A GLAZING SYSTEM

Field of Invention

The present disclosure relates generally to glazing systems or glazing façade systems of buildings. More specifically, the present disclosure relates to a glazing system or glazing façade system for enhancing the overall façade of a building.

Background

There are an increasing number of buildings, particularly multi-story or high-rise buildings, with glazed façades (or glazed façade systems) such as glass façades (or glass façade systems). A glazed façade can be a transparent or translucent wall, or a portion of a wall, of a building. Various types of glass, for example clear, tinted, tempered, and/or laminated glass, can be used for glazing in architectural applications (e.g., when constructing a glazed façade of a building).

There are several advantages commonly associated with glazed façades, more specifically glass façades. A glass façade allows the entry of natural light (i.e., sunlight) into the building, thereby reducing a reliance on artificial lighting. The reduced reliance on artificial lighting reduces energy (i.e., electricity) consumption and associated costs, and is also environmentally friendly.

In addition, certain types of glazing have been associated with a relatively higher thermal performance. A higher thermal performance of a building’s façade system helps to reduce heat gain by the building and hence lower the load on the building’s air-conditioning system. As the air-conditioning system accounts for a significant portion of a typical building's electricity consumption, the thermal performance of a building's façade system will have a direct impact on the building’s electricity or energy consumption. Therefore, the use of certain glazing façades or glass façades can further the extent to which an architectural structure is considered to be environmentally friendly.

Furthermore, buildings with glass façades have often been touted as being aesthetically and architecturally pleasing.

Various technological arrangements, tools, and techniques have been applied for erecting or constructing glass façades of buildings (e.g., high rise buildings). Generally, a glazed façade system or assembly, which can include multiple individual glass panels or units, must be mechanically secured to a substructure of the building. In addition, interconnecting structures for securing the individual glass panels to each other are often visibly present on the surface of said glazed façade system.

Furthermore, support structures are required for lending support to existing glazed façade systems. Such support structures are clearly visible and can be cluttered and bulky. The support structures are often in the form of aluminum mullions and/or transoms, steel trusses and/or columns, stainless steel cables and/or rods, and glass fins, which extend or project from the surface of said glazed façade system.

The extension of the support structures into the interior floor space or area of a building can reduce the effective, available, and/or leasable floor space of the building. In addition, the clearly visible support structures can adversely impact the overall design and/or aesthetic impression of a building’s façade.

It is difficult to obtain a smooth surface for glazed façades, such as glass façades. Conventionally, in an attempt to obtain a smooth outer surface of a glass façade assembly, individual glass units or panels of the assembly were mounted or coupled to each other by means of adhesive bonding. However, for safety reasons, building authorities have generally not permitted or approved such glass façade assemblies, particularly without first necessitating a host of additional safety measures. For example, the use of said adhesive bonding is commonly limited to certain range of thickness and overall size of glass façades.

A particular existing glass façade system is disclosed by United States patent US 4,581,868, wherein sections of glass panels are fastened to supports of a building. The glass façade system of US 4,581,868 includes a planar array of sealed multiple glazing units, each glazing unit having two opposed spaced sheets with a seal between the sheets that defines a sealed gas space. The glazing units are secured to supporting members with

the outer surface of glazing the units sealed edge-to-edge. At least some of the glazing units are secured to the supporting members by a mechanical fixing passing through the outer sheets of the glazing units, external to the seals of the glazing units. In a preferred embodiment of the glass façade system, each glazing unit is secured to a supporting member by bolts whose heads are countersunk into holes, which are countersunk in the outer face of the glazing unit beyond of the seal of the glazing unit.

There are several disadvantages with the glass façade system of US 4,581,868, more specifically in association with aesthetics and manner of assembly. The holes required to accommodate the attaching bolts generally weaken the entire glazing unit, thereby adversely affecting the integrity and surface topography of the outer panel. The bolts even when countersunk into the glazing unit detract from the appearance of the exterior of the glass façade system. In addition, the necessity to carefully drill through multiple layers of glass and align these pieces constitutes an undesirably complex, time-consuming, and costly manufacturing constrain. The drilling of glass to produce a countersunk hole usually requires at least two manufacturing steps or processes, and may entail structural weakening such as by way of glass chipping or fracturing, or possibly glass breakage.

Accordingly, new or alternative glazed façades (or glazed façade assemblies), such as glass façade assemblies, which are capable of overcoming at least one of the above-described limitations and/or disadvantages, are likely to have commercial demand.

Summary

In accordance with a first aspect of the present disclosure, there is disclosed a securing unit for securing portions of an architectural façade to an array of load distributors, the architectural façade including a set of planar components. The securing unit includes a first plate, a second plate couplable to the first plate, and a core structure carried by the first plate and disposed between the first and second plate when the first and second plates are coupled together. The core structure includes a set of load distributor retaining structures formed therein, each load distributor retaining structure within the set of load

distributor retaining structures including a length that is at least substantially parallel the first plate.

In accordance with a second aspect of the present disclosure, there is disclosed a securing unit for securing portions of an architectural façade to an array of load distributors, the architectural façade including a set of planar components. The securing unit includes a first plate couplable to at least two planar components and a core structure carried by the first plate and shaped and dimensioned to fit across a thickness of the at least two planar components. The core structure includes a set of load distributor retaining structures, each load distributor retaining structure from the set of load distributor retaining structures being shaped and dimensioned to couple to a load distributor and to dispose the load distributor coupled thereto at least substantially within the thickness of the at least two planar components. The securing unit further includes a second plate couplable to the core structure in a manner to dispose the core structure and the at least two planar components between the first and second plate.

In accordance with a third aspect of the present disclosure, there is disclosed a glazing façade system including at least two glazing components, a securing unit disposed at a junction between the at least two glazing components, and at least one load distributor coupled to the securing unit and positioned between a first glazing component and a second glazing component of the at least two glazing components. The at least one load distributor is disposed at least substantially within a thickness of the at least two glazing components.

In accordance with a fourth aspect of the present disclosure, there is disclosed a method for assembling a glazing façade system. The method includes providing a securing unit, the securing unit including a core structure that comprises a set of load distributor retaining structures. The method further includes coupling a first load distributor to a first load distributor retaining structure of the set of load distributor retaining structures, and coupling at least two planar components to the securing unit. Each of the at least two planar components includes a first surface and a second surface that are at least substantially parallel relative each other, a thickness of the of at least two planar

components being defined between the first and second surfaces thereof. The first load distributor is disposed at least substantially within the thickness of the of the at least two planar components.

In accordance with a fifth aspect of the present disclosure, there is disclosed an architectural façade system including a plurality of architectural façade panels, each architectural façade panel within the plurality of architectural façade panels having a width, a height, a first outer surface, a second outer surface, and a thickness defined between the first and second outer surfaces. The architectural façade system further includes a load distribution network configured to distribute forces upon the plurality of architectural façade panels, the load distribution network including a set of force distribution elements coupled to the plurality of architectural façade panels. The set of force distribution elements includes a set of load distribution nodes, each load distribution node within the set of load distribution nodes disposed between at least two architectural façade panels within the plurality of architectural façade panels. The set of force distribution elements further includes a plurality of load distributors coupled to the set of load distribution nodes, each load distributor within the plurality of load distributors disposed along one from the group of a portion of an architectural façade panel width and a portion of an architectural façade panel height, and further disposed at least substantially within the thickness of an architectural facade panel of the plurality of architectural façade panels. The load distribution network substantially excludes force distribution elements that extend substantially beyond each of the first outer surface and the second outer surface of an architectural façade panel.

Brief Description of the Drawings

Embodiments of the present disclosure are described hereinafter with reference to the figures, in which:

FIG. 1A is a partial front view of a glass façade system in accordance with an embodiment of the present disclosure;

FIG. 1B is a partial front view of a glass façade system in accordance with another embodiment of the present disclosure;

FIG. 1C is a partial front view of a glass façade system in accordance with yet another embodiment of the present disclosure;

FIG. 2A is a partial planar view of the expended portion “A” as shown FIG. 1A and FIG. 1B;

FIG. 2B is a partial planar view of a single-axis securing unit provided by an embodiment of the present disclosure;

FIG. 2C is a partial cross-sectional view of the securing unit of FIG. 2B;

FIG. 2D to FIG. 2F are partial planar views of particular single-axis securing units provided by various embodiments of the present disclosure;

FIG. 3A is a partial planar view of the expanded portion “B” as shown in FIG. 1A;

FIG. 3B is a partial planar view of a dual-axis securing unit provided by an embodiment of the present disclosure;

FIG. 3C is a partial cross-sectional view of the securing unit of FIG. 3B;

FIG. 3D to FIG. 3F are partial planar views of particular dual-axis securing units provided by various embodiments of the present disclosure;

FIG. 4 is a partial isometric illustration of at least some components of the single-axis securing unit of FIG. 2B;

FIG. 5 is a partial isometric illustration of at least some components of the dual-axis securing unit of FIG. 3B;

FIG. 6A is a partial front view illustrating the fixing of a rod to a building's support or sub-support structure, for example a ceiling or base, in accordance with an embodiment of the present disclosure;

FIG. 6B is a partial cross-sectional view illustrating the fixing of the rod to the building's support or subs-support structure, for example the ceiling or base, in accordance with the embodiment as shown in FIG. 6A;

FIG. 7A is a partial front view illustrating the fixing of a cable to a building's support or sub-support structure, for example a wall, in accordance with an embodiment of the present disclosure;

FIG. 7B is a partial cross-sectional view illustrating the fixing of the cable to the building's support or subs-support structure, for example the wall, in accordance with the embodiment as shown in FIG. 7A;

FIG. 8 shows representative load distribution capacities of the load distributors of a particular glass façade system in accordance with an embodiment of the present disclosure; and

FIG. 9 is a flowchart of a process for assembling particular glass façade systems in accordance with an embodiment of the present disclosure.

Detailed Description

Glazing façades, such as glass façades, are increasingly being incorporated into the overall façade or design of buildings. The use of existing glazing façades or glass façades typically requires support structures that extend or project from the surface or plane of the glazing façade. Such projecting support structures occupy at least some interior floor space or area of the building, thereby reducing the building's overall available, useable, and/or leasable floor space. In addition, the projecting support structures are visible, and can adversely affect the overall aesthetical impression of the building. Smooth glass facades, wherein individual glass panels are simply adhered to each other, have been

proposed. However, such smooth glass facades are often considered unsafe. The use of said smooth glass facades are also typically subjected to a number of safety limitations and/or regulations, for instance a limit on total size and/or thickness of the glass façades, or number of individual glass panels thereof.

Embodiments of the present disclosure relate to glazing facades (or architectural facades), for example glass façades, which address at least one aspect, problem, limitation, and/or disadvantage associated with existing glazing facades.

For purposes of the present disclosure, references to glazing facades include glazing façade systems, glazing façade assemblies, and glazing façade structures. Similarly, references to glass facades include glass façade systems, glass façade assemblies, and glass façade structures.

The term glazing can be understood to include the insertion of glazing units (e.g., glass panels) into prepared or designated openings in an architectural space such as a building's overall façade. In addition, the term glazing can refer to one or more of the components of glazing façade (e.g., glass façade) construction, including glass panels, frames, and fixings. Furthermore, the term glazing can also be understood to refer to the glass itself.

In most embodiments of the present disclosure, the glazing façade includes multiple glazing units (or architectural façade units or panels). For example, the glazing façade can include at least two, three, four, five, ten, twenty, thirty, forty, fifty, sixty, seventy, eighty, ninety, one hundred, two hundred, five hundred, or more glazing units.

