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Standard Guide for Structural Sealant Glazing[1]

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1. Scope

1.1 Structural sealant glazing, hereinafter referred to as SSG, is an application where a sealant not only can function as a barrier against the passage of air and water through a building envelope, but also primarily provides structural support and attachment of glazing or other components to a window, curtain wall, or other framing system.

1.2 This guide provides information useful to design professionals, manufacturers, contractors, and others for the design and installation of a SSG system. This information is applicable only to this glazing method when used for a building wall that is not more than 15° from vertical; however, limited information is included concerning a sloped SSG application.

1.3 Only a silicone chemically curing sealant specifically formulated, tested, and marketed for structural sealant glazing is acceptable for a SSG system application.

1.4 The committee with jurisdiction for this standard is not aware of any comparable standard published by other organizations.

1.5 The calculations and values stated in SI units are to be regarded as the standard. Values in parenthesis and inch-pound units are for information only. SI units in this guide are in conformance with IEEE/ASTM SI 10.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B117 Practice for Operating Salt Spray (Fog) Apparatus
C99 Test Method for Modulus of Rupture of Dimension Stone
C119 Terminology Relating to Dimension Stone
C162 Terminology of Glass and Glass Products
C503 Specification for Marble Dimension Stone
C509 Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
C510 Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants
C568 Specification for Limestone Dimension Stone
C615 Specification for Granite Dimension Stone
C717 Terminology of Building Seals and Sealants
C719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
C794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
C864 Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
C880 Test Method for Flexural Strength of Dimension Stone
C920 Specification for Elastomeric Joint Sealants
C1036 Specification for Flat Glass
C1048 Specification for Heat-Strengthened and Fully Tempered Flat Glass
C1087 Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
C1115 Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories
C1135 Test Method for Determining Tensile Adhesion Properties of Structural Sealants
C1172 Specification for Laminated Architectural Flat Glass
C1184 Specification for Structural Silicone Sealants
C1193 Guide for Use of Joint Sealants
C1201 Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
C1248 Test Method for Staining of Porous Substrate by Joint Sealants
C1249 Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications
C1253 Test Method for Determining the Outgassing Potential of Sealant Backing

[1] This guide is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.10 on Specifications, Guides and Practices.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

C1265 Test Method for Determining the Tensile Properties of an Insulating Glass Edge Seal for Structural Glazing Applications
C1294 Test Method for Compatibility of Insulating Glass Edge Sealants with Liquid-Applied Glazing Materials
C1330 Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
C1369 Specification for Secondary Edge Sealants for Structurally Glazed Insulating Glass Units
C1392 Guide for Evaluating Failure of Structural Sealant Glazing
C1394 Guide for In-Situ Structural Silicone Glazing Evaluation
C1472 Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width
C1487 Guide for Remedying Structural Silicone Glazing
C1521 Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
C1564 Guide for Use of Silicone Sealants for Protective Glazing Systems
D1566 Terminology Relating to Rubber
D2203 Test Method for Staining from Sealants
D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
E283 Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
E330 Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
E331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
E547 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
E631 Terminology of Building Constructions
E783 Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
E1105 Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
E1233 Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential
E1300 Practice for Determining Load Resistance of Glass in Buildings
E1424 Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen
E1425 Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems
E1825 Guide for Evaluation of Exterior Building Wall Materials, Products, and Systems
E1886 Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
E1996 Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
E2128 Guide for Evaluating Water Leakage of Building Walls
E2203 Specification for Dense Thermoplastic Elastomers Used for Compression Seals, Gaskets, Setting Blocks, Spacers and Accessories
E2099 Practice for the Specification and Evaluation of Pre-Construction Laboratory Mockups of Exterior Wall Systems
E2431 Practice for Determining the Resistance of Single Glazed Annealed Architectural Flat Glass to Thermal Loadings
G15 Terminology Relating to Corrosion and Corrosion Testing (Withdrawn 2010)[3]

2.2 *IEEE/ASTM Standard:*[2]
IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.3 *Aluminum Association Manual:*
Aluminum Design Manual[4]

2.4 *ANSI/ASCE Standard:*
ANSI/ASCE 7, Minimum Design Loads for Buildings and Other Structures[5]

