

# ARCIS

## RAINSCREEN PANEL DESIGN GUIDE

**Durable and versatile, ultra-thin, prestressed precast panels—  
at a fraction of the weight**

Exterior facades

Architectural rainscreens

Ventilated façades and sunscreens

Décor, accent walls and interior elements

Louvers and fins

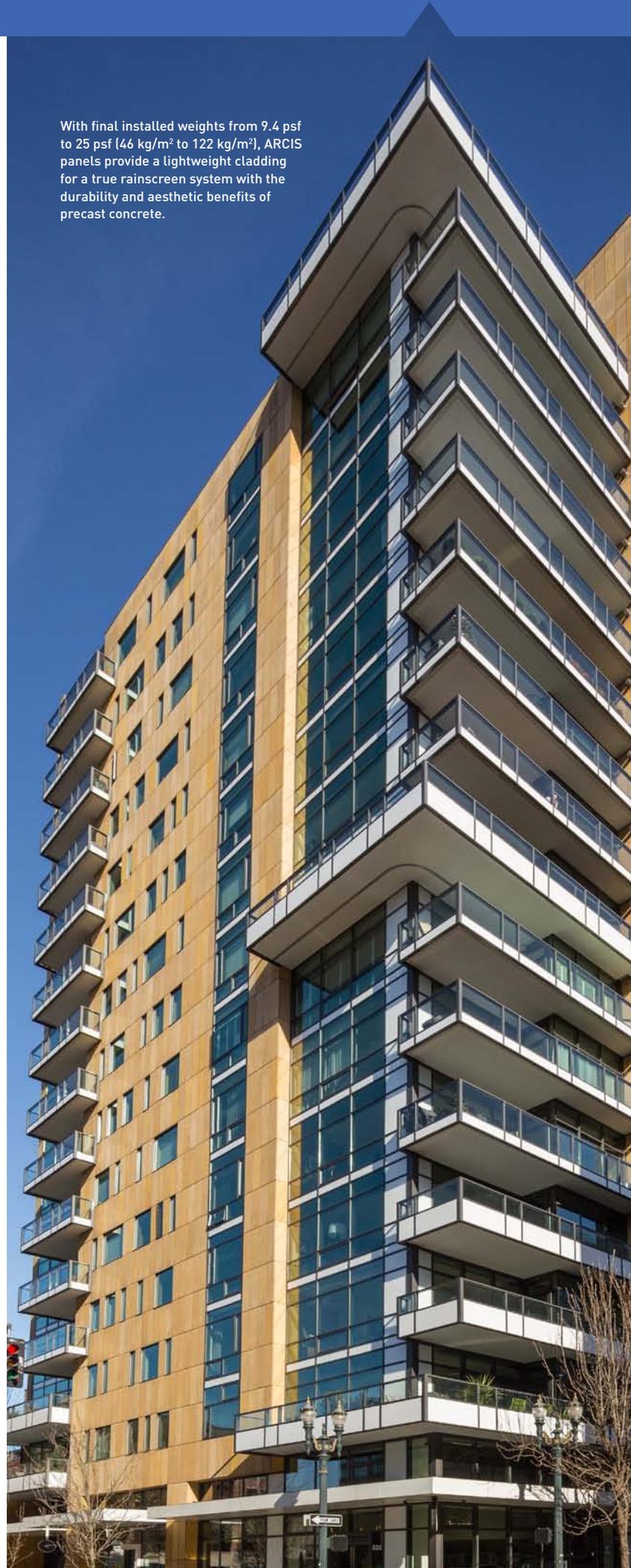
Retail storefronts

Mechanical screens

# Table of Contents

<b>Introduction</b>	<b>3</b>
<b>Project Case Studies</b>	<b>4</b>
<b>Hotel 1000</b>	<b>4</b>
<b>The Casey</b>	<b>4</b>
<b>Block 5 South Pearl Retail</b>	<b>4</b>
<b>Oregon State University Hospital</b>	<b>4</b>
<b>Panel Design Information</b>	<b>5</b>
<b>Panel Sizes</b>	<b>5</b>
<b>Panel Reinforcement</b>	<b>5</b>
<b>Support Structure</b>	<b>5</b>
<b>Bracket Hardware</b>	<b>6</b>
<b>Standard Stud Mounted System</b>	<b>6</b>
<b>Penetrations and Cutting</b>	<b>6</b>
<b>External Attachments</b>	<b>6</b>
<b>Jointing</b>	<b>7</b>
<b>Erection Considerations</b>	<b>7</b>
<b>Transportation Considerations</b>	<b>7</b>
<b>Connection Details</b>	<b>8</b>
<b>Top Hung Bracket</b>	<b>8</b>
<b>Standard J-Bracket</b>	<b>8</b>
<b>Sample Specifications</b>	<b>9-11</b>
<b>AltusGroup precasters</b>	<b>12</b>

With final installed weights from 9.4 psf to 25 psf (46 kg/m<sup>2</sup> to 122 kg/m<sup>2</sup>), ARCIS panels provide a lightweight cladding for a true rainscreen system with the durability and aesthetic benefits of precast concrete.