For purposes of brevity and clarity of the description, the glazing units are said to be made of glass, and are hereinafter referred to as glass panels or glass panes. However, a person of ordinary skill in the art will understand that the glazing units can alternatively be made of a different material, for example polymeric compounds such as transparent polycarbonate sheets of Makrolon® multi UV from Bayer Polymers or other lightweight polystyrene-based compositions.

The glass panels can be made of one, or a combination of two or more, types of glass known in the art. Generally, glass is an amorphous solid material made by fusing silica with a basic oxide. Architectural glass is commonly made from three principal raw materials, namely silica, lime, and sodium carbonate. While particular examples of glass (e.g., architectural glass) are described below, other types of glass not included below can also be encompassed within the scope of the present disclosure.

In many embodiments, the glass panels are made of tempered glass, for example tempered monolithic glass (i.e., a single pane of tempered glass), tempered laminated glass (i.e., two or more panes of glass bonded together), or double-glazed glass units (i.e., two or more panes of glass assembled as one unit with an insulating airspace between the glass panes). In some embodiments, the glass panels are made of low emission glass, which has a metal oxide coating that retains heats generated from within the building, and keeps the cold or heat outside. In other embodiments, the glass panels are made of alarm glass, which is a security glass that is specially laminated with a thin wire (e.g., approximately 0.1mm in diameter) between the sheets of glass. The wire can be part of an electrical circuit that is set off if the glass panel is damaged. Alarm glass is generally useful for securing commercial and/or industrial premises.

In several embodiments, the glass panels can be made of anti-reflective glass. Anti-reflective glass is coated with metal oxide layers, which help the glass reflect a low percentage of light, thereby allowing increased clarity and transparency. Anti-reflective glass is normally used with buildings, for example glass-walled restaurants, where nighttime sight or lighting is desired. In addition, in certain embodiments, the glass panels can be made of body-tinted glass. With body-tinted glass, chemical colorants are added during the glass manufacture process to tint the color of the glass. For example, manganese can be added to create a purple coloration, while pinks can be produced using selenium. Body-tinted glass can help to minimize solar radiation entering a building, thereby keeping the building cooler inside. In addition, body-tinted glass can help make a building look unique and contemporary, and are generally more favored in the design of business headquarters or commercial buildings.

The glass panels of the glass façade system can vary in size and/or shape. In many embodiments of the present disclosure, the glass panels of a particular glass façade have similar sizes and/or shapes. In other embodiments, the glass panels of a particular glass façade have different sizes and shapes. For example, in some embodiments of the present disclosure, the glass panels are approximately quadrilateral in shape, for example, rectangular, rhomboid, or kite. In several embodiments, the glass panels are approximately square-shaped. In other embodiments, the glass panels are approximately polygonal in shape, for example, pentagonal, hexagonal, or octagonal. In yet other embodiments, the glass panels have irregular shapes, or specific shapes or deigns, as desired. In addition, in numerous embodiments, the glass panels are substantially uniformly flat or straight. In other embodiments, the glass panels are curved, for example in an arc-shape and/or S-shape.

As above-mentioned, most embodiments of the present disclosure are directed at glass façade systems or assemblies. Many embodiments of the present disclosure relate to systems, structures, apparatuses, devices, tools, mechanisms, and/or techniques for providing structural support to the glass façade. For instance, numerous embodiments of the present disclosure relate to systems, structures, apparatuses, devices, tools, mechanisms, and/or techniques for interconnecting, holding, securing, fastening, fixing, and/or clamping at least two glass panels (or planar units) together.

In many embodiments, the systems, structures, apparatuses, devices, tools, and/or mechanisms for providing structural support to the glass façade that are separate from a building support or sub-support structure itself are integral, or substantially integral, with the glass panels of the glass façade. In numerous embodiments, such systems, structures, apparatuses, devices, tools, and/or mechanisms for providing structural support to the glass façade are disposed substantially within the same plane as the glass panels. In several embodiments, such systems, structures, apparatuses, devices, tools, and/or mechanisms for providing structural support to the glass façade are disposed entirely within the same plane as the glass panels. This is to say, in several embodiments, such systems, structures, apparatuses, devices, tools, and/or mechanisms for providing structural support to the glass façade, or distributing forces within an array of glass

panels, do not extend or project from the plane of the glass panels (e.g., no, or no substantial, Z-axis extension or projection beyond an X-Y plane of or planar tangent to the glass panels).

For purposes of the present disclosure, “within a plane of a panel”, more specifically “within a plane of a glass panel”, can be defined as being encompassed, or substantially encompassed, between a first plane, which corresponds to a first surface of the panel (e.g., glass panel), and a second plane, which corresponds to a second surface of the panel (e.g., glass panel), the first and second surfaces of the panel (e.g., glass panel) being substantially parallel, and facing substantially opposite directions, relative to each other. For instance, where a glass façade is integrated into a façade of a building, each of the first and second surfaces of glass panels of said glass façade faces one of the interior and exterior of the building.

Particular glass façade systems, as well as various aspects or elements thereof, are described in detail hereinafter with reference to FIG. 1A to FIG. 9, in which like or analogous elements or features are shown numbered with like or analogous reference numerals. Relative to descriptive material corresponding to one or more of FIG. 1A to FIG. 9, the recitation of a given reference numeral can indicate the simultaneous consideration of a FIG. in which such reference numeral is also shown. The embodiments provided by the present disclosure are not precluded from other applications (e.g., architectural or construction applications) in which particular fundamental principles present among the various embodiments described herein, such as structural and/or functional characteristics, are desired.

FIG. 1A to FIG. 1C show particular glass façade systems 10a, 10b, and 10c provided by particular embodiments of the present disclosure. In most embodiments, each of the glass façade systems 10a, 10b, and 10c is an architectural façade system.

The glass façade system 10 can be incorporated, integrated, assembled, or fitted into a space (e.g., architectural space) such as a building’s overall façade or architectural design as desired. For example, the glass façade system 10 can be integrated within a part of a

building's walls. Alternatively, the entire exterior façade of a building can be made of the glass façade system 10.

In many embodiments of the present disclosure, the glass façade system 10 includes a number of glass panels 15 that are positioned or assembled relative to each other. The glass panels 15 can be positioned in a number of different configurations or arrangements as desired, for instance in order to achieve a particular façade design.

In many embodiments, the glass panels 15 are arranged in an ordered, or substantially ordered, configuration. In other embodiments, the glass panels 15 are irregularly arranged.

In many embodiments of the present disclosure, the glass panels 15 are planar units (and can generally be referred to as planar components or planar material). The glass panels 15 include a first surface and a second surface, which are substantially parallel, and facing opposing directions, relative to each other. The plane of the glass panel 15 can be understood as a glass panel thickness that extends between a plane corresponding to the first surface and a plane corresponding to the second surface of the glass panels 15.

The thickness of the glass panel 15 (i.e., distance between the first and second surfaces of the glass panel 15) can be varied as desired, for example depending upon building requirements such as specified loadings and/or modulation of the glass panels 15. In many embodiments, the thickness of the glass panels 15 is between approximately 5 millimeters (mm) and 50mm. In some embodiments, the thickness of the glass panels 15 is between approximately 6mm and 30mm. In selected embodiments, the thickness of the glass panels 15 is between approximately 10mm and 25mm, for example approximately 12mm, 15mm, 17mm, 20mm, 22mm, or 25mm.

The glass panels 15 of the glass façade system 10 are secured, coupled, fixed, and/or interconnected to each other using securing units 20 (also referred to herein as load distribution nodes, securement units, holding units, clamping units, coupling units, anchor units, and/or interconnecting units). In many embodiments, the securing units 20

are positioned or disposed within the glass façade system 10 at regular or ordered intervals relative to each other. In other words, in many embodiments, the securing units 20 are disposed in a regular or ordered configuration as part of the glass façade system 10.

In many embodiments, the securing units 20 are shaped and dimensioned for securing or coupling multiple glass panels 15 (i.e., at least two glass panels 15) to each other. The securing units 20 provided by embodiments of the present disclosure can be of several different designs (e.g., shapes, sizes, and/or configurations).

In several embodiments, for instance as shown in FIG. 1A, the glass façade system 10a includes securing units 20 of at least two different designs. In some embodiments, for instance as shown in FIG. 1B, the glass façade system 10b includes securing units 20 of an identical, generally identical, or similar design. Securing units 20 of the glass façade system 10c as shown in FIG. 1C can also be of a same or similar design. Alternatively, securing units 20 of the glass façade system 10c as shown in FIG. 1C are of at least two different designs.

In many embodiments, the glass façade system 10 further includes a number of load bearing elements, load distribution elements, or load distributors. For example, the glass façade system 10 can include at least two, five, ten, fifteen, twenty, thirty, forty, fifty, one hundred, or two hundred load distributors. In general, the number of the load distributors depends upon the type and/or number of glass panels 15, and the type and/or number of securing units 20 intended to be incorporated in a glass façade system 10. In many embodiments, the load distributors also provide structural support to the glass façade system 10. This is to say, in many embodiments, the load distributors are structural supports of the glass façade system 10.

In most embodiments, the load distributors can be shaped, dimensioned, and/or configured as desired, for instance depending on the shape and/or configuration of the glass panels 15 that are coupled thereto. In many embodiments, the load distributors have

a substantially straight shape or configuration. In some embodiments, the load distributors can be curved, for example in an arc-shape or S-shape.

For purposes of the present disclosure, references to load distributors can be understood to be equivalent to references to support structures (and vice versa).

In many embodiments, the load distributors are disposed or positioned between the glass panels 15, more specifically between the edges of adjacent glass panels 15. Accordingly, the load distributors are integral with, or incorporated within, the glass façade system 10. In many embodiments, the load distributors are disposed substantially within the same plane as the glass panels 15. In numerous embodiments, the load distributors are disposed entirely within the same plane of the glass panel 15. This is to say, the load distributors of glass façade systems 10 provided by many embodiments of the present disclosure do not substantially project or extend from the glass panels 15 at an angle relative thereto.

In numerous embodiments, the load distributors of a particular glass façade system 10 include rods 25. In many embodiments, the load distributors of a particular glass façade system 10 include cables 30. In several embodiments, the load distributors of a particular glass façade system 10 include both rods 25 and cables 30. In selected embodiments, the load distributors can further include other structures, devices, tools, and/or mechanisms that are capable of receiving, withstanding, accommodating, distributing, and/or dissipating a static and/or dynamic load (e.g., force and/or stresses).

In many embodiments, the rods 25 and/or cables 30 are tensioned, pre-tensioned, or pre-stressed rods 25 and/or cables 30. Tensioned, pre-tensioned, or pre-stressed rods 25 and cables 30 are capable of withstanding, accommodating, absorbing, and/or distributing a certain amount of force or load, for instance, in a generally or somewhat resilient manner without permanent deformation. Accordingly, the use of tensioned rods 25 and cables 30 with the glass façade systems 10 of particular embodiments of the present disclosure can enable said glass façade systems 10 to withstand, accommodate, absorb, and/or distribute at least a certain amount of force or load without damage.

In numerous embodiments, the load distributors, for example the rods 25 and/or cables 30, are made of stainless steel. The grade of stainless steel used for the construction of the rods 25 and/or cables 30 can vary, for instance depending on the size of the glass façade system 10, thickness of the glass façade system 10, and/or level or amount of loading that the glass façade system 10 is required to withstand.

