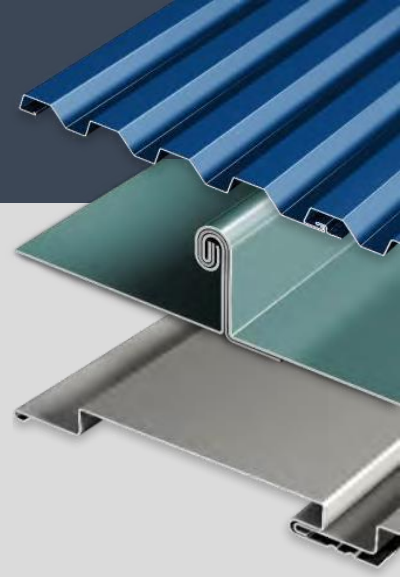
Upon project completion



One Year Later:
Neon signs added

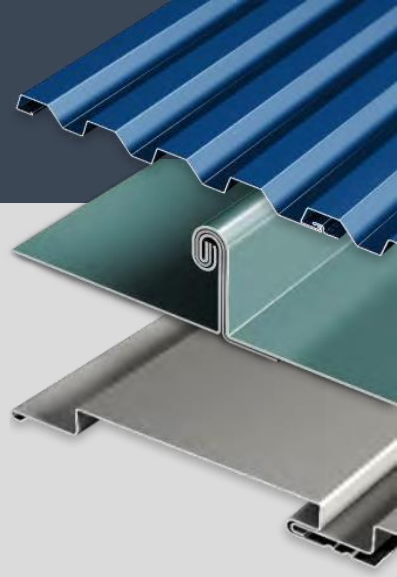
Effects of late-addition details





- Fastened through panel
- Relies on caulk for water-tightness
- Copper ground or other wire touching aluminum panel

Signage does not have to be an after thought



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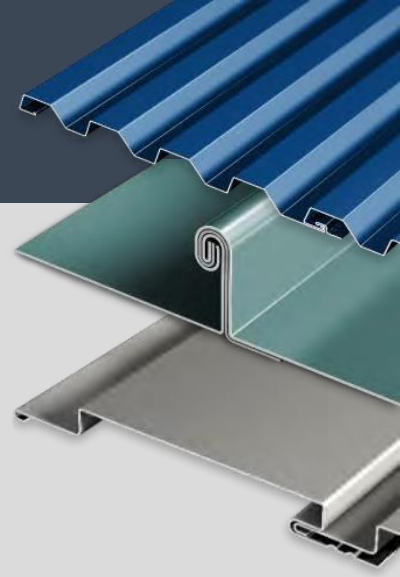
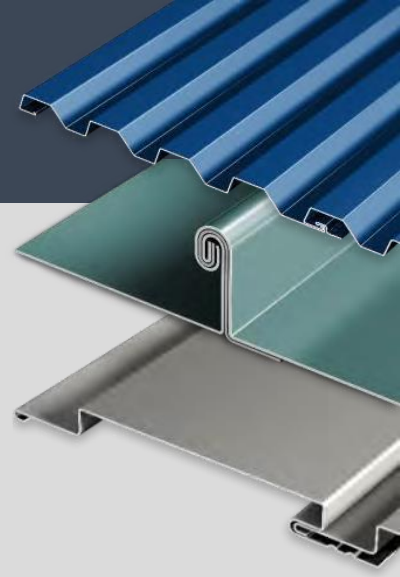
Well-intentioned details



UNC Dental School

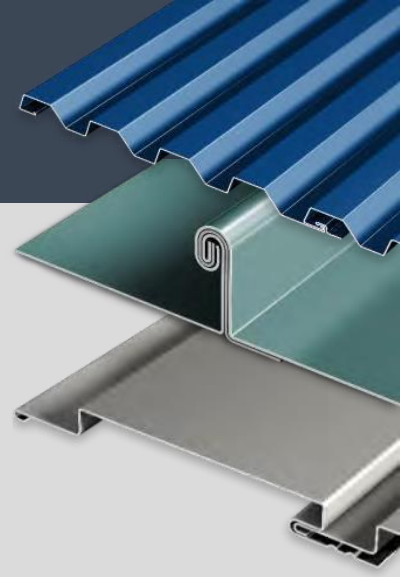
- 80-year-old structure with new cladding
- Weight of new stone copings still had to meet building code
- Wall supports were added during the retrofit design

