

FUZION

ANDREW PEARSON

FUZION by Andrew Pearson

Glass Stairs

Andrew Pearson Design provides unlimited design, fabrication and sourcing capabilities in architectural and decorative glass. Our passion for glass and innovation has made us a leader in cutting edge technology and design capabilities. Our production facility is equipped with state of the art equipment, such as laminating, cutting, edging, mitering, polishing, beveling, UV bonding, sandblasting, back painting, which we call Flaircote[®], UV printing on glass, as well as our newest addition, Fuzion fused glass applications.

Andrew Pearson Glass Stair components are available in a wide variety of glass types, manufactured to your project specifications. Stair treads may be produced from clear and ultraclear glass, tint-ed glass, clear glass with colored laminating interlayers, standard and custom patterned and textured glass, fused textured glass, and with a wide range of color and pattern backcoating technologies.

This guide specification section is intended for use where steel-framed stairs support glass treads and risers. A version is also available that specifies glass treads and risers alone, for offices that have their own decorative metal stair section and need only the added glass components.

Our capabilities are only limited by your imagination. If you have a vision, we can make it happen. We understand our role in the creative process is to help you achieve your vision. Our team of talented and hardworking, service oriented staff provides superior quality at a competitive price. Call us or email.

Contact Andrew Pearson Design for information on design and fabrication services. For more information, see our website at www.andrewpearsonglass.com and call us at (800)969-2156 or email at sales@andrewpearson.us.

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SECTION 05 71 13 – GLAZED DECORATIVE METAL STAIRS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Steel-framed decorative metal stairs with glass treads [and risers] constructed from the following glass products:

Specifier: Edit list after making product selections in Part 2.

1. [Clear] [Ultraclear] laminated glass.
2. Acid-etched laminated glass.
3. Colored laminated glass.
4. Textured patterned laminated glass.

Specifier: If retaining this optional "Related Sections" article, edit paragraphs to correspond to project scope. We recommend you retain cross-references to project sections specifying work that might otherwise be incorporated in work of this section.

1.2 RELATED SECTIONS

- A. Division 05 Section "Metal Pan Stairs" for pre-assembled steel stairs with concrete filled treads.
- B. Division 05 Section "Glazed Decorative Metal Railings" for structural glass railings and glass infill panels in decorative metal railings.
- C. Division 08 Section "Glazing" for standard glass applications.
- D. Division 08 Section "Decorative Glazing" for decorative glass applications.
- E. Division 08 Section "Mirrors" for silvered flat glass mirrors.

Specifier: If retaining this optional "References" article, edit list of references after editing section; retain those references cited in the edited section.

1.3 REFERENCES

- A. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI): www.asce.org
1. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structure
- B. ASTM International (ASTM): www.astm.org
1. ASTM A 36/A 36M - Standard specification for Carbon Structural Steel
 2. ASTM A 307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

3. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
4. ASTM A 513 / A 513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
5. ASTM A 563 / A 563M - Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
7. ASTM C 1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
8. ASTM C 1036 - Specification for Flat Glass
9. ASTM C 1048 - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
10. ASTM C 1172 - Specification for Laminated Architectural Flat Glass
11. ASTM F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
12. ASTM F 1941 / ASTM F 1941M - Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

C. National Floor Safety Institute (NFSI): www.nfsi.org

1. ANSI/NFSI B101.1 - Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials

D. National Association of Architectural Metal Manufacturers (NAAMM): www.naamm.org

1. NAAMM AMP 510 - Metal Stairs Manual

E. National Ornamental and Miscellaneous Metals Association (NOMMA): www.nomma.org

1. NOMMA Voluntary Joint Finish Standards

1.4 COORDINATION

- A. Coordinate selection of steel framing shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations.
- B. Coordinate setting of metal stair anchorages.

1.5 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets for the following:

1. Each glass product and glazing material.
2. Paint products.

Specifier: Retain "LEED Submittals" paragraph when required for project. For LEED for Schools projects, add restrictions on VOCs for shop-applied finishes.

B. LEED Submittals:

1. Credit MR 4 Recycled Content: Product data for products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content, including statement of costs.

C. Samples:

1. Minimum 6 by 6-inch (150 by 150 mm)-square, for each type of glass product.
2. Each type of exposed fastener and accessory.
3. Sample steel framing member with glass supports, with exposed welds, prepared as specified, with primer and finish paint applied.

D. Steel Framing Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Include details of cuts and connections.
2. Indicate welds by standard AWS symbols. Indicate grinding, finish, and profile of welds.
3. Indicate type, size, and length of bolts.
4. Indicate exposed surfaces and edges and surface preparation being used.