In numerous embodiments, the rods 25 are elongated structures, and are disposed vertically relative the ground when the glass façade system 10 is integrated or incorporated into a building's façade. In addition, in several embodiments, the cables 30 are elongated structures, and are disposed horizontally relative the ground, when the glass façade system 10 is integrated or incorporated into a building's structure (e.g., support or sub-support structure). While the above orientation of rods 25 and cables 30 are described, a person of ordinary skill in the art will understand that the rods 25 can alternatively be positioned horizontally relative the ground, and the cables 30 can alternatively be positioned vertically relative the ground when the glass façade system 10 is integrated into a building's structure, depending upon embodiment details. In certain embodiments, rods 25 and/or cables 30 can be positioned at an angle (e.g., in a diagonal lattice-type configuration) with respect to the ground and/or a set of building support structures.

In numerous embodiments, the glass façade system 10 further includes anchoring or fixing unit(s), components, and/or mechanism(s) for anchoring the glass façade system 10 to a building, more specifically to a building's existing support or sub-support structure (e.g., base, wall, pillar, or ceiling). In several embodiments, the anchoring units are positioned or disposed at extreme edges of the glass façade system 10. This is to say, the anchoring units are positioned along the edges of glass panels 15 disposed along the outer perimeter of the glass façade system 10.

In some embodiments, the rods 25 and/or cables 30 extend or protrude at least some distance from the edges of the glass panels 15 (e.g., from the outermost edges, or perimeter, of the glass façade system 10) in a manner that facilitates coupling or securing to the anchoring units, and correspondingly to a building's support structure.

Accordingly, in some embodiments, the anchoring units can include at least a portion of the ends or extremities of the rods 25 and/or cables 30. In some embodiments, the anchoring units include peripheral support structures that are couplable to the load distributors (e.g., rods 25 and/or cables 30).

As above described, the securing units 20 can be positioned in regular or ordered configuration as part of the glass façade system 10. In many embodiments, the securing units 20 are positioned at regular or ordered intervals along a length of the load distributors, more specifically along a length of the rods 25 and/or cables 30.

In most embodiments, each securing unit 20 includes a set of load distributor retaining structures that facilitate or effectuate coupling to at least one rod 25 or to at least one cable 30. In many embodiments, each securing unit 20 facilitates or effectuates a coupling between at least two rods 25. In many embodiments, each securing unit 20 facilitates or effectuates a coupling of at least one rod 25 with at least one cable 30.

In addition, in most embodiments, each securing unit 20 facilitates or effectuates a coupling of at least two glass panels 15 with at least one rod 25, and/or at least one cable 30. In many embodiments, the securing unit 20 facilitates or effectuates a coupling between at least two glass panels 15 and at least two rods 25. In numerous embodiments, the securing unit 20 facilitates or effectuates a coupling of at least two glass panels 15 with at least one rod 25 (e.g., two rods) and at least one cable 30.

As mentioned above, the securing units 20 of embodiments of the present disclosure can have different designs (e.g., size, shape, and/or configuration). Particular securing units 20 of the present disclosure, and/or aspects or elements thereof, are described hereinafter with reference to FIG. 2A to FIG. 5.

FIG. 2A to FIG. 2F, as well as FIG. 4, specifically illustrate particular single-axis securing units 20a, and aspects thereof, as provided by various embodiments of the present disclosure.

In most embodiments, the single-axis securing unit 20a can carry or be coupled to two glass panels 15 (i.e., the single-axis securing unit 20a can interconnect two glass panels 15). In many embodiments, the single-axis securing unit 20a can be further coupled to two rods 25. This is to say, the single-axis securing unit 20a can mediate coupling and/or connection between two glass panels 15 and two rods 25.

In many embodiments, the single-axis securing unit 20a is shaped, dimensioned, and configured for disposing the rods 25 that are coupled thereto in a direction corresponding to a single axis along the plane of the glass panels 15 (i.e., in a single direction along the plane of the glass panels 15). For instance, the single-axis securing unit 20a can position a set of rods 25 along or substantially along a representative y-axis in a manner defined in FIG. 2A.

In many embodiments, the single-axis securing unit 20a is shaped, dimensioned, and configured for disposing the rods 25 that are coupled thereto between the two glass panels 15, more specifically between the edges of the two glass panels 15. In numerous embodiments, the rods 25 are disposed within gaps, joints, or spaces present between the edges of adjacent glass panels 25.

In many embodiments, the single-axis securing units 20a are shaped, dimensioned, and configured for disposing the rods 25 that are coupled thereto substantially within, or even entirely within, the plane of the glass panels 15. This is to say, in many embodiments, the rods 25 do not extend, protrude, or project away, from the plane of the glass panels 15. In other embodiments, the rods 25 can extend somewhat or slightly beyond the plane of the glass panels 15.

The single-axis securing unit 20a includes a number of components or elements that are couplable to each other. In many embodiments, the single-axis securing unit 20a includes a first holding or clamping plate 50a. The first holding plate 50a can also be referred to as a front holding or clamping plate. In some embodiments, the first holding plate 50a can be defined as a first cover member.

With particular reference to FIG. 2B and 2C, and FIG. 4 to aid understanding, in many embodiments, the first holding plate 50a includes a body 52a with a glass-facing surface 54a and an out-facing surface 56a (as particularly shown in FIG. 4), the glass-facing surface 54a and the out-facing surface 56a being on opposite sides of the first holding plate 50a. The glass-facing surface 54a is proximal the surface of the glass panels 15, and the out-facing surface 56a is distal the surface of the glass panels 15, when the single-axis securing unit 20a is coupled to the glass panels 15.

In addition, the first holding plate 50a includes a core structure 58a that is coupled to the glass-facing surface 54a thereof. In many embodiments, the core structure 58a is centrally disposed with respect to the first holding plate 50a (e.g., at the center of the glass-facing surface 54a). In numerous embodiments, the core structure 58a is an extension of the first holding plate 50a from the glass-facing surface 54a thereof.

In several embodiments, the core structure 58a is shaped and dimensioned for fitting into a receiving recession 60a formed by the two glass panels 15 as illustrated in FIG. 4. For example, where the two glass panels 15 provide a substantially circular receiving recession 60a, the core structure 58a of the first holding plate 50a has a substantially circular shape for shape-fitting through the receiving recession 60a formed by the two glass panels 15.

In numerous embodiments, the first core structure 58a includes a set of load distributor retaining structures, which can include a set of receptacles 62a. The receptacles 62a can be, for instance, openings, holes, depressions, cavities, or passages formed within the core structure 58a. In several embodiments, the set of receptacles 62a include two receptacles 62a, which are positioned or disposed at opposite sides of the core structure 58a.

Each receptacle 62a is shaped and dimensioned for receiving a rod 25, more specifically an end or extremity of the rod 25, therewithin. In some embodiments, the walls of the receptacle 62a are configured for facilitating or effectuating a secure fit or coupling with the rod 25. For example, where the end of the rod 25 has external threads (or male

threads), the receptacle 62a can include internal threads (or female threads) such that the external threads of the rods 25 fit-couple with the internal threads of the receptacle 62a to facilitate a secure coupling between the receptacle 62a and the rod 25.

The positioning of the receptacles 62a at opposite sides of the core structure 58a enables positioning of the rods 25 that are coupled thereto at least substantially along a single axis. For instance, the positioning of the receptacles 58a at opposite sides of the core structure 58a enables disposition of the rods 25 that are coupled thereto along a straight line.

In many embodiments, the single-axis securing unit 20a includes a second holding plate 64a. The second holding plate 64a is couplable to the first holding plate 50a, more specifically to the core structure 58a of the first holding plate 50a. In some embodiments, the second holding plate 64a can be defined as a second cover member.

Similar to the first holding plate 50a, the second holding plate 64a includes a body 66a with a glass-facing surface 68a and an out-facing surface 70a. The glass-facing surface 68a of the second holding plate 64a is proximal to the glass panels 15, and the out-facing surface 70a of the second holding plate 64a is distal to the glass panels 15, when the single-axis securing unit 20a is being coupled to the glass panels 15.

As illustrated in FIG. 2D to 2F, each of the body 52a of the first holding plate 50a and the body 66a of the second holding plate 64a can be of various shapes, for example circular, triangular, square, rectangular, pentagonal, or hexagonal in shape, for instance, depending on desired design of the glass façade system 10.

In many embodiments, the second holding plate 64a is shaped and configured for facilitating or effectuating secure coupling with the first holding plate 50a. In some embodiments, the second holding plate 64a includes a number of openings or holes 72a (e.g., one, two, three, four, five, or more holes) formed therein for allowing passage of one or more fasteners such as screws or bolts 74a, which are subsequently affixed to the core structure 58a of the first holding plate 50a.

In many embodiments, the glass panels 15 are disposed between the first and second holding plate 50a, 64a when the first holding plate 50a is coupled to the second holding plate 64a.

In some embodiments, the single-axis securing unit 20a includes a first gasket 76a (e.g., a first fiber gasket) that is disposable between the first holding plate 50a, more specifically the glass-facing surface 54a of the first holding plate 50a, and the glass panels 15. In several embodiments, the single-axis securing unit 20a further includes a second gasket 78a (e.g., a second fiber gasket) that is disposable between the second holding plate 64a, more specifically the glass-facing surface 68a of the second holding plate 64a, and the glass panels 15. In many embodiments, the first and second gaskets 76a, 78a are shaped and dimensioned for fitting around at least a portion of the core structure 58a of the first holding plate 50a. In some embodiments, the first and second gaskets 76a, 78a include, or define, an opening or hole formed therewithin through which the core structure 58a is able to fit.

A gasket is a generally defined as mechanical seal that fills a space between two mating surfaces (e.g., the glass-facing surface 54a of the first holding plate 50a and the glass panel 15 or the glass-facing surface 68a of the second holding plate 64a and the glass panel 15). A gasket helps to secure two mating surfaces together. In addition, a gasket often accommodates at least some thermal expansion of either of the two mating surfaces, as well as facilitates transfer of forces, tension, or stresses between the two mating surfaces. Generally, gaskets can be manufactured from sheet materials, for example fiberglass, plastic polymers, metal, gasket paper, rubber, and/or silicone.

Accordingly, in numerous embodiments, the first gasket 76a enhances coupling or mating between the first holding plate 50a and the glass panels 15, and the second gasket 78a enhances coupling or mating between the second holding plate 64a and the glass panels 15.

In many embodiments, when the single-axis securing unit 20a is secured to the glass panels 15 (i.e., disposed within the glass façade system 10), the body 52a of first holding

plate 50a is disposed at one side of the glass panels 15, or plane of the glass panels 15, while the body 66a of the second holding plate 64a is disposed at the other, or opposite, side of the glass panels 15, or plane of the glass panels 15. In numerous embodiments, each of the body 52a, 66a of the first and second holding plates 50a, 64a lies substantially parallel the plane of the glass panels 15. This is to say in many embodiments of the present disclosure, the bodies 52a, 66a of each of the first and second holding plates 50a, 64a are not disposed at an angle, or a substantive angle, relative the plane of the glass panels 15.

A single-axis securing unit 20a provided by particular embodiments of the present disclosure is detailed in the description provided above. However, as above-mentioned, the securing units 20 of particular glass façade systems 10 of the present disclosure can be of various different designs (e.g., size, shape, and/or configuration). For example, the securing unit 20 can alternatively be a dual-axis securing unit 20b.

FIG. 3A to 3F, as well as FIG. 5, show particular dual-axis securing units 20b, and aspects thereof, as provided by various embodiments of the present disclosure.