# Introduction

Rainscreen design and methodology has been used since the turn of the century. The primary goal is to provide an external protective coating installed over a building's insulation layer and waterproof membrane layers. Often, this protective coating is installed with an air cavity directly behind it in an effort to efficiently manage moisture and reduce water migration through the opaque wall assembly.

Licensed AltusGroup members are proud to offer thin ARCIS panels, a critical component of the rainscreen system. The ARCIS panels are manufactured from high performance concrete and stainless steel prestressing cables. Each panel is manufactured for a specific project, with exacting details in accord with PCI MNL 117 and more exacting dimensional tolerances. ARCIS achieves the architectural look and durability of a traditional precast enclosure without the extra weight or loss of design performance.

Panels range from 0.75 inches (19mm) to 2 inches (51mm), depending on application, and have final installed weights of 9.4 psf to 25 psf. (46 kg/m<sup>2</sup> to 122 kg/m<sup>2</sup>)

Product finishes and colors match high-end architectural precast applications of sand blast, acid etch and polishing. Each concrete mix design is specially formulated for the project's specifications, with strengths in excess of 5,000 psi.

ARCIS panels attach to the structure using a J-Channel and metal clips bolted to the back of the panel. The lightweight panel allows for installation via tower crane, at nearly any radius, or light weight mobile equipment, or in some instances, they can be delivered and installed through the windows. This method of attachment, along with pre-engineered pieces, allows for a fast, simple installation.

The following guide provides information for the designer to detail and specify the use of thin ARCIS prestressed panels.

ARCIS rainscreen product ready for transport



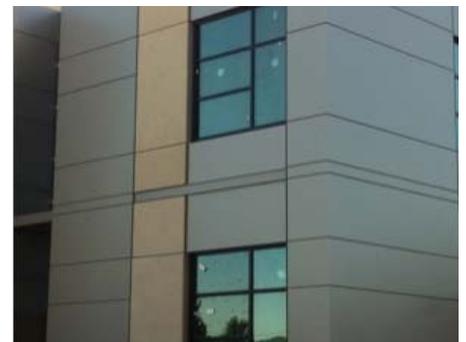
Manual installation of light-weight panel over insulation



Lightweight mechanical screen application



Lightweight rainscreen application



# Project Case Studies

## HOTEL 1000

Construction Date: 2006  
Architect: Weber + Thompson Architects  
Location: Seattle, Washington  
Product: 20,000 sq. ft. (1858m<sup>2</sup>) of  
1" (25mm) thick  
Architectural Panel

ARCIS rainscreen enclosure solution.  
Two solid color panels in dark brown and light cream.



## THE CASEY

Construction Date: 2007  
Architect: GBD  
Location: Portland, Oregon  
Product: 40,000 sq. ft. (3716m<sup>2</sup>) of  
1" (25mm) thick  
Architectural Panel

ARCIS rainscreen enclosure solution.  
Five different solid color panels installed in a random fashion.



## BLOCK 5 SOUTH PEARL RETAIL

Construction Date: 2003  
Architect: GBD  
Location: Portland, Oregon  
Product: 20,000 sq. ft. (1858m<sup>2</sup>) of  
1" (25mm) thick  
Architectural Panel

ARCIS rainscreen enclosure solution.  
Dark gray solid color panels.



## BAY AREA HOSPITAL

Construction Date: 2013  
Architect: ZGF  
Location: Coos Bay, Oregon  
Product: 19,500 sq. ft. (1812m<sup>2</sup>) of  
1" (25mm) thick  
Architectural Panel

Acid wash finish on panels  
Cavity wall construction with large cavity so panel face aligns with brick.  
Adjustable bracketing system allowed tolerance to adjust panels at corners.



