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Standard Guide for In-Situ Structural Silicone Glazing Evaluation[1]

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INTRODUCTION

SSG is popular because of its unique method of retaining glass or other panels in smooth exterior walls, interrupted only by narrow sealant joints. The first four-sided SSG in commercial construction is on the former corporate headquarters building of SHG Incorporated (formerly known as Smith, Hinchman & Grylls) in Detroit, MI, built in 1971. Since then, buildings containing two- or four-sided (or, occasionally, other numbers of sides of nonrectangular-shaped panels) SSG walls have been constructed within most cities, some as tall as 80 stories.

While SSG popularity increases, the sealant industry remains concerned over potential failures due to the increasing number of buildings containing structural glazing that are aging; unknown structural sealant durability; and the level of understanding of the principles of SSG by glazers. This guide addresses these concerns by providing suggestions for in situ evaluations of completed installations of any age.

1. Scope

1.1 It is recommended to periodically evaluate the existing condition of structural sealant glazing (hereinafter called SSG) installations in situ to detect problems before they become severe or pervasive. Evaluation of existing SSG installations are required by certain building codes and local ordinances. This guide provides a program to evaluate the existing conditions, lists typical conditions, which might be found, and suggests times when such evaluations are appropriate. The committee with jurisdiction over this standard is not aware of any comparable standards published by any other organizations.

[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. Referenced Documents

2.1 *ASTM Standards:* [2]

C 717 Terminology for Building Seals and Sealants

C 1392 Guide for Evaluating Failure of Structural Sealant Glazing

C 1401 Guide for Structural Sealant Glazing

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process

3. Terminology

3.1 *Definitions:* The definitions of the following terms used in this guide are found in Terminology C 717: structural sealant; structural sealant glazing; two-sided structural sealant glazing; four-sided structural sealant glazing; fluid migration.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *qualified person*—one with a recognized degree or professional registration and extensive knowledge and experience in the field of structural sealant glazing, and who is capable of design, analysis, evaluation, and specifications in the subject.

4. Significance and Use

4.1 Guidelines are provided for the procedures to evaluate existing SSG installations, including two- and four-sided installations. Due to the unlimited range of materials that may be used in a particular building, the information contained in this guide is general in nature. For a discussion of new SSG installations, refer to Guide C 1401.

4.2 Typical conditions are listed that might be discovered during, or suggest the need for, such evaluations. Guidelines are also suggested for times to perform evaluations. These guidelines are also necessarily general. Professional judgement of a qualified person should be used in determining the appropriate time to perform an evaluation on a particular building.

4.3 This guide should not be the only reference consulted when determining the scope of a proposed evaluation. For example, the local building code and the manufacturers' product literature for the actual materials used (if known) should also be considered.

4.4 This document is not a substitute for experience and judgement in assessing the condition of the specialized types of construction discussed.

5. Reasons to Perform an Evaluation

5.1 There are numerous reasons that a building owner or manager (hereinafter "owner") may choose to evaluate an SSG system, whether discretionary or to comply with an ordinance. The recommended evaluation levels, as discussed in Section 7, are referenced for each situation. The findings from one level of investigation may trigger the need for a more in-depth investigation. At a minimum, it is recommended that an existing SSG installation be evaluated when triggered by any of the following events:

5.1.1 After a natural disaster, such as an earthquake or major wind storm, or a man-made disaster such as a bomb blast, Level 2;

5.1.2 After a recall or published concern over a specific product or system, Level 1;

5.1.3 Upon a change of property ownership, Level 1;

5.1.4 Before repeating a new design, Level 1;

5.1.5 As dictated by government regulations, Level 1 or 2; or

5.1.6 When distress is discovered (see Section 8), Level 2, or, if prevalent distress is found, Level 3.

5.2 In addition to event-triggered evaluations, it is recommended that proactive owners also perform periodic evaluations at the following intervals: (Note that some of these periods may overlap. If distress is found during any evaluation, then more frequent and more in-depth evaluations should be considered.)

5.2.1 When convenient, such as in conjunction with occasional glass replacement, or when access is available, Level 1;

5.2.2 Immediately after installation of a new system, Level 2;

5.2.3 Just before expiration of the warranty period, Level 2;

5.2.4 Between 1 and 2 years after substantial completion, Level 1;

5.2.5 After 5 years, Level 1;

5.2.6 After 10 years, Level 2;

5.2.7 After 15 years, Level 1 (if Level 2 was performed as recommended after 10 years); and

5.2.8 After 20 years, and each successive 10 years, Level 2.

6. Symptoms of Problems With SSG

6.1 Whether due to original construction mistakes or latent defects, SSG installations sometimes exhibit distress. The following list summarizes conditions that may indicate poor original construction or a subsequent failure of the structural sealant, and therefore require evaluation. This list may not be all-inconclusive.