In many embodiments of the present disclosure, the dual-axis securing unit 20b is couplable to four glass panels 15. In many embodiments, the dual-axis securing unit 20b is further couplable to a number of load distributors. The load distributors connected to the dual-axis securing unit 20b are disposed along two axes, more specifically along a first axis (e.g., an X-axis or a first spatial direction) and a second axis (e.g., a Y-axis or a second spatial direction) along the plane of the glass panels 15, for instance in a manner indicated in FIG. 3A. In addition, the load distributors are disposed between the glass panels 15, more specifically between the edges of the glass panels 15.

In many embodiments, the dual-axis securing unit 20b receives two rods 25 and a cable 30. In several embodiments, the cable 30 is disposed along the first axis (e.g., X-axis) and the rods 25 are disposed along the second axis (e.g., Y-axis). However, in other embodiments, the cable 30 can be disposed along the Y-axis and the rods 25 can be disposed along the X-axis. In many embodiments, the rods 25 and/or cable 30 are

disposed at least substantially, or even entirely, within the plane of the glass panels 15. In other embodiments, the rods 25 and/or cable 30 can extend somewhat or slightly beyond the plane of the glass panels 15.

The dual-axis securing unit 20b includes a number of components or elements that are couplable to each other. In many embodiments, the dual-axis securing unit 20b includes a first holding or clamping plate 50b. The first holding plate 50b can also be referred to as a front holding or clamping plate. In some embodiments, the first holding plate 50b can be defined as a first cover member.

In many embodiments, the first holding plate 50b includes a body 52b with a glass-facing surface 54b and an out-facing surface 56b, the glass-facing surface 54b and the out-facing surface 56b being on opposite sides of the first holding plate 50b. The glass-facing surface 54b is proximal to the glass panels 15, and the out-facing surface is distal to the glass panels 15, when the dual-axis securing unit 20b is coupled to the glass panels 15.

In many embodiments, the first holding plate 50b includes a core structure 58b that is coupled to a center of the glass-facing surface 54b. The core structure 58b is shaped and dimensioned for shape-fitting into a receiving recession 60b formed or created by four glass panels 15, more specifically by a corner of each of the four glass panels 15. For example, as more clearly illustrated in FIG. 5, each of the four glass panels 15 contributes to a curved-square shaped receiving recession 60b for receiving the core structure 58b therewithin.

The core structure 58b of the first holding plate 50b of the dual-axis securing unit 20b includes a plurality of load distributor retaining structures, which are shaped and dimensioned for receiving the rods 25 and cable 30, and disposing the rods 25 and cable 30 along each of the two axes (e.g., the Y-axis and the X-axis respectively). In some embodiments, plurality of load distributor retaining structures carried by the core structure 58b includes a set of receptacles 62b for receiving the rods 25, more specifically the extremities or ends of the rods 25, and a channel 85 or passage for receiving the cable 30, more specifically a length of the cable 30.

In many embodiments, the set of receptacles 62b of the core structure 58b of the dual-axis securing unit 20b is similar to the set of receptacles 62a of the core structure 58a of the single-axis securing unit 20a. For instance, the set of receptacles 62b of the core 58b structure of the dual-axis securing unit 20b can be openings, holes, depressions, cavities, or passages formed within the core structure 58b. In addition, in many embodiments, the set of receptacles 62b includes two receptacles 62b that are positioned at opposite sides of the core structure 58b for disposing the rods 25 coupled thereto at least substantially along a single axis (e.g., the second axis or Y-axis).

In many embodiments, the channel 85 of the core structure 58b is substantially perpendicular a length of the receptacles 62b (e.g., a length of the passages). In some embodiments, the channel 85 of the core structure 58b is in the form of a trough, a recess, or an elongated depression.

In many embodiments, the dual-axis securing unit 20b further includes a cable clamp 87 (also known as a cable anchor, a cable retainer, or a cable fastener). The cable clamp 87 can be coupled or secured to the core structure 58b of the first holding plate 50b. In numerous embodiments, the cable clamp 87 can be secured to the core structure 58b with the use of a number of interconnecting, securing, or fastening tools, for example fasteners such as screws and/or bolts 74b. In some embodiments, the cable clamp 87 includes a number of holes 91 through which the screws and/or bolts 74b are inserted for subsequent affixing, or securing, to the core structure 58b.

In many embodiments, the cable clamp 87 facilitates or effectuates clamping, holding, or securing of the length of the cable 30 to the core structure 58b of the first holding plate 50b. In many embodiments, the length of the cable 30 is disposed or secured between the core structure 58b and the cable clamp 85.

In many embodiments, the cable clamp 87 includes a channel 85 disposed along the middle thereof. In many embodiments, the channels 85 of the core structure 58b and the cable clamp 87 are shaped and dimensioned for shape-fitting about the length of the cable 30. In some embodiments, the channel 85 of the cable clamp 87 is a trough or elongated

depression, similar to that carried by the core structure 58b. Accordingly, in some embodiments, the channel 85 of the core structure 58b together with the channel 85 of the cable clamp 87 forms a complete passageway within which the length of the cable 30 is accommodated. For instance, as more clearly illustrated in FIG. 5, each of the channels 85 of the core structure 58b and the cable clamp 87 creates a semi-circular trough which, when placed adjacent each other, form a complete substantially circular passageway within which the length of the cable 30 can be accommodated.

In many embodiments, the dual-axis securing unit 20b further includes a second holding plate 64b. In some embodiments, the second holding plate 64b can be defined as a second cover member. The second holding plate 64b is couplable to the first holding plate 50b, more specifically to the core structure 58b of the first holding plate 50b. Similar to the first holding plate 50b, the second holding plate 64b includes a body 66b with a glass-facing 68b surface and an out-facing surface 70b. The glass-facing surface 68b of the second holding plate 64b is proximal the glass panels 15, and the out-facing surface 70b of the second holding plate 64b is distal the glass panels 15, when the dual-axis securing unit 20b is coupled to the glass panels 15.

The first and second holding plates 50a and 64a of the single-axis securing unit 20a, as well as the first and second holding plates 50b and 64b of the dual-axis securing unit 20b can be of various shapes, for example a circle, oval, triangle, square, rectangle, hexagon, or pentagon, for instance depending upon a desired design of the glass façade system 10.

FIG. 2B and FIG. 3B show, respectively, the single-axis securing unit 20a and the dual-axis securing unit 20b having plates (50a, 50b, 64a, 64b) that are circular in shape. FIG. 2D and FIG. 3D show, respectively, the single-axis securing unit 20a and the dual-axis securing unit 20b having plates (50a, 50b, 64a, 64b) that are square in shape. FIG. 2E and FIG. 3E show, respectively, the single-axis securing unit 20a and the dual-axis securing unit 20b having plates (50a, 50b, 64a, 64b) that have a diamond shape. In addition, FIG. 2F and FIG. 3F show, respectively, the single-axis securing unit 20a and the dual-axis securing unit 20b having plates (50a, 50b, 64a, 64b) that have a pentagonal shape.

In many embodiments, the second holding plate 64b is shaped and configured for facilitating or effectuating secure coupling with the first holding plate 50b. In some embodiments, the second holding plate 64b includes a number of openings or holes 72b (e.g., one, two, three, four, five, or more holes) formed therein for allowing passage of screws or bolts 74b, which are subsequently affixed within the core structure 58b of the first holding plate 50b.

In many embodiments, the four glass panels 15, or at least portions of each of the four glass panels 15, are disposed between the first and second holding plates 50b, 64b when the first holding plate 50b is coupled to the second holding plate 64b.

In some embodiments, the dual-axis securing unit 20b includes a first gasket 76b (e.g., a first fiber gasket) that is disposable between the first holding plate 50b, more specifically the glass-facing surface 54b of the first holding plate 50b, and the glass panels 15. In several embodiments, the dual-axis securing unit 20b further includes a second gasket 78b (e.g., a second fiber gasket) that is disposable between the second holding plate 64b, more specifically the glass-facing surface 68b of the second holding plate 64b, and the glass panels 15. In numerous embodiments, the first gasket 76b enhances coupling or mating between the first holding plate 50b and the glass panels 15, and the second gasket 78b enhances coupling or mating between the second holding plate 64b and the glass panels 15.

In many embodiments, when the dual-axis securing unit 20b is secured to the glass panels 15 (i.e., disposed within the glass façade system 10), the body 52b of first holding plate 50b is disposed at one side of the glass panels 15, or plane of the glass panels 15, while the body 66b of the second holding plate 64b is disposed at the other, or opposite, side of the glass panels 15, or plane of the glass panels 15. In numerous embodiments, each of the bodies 52b, 66b of the first and second holding plates 50b, 64b lies substantially parallel the plane of the glass panels 15. This is to say, the bodies 52b, 66b of the each of the first and second holding plates 50b, 64b do not project, or substantially project, from the glass panels 15 at an angle thereto.

Although the dual-axis securing unit 20b as described above, is disclosed to receive two rods 25 and one cable 30, it will be understood by a person of ordinary skill in the art that the dual-axis securing unit 20b, more specifically the core structure 58b of the first holding plate 50b, can be alternatively shaped and configured for receiving four rods 25, for instance, two rods 25 that are disposed relative to angles along the first axis (e.g., X-axis), and two rods 25 that are disposed relative to angles along the second axis (e.g., Y-axis). In such a configuration, the core structure 58b includes two sets of receptacles 62b, each set including two receptacles 62b, for receiving the rods 25 therewithin.

In addition, it will be understood by a person of ordinary skill in the art that the dual-axis securing unit 20b, more specifically the core structure 58b of the first holding plate 50b, can be alternatively shaped and configured for receiving three rods 25, one rod 25 being disposed in either the first or second axis (e.g., X- or Y-axis), and the other two rods 25 being disposed in the other of the first and second axis (e.g., X- or Y- axis). In selected embodiments, the securing unit 20b can be adapted for accommodating other numbers of rods 25, for example three, five, six, seven, eight or more rods 25, each rod 25 being disposed relative to angles along one of the first and second axis (e.g., X- or Y- axis).

For instance, in some embodiments, securing units 20 used with the glass façade system 10c as shown in FIG. 1C can include six receptacles 62 for receiving, or coupling to, six rods 25. In several embodiments, the six receptacles 62 are positioned at fixed and/or regular angles relative to each other in order to dispose the rods 25 that are coupled thereto at corresponding angles relative to each other along the X- and Y-axis at least substantially within the plane of the glass panels 15.

In other embodiments, the securing units 20 that are used with the glass façade system 10c of FIG. 1c can be alternatively shaped and configured to receive both rods 25 and cables 30. For instance, in selected embodiments, the securing unit 20 can include four receptacles 62 for receiving, or coupling to, four rods 25, and a channel 85 for receiving, or coupling to, a cable 30. In selected embodiments, the four receptacles 62 are positioned at fixed angles relative to each other for disposing the rods 25 that are coupled thereto at corresponding angles along the Y-axis. In addition, the channel 85 is positioned

substantially along the X-axis for disposing the cable 30 coupled thereto substantially along the X-axis. In various embodiments, the rods 25 and cables 30 are disposed at least substantially within the plane of the glass panels 15.

In many embodiments, the single-axis securing unit 20a and the dual-axis securing unit 20b enable the load distributors such as the rods 25 and/or cables 30 (which are support structures) to be disposed substantially within, or even entirely within, the plane of the glass panels 15. The disposition of load distributors within the plane of the glass panels 15, for example between the glass panels 15, eliminates or removes the need for support structures that project or extend at an angle relative the plane of the glass panels 15 of the glass façade system 10. Removing the need for support structures that project or extend at an angle relative the plane of the glass panels 15 can help maximize available internal floor space or floor area, thereby increasing useful and/or leasable floor space.