# Panel Design Information

## Panel Sizes

Panel size is governed by the attachment system, the panel thickness, and the installer's method of handling the panels. The panels span vertically between J clips. For most high-rise applications, wind loading controls the design. 1" (25mm) thick panels can span between clips approximately 60" (152cm) with a 35 PSF wind load. 1 1/4" (31mm) panels can span 80" (203cm) with a 30 psf (1.4 kPa) wind load. The panels can cantilever above and below the clips. Thicker panels can span farther, as can panels with ribs or stiffeners. Panel width is controlled only by installation, with a maximum width up to eight feet.

Maximum panel size is 8'x13', [2.4m x 4m] and the minimum size is generally in the range of 20-30 Ft<sup>2</sup> [1.8m<sup>2</sup>-2.7m<sup>2</sup>] total depending on dimension and panel orientation.

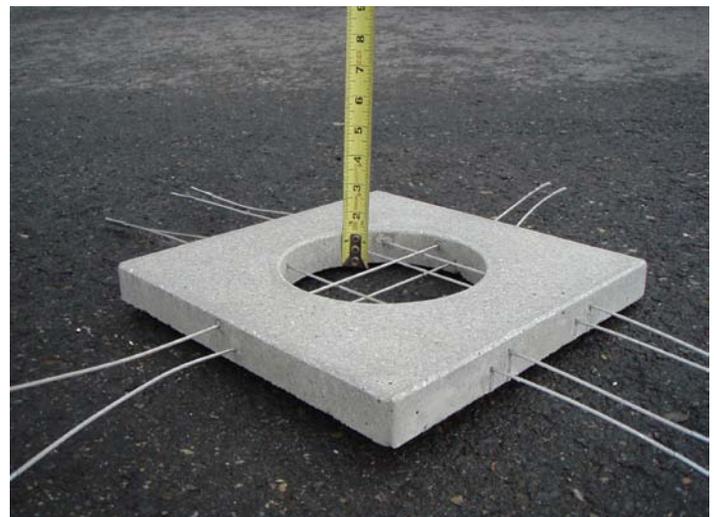
## Panel Reinforcement

Panels are designed as prestressed members in both directions following ACI 318. The reinforcement used in both directions is a stainless steel pretensioned braided cable. These cables are located in groups of two, spaced every 3" (76mm) to 4" (101mm). No other reinforcement is used in the panel construction, eliminating corrosion, rust, and long term moisture problems. The reinforcement is fully bonded and has a development length of approximately 2" (50mm), allowing the panels to be cut to fit and modified with ease.

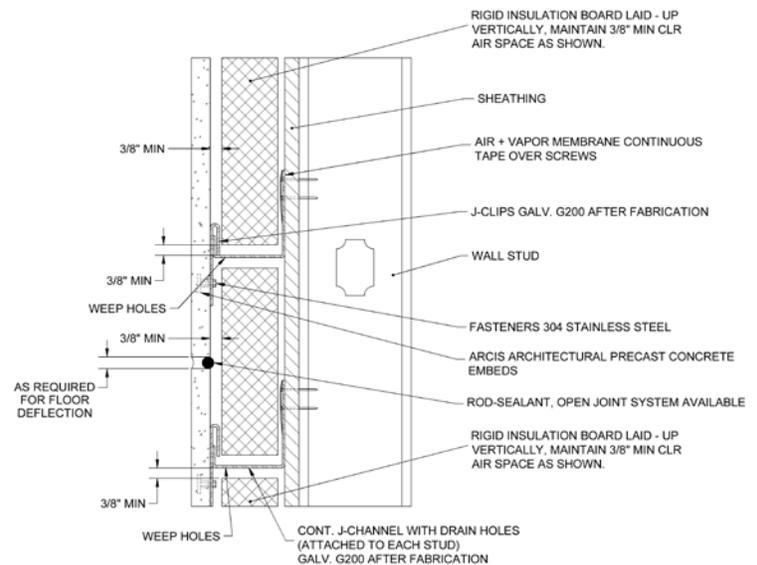
Connection points on the back of the panel are provided using a metal fastening clip attached to the pretensioned cable. These inserts allow a Z-Clip to be bolted to the back with slots for vertical and horizontal adjustment, providing maximum flexibility for field installation.