2.5 *AAMA Standards:*
501.1 Standard Test Method for Metal Curtain Walls for Water Penetration Using Dynamic Pressure[6]
501.2 Field Check of Metal Curtain Walls for Water Leakage[6]
TIR-A11–1996 Maximum Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads[6]

2.6 *ANSI Standard:*
Z97.1 Safety Performance Specifications and Methods of Test for Glazing Materials Used in Buildings[5]

2.7 *CPSC Standard:*
16 CFR 1201 Standard on Architectural Glazing Materials[7]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology C119 for definitions of the following terms used in this guide: dimension stone, granite, hysteresis, limestone, and marble.

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[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from the Aluminum Association, 900 19th St., N.W. Washington, DC 20006.
[5] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.
[6] Available from the Architectural Aluminum Manufacturers Association (AAMA).
[7] Available from the Consumer Product Safety Commission (CPSC), Washington, D.C. 20207.

3.1.2 Refer to Terminology C162 for definitions of the following terms used in this guide: chip, chipped glass, double glazing unit, flat glass, glass, heat-strengthened glass, heat-treated, laminated glass, lite, pyrolitic coating, safety glass, skylight, spandrel glass, tempered glass, thermal stress, toughened glass, and wave.

3.1.3 Refer to Terminology C717 for definitions of the following terms used in this guide: adhesive failure, bicellular sealant backing, bite, bond breaker, butt glazing, cell, chemically curing sealant, closed cell, closed cell material, closed cell sealant backing, cohesive failure, compatibility, compound, cure, durability, durability limit, elastomeric, elongation, gasket, glazing, glazing construction site, hardness, joint, lite, modulus, open cell, open cell material, open cell sealant backing, outgassing, premature deterioration, primer, seal, sealant, sealant backing, secant modulus, service life, setting block, shop glazing, silicone sealant, spacer, standard conditions, structural sealant, substrate, thickness, and tooling.

3.1.4 Refer to Terminology D1566 for the definition of the following term used in this guide: compression.

3.1.5 Refer to Terminology E631 for the definitions of the following terms used in this guide: air-leakage, anchorage, anchorage system, building envelope, cladding system, curtain wall, glaze, mechanical connection, mockup, operable, panel, performance standard, sealed insulating glass, shop drawing, specification, static load, tolerance, water-vapor retarder, weephole, and working drawing.

3.1.6 Refer to Terminology G15 for the definition of the following term used in this guide: chemical conversion coating.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aspect ratio (AR), n*—the ratio of the long dimension of the glass to the short dimension of the glass. AR is always equal to or greater than 1.0.

3.2.2 *negative pressure, n*—an applied load, usually wind induced, that tends to pull a glass lite or panel away from a building surface.

3.2.3 *opacifier, n*—an opaque material applied to the interior facing surface of a glass spandrel panel, which can include materials, such as adhesively applied organic films, a liquid-applied silicone coating, or a fired-on ceramic enamel frit.

3.2.4 *panel, n*—a cladding material other than glass that is manufactured or fabricated from solid, laminated or composite assemblies of materials such as dimension stone, metal or plastic.

3.2.5 *positive pressure, n*—an applied load, usually wind induced, that tends to push a glass lite or panel inward from a building surface.

3.2.6 *snap time, n*—the time in minutes at which a multi-component sealant tears within itself and does not string when a spatula is removed from the curing sealant.

3.2.7 *stick system, n*—a metal framing system of numerous elements that is construction site assembled and field glazed, usually in-place on the face of a building.

3.2.8 *thermal bridge, n*—a method that transfers thermal energy, usually by means of a metallic path from the interior to the exterior of a window or curtain wall system.

3.2.9 *unitized system, n*—a panelized metal framing system that is preassembled and usually shop-glazed, with the panels transported to a construction site for erection on a building.

3.3 *Symbols:*

A = solar absorptivity coefficient.
α = coefficient of linear thermal movement mm/mm/°C (in./in./°F).
B = structural sealant joint bite mm (in.).
C = perpendicular distance between parallel sides m (ft).