The ability to position the load distributors or support structures at least substantially, or even entirely, within the plane of the glass panels 15 (i.e., to integrate the load distributors or support structures within the glass façade system 10), as provided by various embodiments of the present disclosure, facilitates construction of glass façade systems 10 of at least substantially smooth interior and exterior surfaces. Such smooth interior and exterior surfaces of glass façade systems 10 can be aesthetically or architecturally advantageous. The disposition of load distributors or support structures at least substantially, or even entirely, within the plane of the glass panels 15 increases the design or architectural options for a building's façade.

The glass façade systems 10 of many embodiments of the present disclosure can be integrated or incorporated into a portion of a building's structure, such as an overall façade of a building. In many embodiments, the glass façade system 10 can be mounted, secured, attached, fixed, or coupled to a building's support or sub-support structure (e.g., base, ceiling, walls, side, and pillars).

In many embodiments, the glass façade system 10 is mounted, secured, fixed, attached, or coupled to the building's support or sub-support structure via the rods 25 and/or the

cables 30 of the glass façade system 10. This is to say fixing or attaching of the rods 25 and/or the cables 30 to the building's support or sub-support structure facilitates or effectuates the incorporation of the glass façade system 10 to the building's overall façade.

FIG. 6A and FIG. 6B illustrate aspects of the attachment or fixing of a rod 25 to a building's support or sub-support structure (e.g., a base structure, wall, or ceiling) according to an embodiment of the present disclosure. More specifically, FIG. 6A and FIG. 6B show the attachment of a rod 25 to a ceiling, or base, of a building.

As shown in FIG. 6A and 6B, the rod 25 is attached to the building's support or sub-support structure via, or with the aid of, structural steel components.

Structural steel is a steel construction material that is commonly used in the construction industry (e.g., for constructing building or building facades). Different structural steel components or structures have specific shapes or cross-sections, as well as standards of chemical composition and strength. Structural steel shape, size, composition, strength, storage, etc, is regulated in most industrialized countries.

In many embodiments, the rod 25 is attached to the building's support structure via, or with the use of, several structural steel components or structures, for instance galvanized MS (i.e., mild steel) angle(s) 105, steel I-beam(s) 110, and/or galvanized MS stiffener plate(s) 115.

Galvanized MS steel angles 105 are pieces of metal with an L-shaped cross section or angle. Steel I-beams 110 (also known as H-beams, W-beams, rolled steel joist, or double T) are beams with an I- or H- shaped cross-section. The horizontal elements of the I-beams 110 are flanges, while the vertical element of the I-beam is the web. The Euler-Bernoulli beam equation has indicated that I-beams 110 can be very efficient in carrying both bending and shear (which are types of forces or stresses) in the plane of the web. I-beams 110 are commonly utilized in the construction industry and are available in a variety of standard sizes. Steel stiffener plates, for example galvanized MS stiffener

plates 115, when coupled to I-beams 110 can help to maintain the structural integrity of the I-beams 110 (e.g., provide an anti-buckling function).

In some embodiments, the steel I-beams 110 are attached or coupled to the building's support or sub-support structure, and can be considered to be integral to the building's support or sub-support structure. An outermost edge of the glass façade system 10 (e.g., a top perimeter of the glass panels 15) is disposed adjacent to the I-beams 110. In several embodiments, the outermost edge of the glass façade system 10 is aligned at least substantially parallel to the flanges of the I-beams 110. This is to say the edges of the glass panels 15 along a side of the top perimeter of the glass façade system 10 is aligned at least substantially parallel to the flanges of the I-beams 110.

In numerous embodiments, galvanized MS angles 105 are disposed on either sides of the glass façade system 10, or glass panels 15, that is disposed directly adjacent the I-beams 110. The galvanized MS angles 105 are attached or fixed to the I-beams 110, more specifically the outer surfaces of the flanges of the I-beams 110. In several embodiments, weather proof sealant 125 is used for sealing spaces between the glass façade system 10, or glass panels 15, and the galvanized MS angles 105 that are disposed on either sides thereof.

In many embodiments, the rod 25 of the glass façade system 10 extends at least some distance beyond the outermost edges of the glass panels 15, i.e., beyond the outer perimeter of the glass façade system 10 as defined by edges of the glass panels 15. In many embodiments, the rod 25, more specifically the end or extremity of the rod 25, is inserted through the flange of the I-beam 110 into the space therewithin. This is to say, the flange of the I-beam 110 includes a hole(s) that is shaped and dimensioned for allowing insertion of the rod therethrough and access into the interior space of the I-beam 110. In many embodiments, a number of fastening units, more specifically nuts 130, are attached or secured to the rod 25 within the interior space of the I-beam 110 to thereby facilitate or effectuate securement of the rod 25 to the I-beam 110, and hence to the building's support structure (e.g., ceiling). The nuts 130 are shaped and dimensioned to

tightly fit around the rod 25 (which can be seen as a bolt) to facilitate or effectuate securing of the rod 25 to the I-beam 110.

In numerous embodiments, there are multiple rods 25 extending from the top of the glass façade system 10 (i.e., from the top edge or perimeter of the glass façade system 10). In several embodiments, each of the multiple rods 25 is received within a corresponding hole within the flanges of the I-beams 110 fixed or coupled to the building's support structure (e.g., ceiling), and is secured thereat with the use of nut(s) 130.

Although particular means, mechanisms, structures, and/or components, by which the rod(s) 25 can be secured to a building's support structure are disclosed above, a person of ordinary skill in the art will understand that other means, mechanisms, structures, and/or components, can also be applied for securing the rod(s) 25 to a building's support structure, and hence securing the glass façade system 10 to the building's support structure. In addition, a person of ordinary skill in the art, with the present disclosure, will be able to alter or adapt the various steel components in association with securing of a particular glass façade system 10 to a building's support or sub-support structure within the scope of the present disclosure.

The glass façade system 10 provided by particular embodiments of the present disclosure can additionally or alternatively be secured to a building's support or sub-support structure via the cables 30. FIG. 7A and 7B illustrate the attachment of a cable 30 to a building's support or sub-support structure, more specifically to a wall or pillar of the building.

As shown in FIG. 7A and 7B, the cable 30, more specifically an end or extremity of the cable 30, is attached to the wall of the building via, or with the aid of, several structural steel components. In some embodiments, the structural steel components aiding the attachment of the cable 30 to the wall of the building include galvanized MS angle(s) 105, steel I-beam(s) 110, galvanized MS stiffener plate(s) 115, galvanized MS plates 145, plain washer(s) 135, and/or spring washer(s) 140.

Generally, a washer is a thin plate structure with a hole typically in the middle, which can be used to distribute the load of component(s) coupled thereto. Washers are generally made of metal or plastic. Spring washers are washers that have spring association properties or functions. Generally, spring washers can be used to apply a pre-load or pre-tension to a component (e.g., a cable) that is coupled thereto, as well as for providing a flexible quality to a bolted joint. Spring washers are commonly used for securing or locking a joint that experiences a significant amount of thermal expansion and contraction.

In numerous embodiments, the I-beam 110 is securely attached to the wall of the building, and can be considered to be an integral part of the building's support or sub-support structure. The galvanized MS stiffener plate 115 is coupled or attached to the I-beam 110 for providing structural strength to the I-beam 110. For instance, the attachment of the galvanized MS stiffener plate 115 to the I-beam 110 can help to maintain the structural integrity of the I beam 110 (e.g., provide anti-bucking support to the I-beam 110).

In several embodiments, the galvanized MS plate 145 is attached to the web of the I-beam 110. More specifically, the galvanized MS plate 145 is disposed within the interior space of the I-beam 110, and positioned parallel the flanges of the I-beam 110.

In many embodiments, an outermost edge of the glass façade system 10 (e.g., a side perimeter of the glass façade system 10) is disposed adjacent the I-beam 110 attached to the wall of the building. In several embodiments, the outermost edge of glass façade system 10 or the side perimeter of the glass façade system 10 is aligned at least substantially parallel the flange of the I-beam 110 attached to the wall of the building.

The galvanized MS angles 105 are attached or coupled to the I-beam 110, more specifically the exterior surface of the flange of the I-beam 110. In several embodiments, weather-proof sealant 125 is used for sealing spaces between the glass façade system 10, or glass panels 15, and the galvanized MS angles 105 that are disposed on both sides thereof.

In numerous embodiments, the galvanized MS angles 105 are disposed on either sides of the outermost edges of the glass façade system 10, or glass panels 15, directly adjacent the I-beam 110.

In many embodiments, the cable 30 extends beyond the outermost edges of the glass façade system 10, i.e., beyond the side perimeter of the glass façade system 10. In many embodiments, the cable 30 is inserted through the flange of the I-beam 110 into the space defined therewithin. The flange of the I-beam 110 includes an opening or a hole that is shaped and dimensioned for allowing the insertion or passage of the cable 30 therethrough.

In addition, in many embodiments, the cable 30, more specifically the end thereof, is further inserted through the galvanized MS plate 145 that is disposed within the interior space of the I-beam 110. Accordingly, the galvanized MS plate 145 includes an opening or a hole shaped and dimensioned for allowing insertion or passage of the cable 30 therethrough.

In numerous embodiments, the plain washer(s) 135 and the spring washer(s) 140 are carried by the cable 30 and disposed between the galvanized MS plate 145 and the flange of the I-beam 110 through which the cable 30 is inserted. In several embodiments, the plain washer(s) 135 and the spring washer(s) 140 are shaped and dimensioned for fit coupling to the cable 30 (e.g., to fit securely around the cable). In several embodiments, the spring washer(s) 140 facilitates or effectuates pre-tensioning of the cable 30.

In many embodiments, a number of fastening units, more specifically nuts 130, are attached or secured to the cable 30 within the interior space of the I-beam 110 to thereby facilitate or effectuate securement of the cable 30 to the I-beam 110 that is attached to the wall of the building. In several embodiments, the nuts 130 are shaped and dimensioned to fit tightly around the cable 30 (which can be seen as a bolt) so as to secure the cable 30 to the I-beam 110.

In many embodiments, there are multiple cables 30 (e.g., at least two, five, ten, twenty, thirty, forty, fifty, or one hundred cables 30) extending from the side perimeter of the glass façade system 10 (i.e., at the side of the glass façade system 10 between the top and the bottom thereof). In several embodiments, each of the multiple cables 30 is received within a corresponding hole within the flanges of the I-beams 110 that are coupled to the building's wall. In addition, each of the multiple cables 30 are secured to the I-beams 110, and hence to the building's wall, with the use of tightly fitting nuts 130.

Although particular means, mechanisms, structures, and/or components, by which the cables 30 can be secured to a building's support structure are disclosed above, a person of ordinary skill in the art will understand that other means, mechanisms, structures, and/or components, can also be applied for securing the cables 30 to a building's support structure, and correspondingly for securing the glass façade system 10 to the building's support structure.

In several embodiments of the present disclosure, the glass façade system 10 can be integrated or incorporated into am architectural feature or building's overall structure (e.g., support or sub-support structure). The integration of the glass façade system 10 into a building's overall structure is facilitated or mediated by fixing of the support structures (or load distributors), more specifically the rods 25 and cables 30, to the building's support or sub-support structures (e.g., base, ceilings, pillar, and walls).