## Support Structure

The most common stud gauges used are 16 gauge and 18 gauge, depending on panel size, to get the proper capacity from the fasteners. The project structural engineer should consider the bracket point loading in the design of the stud. A self-healing waterproof membrane should be used over gypsum sheathing to minimize water infiltration at the screws. AltusGroup suggests using caulking over the brackets or screws, as shown in the connection detail section of this guide. We suggest the slab edges be held back slightly, 1" (25mm) or 1/2" (38mm) from the outside of the stud, to allow tolerance in setting the studs. Setting studs straight is critical to the economy of the system to reduce shimming and negate the requirement for adjustable bracketing, which can add both time and money to installation. The stud gauge needs to be adequate to develop the screw capacity for the clip attachments. This varies by panel size, but should not be less than 18 gauge. If floor deflection is anticipated, the ARCIS panel bracket placement needs to be coordinated with the framing deflection head. In most cases, either the top or bottom J-Clip can be the bearing member, with the other acting as a floating member.



ARCIS panels use non-corrosive, high-strength aerospace grade stainless steel prestressing place longitudinally and transversely in the panel to impart strength, crack control and durability.



The project structural engineer should consider the bracket point loading in the design of the stud. A healing waterproof membrane should be used to minimize water infiltration at the screws.

## Panel Design Information (continued)

### Bracket Hardware

Bracketing may be made from G90 galvanized plate, hot dip galvanized plate, stainless steel, or aluminum. The cost associated with the various brackets varies significantly. Selection of the material is often left to the architect or engineer, however galvanized is the most common. Noted in the image to the right, the hole in the lower plate is centered on the joint, which allows a screw to be placed into the joint and fastened to the J-Clip. This connection provides in-plane panel restraint.

### Standard Stud Mounted System

The stud mounted system is comprised of a horizontal rail that is screwed through the sheeting and into the studs. Waterproofing and flashing details are as designed by the architect, but usually include a self-healing membrane on the outside of the sheeting. AltusGroup suggests the use of this self-healing membrane to prevent moisture from migrating into the sheeting from around the screws.

### Penetrations and Cutting

Holes can easily be cored and cut into panels. Openings can be created using traditional concrete cutting tools. Block outs for mechanical penetrations, electrical outlets, etc. can be field cut, but need to be coordinated with the panel bracketing and connection system, so the opening size and location should be coordinated with the panel engineer.

### External Attachments

Signs and other lightweight items, up to 20 lbs, (9kg) can be attached to ARCIS panels. Additional weight or items that place loads on the panels, must be reviewed by the panel designer. Usually a lead or plastic insert is used for attachment. Any holes drilled into panels must be cored with a non-hammer type drill. Core bits are available as small as 3/8" (9.5mm). Hammer type drills will spall the back of the panel and could affect the integrity of the panel. Holes should be located 2" (51mm) or more from the edge of a panel.



Top: Left and Right: Installation of J clip bracketing hardware.  
Bottom Left and Right: typical conventional coring and cutting tools used with ARCIS panels.

## Panel Design Information (continued)

### Jointing

In general, story drift issues need to be considered in specifying window systems and laying out panel joints.

The ARCIS J clip system allows unlimited story drift movement and is an excellent solution for detailing movement issues, more so than most other panel systems. The panels can be designed to slide on the installation track as well. As with all panel systems, special attention is required where two different systems meet. When window systems and curtain walls are used in conjunction with ARCIS panels, it is important to coordinate the joint locations with the window system requirements. Some window systems rack and some slide with story drift. If the window system story drift occurs at a specific location, it is best to have an ARCIS panel joint at the same location to facilitate similar movement. An alternate solution might be a wide joint between the systems to allow the two systems to move independently. Jointing requirements can differ depending on building jurisdiction and seismic design category (SDC).

At corners, some jurisdictions require that the full story drift movement be accounted for in the corner joint. The panels are set on a horizontal rail and can be allowed to slide which reduces this return size, if allowed by the jurisdiction. Corners can be mitered, butt jointed, inclusion of a short return, or a corner piece can be used.

The J-Clip attachments can be installed to allow live load deflection on the floors. The joint thus needs to be sized to receive the movement without exceeding the caulking deflection criteria.