ΔL = thermal movement mm (in.).
ΔT_s = summer temperature differential °C (°F).
ΔT_w = winter temperature differential °C (°F).
F_d = allowable structural sealant dead load stress kPa (psi).
F_t = allowable structural sealant tension stress kPa (psi).
F_v = allowable structural sealant shear stress kPa (psi).
f_t = computed tensile stress kPa (psi).
f_v = computed shear stress kPa (psi).
H = heat capacity constant.
L = side of lite or panel m (ft).
L_1 = long side of lite or panel m (ft).
L_2 = short side of the lite or panel m (ft).
$\%$ = shear movement percent.
P_w = lateral load due to wind kPa (psf).
R = radius of a lite or panel m (ft).
T = structural sealant joint thickness mm (in.).
T_a = ambient summer temperature °C (°F).
T_s = summer surface temperature °C (°F).
T_w = ambient winter temperature °C (°F).
W = unit weight of lite or panel kg/m^2 (lb/ft^2).
φ = angle in degrees.

4. Summary of Guide

4.1 *General*—This guide has been subdivided into major headings. A very brief description of each major heading is provided to assist the reader in locating general areas of information. For a more detailed listing of guide topics and section headings, refer to Appendix X1 for a complete listing of the numbered sections and their descriptors.

4.2 *Predesign Considerations (Section 6),* in general, the responsibilities and relationships of the various participants in SSG system development and implementation.

4.3 *Performance Criteria Considerations (Sections 7 – 14),* SSG system structural loads, movements, construction tolerances, weather tightness, sound transmission, fire resistance, and durability.

4.4 *System Design Considerations (Sections 15 – 18),* information is provided about the basic types of SSG and related systems, as well as system weatherproofing concepts.

4.5 *Component Design Considerations (Sections 19 – 26),* framing systems, framing finishes, glass, panels, structural sealants, weather seal sealants, and accessory material information.

4.6 *Structural Sealant Design Considerations (Sections 27 – 31),* structural joint location and configuration, adhesion and compatibility concerns, theoretical structural design, and other design and weather seal considerations.

4.7 *Testing Considerations (Sections 32 – 37),* predesign scale model wind and snow load testing, design and fabrication component testing for quality, adhesion, and compatibility, and full-size assembly mock-up testing information.

4.8 *Shop Glazing Considerations (Sections 38 – 42),* materials prequalification, quality control programs, and inspection and testing quality assurance issues.

4.9 *Construction-Site Glazing Considerations (Sections 43 – 47),* materials prequalification, quality control programs, and inspection and testing quality assurance issues.

4.10 *Post-Installation Considerations (Sections 48 – 51),* quality control, maintenance, and periodic monitoring programs.

5. Significance and Use

5.1 The old saying "A chain is only as strong as its weakest link" is very applicable to a SSG system. In reality, a SSG system, to be successful, must establish and maintain a chain of adhesion. For example, a factory applied finish must adhere adequately to a metal framing member, a structural glazing sealant to that metal finish, that structural glazing sealant to a reflective coating on a glass lite, and lastly, that reflective coating to a glass surface. This guide will assist in the identification and development of, among others, performance criteria, test methods, and industry practices that should be implemented to obtain the required structural glazing sealant adhesion and compatibility with other system components.

5.2 Although this guide has been arranged to permit easy access to specific areas of interest, it is highly recommended that the entire guide is read and understood before establishing the requirements for a particular SSG system.

5.3 This guide should not be the only criteria upon which the design and installation of a SSG system is based. The information herein is provided to assist in the development of a specific program with a goal of achieving a successful SSG system installation. Information and guidelines are provided for the evaluation, design, installation, and maintenance of a SSG system and many of its various components. Considering the range of properties of structural glazing silicone sealants, as well as the many types of framing system designs, material combinations that can be used, various material finishes, and the many types and varieties of accessories, the information contained herein is general in nature.

5.4 Generally, the design, fabrication, and installation of a SSG system requires more technical knowledge and experience then is required for a conventionally glazed window or curtain wall system. To ensure the success of a SSG system, it is important that suppliers, fabricators, and installers of materials and components have a sound knowledge of SSG system requirements and become involved in the design and planning for each application. Suppliers of, among others, sealants, framing finishes, glazing materials and components, and various accessories should review and agree with the developed SSG system plans, requirements, and quality control program.