Well-intentioned details



Metal canopies provide shade while tying into the accentuating wall panels

Project profile at Georgia Southern University



Same panel profile

- Standard installation
- Same profile - reverse run

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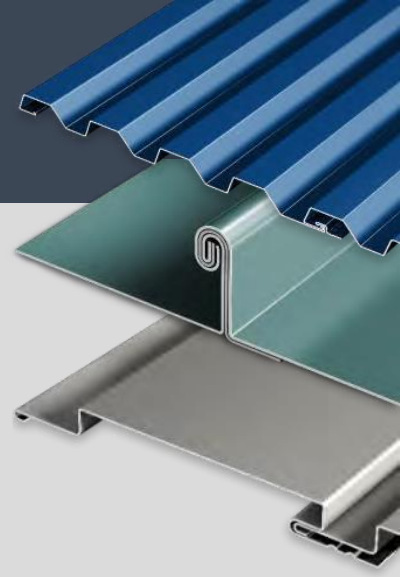
Project profile – same project, different elevation



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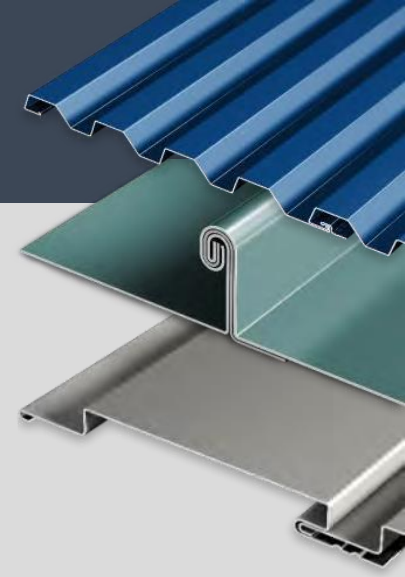
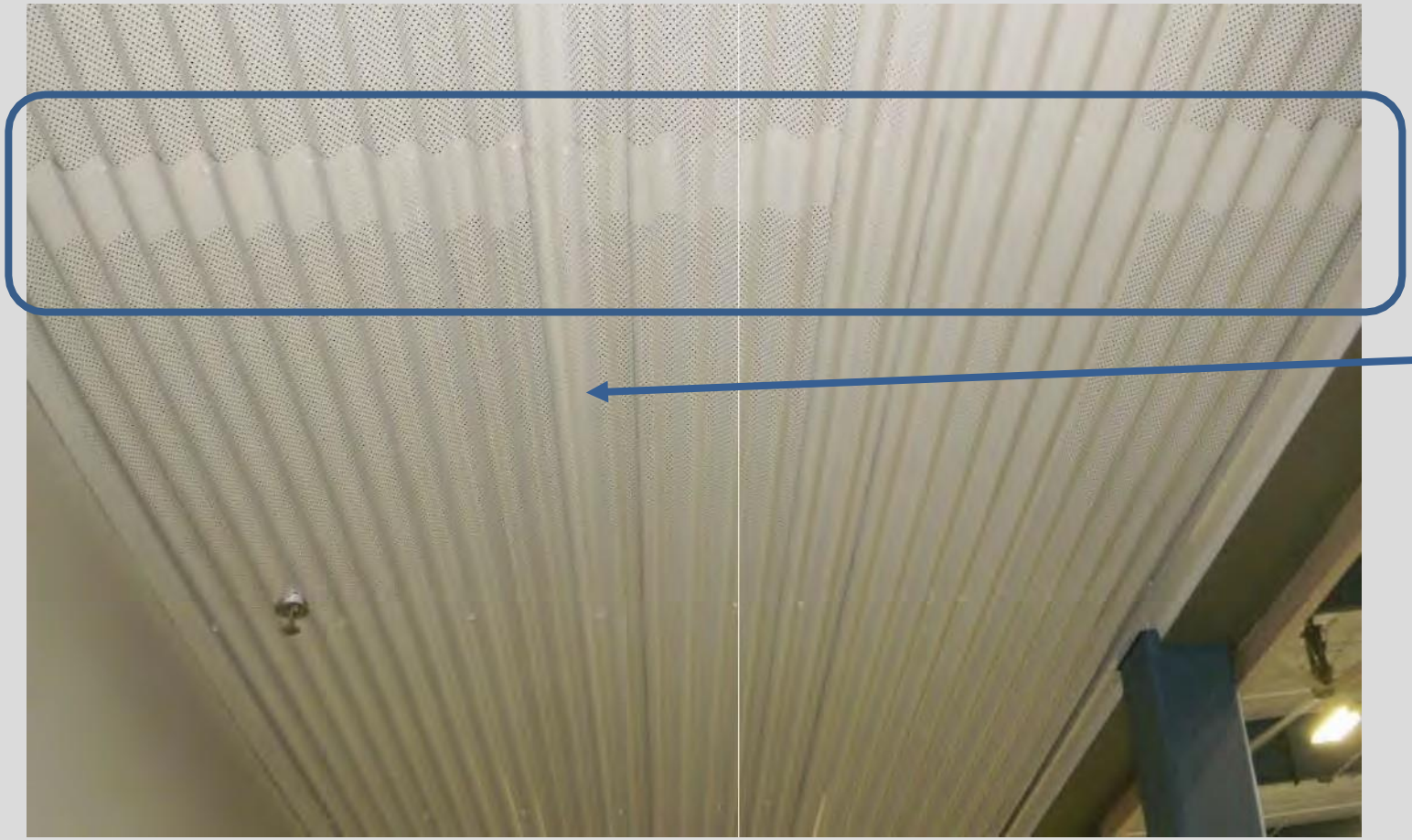
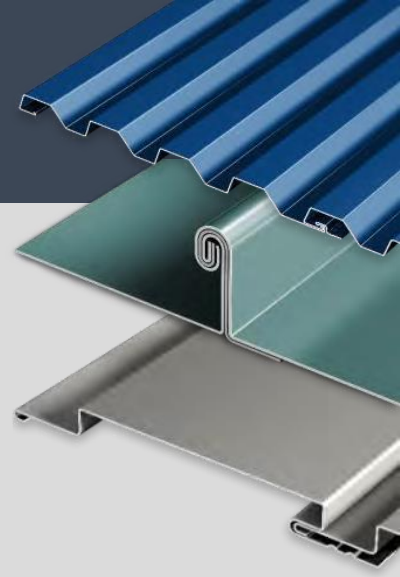
Perforation panel: holes NEVER line up