The support structures of the glass façade system 10 (e.g., rods 25 and/or cables 30) of many embodiments of the present disclosure are interconnected or coupled with the use of securing units 20. In many embodiments, the receptacles 62 of the core structure 52 are placed opposite each other such that the rods 25 that are coupled thereto are arranged in a substantially straight line. In several embodiments, the rods 25 of the glass façade system 10 are disposed parallel each other.

In numerous embodiments, particularly where the glass façade system 10 includes dual-axis securing units 20b, a longitudinal length of the receptacles 62b and a longitudinal length of the channel 85 are substantially perpendicular to each other. Accordingly, the

rods 25 and/or the cable 30 that are coupled to the securing unit 20b, more specifically the receptacles 62b and the channels 85 respectively, are disposed substantially perpendicular to each other.

Components of the support structure of particular glass façade systems 10 of the present disclosure are arranged in a substantially grid-like design when integrated within a building's structure.

In many embodiments, the glass panels 15 are coupled to the rods 25 and/or the cables 30 via the securing unit 20. More specifically, in numerous embodiments, the glass panels 15 of the glass façade system 10 is disposed such that each edges of each glass panel 15 is aligned with at least one rod 25 and/or at least one cable 30. For instance, in some embodiments, the vertical edges of the glass panels 15 are aligned parallel the rods 25, and the horizontal edges of the glass panels 15 are aligned parallel the cables 30.

In numerous embodiments, each edge of each glass panels 15 is adjacent, and even in contact with at least one rod 25 and/or at least one cable 30. In many embodiments, forces, loads, tensions, and/or stresses applied onto the glass panel(s) 15 can be transferred to the rods 25 and/or cables 30 that are placed adjacent, and/or in contact, therewith. In several embodiments, forces, loads, tensions, and/or stresses applied onto the glass panel(s) 15 can be transferred to the rods 25 and/or cables 30 via the interconnecting securing units 20.

Consequently, the forces, loads, tensions, and/or stresses are then carried, accommodated, and/or distributed, along the rods 25 and/or cables 30. In many embodiments, when the glass façade system is integrated into the building's structure (e.g., support or sub-support structure), the forces, loads, tensions, and/or stresses are then carried, accommodated, and/or distributed, along the rods 25 and/or cables 30 for transfer to the building's structure.

FIG. 8 shows representative force, load, tension, stress (hereinafter generally referred to as load) distribution capacities of a load distribution network of a glass façade system 10

(or an architectural façade system) configured in accordance with an embodiment of the present disclosure.

In most embodiments, the load distribution network is configured to distribute forces applied to or upon a plurality of glass panels 15 (which can be configured as an array of architectural façade panels, a façade panel array, or a panel array) that are coupled thereto. In many embodiments, the load distribution network represents the support structure, or support network, of the glass façade system 10.

In many embodiments, the load distribution network includes a set of force distribution elements that can be coupled to the glass panels 15. The set of force distribution elements includes a collection, or set, of load distributors or load distributing elements (e.g., rods 25 and/or cables 30) and a collection, or set, of load distribution nodes (e.g., securing units 20). The load distributors of the load distribution network are coupled or interconnected to each other by way of the securing units 20.

As previously described, each glass panel 15 (or architectural façade panel) has a width, a height, a first surface (or first outer surface), a second surface (or second outer surface), and a thickness defined between the first and second surfaces. In numerous embodiments, each load distributor within the collection, or set, of load distributors is disposed along one of the width and height of a glass panel 15 (e.g., defined by an X-axis or a first spatial direction, and a Y-axis or second spatial direction, respectively), and at least substantially within the thickness of the glass panel 15 (e.g., defined by a Z-axis or third spatial direction that is transverse to the X and Y axes). In several embodiments, each load distributor within the collection, or set, of load distributors and each load distribution node is disposed between adjacent glass panels 15.

In many embodiments, the load distribution network substantially excludes force distribution elements (e.g., securing units 20, rods 25 and/or cables 30) that extend substantially beyond each of the first surface and the second surface of the glass panel 15. More specifically, in many embodiments, the load distribution network substantially excludes force distribution elements (e.g., rods 25 and/or cables 30) that extend more

than approximately 15mm to 25mm from each of the first surface and the second surface of the glass panel 15. In numerous embodiments, the load distribution network substantially excludes force distribution elements that extend more than approximately 10mm from each of the first surface and the second surface of the glass panel 15. In several embodiments, the force distribution elements extend between approximately 0mm and 5mm from each of the first surface and the second surface of the glass panel 15. In selected embodiments, the force distribution elements extend between approximately 0mm and 2mm from each of the first surface and the second surface of the glass panel 15.

In some embodiments, the load distribution network includes a set of peripheral support structures coupled to the load distributors and/or load distribution nodes. In several embodiments, each peripheral support structure within the set of peripheral support structures is disposed external the façade panel array. In selected embodiments, each peripheral support structure within the set of peripheral support structures is disposed adjacent the façade panel array. A peripheral support structure can be, or include, for instance, a portion of a building's support or sub-support structure.

In the representative embodiment as shown in FIG. 8, the glass façade system 10, more specifically the façade panel array of the glass façade system 10, has a width of approximately 8meters and a height of approximately 7.5 meters. In addition, each glass panel 15 of the glass façade system 10 as shown in FIG. 8 has a width of approximately 1.6meters and a height of approximately 2.5meters. In addition, each glass panel has a thickness of approximately 17.52millimeters (mm), and includes two 8mm-thick clear tempered glass panels with a 1.52mm thick PVB interlayer disposed therebetween. In selected embodiments, the mass of the glass façade system 10 shown in FIG. 8 is $40kg/m^2$.

FIG. 8 also provides data representing particular imposed loads and reaction loads along the load distributors, more specifically rods 25 and cables 30, and at the interface between the load distributors and the building structure, under a deadload of approximately 1.4 kilonewton (kn) and a windload of approximately 1.4 kn.

The representative values of the imposed and reaction loads shown in FIG. 8 correspond to quantity of load or force distributed and/or transferred along the load distributors, more specifically the rods 25 and cables 30 with respect to the securing units 20 to which they are coupled, and subsequently at the building's structure (e.g., support structure such as the base, walls, pillars, and/or ceiling).

Although representative imposed and reaction loads are illustrated in FIG. 8, a person of ordinary skill in the art will understand the imposed and/or reaction loads can vary depending upon a variety of factors. For instance, the imposed loads to a building's structure can vary depending on size of individual glass panels 15 as well as size and/or location of overall glass façade system 10 to be integrated thereinto. In addition, a change of the deadload and/or windload will necessitate an alteration of the imposed and reaction loads of the load distributors.

In many embodiments of the present disclosure, the load distributors, more specifically the rods 25 and/or cables 30 can be designed and/or constructed as desired, for instance in a manner so as to enable the glass façade system 10 to withstand a specific amount of windload and/or deadload. In several embodiments, the tension or pre-tension applied to the rods 25 and/or cables 30 when the glass façade system 10 is mounted or integrated into a building's structure can be varied, for instance in order to enable the glass façade system 10 to withstand a specific amount of windload and/or deadload.

Processes for assembling or constructing particular glass façade systems 10 are provided by embodiments of the present disclosure. Although the following description of the processes are primarily for the assembly or construction of particular glass façade systems 10 provided by embodiments of the present disclosure, a person of ordinary skill in the art will understand that the processes, or particular process portions thereof, can also be applied for assembling or constructing glazing façade systems 10 or glass façade systems 10 that are not presently described, within the scope of the present disclosure.

A process 200 for assembling a glass façade system 10 is provided in accordance with an embodiment of the present disclosure. A flowchart of the process 200 is shown in FIG. 9.

For purposes of brevity and clarity, the process 200 will be described in association with the assembling of the glass façade system 10a as shown in FIG. 1A. This is to say, the process 200 facilitates or effectuates assembling or construction of glass façade systems 10a that include both rods 25 and cables 30, as well as securing units 20 of at least two different designs.

A first process portion 210 of the process 200 involves the assembling of support structures or load distributors. More specifically, the first process portion involves assembling or interconnecting of rods 25 and cables 30 of the glass façade system 10a.

In most embodiments of the present disclosure, the support structures are assembled with the use of the securing units 20, more specifically with the use of the first holding plates 50 and the cable clamps 87 of the securing units 20.

As above described, the core structure 58 of each securing unit 20 is shaped, dimensioned, and/or configured for receiving two rods 25, and a cable. This is to say, each securing unit 20 is shaped, dimensioned, and/or configured for interconnecting two rods 25 and a cable 30.

As previously described, the receptacles 62 of the core structures 58 are disposed on opposite sides of the core structures 58 for disposing the rods 25 that are coupled thereto along a single axis (e.g., Y-axis), more specifically along a straight line or a single direction. In some embodiments, the rods 25 are snap fitted into the receptacles 62. In other embodiments, the rods 25 are screwed into the receptacles 62. Alternatively, it will be understood by a person of ordinary skill in the art that the rods 25 can be coupled to the receptacles 62 using other coupling means, techniques, or methods known in the art.

In many embodiments, the securing units 20, more specifically the first holding plates 50 and the cable clamps 85 of the securing units 20, are disposed at ordered intervals along the cable 30. In many embodiments, the cable clamps 87 are secured to the core structures 58 with the use of securing or fastening tools, for example screws and/or bolts. The securing of the cable clamp 85 to the core structure 58 of the first holding plate 50

couples the core structure 58 of the first holding plate 50, and the two rods 25 that are coupled to the set of receptacles 62, with the cable 30.

The interconnection of the rods 25 and cables 30 by way of the securing units 20, more specifically first holding plate 50 and the cable clamp 85 of the securing units 20, disposes the rods 25 and cables 30 substantially perpendicular to one another. In most embodiments of the present disclosure, the arrangement of securing units 20, more specifically the arrangement of the first holding plate 50 and the cable clamp 87 of the securing units 20, can be varied as desired for varying an end arrangement or configuration of the assembled support structure or load distributors (e.g., rods 25 and cables 30).

A second process portion 220 of the process 200 involves the mounting, attaching, or fixing of the assembled, or partially assembled, support structure, to the building's support or sub-support structure.

In many embodiments of the present disclosure, the rods 25 are secured or fixed to the ceilings and base of the building, and the cables 30 are secured or fixed to the walls of the buildings. However, it will be understood by a person of ordinary skill in the art, with the present disclosure, that the rods 25 and cables 30 can be fixed or coupled to alternative support or sub-support structures of the building, within the scope of the present disclosure. For instance, a person of ordinary skill in the art will understand, with the present disclosure, that the rods 25 can alternatively be fixed to the walls and/or pillars of the building, and the cables 30 can alternatively be fixed to the base and/or ceiling of the building, within the scope of the present disclosure.

In several embodiments, securing of the support structure to the building's support or sub-support structure involves the securing or fixing of the rods 25 and cables 30 to the I-beams 110 that are attached to, or integrated within, the building's support or sub-support structure, more specifically the building's walls, pillars, ceilings, and/or base.

In some embodiments, the rods 25 and/or cables 30 are pre-tensioned or pre-stressed to a specified tension as desired, for instance in order to withstand or accommodate a

particular force without incurring structural damage or deformation thereto. In some embodiments, the tension to which the rods 25 and/or cables 30 are pre-stressed depends on the loading of the glass façade system 10a, overall size of the glass façade system 10a, and/or thickness of the glass façade system 10a.