5.5 The results of not planning for and implementing quality control programs during at least the design, testing, fabrication, and installation phases of a SSG system's development can result in less than desirable results, which can include nuisance air or water leakage or catastrophic failure where life safety of the public can be at risk (**1**, **2**).[8]

PREDESIGN CONSIDERATIONS

6. Roles of Major Participants

6.1 *General*—Responsibility for the design, implementation, and maintenance of a SSG system depends largely on the contractual relationships between the participants and their extent of participation. This relationship can vary on individual projects, but it should be established clearly at the beginning and understood by all concerned parties. The following descriptions briefly describe the normal roles and duties generally ascribed to the participants, which usually is adequate for the development of a SSG system.

6.2 *Building Owner*— The building owner should review and approve the design concept and budget for the development and implementation of a SSG system. It is the building owner's responsibility to establish and maintain a realistic post-construction inspection and testing program to evaluate structural sealant integrity. Typically, the building owner also should authorize required maintenance, structural repairs, and replacement of components expeditiously.

6.3 *Architect*—The architect should provide the basic system design concept, performance criteria, and a cost estimate for the owner's review and approval. The architect also should provide the owner with an explanation of the SSG system design concept, degree of risk involved, and maintenance and eventual replacement requirements. The architect has the responsibility to conduct a feasibility review of the basic design concept, system features, and material requirements with potential manufacturers and contractors. The architect also should engage a SSG system consultant, if one is needed, and provide contract documents (working drawings and specifications) in accordance with the chosen construction method and the architect's professional services agreement. Construction administration by the architect usually includes, among others, shop drawing, product data, sample review, and approval or other appropriate action. The architect also makes on-site visits in accordance with the professional services agreement.

6.4 *Consultant*—A consultant usually is engaged by the architect but also can be engaged by the general contractor, curtain wall subcontractor, or the owner. The consultant provides guidance and technical expertise and establishes requirements for the design and implementation of the SSG system, among others.

6.5 *Building Code Authority*—All codes accept traditional glazing with conventional mechanical glazing retainage; however, some jurisdictions may permit SSG systems only with supplementary mechanical retainage. Other code jurisdiction requirements can include, among others, establishment

[8] The boldface numbers in parentheses refers to the list of references at the end of this standard.

and certification of specific structural sealant material properties, controlled inspection of a SSG system installation, and post-installation periodic inspection and certification programs. For example, the ICBO Evaluation Service, Inc., a subsidiary of the International Conference of Building Officials (ICBO), which publishes the Uniform Building Code (UBC), requires fulfillment of certain criteria before a structural sealant is acceptable for use in jurisdictions that have adopted the UBC. Code acceptance criteria may involve testing and conditions of testing that normally are not conducted by structural sealant manufacturers or require conditions of use that will limit the type and character of a SSG system. Additionally, other code requirements for example impact resistance may also have an effect on the design of an SSG system (See 8.6) The building code and the specific code jurisdiction authorities should be consulted prior to any SSG system detailed design.

6.6 *Contractor*—The contractor selects the subcontractors and reviews, approves, and submits to the architect submittals, such as shop drawings, product data, and samples. The contractor also performs the construction and other services in accordance with the contract documents and the approved submittals. Supervision, direction, and coordination of the construction and other services, to assure compliance with the contract documents, also is performed by the contractor. Most importantly, the contractor has the responsibility for and control of construction means, methods, techniques, sequences, and procedures unless the contract documents direct otherwise.

6.7 *SSG System Designer*—This responsibility often is the architect's, however, a SSG system consultant or a curtain wall subcontractor also can perform this work. Responsibilities include the design of the SSG system to meet the architect's design parameters and performance criteria and development of specific material selection criteria for glass, panels, metal finishes, sealants, gaskets, and other SSG system components. Importantly, the system designer also should develop a SSG system that can be resealed or reglazed, easily and adequately, if glass, sealant, or other component replacement is necessary.