Specifier: Retain "Delegated Design Submittal" paragraph and related Part 2 requirements when required by authorities having jurisdiction.

Project-specific engineering of stairs must be provided by structural engineer of record or stair fabricator's professional engineer.

5. **Delegated Design Submittal:** Prepared by Contractor's qualified professional engineer, with calculations demonstrating compliance with structural loading requirements.

E. Glazing Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show details of clearances to adjacent materials. Show installation accessories and details of concealed and exposed fasteners.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Information: For steel fabricator[, Contractor's professional engineer], and Installer firm.

B. Warranties: Submit sample warranties meeting requirements of this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Source: Obtain each type of glass product from a single glass manufacturer for each glass product type.

B. Installer Qualifications: Experienced Installer with minimum of 5 successful completed projects of similar materials and scope.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

Specifier: Retain "Work Samples" paragraph on projects whose size or complexity warrants this additional quality assurance requirement and expense.

- D. **Work Samples:** Prior to fabricating steel frame components and glazing units, build sample units including example joinery, metal finishes, glass unit edge treatments and exposed fasteners to demonstrate materials and workmanship.
- E. **Preinstallation Conference:** Conduct conference at Project site in compliance with Division 01 requirements.

1.8 PRECONSTRUCTION TESTING

Specifier: Insert text here if preconstruction testing of project-specific designs to verify that stair components meet performance requirements is required by authorities having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials during shipping, handling, and storage to prevent breakage, scratching, damage to seals, or other visible damage. Deliver, unload, store, and erect glazing materials without exposing panels to damage from construction operations.

1.10 WARRANTY

- A. **Warranty for Glass Products:** Manufacturer's standard form, signed by manufacturer, agreeing to provide replacement glass for units that display peeling, cracking, and other deterioration under normal use, within [five] years of date of substantial completion.
- B. **Warranty for Laminated Glass:** Manufacturer's standard form, signed by manufacturer, agreeing to replace laminated-glass units that display edge separation, delamination, and blemishes exceeding those allowed by ASTM C 1172, within [five] years of date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Glass product selections are based upon the manufacturer below. Provide basis of design product [, or comparable product of a listed manufacturer approved by the Architect prior to bid]:
 - 1. Andrew Pearson, Mt. Airy, NC 27030; (800)969-2156;
sales@andrewpearson.us; www.andrewpearsonglass.com.

2.2 PERFORMANCE REQUIREMENTS

Specifier: Retain "Delegated Design" paragraph and "Structural Performance of Stairs" paragraph along with related requirement under Action Submittals article for projects where the Contractor, rather than

the structural engineer of record, is responsible for structural design of stair components, and where required by authorities having jurisdiction.

Project-specific engineering of stairs must be provided by structural engineer of record or stair fabricator's professional engineer.

- A. **Delegated Design:** Engage a qualified professional engineer, licensed in the Project jurisdiction, to design stairs.
- B. **Structural Performance of Stairs:** Design stairs to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from loads specified above and including railing loads.
 - 5. Limit deflection of treads, platforms, and framing members to L/360.

Specifier: Retain "Seismic Performance of Stairs" Paragraph below for projects requiring seismic design. Verify requirements of authorities having jurisdiction.

Project-specific engineering of stairs must be provided by structural engineer of record or stair fabricator's professional engineer.

- C. **Seismic Performance of Stairs:** Stairs shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7].
 - 1. Component Importance Factor: 1.5.

Specifier: Retain one of two "Slip Resistance" paragraphs based upon requirements applicable to project.

- D. **Slip Resistance:** Provide stair tread walking surfaces with static coefficient of friction not less than 0.6 wet and dry when tested in accordance with ASTM C 1028.
- E. **Slip Resistance:** Provide stair tread walking surfaces with static coefficient of friction not less than 0.6 wet and dry when tested in accordance with ANSI/NFSI B101.1.

Specifier: Andrew Pearson provides a wide variety of standard and customized glass products available for glass stair applications. Consult your API representative for available additions to the selections shown below.

2.3 GLASS STAIR UNITS

- A. Glass Treads: Clear laminated glass units.
 - 1. Glass: [Clear] [Ultraclear] fully tempered float glass.
 - 2. Interlayer Color: Clear.
 - 3. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
 - 4. Number of Glass Plies: Not less than [Three] [Four].

5. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [2 inch (51 mm)] [Insert thickness].
6. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

B. Glass Treads: Tinted laminated glass units.

1. Glass: Tinted fully tempered float glass.
2. Tinted Glass Color: [Blue] [Blue-green] [Bronze] [Green] [Gray].
3. Interlayer Color: Clear.
4. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
5. Number of Glass Plies: Not less than [Three] [Four].
6. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
7. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

C. Glass Treads: Colored interlayer laminated glass units.

1. Glass: Clear fully tempered float glass.
2. Interlayer Color: [Clear] [Color as selected by Architect from manufacturer's full range].
3. Interlayer Color and Pattern: [As selected by Architect from manufacturer's full range].
4. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
5. Number of Glass Plies: Not less than [Three] [Four].
6. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
7. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

D. Glass Treads: Light-dispersing translucent laminated glass units.

1. Glass: Acid-etched clear fully tempered float glass.
2. Interlayer Color: Clear.
3. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
4. Number of Glass Plies: Not less than [Three] [Four].
5. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
6. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

E. Glass Treads: Opaque-coated clear laminated glass units.

1. Glass: Clear fully tempered float glass.
2. Interlayer Color: Clear.
3. Opaque Coating Color: [Match <Insert Pantone or paint system color>].
4. Opaque Coating Location: Number [two] surface.
5. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
6. Number of Glass Plies: Not less than [Three] [Four].
7. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
8. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

- F. Glass Treads: Ceramic frit-coated clear laminated glass units.
1. Glass: Clear fully tempered float glass.
 2. Interlayer Color: Clear.
 3. Ceramic Frit Color: [Match <Insert Pantone or paint system color>].
 4. Ceramic Frit Pattern: [Insert pattern description].
 5. Ceramic Frit Location: Number [two] surface.
 6. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
 7. Number of Glass Plies: Not less than [Three] [Four].
 8. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
 9. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

- G. Glass Treads: Textured laminated glass units.
1. Glass: Clear fully tempered float glass.
 2. Interlayer Color: Clear.
 3. Textured Glass Pattern: [Obscure] [Slip resistant texture] [Insert texture description or basis of design product].
 4. Textured Glass Pattern Location: [Number one surface] [Number two surface].
 5. Glass Plies for Structural Glass Treads: Not less than [10] [12] mm thick, each.
 6. Number of Glass Plies: Not less than [Three] [Four].
 7. Total Glass Tread Thickness: As required by structural loads, but not less than [1-1/8 inch (29 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
 8. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

- H. Glass Risers:
1. Glass: Match riser.
 2. Interlayer Color: Match riser.
 3. Textured Glass Pattern and Location: Match riser.
 4. Glass Plies: Not less than [10] [12] mm thick, each.
 5. Number of Glass Plies: Not less than [Three] [Four].
 6. Total Glass Riser Thickness: Not less than [1/2 inch (12 mm)] [1 inch (25 mm)] [1-1/2 inch (38 mm)] [Insert thickness].
 7. Slip-Resistant Treatment Pattern: [Raised 1/2 inch (12 mm) squares] [_____] [_____].

Specifier: Retain the applicable glass product standards based upon selections made for project.

2.4 GLASS PRODUCTS

- A. Ultraclear Float Glass (Low Iron): ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear or ultraclear) or Class 2 (tinted) as indicated, Quality-Q3.

- C. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Kind LT (laminated tempered), Quality-Q3 with multiple plies of glass and polyvinyl butyral interlayer not less than [0.060 inch (1.52 mm)] thick.
- D. Ceramic-Coated Glass: Fully-tempered float glass, Condition C; with ceramic enamel applied by silk-screened process.

2.5 ACCESSORIES FOR GLAZING INSTALLATION

- A. Accessories for Structural Glazing: Resilient setting supports, shims, and related accessories as recommended or supplied by glass manufacturer for installing structural glazing on metal supports. Provide resilient washers for placement between fasteners and glass units.
- B. Glass Component Fastener Materials: Bolts, spacers, standoffs, and related materials as indicated on Drawings; unless otherwise indicated, provide Type 304 stainless-steel fasteners with satin-polished No. 4 finish.
- C. Fastener Sizing: Select fasteners of type, grade, and class required to produce connections suitable for anchoring structural glass components to other construction indicated on Drawings, and capable of withstanding design loads.
- D. Provide concealed fasteners for steel framing unless otherwise indicated on Drawings.
 1. Provide [tamper-resistant] [square or hex socket] flat-head machine screws for exposed fasteners unless otherwise indicated.
 2. For exposed fasteners, provide Type 304 stainless steel fasteners.