In a third process portion 230 of the process 200, glass panels 15 are attached or coupled to the assembled and mounted support structure. In many embodiments, the glass panels 15 are shaped and dimensioned for fitting into, or with, the support structure. In many embodiments, the edges and/or corners of the glass panels 15 are shaped and dimensioned for fitting around or about the core structures of the first holding plates 50 that are coupled to the support structures (i.e., the rods 25 and cables 30).

In many embodiments, the attachment of the glass panels 15 to the support structure in the third process portion 230 involves coupling of the first gasket to the first holding plate 50, more specifically the glass-facing surface 54 of the first holding plate 50. The first gasket 76 is disposed between the first holding plate 50 and the glass panels 15.

A fourth process portion 240 involves securing or attaching of the second holding plates 64 to the first holding plates 50, more specifically to the core structures 58 of the first holding plate 50 to thereby secure the glass panels 15 to the support structures. As above described, the second holding plate 64 can be secured to the core structure 58 with the use of one or more fastening units, for example screws and/or bolts. In several embodiments, the use of screws and/or bolts facilitates or effectuates tighter or securer coupling of the securing unit to the glass panels 15.

In numerous embodiments, the fourth process portion 240 involves disposing the second gasket 78 between the glass panels 15 and the second holding plates 64, more specifically the glass-facing surface 68 of the second holding plates 64.

Control and adjustment of tension within the rods 25 and/or cables 30 can be performed during each of the process portions 230 and 240 as desired, for example depending upon the loading of the glass façade system 10A at a given time, environmental conditions,

and/or one of size, shape, and dimensions of the glass panels 15 being attached to the support structure.

In a fifth process portion 250, a sealant is applied for covering the rods 25 and/or cables 30 that are disposed between the adjacent glass panels 15.

A sealant is a viscous material that changes state to become a solid when applied. Sealants generally has three basic functions, namely for filling gaps between two or more substrates; forming a barrier to access of a particular substrate; and providing sealing properties for a particular substrate. Sealants are commonly used for preventing penetration of air, gas, liquid, dust, and/or smoke between two adjacent spaces.

In many embodiments of the present disclosure, the application of sealant onto the rods 25 and/or cables 30 disposed between adjacent glass panels 15 (i.e., at joints between the glass panels 15) helps to hide or obscure the rods 25 and/or cables 30 from view. In addition, the sealant can function as a barrier to access, thereby preventing gas, liquid, or air from contacting the rods 25 and/or sealants. Examples of sealants used in the present disclosure include, but are not limited to, silicon sealants, rubber sealants, and plastic sealants.

Although the process portions 210 to 250 as described above are numbered as such, and are arranged in the above manner, a person of ordinary skill in the art, with the present disclosure, will understand that the ordering of the process portions 210 to 250 can be altered as desired, within the scope of the present disclosure. For example, at least one, even several, glass panels 15 can be attached and/or secured to the support structures (i.e., the rods 25 and cables 30) before fixing the support structures to the building's support or sub-support structure.

As above-mentioned, the process 200 is primarily performed in association with the assembling of particular glass façade systems 10, more specifically the glass façade system 10a as shown in FIG. 1A. However, a person of ordinary skill in the art will understand that the process 200, and/or one or more process portions thereof (i.e., one or

more of process portions 210 to 250) can be modified as required for assembling other glass façade systems 10 in accordance with the present disclosure, for instance the glass façade systems 10a and 10c shown in FIG. 1B or FIG. 1C, within the scope of the present disclosure.

For instance, in some embodiments, the assembling of the support structures performed in the process portion 210 can be modified for assembling the glass façade system 10b as shown in FIG. 1B.

The glass façade system 10b as shown in FIG. 1B includes securing units 20 of one similar design, more specifically the securing unit 20a as shown in FIG. 2A to FIG. 2F, and FIG. 4. The securing units 20a of said glass façade system 10b are for interconnecting rods 25 along a single axis (e.g., Y-axis). More specifically, the receptacles formed in the core structures of the securing units 20a of said glass façade system 10b disposes the rods 25 that are coupled thereto along a single axis or Y-axis along the plane of the glass panels 15. Accordingly, in a process for assembling of the glass facade system 10b as shown in FIG. 1B, the process portion 210 (i.e., assembling of the support structure) will result in an assembly of rods 25 along parallel Y-axes with single-axis securing units 20a interspersed within the assembly of rods 25, the single-axis securing units 20a used for interconnecting said rods 25.

As described above, embodiments of the present disclosure relate to glazing façade systems, more specifically glass façade systems, and processes for the assembly thereof, that address at least one aspect, disadvantages, and/or limitations associated with existing glazing façade systems.

For instance, the support structures (e.g., rods and cables) of particular glass façade systems provided by the present disclosure can be disposed substantially, or even entirely, within the plane of the glass panels. Accordingly, particular glass façade systems of the present disclosure do not have support structures that substantially extend, project, or protrude away from the plane of the glass panels (e.g., at an angle relative thereto). The absence of said projecting support structures can help facilitate maximization of

available and/or leasable internal floor space of the building. In addition, glass façade systems without, or substantially without, visible support structures can be considered to be aesthetically or architecturally enhanced (e.g., of a better design).

Although the support structures of the glass façade systems of many embodiments of the present disclosure are disposed substantially, or even entirely, within the same plane as the glass panels, in certain embodiments, portions of the glass façade can further include additional support structures, for example struts, tension cables (e.g., space tension cables), or tension rods, that extend or project away from the plane of the glass panels. For instance, in selected embodiments, the glass façade can include tension cables and/or tension rods that project from the glass façade at an angle to the plane of the glass panels for attachment to a building's support or sub-support structure (e.g., base, pillar, wall, and/or ceiling) to thereby provide additional structural support to the glass façade.

In addition, although only particular securing units, more specifically single-axis securing units and dual-axis securing units, are described above, the present disclosure does not preclude the possibility of particular glass façade systems, within the scope of the present disclosure, from further including one or more three-axis securing unit(s).

Particular three-axis securing units as provided within the scope of the present disclosure allow positioning or disposition of load distributors or support structures in three axes (or three spatial directions), more specifically in the first axis (e.g., X-axis or first spatial direction), the second axis (e.g., Y-axis or second spatial direction), and a third axis (e.g., Z-axis or third spatial direction). This is to say, the three-axis securing unit allows for three-dimensional positioning of the load distributors or support structures.

In some embodiments, the three-axis securing unit mediates or facilitates projection or extension of the load distributor(s) or support structure(s) at an angle relative to the plane of the glass panels. For example, the three-axis securing unit mediates or facilitates projection or extension of the load distributor(s) at an at least 10°, 20°, 40°, 60°, or 90° angle relative the plane of the glass panels.

In various embodiments, the three-axis securing unit includes at least some of the components and/or structural features of the single-axis securing unit and/or the dual-axis securing unit. In certain embodiments, the three-axis securing unit includes a substantial number of components and/or structural features of the single-axis securing unit and/or dual-axis securing unit. For example, the three-axis securing unit can include one or more of the first holding plate, the second holding plate, the cable clamp, the first gasket and/or the second gasket.

In many embodiments, the three-axis securing unit has a modified first holding plate, more specifically a modified core structure of the first holding plate, as compared to that of the dual-axis securing unit. For instance, in some embodiments, the core structure of the three-axis securing unit is modified to enable coupling of load distributors or support structures thereto that project or extend at an angle relative the glass panels.

In selected embodiments, the core structure of the three-axis securing unit not only includes a set of receptacles for receiving rods and a channel for receiving a cable, as is similar to the dual-axis securing unit, but the three-axis securing unit further includes a number of retainers (also known as anchors, holders, or receivers), to which a corresponding number of load distributors can be coupled or attached, said corresponding number of load distributors projecting from the multi-axis securing unit at an angle relative to the glass panels.

In specific embodiments, the number of retainers are shaped and dimensioned to couple with corresponding number of rods (e.g., tension rods), the rods projecting from the multi-axis securing unit at an angle relative the glass panels for affixing to a building's support or sub-support structure (e.g., base, walls, pillar, and/or ceiling). In other embodiments, the retainer is shaped and dimensioned to receive, or couple to, a cable, the cable projecting from the multi-axis securing unit at an angle relative the glass panels for affixing to a building's support or sub-support structure

Aspects of particular embodiments of the disclosure addresses at least one aspect, problem, limitation, and/or disadvantage associated with exiting glazing facades. While

features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by a person of ordinary skill in the art that several of the above-disclosed systems, components, processes, or alternatives thereof, may be desirably combined into other different systems, components, processes, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope and spirit of the present disclosure.

Claims

1. A securing unit for securing portions of an architectural façade to an array of load distributors, the architectural façade comprising a set of planar components, the securing unit comprising:

a first plate;

a second plate couplable to the first plate;

a core structure carried by the first plate and disposed between the first and second plate when the first and second plates are coupled together, the core structure comprising a set of load distributor retaining structures formed therein, each load distributor retaining structure within the set of load distributor retaining structures comprising a length that is at least substantially parallel the first plate.

2. The securing unit as in claim 1, wherein each load distributor retaining structure of the set of load distributor retaining structures is shaped and dimensioned to receive a portion of a load distributor therewithin to thereby dispose the load distributor at least substantially parallel the first plate.

3. The securing unit as in claim 2, wherein the set of load distributor retaining structures is shaped and configured to couple to one or more of a rod and a cable.

4. The securing unit as in claim 3, wherein the set of load distributor retaining structures comprises one or more of a receptacle and a passage.

5. The securing unit as in claim 1, wherein each of the first and second plates is disposed parallel to each other when coupled together.

6. The securing unit as in claim 2, wherein the core structure is shaped and dimensioned to couple with at least two planar components.

7. The securing unit as in claim 6, wherein the load distributor carried by each load distributor retaining structure is disposed at least substantially within a thickness of the at least two planar components.

8. The securing unit as in claim 7, wherein the at least two planar components are at least two glazing components.

9. The securing unit as in claim 8, wherein the at least two glazing components comprise at least two glass panels, the core structure shaped and dimensioned to be fit into an opening defined by the at least two glass panels for placement at least substantially across the thickness of the at least two glass panels.

10. The securing unit as in claim 9, wherein each load distributor is disposed between the edges of at least two adjacent glazing components.

11. The securing unit as in claim 4, wherein the receptacle is shaped and dimensioned to receive at least a portion of the rod therewithin.

12. The securing unit as in claim 11, wherein the passage is shaped and dimensioned to receive at least a portion of the cable therewithin.

13. The securing unit as in claim 12, wherein a longitudinal length of the passage is at least substantially perpendicular a longitudinal length of the receptacle for disposing the cable received within the passage at least substantially perpendicular the rod received by the receptacle.

14. The securing unit as in claim 12, further comprising a cable clamp couplable to the core structure, the cable clamp being shaped and dimensioned to receive at least a portion of the cable therewithin for one of facilitating and effectuating securing of the cable to the core structure.

15. The securing unit as in claim 14, wherein the cable clamp is disposed between the first and second plates when the first and second plates are coupled together.

16. The securing unit as in claim 5, further comprising a first gasket and a second gasket shaped and dimensioned to fit around at least a portion of the core structure.

17. The securing unit as in claim 16, wherein the first gasket is disposable between the first plate and the at least two planar components and the second gasket is disposable between the second plate and the at least two planar components when the first and second plate is coupled together.

18. A securing unit for securing portions of an architectural façade to an array of load distributors, the architectural façade comprising a set of planar components, the securing unit comprising:

a first plate couplable to at least two planar components;

a core structure carried by the first plate and shaped and dimensioned to fit across a thickness of the at least two planar components, the core structure comprising a set of load distributor retaining structures, each load distributor retaining structure from the set of load distributor retaining structures being shaped and dimensioned to couple to a load distributor and to dispose the load distributor coupled thereto at least substantially within the thickness of the at least two planar components; and

a second plate couplable to the core structure in a manner to dispose the core structure and the at least two planar components between the first and second plate.