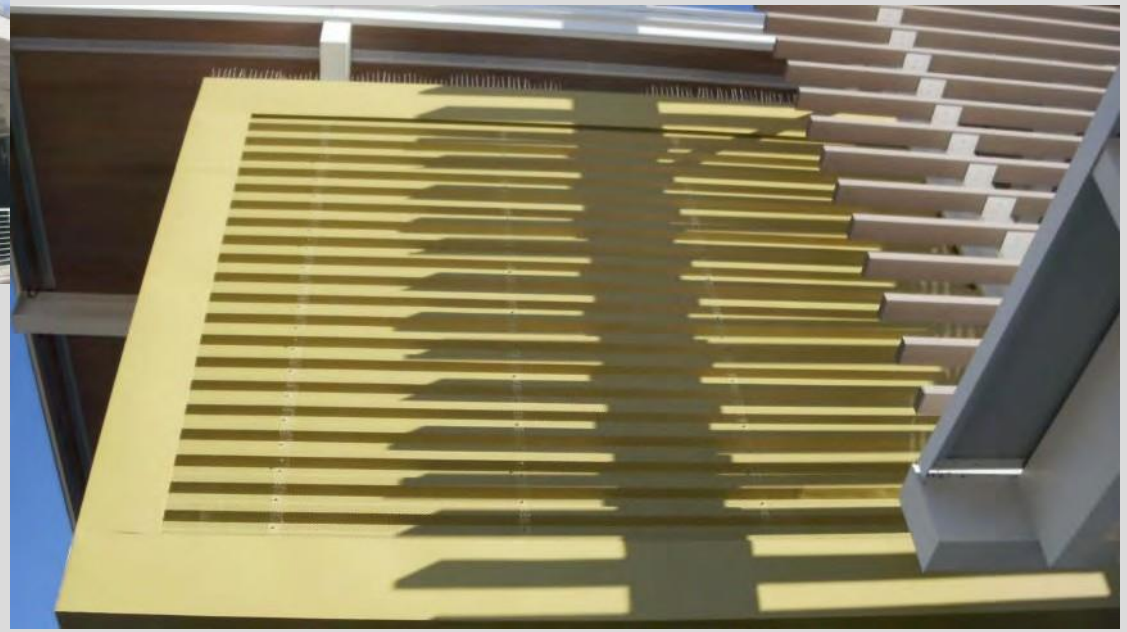
Note the side laps as well as the end laps are visible (look solid)

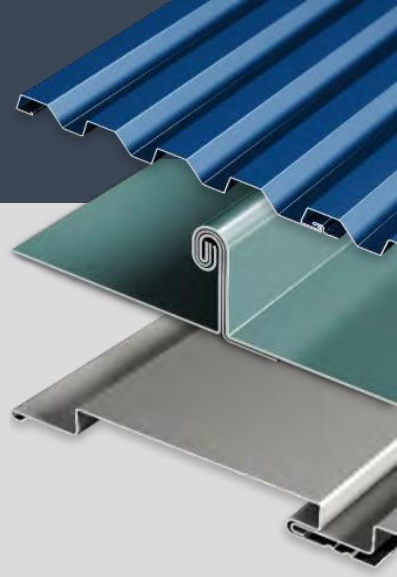
Perforation project



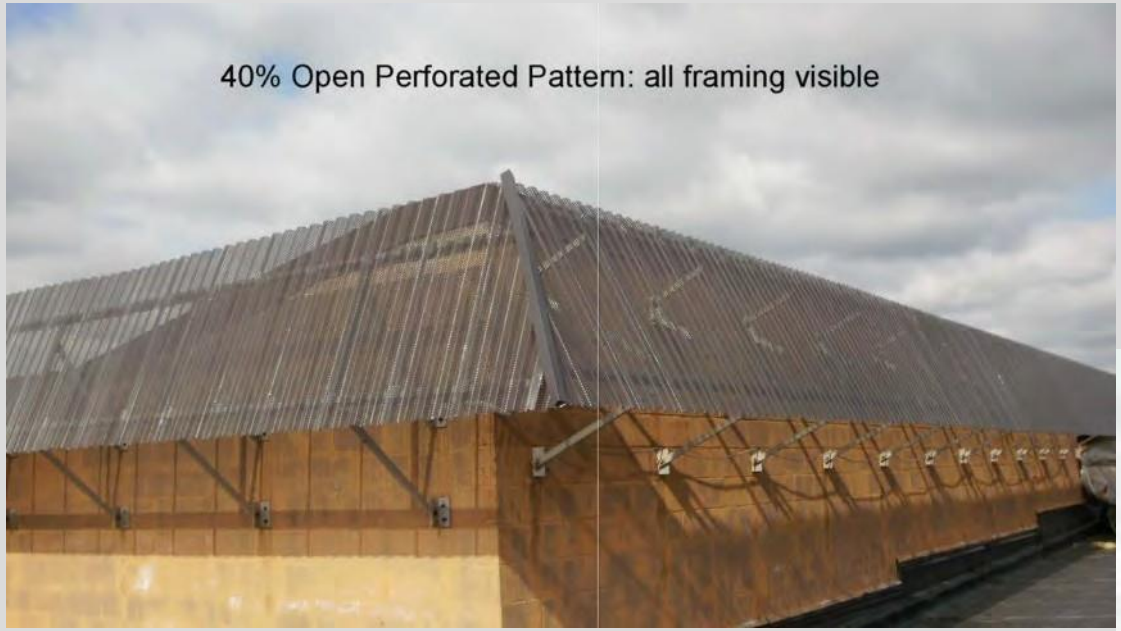
- Perforated .040
- No end or side laps
- Suspended to structural framing (not structurally attached)
- Sound deadening