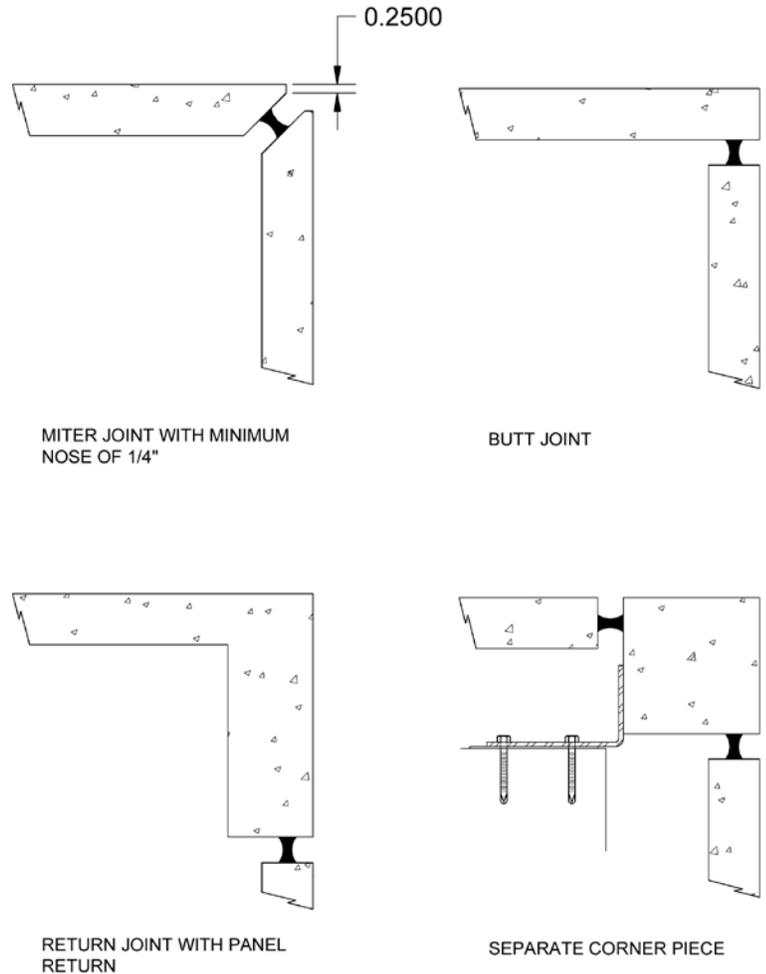
### Erection Considerations

Clearance is required above a panel, where it meets a fixed item (pre-installed pipe, window washing davit, window installed before panel etc.), so that the panel can be raised up and over the J-Clip.

### Transportation Considerations

A typical tractor trailer delivery truck can ship approximately 42,000 lbs. (19,050 kg). Due to the unique ARCIS panel thickness, at  $\frac{3}{4}$ " (19mm) in thickness, nearly 4,400 square feet (408.7 m<sup>2</sup>) of ARCIS panels can be delivered at once and at 2" (51mm) in thickness, nearly 1,700 square feet (158m<sup>2</sup>) makes up one delivery truck. This allows for economical delivery of ARCIS coast to coast.

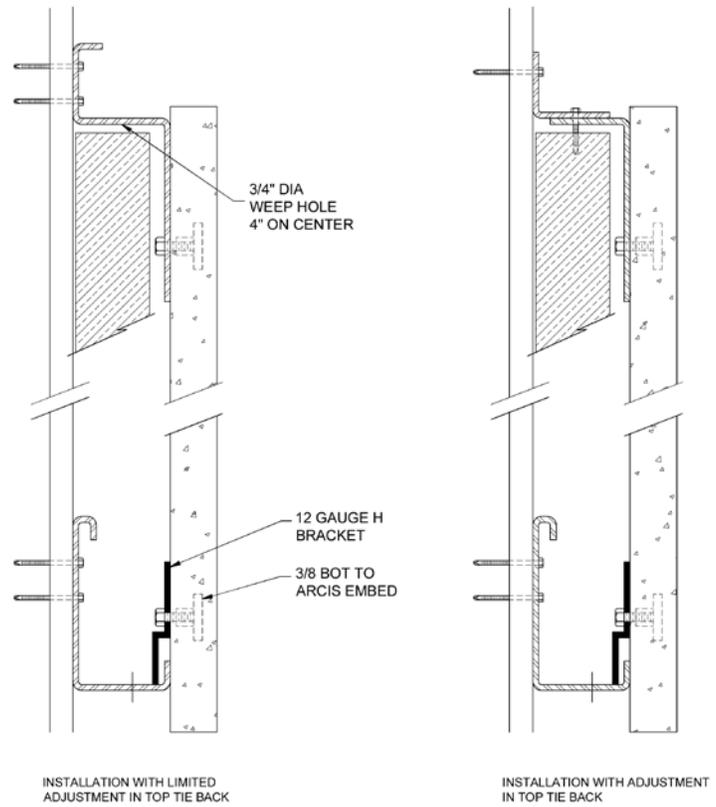
Compared to a traditional architectural precast panel at 6" (152mm) thick, a maximum of 560 square feet (52m<sup>2</sup>) could be delivered in one truck load.