6.8 *SSG System Subcontractor*—Responsibilities include obtaining the approval of, among others, panel, metal finish, glass, and sealant manufacturers for use of their products in a SSG application; preparation and submittal of shop drawings to the general contractor for processing and approval; and, fabrication and installation of the SSG system in accordance with, among others, the contract documents, approved shop drawings, mock-ups, and component manufacturer's recommendations. Sometimes a separate SSG system installation subcontractor is retained. Coordination between the system manufacturer and the installer is required.

6.9 *Metal Framing Fabricator or Supplier*—Responsibilities include coordinating with the metal supplier and the finish applicator; monitoring of metal surface finish quality control; and, approval of the product for the specific SSG application. The metal framing fabricator also has the responsibility to provide representative production run samples of metal finishes for adhesion and compatibility evaluation by the structural sealant manufacturer.

6.10 *Glass Manufacturer or Fabricator*—Responsibilities include review of the project design requirements; recommendation of glass thickness and type to meet, among others, wind load and thermal stress conditions as specified for the SSG system; quality control of the secondary seal of insulating glass units and any glass coatings, such as reflective or low-emissivity; and, approval of the glass product(s) for a specific SSG application. The glass manufacturer also has the responsibility to provide production run representative samples of the glass type(s) for adhesion and compatibility evaluation by the structural sealant manufacturer. The glass manufacturer also has the responsibility to determine with the cooperation of the fabricator of the insulating glass units, if a separate party, the compatibility of at least the structural sealants and accessories that may have an effect on the performance of the insulating glass unit edge seal.

6.11 *Panel Manufacturer or Fabricator*—Panel types include metal, composite, plastic, and stone among others (See Section 23). Responsibilities include: review of the project design requirements; recommendation of panel type to meet, among others, wind load and thermal stress conditions as specified for the SSG system; quality control of any panel finishes or coatings and approval of the panel product(s) for a specific SSG application. The panel manufacturer also has the responsibility to provide production run representative samples of the panel type(s) for adhesion and compatibility evaluation by the structural sealant manufacturer.

6.12 *Structural Sealant Manufacturer*—Responsibilities include conducting structural sealant compatibility testing with, among others, spacers, gaskets, setting blocks and other sealants; adhesion testing of the structural sealant(s) to the panel surface, metal finish and glass substrates; review and approval of the structural sealant joint dimensions provided by the SSG system designer; recommendation of a sealant(s) for the structural and weather seals, as well as, if necessary, a primer; and approvals of the sealant products for the specific SSG application.

6.13 *Accessory Material Suppliers*—Accessory material suppliers have the responsibility to provide spacers, gaskets, setting blocks and other products of the correct material formulation, hardness, shape, and tolerances as specified by the architect, consultant, or SSG system designer. The accessory material supplier also has the responsibility to provide production run representative samples of the accessories for adhesion and compatibility evaluation by the structural sealant manufacturer.

PERFORMANCE CRITERIA CONSIDERATIONS

7. General

7.1 Typical performance criteria that are applicable to a conventional glazing system also apply to a SSG system; however, some of these performance criteria may require different treatment, extra care, or additional criteria. The following typical performance criteria are described where SSG issues need to be considered. Typically, some combination of the following structural loads and movements, depending on an engineering analysis of a particular SSG system's design requirements, may have to be considered. For example, the effect of wind load and thermal movement is a commonly encountered combination that may have to be evaluated when designing a structural sealant joint. Additional general glazing, as well as performance criteria information, is available from industry associations, such as the American Architectural Manufacturers Association (AAMA), the Glass Association of North America (GANA) (formerly the Flat Glass Marketing Association, and the American Society of Civil Engineers (ASCE).

8. Structural Loads

8.1 *Dead*—A SSG system, depending on a particular design, may require the structural sealant joint to resist a constant dead load stress. This usually occurs when glass or panels are unsupported by setting blocks or other mechanical devices and also at suspended soffit construction. The allowable dead load stress for design will depend on the modulus of the structural sealant and the dimensions of the structural sealant joint. Some structural sealant manufacturers will not permit glass or panels to be suspended or unsupported by setting blocks or other means. For those sealant manufacturers who permit dead load stressing of the structural sealant, there has been a precedent to limit the dead load stress to no more than 7 kPa (1 psi). The structural sealant manufacturer should be consulted early during SSG system design since not all sealant manufacturers will permit a constant dead load stress on the sealant joint or permit exceeding a 7 kPa (1 psi) limit.