Well-intentioned details

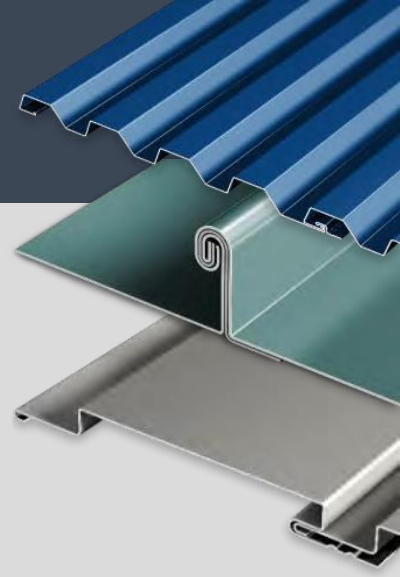




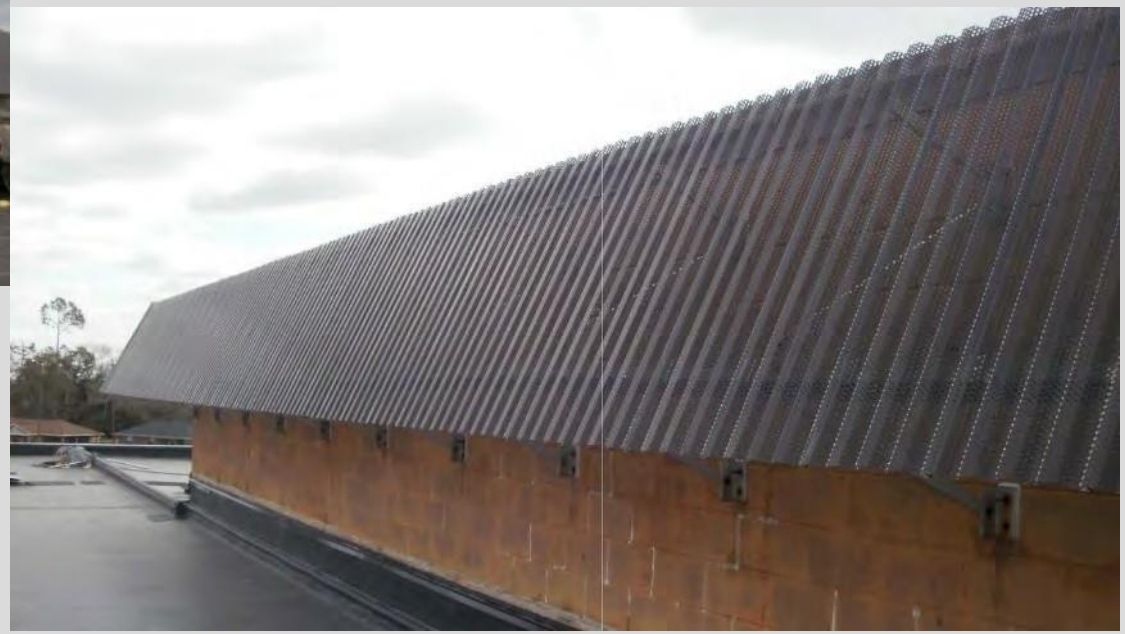
Well-intentioned details



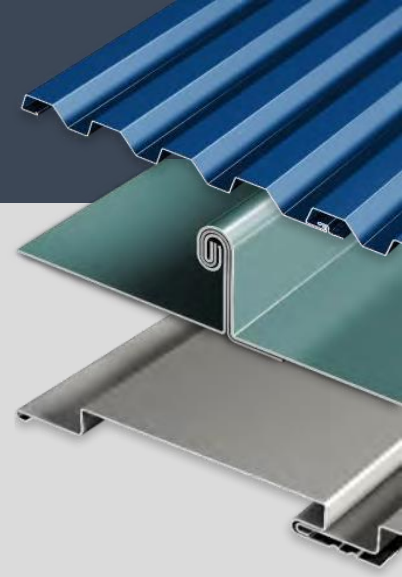
Panel length was determined
by visibility from ground