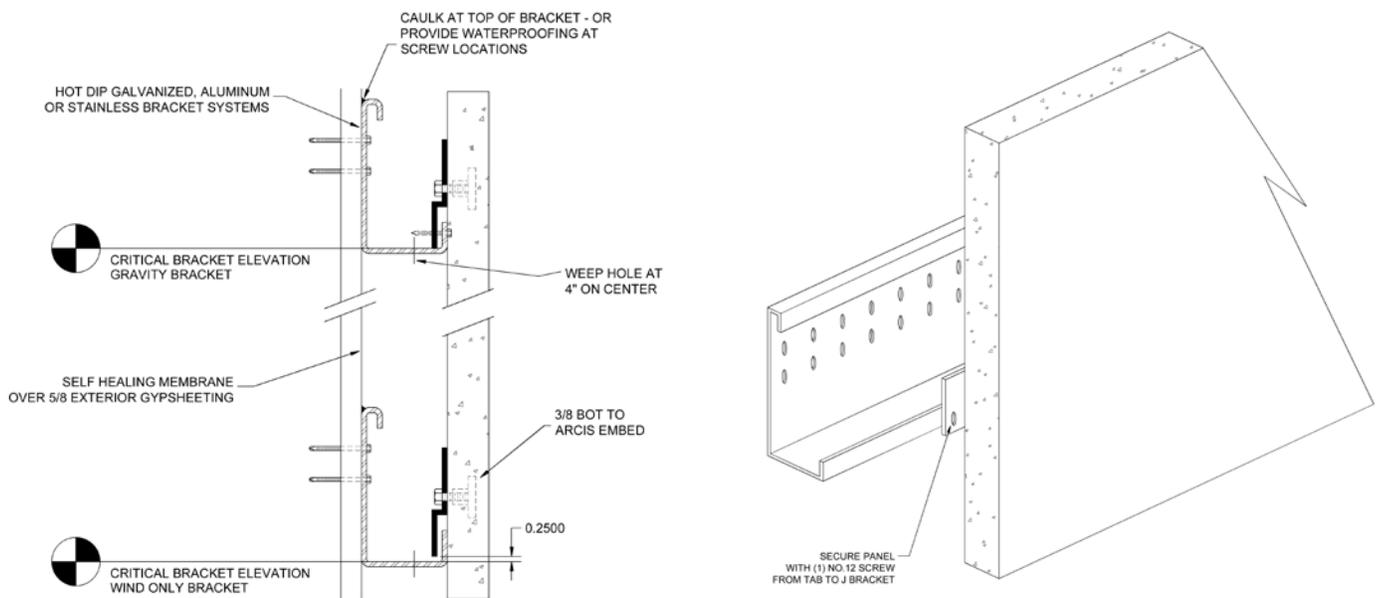
# Connection Details

## Top Hung Bracket

Allows the panel to be erected and attached to the structure at the top of the panel.



## Standard J-Bracket



The number 12 screw is used for in-plane lateral restraint and vertical uplift of the panel.

# Sample Specifications

## Section 03410 / ARCIS panel (rainscreen)

### Part 1 General

#### 1.1 Section includes

- 1.1.1 Shop cast prestressed precast cladding
- 1.1.2 Supports, anchors and attachments

#### 1.2 Related Sections

- 1.2.1 051200 Steel Framing
- 1.2.2 054000 Cold-Formed Metal Framing
- 1.2.3 055000 Metal Fabrications
- 1.2.4 071900 Water Repellents
- 1.2.5 072500 Weather Barriers
- 1.2.6 079005 Joint Sealers
- 1.2.7 092100 Exterior Sheeting
- 1.2.8 098000 Special Coatings

#### 1.3 References

- 1.3.1 PCI MNL 116 Manual for quality control: Structural precast concrete
- 1.3.2 PCI MNL 117 Manual for quality control: Architectural precast concrete
- 1.3.3 ACI 318 Building code requirements for Reinforced Concrete
- 1.3.4 ASTM A 123/A 123M Standard specification for hot dip galvanized Zinc Coatings
- 1.3.5 ASTM C33 Concrete Aggregates
- 1.3.6 ASTM C150 Portland Cement
- 1.3.7 ASTM C260 Air entraining admixtures
- 1.3.8 ASTM C979 Pigments for integrally Colored Concrete

#### 1.4 System Description

- 1.4.1 Thin precast cladding placed under compression with type 316 stainless steel prestressing tendons.