2.6 FABRICATION OF GLAZING UNITS, GENERAL

- A. Fabricate decorative glass in dimensions required, with edge and face clearances, and edge and surface conditions in accordance with glazing manufacturer's instructions, referenced glazing publications, and approved shop drawings.
- B. Edge Finishing: Fabricate decorative glazing finished edges to produce smooth edges without chips or scratches, ground, polished, and warp-free. Provide finished edges of type(s) shown on Drawings. Provide slight chamfers at junctions of edges and faces.
- C. Machining: Drill, notch, and cutout decorative glazing as indicated. Make cutouts smooth and uniform.

2.7 METAL STAIRS

- A. NAAMM Stair Standard: "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, Architectural class.
- B. Comply with requirements for Category 1 architecturally-exposed structural steel (AESS).
- C. Metal Surfaces, General: Provide materials with smooth, flat surfaces. For components exposed to view, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

- D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] percent.
- E. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- F. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

2.8 ACCESSORIES FOR STEEL-FRAMED STAIRS

- A. Stair Framing Fasteners: Zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, and flat washers.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563 (ASTM A 563M), and flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36; with nuts, ASTM A 563 (ASTM A 563M).
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors; carbon-steel components zinc plated, ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5.
- E. Shop Primers: Comply with Section 099600 "High-Performance Coatings."
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer compatible with topcoat.

2.9 STEEL-FRAMED STAIR FABRICATION

- A. Provide complete stair assemblies, including metal framing, clips, bearing plates, and other components necessary to support and anchor stairs and platforms. Join components by welding, using connections that develop full structural capacity of joined pieces.
- B. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld connections using materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Weld exposed corners and seams continuously unless otherwise indicated.
 - 1. At exposed connections, finish exposed welds to comply with NOMMA Type 1 welds: no evidence of a welded joint.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- E. Stair Framing:
 - 1. Fabricate stringers and platforms of steel shapes indicated on Drawings.
 - a. Provide closures for exposed ends of channel or tube stringers.
 - 2. Weld stringers to headers; weld framing members to stringers and headers.

- F. Glass Tread and Riser Supports:
 - 1. Fabricate tread and riser steel supports of steel shapes indicated on Drawing and approved shop drawings.
 - 2. Weld supports to stringers. Locate welds on top of subtreads where they will be concealed by finished treads.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Steel Framing: Verify locations of bearing surfaces and embedments for compliance with requirements of approved shop drawings.
- B. Glazing Supports: Verify that glazing supports are clean and ready to accept glass installation. Confirm that minimum required face and edge clearances will be maintained.
- C. Glazing Units: Examine glazing units prior to setting. Reject units that display edge or face damage that may impede performance of unit or that will be visible when installed.
- D. Proceed with installation once unsatisfactory conditions have been corrected.

3.2 STEEL STAIR FRAMING INSTALLATION

- A. Fastening: Provide anchorage devices and fasteners for securing metal stairs, including threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete in accordance with approved shop drawings, unless otherwise indicated.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints.

3.3 GLAZING INSTALLATION

- A. General: Install glass and glazing materials in accordance with approved shop drawings.
 - 1. Install setting materials of size and in location required by glass manufacturer.
 - 2. Provide spacers for glass where recommended.
- B. Fasten glass units to supports using fasteners provided by or recommended by manufacturer for application. Tighten fasteners according to requirements indicated on approved shop drawings. Prior to project turnover, test and re-tighten fasteners.

3.4 ADJUSTING, CLEANING AND PROTECTION

- A. Steel Framing Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."
- B. Protect installed glass from damage. Attach streamers or warning tape to framing members, away from contact with glass. Remove nonpermanent labels.
- C. Protect glass from contact with contaminating substances during construction. Immediately clean glass exposed to contamination using methods recommended by glass manufacturer.
- D. Clean all exposed glass surfaces using methods recommended by manufacturer.
- E. Remove and replace broken or damaged glass units.

END OF SECTION

Evaluating Submittals and Substitution Requests

Submittals and Substitutions: When reviewing submittals or substitution requests, Andrew Pearson recommends particular attention to the following issues:

Confirm that all required submittal items have been provided before reviewing submittal.

Review proposed warranty terms and conditions.

Examine production samples to verify that visual and performance qualities of proposed product meet design intent.

Confirm scheduled availability through qualified manufacturer/fabricator.

Coordination with Drawings: We recommend you coordinate the following:

Locations of each type of glazing unit; coordinate with unit designations used in this section.

Locations where safety glazing is required

Locations for types of glazing setting methods

Details of glazing methods, including profiles of gaskets if used

Profiles and edge conditions of treads and risers

Types and sizes of fasteners, including metal types for exposed fasteners

Details of reveals and edge conditions between glazing units and structural supports