6.1.1 *Glass breakage from an unknown cause*—There are numerous potential causes of spontaneous glass breakage; if the cause is unknown, then it should be investigated prior to glass replacement whether an SSG defect contributed to the failure.

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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*, ~~Vol 04.07.~~ volume information, refer to the standard's Document Summary page on the ASTM website.

6.1.2 *Air or water infiltration*—If air or water migrates through or to the structural sealant joint, then it must also have lost its structural function—at least for part of its length. Symptoms of air or water leakage include:

6.1.2.1 Visible accumulation of liquid water during or following storms;

6.1.2.2 Wet insulation;

6.1.2.3 Organic growth;

6.1.2.4 Water stains or salt deposits;

6.1.2.5 Audible rattle or whistle;

6.1.2.6 Discoloration of laminated glazing;

6.1.2.7 Condensation or frost on glazing;

6.1.2.8 Fogging of insulated glass units;

6.1.2.9 *Opacifier failure on spandrel glass*—Moisture is a factor in the failure of some opacifiers, and may indicate water infiltration; and

6.1.2.10 *Visible sealant failures*— Sealant failures may be observed from inside or outside, depending on the design, and may involve the weather-seal joint as well as the structural joint. Visible manifestations of sealant failures include:

6.1.2.10.1 Intermittent loss of adhesion —Nonadhered sealant may differ in iridescence or reflectivity compared to adhered sealant when viewed through the glass;

6.1.2.10.2 Fluid migration or exudation — The accumulation of a fluid residue on the sealant or glass may indicate a chemical reaction between the sealant and an incompatible adjacent material;

6.1.2.10.3 Discoloration of the sealant —A color change may indicate a chemical reaction between the sealant and an incompatible adjacent material;

6.1.2.10.4 Cohesive failure— Although difficult to observe from inside or outside, cohesive failure could indicate overstressing of the sealant;

6.1.2.11 Disengaged or nonaligned lites, or displaced spacers or setting blocks, which may indicate glass displacement; and

6.1.2.12 *Poor dimensional control of a structural sealant joint*—When viewed from inside or outside, the structural sealant should have uniform dimensions and full joints. Varying dimensions may indicate poor original installation practices, or improper/inadequate cure of the sealant.

7. Procedures for Evaluating Existing Conditions

7.1 The following evaluation procedures are recommended to be performed in determining the condition of an SSG installation. Depending on the reason for the evaluation and the type of installation, only certain procedures may be necessary; for example, more scrutiny is warranted for high-rise, 4-sided SSG than for low-rise, 2-sided SSG. The objective of the evaluation is to obtain a reasonable degree of confidence in the existing system, since one hundred percent certainty is not possible.

7.2 Different levels of expertise are needed to perform the various levels of evaluation, but in all cases ~~the evaluation should be supervised by~~ a qualified person should supervise the evaluation.

7.3 *Level 1*—Perform all of the following evaluation procedures:

7.3.1 Review project documentation, including original design drawings, shop drawings, mock-up testing report, and previous evaluation reports. Review original SSG design calculations, or if not available, perform calculations to determine stress on sealant from thermal and wind loading (and, where appropriate, seismic loading);

7.3.2 Interview building management and maintenance personnel and tenants regarding breakage history of lites and other distress. Map findings on elevation drawings, and assess whether a pattern exists; and

7.3.3 Perform a cursory visual assessment from the interior, and from the exterior ground, roofs, and balconies.

7.4 *Level 2*—Perform the following, plus all of the procedures of Level 1 (unless a Level 1 evaluation has been performed previously and the documentation recommended to be kept by the owner in 8.2 is available):

7.4.1 Perform close-up visual evaluation from the interior;

7.4.2 Observe weatherseal joints and structural joints from the exterior. Document distress, and assess whether a pattern exists. Utilize high-powered optical tools to assist in observing from remote viewing areas, or from suspended scaffolding. Choose scaffold “drops” to represent the entire building, including different wind zones, elevations, exposures, details, and construction times; and

7.4.3 Qualitatively measure the sealant adhesion by pressing in with a thumb. Alternatively, semi-quantitative adhesion strength data can be obtained using a Chatalon spring load indicator, or pulling cut tabs to failure and measuring the elongation.