#### 1.5 Performance Requirements

- 1.5.1 Design units and support to withstand project specified loading requirements including static, anticipated dynamic loading, and anticipated displacements.

#### 1.6 Submittals

- 1.6.1 12" square sample with color and finish of precast for approval.
- 1.6.2 Shop drawings
  - 1.6.2.1 Indicate layout, unit locations, configuration, connection details, and support items.
- 1.6.3 Provide calculations prepared by a registered professional engineer.
- 1.6.4 Provide precast mix design.
- 1.6.5 Provide cleaning and maintenance instructions.

#### 1.7 Quality Assurance

- 1.7.1 Maintain plant records and quality control program during production of prestressed precast concrete. Make records available upon request. Perform work in accordance with PCI MNL 116 and PCI MNL 117 requirements.
- 1.7.2 Provide periodic 3rd party inspection of installation and fasteners.

#### 1.8 Product delivery, storage and handling

- 1.8.1 Panels to be palletized sufficient to transport and handle without distortion.
- 1.8.2 Identify and mark individual units with same mark as indicate on approved shop drawings.
- 1.8.3 Stack panels with plastic shims or other non-staining materials.
- 1.8.4 Block between panels with plastic panel plastic pads. Support to line up vertically through the stack to translate the weight through the stack, not loading any individual panel.
- 1.8.5 Strap panels using non-staining, clean materials that will not harm exposed surfaces.
- 1.8.6 Store pallets on level and adequate support to avoid distortion.
- 1.8.7 Lift and handle panels from designated pick points as approved by manufacturer.



## Sample Specifications (continued)

### Part 2 Products

#### 1.9 Manufacturer

- 1.9.1 AltusGroup licensed manufacturer  
Select at: [www.arcispanel.com](http://www.arcispanel.com)

#### 1.10 Precast materials

- 1.10.1 Concrete
  - 1.10.1.1 Compressive strength 5,000 psi at 28 days.
  - 1.10.1.2 Entrained air 5-8% in accordance with ACI 318.
- 1.10.2 Aggregates: ASTM C33
- 1.10.3 Cement: ASTM C150
- 1.10.4 Air entraining admixtures: ASTM C260
- 1.10.5 Color pigments: ASTM C979, inorganic natural iron oxide pigments.

#### 1.11 Reinforcement

- 1.11.1 Type 316 stainless steel prestressing tendons: ASTM A492, ASTM A240 and Federal Standard RR-W-410D.

#### 1.12 Embeds

- 1.12.1 Type 316 stainless steel: ASTM A240

#### 1.13 Finish

- 1.13.1 A set of range panels, a target along with, a darker and lighter, will be used to establish the expected color variation in the panels as well as the expected variation in the depth of finish.
- 1.13.2 Sand blast to match architect's range samples.
- 1.13.3 Acid etch to match architect's range samples.
- 1.13.4 Polish to match architect's range samples.

#### 1.14 Support Brackets and accessories

- 1.14.1 Brackets in moist environments to be hot dip galvanized after fabrication: ASTM A 123 Grade 100 or ASTM A653 G210. Bracketing in dry areas fabricated from G90 galvanized sheet, ASTM A653.
- 1.14.2 Fasteners to structure in moist environments to be Elco Industries drill flex, Elco Bi-Flex Stainless Steel, or approved equal.

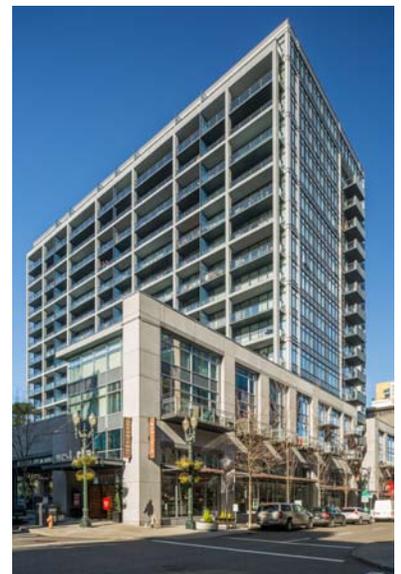
#### 1.1 Support structure

- 1.15.1 Structural studs supporting panels to be a minimum 18 gauge, designed to support all loads from panels. Metal studs to be placed to provide support at bracket ends. Metal stud shop drawings to be reviewed and approved by thin precast manufacturer. Metal studs that support Arcis panels to be a minimum of \_\_\_\_\_gauge, \_\_\_\_\_flange width, spaced at \_\_\_\_\_on center and at all bracket edges.
- 1.15.2 Nonadjustable stud mounted clip systems require the exterior stud to be set to the same tolerance as required for the finished face of precast,
- 1.15.3 Support structure to be designed for a maximum deflection of L/360.
- 1.15.4 Support structure and metal stud shop drawings to be submitted and approved by precast manufacturer.