8.2 *Wind*—The realistic establishment of negative and positive wind loads is important (**3, 4**). It is primarily the wind loading conditions, except for some seismic zones, which determine the size and shape of a structural sealant joint in a SSG system. Other secondary loading conditions, such as dead load and thermal movement also can contribute to the design of a structural sealant joint. The building code applicable to a SSG system will establish minimum requirements for the wind load to be resisted by a curtain wall or window system and therefore a SSG system. Often, cladding wind loads are not adequately described by those building codes that use a simple table of wind load values. The ASCE standard ANSI/ASCE 7, which also is referenced in some of the national model building codes, provides a detailed analysis and description of the wind loads to be resisted by a curtain wall or window system. The building code and the ANSI/ASCE 7 determined wind load values typically apply to buildings of square or rectangular shape with vertical walls. The use of a building code or the analytical procedure in ANSI/ASCE 7 may not be sufficient for these buildings, particularly when of other shapes. Often, this is the case when a building is in an urban environment; of unusual configuration; closely related to other buildings as in a campus setting; or, in an area of unusual or unpredictable wind patterns. For these and other reasons scale model testing of a building in a boundary layer wind tunnel (BLWT) may be necessary (see 33.1.1).

8.3 *Snow*—For sloped wall surfaces or skylights, the effect of snow loading and drifting patterns on a SSG system must be considered. The building code and ANSI/ASCE 7 establish values that can be used for design. Also, the AAMA skylight and sloped glazing, 501.1 and 501.2, will provide the design professional with design information for snow loading and control on sloped surfaces. Since the actual pattern and velocity of wind flow around a building can have a dramatic impact on drifting and snow load, however, the use of a scale model testing facility to establish these patterns and loads is recommended (see 33.1.3). Snow and ice loads usually cause a long-term compressive stress on a structural sealant joint and can become another of the secondary loading conditions that should be evaluated when designing a SSG system. The effect of snow load on vertical wall surfaces usually is not a performance criterion; however, the additional dead load generated by hardened snow or ice sheets, which can form on vertical and other surfaces, may need to be considered.

8.4 *Live (Maintenance)*—Normally, loads transferred directly to a window or curtain wall framing member by maintenance platforms will not have a significant effect on the structural joints in a SSG system; however, the use of continuous maintenance tracks, as well as intermittent tie-back buttons or other devices, may have an influence on the practical aspects of SSG system design, such as adequate access to apply the structural sealant in the joint opening and the development of thermal bridges (see 11.4.1).

8.5 *Seismic:*

8.5.1 Seismic design largely is based on probability and economics (**3**). The magnitude and frequency of seismic loads cannot be determined with the same degree of accuracy as other types of building loads. It is possible the magnitude of loading may vary by a factor of two or more; therefore, due to economic reasons, a commonly accepted earthquake design philosophy is to control major structural damage while allowing some minor nonstructural damage as a result of an earthquake.

8.5.2 The applicable building code should be consulted for seismic design guidelines. There are benefits to using a SSG system in areas prone to earthquakes. The resilient attachment of a glass lite or panel to the supporting framework by the structural sealant joint has proven to be beneficial in controlling and in some cases eliminating breakage normally experienced during a small to moderate earthquake. Since the lite or panel is not captured in a metal glazing pocket the opportunity for it to impact the metal glazing pocket surfaces is minimized, eliminating a primary cause of breakage. Depending on system design, however, adjacent glass lite or panel edges could contact each other and cause breakage or other effects. Also, when a glass lite break does occur, the SSG system, due to continuous attachment of the glass edge, can retain much if not all of the broken glass, depending on glass type, and provided that the structural joint retains sufficient integrity. Resilient attachment of a glass lite also has proven beneficial in other violent natural occurrences such as hurricanes.

8.5.3 The level of performance required of a SSG system during and after an earthquake will vary depending on the system design philosophy. The SSG system should remain stable after an earthquake. For example, depending on the magnitude of an earthquake, glass may or may not break. Laminated glass often is used in seismic regions so that it can remain in the opening if it does break; however, whether or not