7.5 *Level 3*—Perform all of the following procedures under the field supervision of a qualified person, plus the procedures of Levels 1 and 2 (except that Level 1 may be eliminated if it has been performed previously and the documentation recommended to be kept by the owner in 8.2 is available:

7.5.1 Consider whether the existing conditions indicate that evaluation of all lites is warranted. If not, develop a rational approach for evaluating a representative sample of the total lites. There is a trade-off between accuracy and the cost of the study. For quantitative tests and measurements, it is recommended that the number of specimens or tests be selected to ensure achieving at least a 90 % confidence interval with a maximum 20 % margin of error. Different levels of study may require stricter parameters; and

7.5.2 Perform in-situ load testing on selected lites, either by uniform load (air pressure) or point load (suction cups). One

applicable test method is described in Guide C 1392.

8. Report and Record Keeping

8.1 At the conclusion of the evaluation, a written report should be prepared presenting findings, conclusions, and, if appropriate, recommendations for remedial action.

8.2 It is very important that the evaluation data be maintained by the building owner in a standardized format to facilitate comparisons over time. It is recommended that all evaluation reports ~~are~~ be kept in one notebook binder, along with other information pertinent to the SSG installation.

8.3 The report should provide the following information:

8.3.1 Building identification, background information, and references to original design and construction firms.

8.3.2 Purpose of evaluation, and triggering event or reason.

8.3.3 Evaluation procedures used, including referencing the specified levels of evaluation in this guide.

8.3.4 Availability and adequacy of original design and construction documentation, drawings, and calculations, especially in relation to current code requirements or state-of-the-art SSG design procedures.

8.3.5 Distress and defects observed.

8.3.6 Changes since last evaluation.

8.3.7 Field testing results. Record findings and test locations on elevation drawings in an appendix.

8.3.8 Expected reliability of extrapolating the findings from limited areas to the entire system.

8.3.9 Recommendations for further evaluation or remedial action.

9. Keywords

9.1 distress; durability; glazing; structural glazing; structrual sealant glazing; structural sealant joint; structural silicone; SSG; SSG design calculation; SSG design procedure; SSG evaluation; SSG installations;

APPENDIX

(Nonmandatory Information)

X1. BIBLIOGRAPHY

X1.1 For more information see the following:

X1.1.1 *Documents prepared by manufacturers and trade associations*:

X1.1.1.1 Structural Silicone Glazing, by Dow Corning Corporation.

X1.1.1.2 Structural Silicone Glazing Guide, by General Electric (GE Silicones) Company

X1.1.1.3 Architectural Guidelines for Glazing Systems, by Tremco Corporation

X1.1.1.4 Curtain Wall Manual No. 13, Structural Sealant Glazing Systems (CW-13), AAMA, Schaumburg, Illinois, 1985.

X1.1.2 *Books*:

X1.1.2.1 *Sealants in Construction*, Jerome M. Klosowski, Marcel Dekker, Inc., 1989.

X1.1.2.2 *Construction Sealants and Adhesives* , Julian R. Panek & John P. Cook, John Wiley & Sons, 1984.

X1.1.3 *Technical Papers and Special Technical Publications*:

X1.1.3.1 ASTM STP 638, Sealant Technology in Glazing Systems, Chuck Peterson, Jr., ed.

X1.1.3.2 ASTM STP 1054, Science and Technology of Glazing Systems, Chuck Parise, ed.

X1.1.3.3 ASTM STP 606, Building Seals and Sealants, Julian Panek, ed.

X1.1.3.4 ASTM STP 1069, Building Sealants: Materials, Properties, and Performance, Tom O'Connor, ed.

X1.1.3.5 ASTM STP 1034, Exterior Wall Systems: Glass and Concrete Technology, Design, and Construction

X1.1.3.6 ASTM STP 1168, 1st Building Seals, Sealants, Glazing, and Waterproofing, Chuck Parise, ed.

X1.1.3.7 ASTM STP 1200, 2nd Science and Technology of Building Seals, Sealants, Glazing and Waterproofing, Jerry Klosowski, ed.

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X1.1.3.9 ASTM STP 1243, 4th Science and Technology of Building Seals, Sealants, Glazing, and Waterproofing, David Nicastro, Ed.

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