### Part 3 Execution

#### 3.1 Examination

- 3.1. Verify that support structure, anchors, devices are ready to receive work of this section. Support locations types and sizes to be submitted for approval by panel manufacturer.
  - 3.1.1.1 Verify studs (or backing) is located and spaced properly to support panel brackets. Add studs (or backing) to support panel brackets including splices and ends of brackets.
- 3.1.2 Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.



## Sample Specifications (continued)

### 3.2 Erection

- 3.2.1 Work to be performed by manufacturer or a qualified installer.
- 3.2.2 Erect units without damage to shape or finish.
- 3.2.3 Attach units per project specifications.
- 3.2.4 Flash or caulk any penetrations of waterproof membranes.

### 3.3 Field modifications

- 3.3.1.1 Field modifications of brackets to be coordinated with manufacturer.
- 3.3.1.2 Galvanized brackets field cut or drilled to be coated with galvanizing compound per section 09800 Special Coatings.
- 3.3.1.3 Drilling and Cutting
  - 3.3.1.3.1 Refer to manufacturer specific instructions for drilling. Use non-hammering equipment with diamond core bits.
  - 3.3.1.3.2 Refer to manufacturer instructions for cutting. Cut with diamond blades from the top (finished) side. Protect finish with tape or other where tools will be in contact with material.
  - 3.3.1.3.3 Refer to manufacturer instructions for edging. Edge with diamond wheel on grinding jig.
  - 3.3.1.3.4 Verify locations and conditions with shop drawings, avoid contact with embedded items and support structure, verify hole sizes and edge distances manufacturer.

### 3.4 Attachment of items to precast cladding

- 3.4.1 Verify locations, loads and anchorages with manufacturer.
- 3.4.2 Install in holes that do not penetrate back of panel. Use non-corrosive chemical or expansion anchors approved by manufacturer.

### 3.5 Cleaning and Maintenance

- 3.5.1 Do not use acid based cleaning agents.
- 3.5.2 Refer to Manufacturer's instructions.

### 3.6 Tolerance

- 3.6.1 Fabrication and installation to be in accordance with PCI MNL 116 and/or PCI MNL 117.

### 3.7 Field Quality Control

- 3.7.1 Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.
- 3.7.2 Field welds will be subject to visual inspections and nondestructive testing to ASTM E165 or ASTM E709.
- 3.7.3 Screws and fasteners may be subject to periodic inspection for type, proper spacing, proper placement into backing, and conformance with shop drawings.

**End of section 03410**



## Innovation from the leading minds in precast



ARCIS® technology is now available throughout the United States and Canada through select producer members of AltusGroup, the only international collaboration of precast manufacturers dedicated to innovative precast solutions for improving the built environment.

ARCIS complements AltusGroup's highly successful and award-winning CarbonCast® Precast Enclosure Systems and Double Tees, which comprise more than 34 million square feet (3.2 million square meters) of precast surface area and over 1,000 projects sold to date.

### ARCIS products are available from these AltusGroup precaster members:

#### Armtec

Richmond, B.C.  
armtec.com

#### EnCon

Denver, Colo.  
enconunited.com

#### Enterprise Precast

Omaha, Neb.  
enterpriseprecast.com

#### Gage Brothers

Sioux Falls, S.D.  
gagebrothers.com

#### Knife River

Portland, Ore.  
kniferiverprestress.com

### Founding AltusGroup Precaster Members

Oldcastle Precast Building Systems  
Metromont Corporation  
High Concrete Group LLC

ARCIS product technology is licensed exclusively to AltusGroup and its members and is protected under the following U.S. and Canadian Patents: USPTO 6,711,866 B2 titled "Thin Pre-Stressed Concrete Panel and Apparatus for Making the Same," issued March 30, 2004, and the similar Canadian Patent 2,357,834, issued 11/20/2007.

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ARCIS is a trademark of Arcis-Corporation.

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For ARCIS sample specifications and technical resources, visit [www.arcispanel.com](http://www.arcispanel.com)

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