19. The securing unit as in claim 18, wherein the first plate is disposable substantially parallel a first surface of the at least two planar components and the second plate is disposable substantially parallel a second surface of the at least two planar components, the first and second surfaces being substantially parallel and facing substantially opposite directions relative to each other, the thickness of the at least two planar components being defined between the first and second surfaces.

20. The securing unit as in claim 18, the set of load distributor retaining structures comprising at least one receptacle that is shaped and dimensioned to couple to a rod.

21. The securing unit as in claim 20, comprising two receptacles formed at opposite sides of the core structure and shaped and dimensioned to dispose the rods coupled thereto substantially along a straight line at least substantially within the thickness of the at least two planar components.

22. The securing unit as in claim 20, comprising at least three receptacles formed within the core structure at predetermined angles relative to each other to thereby dispose the rods coupled thereto at corresponding angles relative to each other at least substantially within the thickness of the at least two planar components

23. The securing unit as in claim 20, wherein the rod is disposed between the edges of at least two adjacent planar components.

24. The securing unit as in claim 20, wherein the set of load distributor retaining structures further comprises a passage formed therein that is shaped and dimensioned to couple with at least a portion of a cable therewithin.

25. The securing unit as in claim 24, wherein the cable coupled to the passage is disposed at least substantially within the plane of the at least two planar components.

26. The securing unit as in claim 24, further comprising a cable clamp couplable to the core structure, the cable clamp being shaped and dimensioned to fit around at least a portion of the cable to one of facilitate and effectuate securing of the cable to the core structure.

27. The securing unit as in claim 24, wherein a longitudinal length of the passage is at least substantially perpendicular a longitudinal length of the at least one

receptacle to thereby facilitate deposition of the cable that is coupled to the passage at least substantially perpendicular the rod that is coupled to the at least one receptacle.

28. The securing unit as in claim 18, wherein each load distributor one of facilitates and effectuates at least one of accommodation, distribution, transmission of load therealong.

29. A glazing façade system comprising:

at least two glazing components;

a securing unit disposed at a junction between the at least two glazing components; and

at least one load distributor coupled to the securing unit and positioned between a first glazing component and a second glazing component of the at least two glazing components, the at least one load distributor disposed at least substantially within a thickness of the at least two glazing components.

30. The glazing façade system as in claim 29, the securing unit comprising a core structure shaped and dimensioned to be fit coupled with the at least two glazing components, at least part of the core structure being disposed across the thickness of the at least two glazing components.

31. The glazing façade system as in claim 30, the core structure comprising a set of load distributor retaining structures, each load distributor retaining structure of the set of load distributor retaining structures shaped and dimensioned to couple with one load distributor.

32. The glazing façade system as in claim 31, the set of load distributor retaining structures comprising one or more of a receptacle and a passage.

33. The glazing façade system as in claim 32, the set of load distributor retaining structures being shaped and dimensioned to couple to one or more of a rod and a cable.

34. The glazing façade system as in claim 33, wherein the set of load distributor retaining structures comprises two receptacles formed at opposite sides of the core structure and shaped and dimensioned for coupling to two rods, the two rods when coupled to the two receptacles being disposed along a substantially straight line within the thickness of the at least two glazing components.

35. The glazing façade system as in claim 33, wherein the set of load distributor retaining structures comprises at least three receptacles formed within the core structure at predetermined angles relative each other and shaped and dimensioned for coupling to at least three rods, the at least three rods coupled to the at least three receptacles being disposed at corresponding angles relative each other within the thickness of the at least two glazing components.

36. The glazing façade system as in claim 30, the securing unit comprising a first plate coupled to the core structure, the first plate being shaped and dimensioned for placement at least substantially parallel alongside a first surface the at least two glazing components.

37. The glazing façade system as in claim 36, the securing unit comprising a second plate reversibly couplable to the core structure, the second plate being shaped and dimensioned for placement at least substantially parallel alongside a second surface the at least two glazing components, the first and second surfaces being substantially parallel and facing substantially opposite directions relative to each other, the thickness of the at least two planar components being defined between the first and second surfaces.

38. The glazing façade system as in claim 33, wherein the passage is shaped and dimensioned for coupling with a portion of the cable.

39. The glazing façade system as in claim 38, further comprising a clamp couplable to the core structure, the clamp being shaped and dimensioned for one of facilitating and effectuating securing of the cable to the core structure.

40. The glazing façade system as in claim 38, wherein a longitudinal length of the passage is substantially perpendicular a longitudinal length of the receptacle to thereby facilitate deposition of the cable that is coupled to the passage at least substantially perpendicular the rod that is coupled to the receptacle.

41. The glazing façade system as in claim 29, wherein the at least one load distributor one of facilitates and effectuates at least one of accommodation, distribution, transmission of load therealong.

42. The glazing façade system as in claim 41, wherein the glazing façade system is mountable to a building's support structure via the at least one load distributor, the at least one load distributor one of facilitates and effectuates load transfer from the glazing façade system to the building's support structure.

43. A method for assembling a glazing façade system comprising:

providing a securing unit, the securing unit comprising a core structure that comprises a set of load distributor retaining structures;

coupling a first load distributor to a first load distributor retaining structure of the set of load distributor retaining structures; and

coupling at least two planar components to the securing unit, each of the at least two planar components comprising a first surface and a second surface that are at least substantially parallel relative each other, a thickness of the of at least two planar components being defined between the first and second surfaces thereof,

wherein the first load distributor is disposed at least substantially within the thickness of the of the at least two planar components.

44. The method as in claim 43, further comprising:

coupling a second load distributor to a second load distributor retaining structure of the set of first load distributor retaining structures, the second load distributor being deposed at least substantially within the thickness of the of the at least two planar components.

45. The method as in claim 44, wherein the first and second first load distributor retaining structures of the set of first load distributor retaining structure are disposed at opposite sides of the core structure for deposing the first and second load distributors in a substantially straight line at least substantially within the thickness of the of the at least two planar components.

46. The method as in claim 43, wherein the set of load distributor retaining structures comprises one or more of a receptacle and a passage.

47. The method as in claim 46, wherein the receptacle is shaped and dimensioned for coupling with a rod, and the passage is shaped and dimensioned for coupling to a cable.

48. The method as in claim 46, further comprising

coupling a length of the cable within a passage; and

fitting a cable clamp around the length of the cable; and

coupling the cable clamp to the core structure to thereby one of facilitate and effectuate securing of the cable to the core structure.

49. The method as in claim 43, further comprising:

attaching the first load distributor to a building’s support structure, the first load distributor one of facilitates and effectuates load transfer from the least two planar components to the building’s support structure.

50. An architectural façade system comprising:

a plurality of architectural façade panels, each architectural façade panel within the plurality of architectural façade panels having a width, a height, a first outer surface, a second outer surface, and a thickness defined between the first and second outer surfaces;

a load distribution network configured to distribute forces upon the plurality of architectural façade panels, the load distribution network including a set of force distribution elements coupled to the plurality of architectural façade panels, the set of force distribution elements comprising:

a set of load distribution nodes, each load distribution node within the set of load distribution nodes disposed between at least two architectural façade panels within the plurality of architectural façade panels; and

a plurality of load distributors coupled to the set of load distribution nodes, each load distributor within the plurality of load distributors disposed along one from the group of a portion of an architectural façade panel width and a portion of an architectural façade panel height, and further disposed at least substantially within the thickness of an architectural facade panel of the plurality of architectural façade panels,

wherein the load distribution network substantially excludes force distribution elements that extend substantially beyond each of the first outer surface and the second outer surface of an architectural façade panel.

51. The architectural façade system as in claim 50, wherein the load distribution network substantially excludes force distribution elements that extend substantially beyond each of the first outer surface and the second outer surface of each architectural façade panel within the plurality of architectural façade panels.

52. The architectural façade system as in claim 50, wherein the load distribution network excludes force distribution elements that extend substantially beyond

each of the first outer surface and the second outer surface of each architectural façade panel within the plurality of architectural façade panels.

53. The architectural façade system as in claim 50, wherein each load distribution node within the set of load distribution nodes is disposed between at least two adjacent architectural façade panels within the plurality of architectural façade panels.

54. The architectural façade system as in claim 50, wherein the plurality of load distributors comprises at least one from the group of a set of rods and a set of cables.

55. The architectural façade system as in claim 50, wherein the plurality of load distributors comprises a set of rods and a set of cables.

56. The architectural façade system as in claim 50, wherein the plurality of architectural façade panels forms a façade panel array having a panel array width defined with respect to a first spatial direction and a panel array height defined with respect to a second spatial direction transverse to the first spatial direction.

57. The architectural façade system as in claim 56, wherein the set of force distribution elements extends along at least one of the panel array width and the panel array height.

58. The architectural façade system as in claim 56, wherein the set of force distribution elements extends along each of the panel array width and the panel array height.

59. The architectural façade system as in claim 56, wherein each architectural façade panel within the façade panel array is disposed adjacent to another architectural façade panel, and wherein at least one load distributor is disposed between adjacent architectural façade panels.

60. The architectural façade system as in claim 56, wherein the load distribution network further comprises a set of peripheral support structures coupled to the plurality of load distributors, each peripheral support structure within the set of peripheral support structures disposed external to the façade panel array.

61. The architectural façade system as in claim 56, wherein the load distribution network further comprises a set of peripheral support structures coupled to the plurality of load distributors, each peripheral support structure within the set of peripheral support structures disposed adjacent to the façade panel array.

62. The architectural façade system as in claim 56, wherein the load distribution network is configured to distribute forces upon the façade panel array in three transverse spatial directions in at least the substantial absence of force distribution elements coupled to the façade panel array along a coupling path that includes a vector component substantially parallel to the thickness of an architectural façade panel.

63. The architectural façade system as in claim 56, wherein the load distribution network is configured to distribute forces upon the façade panel array in three transverse spatial directions in the absence of force distribution elements coupled to the façade panel array along a coupling path that includes a vector component substantially parallel to the thickness of an architectural façade panel.

64. The architectural façade system as in claim 50, wherein each load distribution node within the set of node distribution nodes comprises a core structure that includes a set of load distributor retaining structures, each load distributor retaining structure within the set of load distributor retaining structures comprising a length that is at least substantially transverse to an architectural façade panel thickness.

65. The architectural façade system as in claim 64, wherein the set of load distributor retaining structures includes a set of receptacles, each receptacle within the set of receptacles configured to receive a length of a load distributor.

66. The architectural façade system as in claim 65, wherein each receptacle within the set of receptacles is configured to receive an end portion of a rod.

67. The architectural façade system as in claim 64, wherein the set of load distribution retaining structures includes a channel configured to receive a load distributor.

68. The architectural façade system as in claim 67, wherein the channel is configured to carry a portion of a cable.

69. The architectural façade system as in claim 68, wherein the cable extends through the core structure.

70. The architectural façade system as in claim 64, wherein the load distribution node further comprises:

a first cover member; and

a second cover member couplable to the first cover member,

wherein the core structure is disposed between the first cover member and the second cover member when the first cover member is coupled to the second cover member.

71. The architectural façade system as in claim 70, wherein at least one of the first cover member and the second cover member comprises a plate.

72. The architectural façade system as in claim 70, wherein the first cover member comprises a plate that carries the core structure.