Panels retrofitted to hide
outdated mechanical screen wall



Project profile: sun shade



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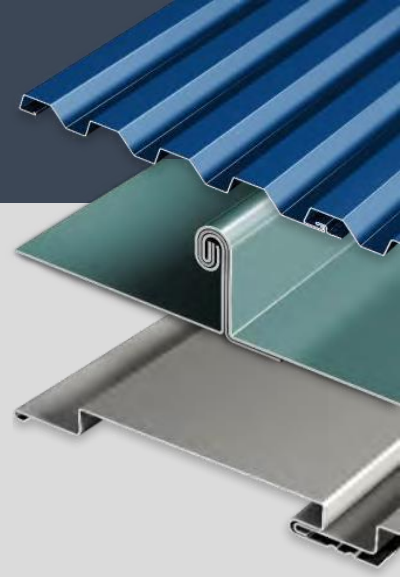
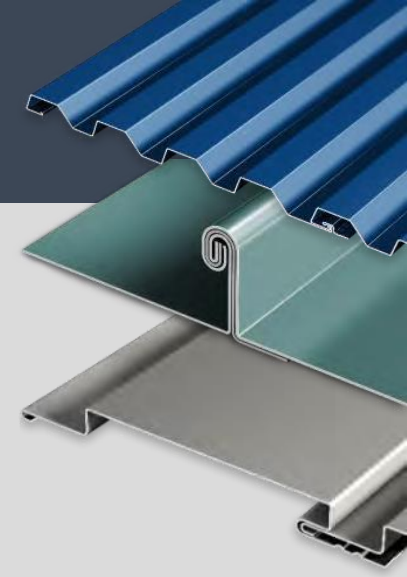
Project profile: equipment screen



Project profile: parking garage



International Drive, Orlando

- Perforated screen wall (aesthetic)
- 51% air space (large hole)

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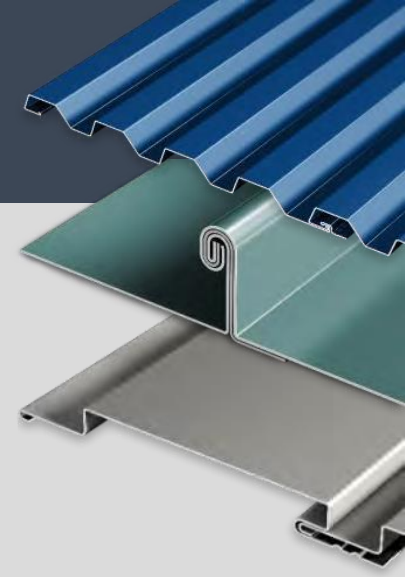
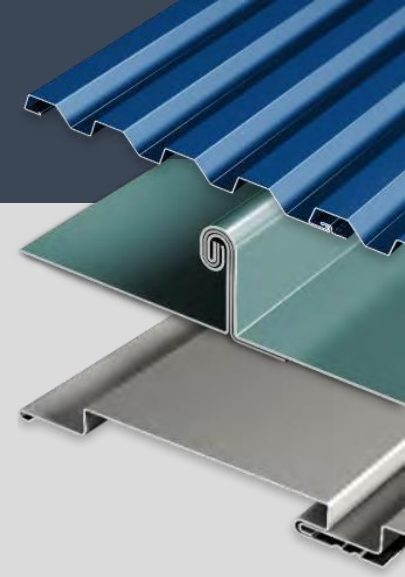
Metal is 100% recyclable



Even the alloys are separated!



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