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[redacted] Florida
Glazing Damage Assessment
FINAL – 1-10-22

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1/10/2022

Re: Storm Related Structural Glazing Assessment

[redacted]
[redacted] **Florida 32507**

TSSA Project # [redacted] **-** [redacted] **- 2021-10-9**
Date of Loss: September 16th, 2020
FINAL - 1/10/2022

Dear Mr. [redacted]

As requested by [redacted] TSSA Storm Safe DAC Inc. (TSSA) conducted a glazing damage assessment of the [redacted] residence on 10/9/2021. The purpose of this inspection was to evaluate the condition of the installed glazed systems (listed below) as they currently exist following the effects of a [redacted] that passed through the area on September 16th, 2020.)

Single Hung Window System - 35" X 58"
Picture Window System - 70" X 58"
Entry Door - 36" X 80"
Horizontal Roller Window System - 58" X 33"
Single Hung Window System - 35" X 35"
Double Mulled Single Hung Window System - 72" X 70"
Single Hung Window System - 26" X 72"
Single Hung Window System - 26" X 72"
Single Hung Window System - 23" X 70"
Single Hung Window System - 23" X 35"
Geometric Arch with Col Grid - 36" X 18"
Single Hung Window System - 23" X 51"
Single Hung Window System - 35" X 51"

Present during our TSSA inspection of the [redacted] Residence was Ivan Browner (President,) Steven Browner (Vice President,) and Nick O'Halloran (Director of Field Inspections) from TSSA Storm Safe DAC Inc. In addition, the homeowners, Mr. & Ms. [redacted] were also present during the inspection.

Inspection Protocol, Methodology, and Compliance:

The TSSA Storm Safe DAC Inc. inspection protocol, field inspection methodology, analysis, and reporting were performed in general compliance with standards and recommendations set forth by ASCE, FEMA, ASTM, and FGIA/AAMA.

Inspection Protocol: In general compliance with ASCE/SEI 30-14 "Guideline for Condition Assessment of the Building Envelope," TSSA employed a systematic inspection protocol to document and notate the physical damage profile seen on the installed glazed systems. The inspection protocol considered system installation, operational capacity, frame disposition, glazing disposition, and adherence to the main structure.

During the evaluation of the [redacted] Residence, TSSA inspectors employed the following protocol and procedures.

- Conducted a visual, non-destructive assessment of the residence to document, photograph, and evaluate damage witnessed on the glazed systems/.
- Collected field dimensions of the [redacted] Residence to illustrate the structure's general configuration and the location of all the observed damage to the windows.
- Reviewed published weather data and subsequent analysis for the effects of Hurricane Sally in [redacted] Florida.
- Prepare an in-depth inspection analysis of each glazed opening, notating each specific type of Hurricane-related physical damage witnessed during our site visit.
- Prepared Executive Findings report summarizing the field investigation results and our storm damage evaluation and conclusions.
- Make a repair/replace recommendation after analyzing the damage witnessed and applying glazing science, technology, and standard practice concepts.

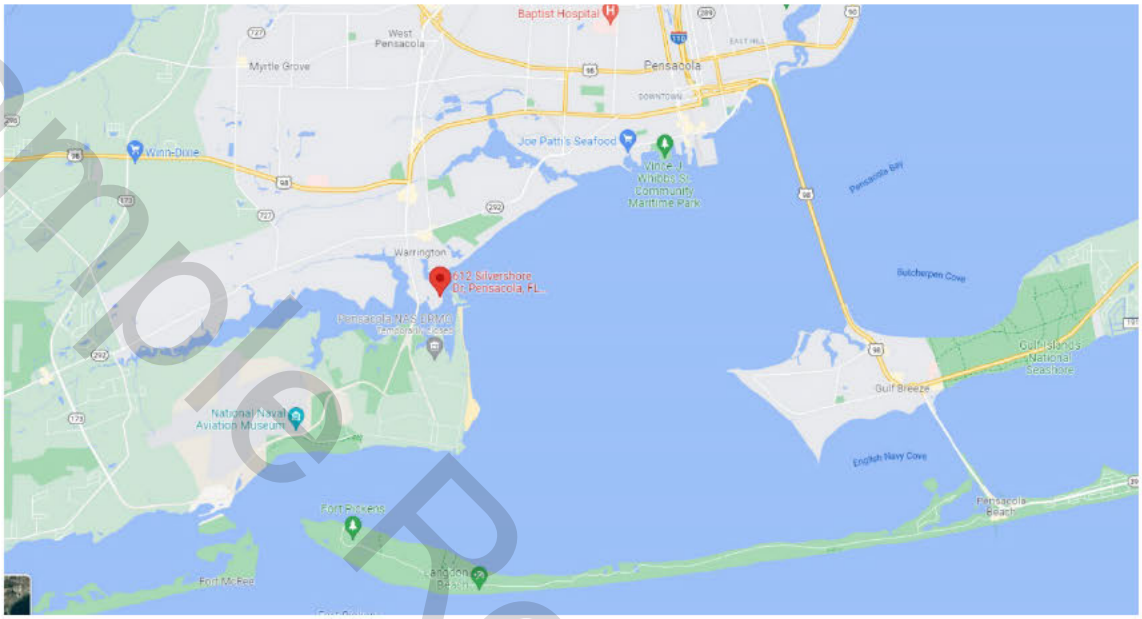
Overview of Site Conditions

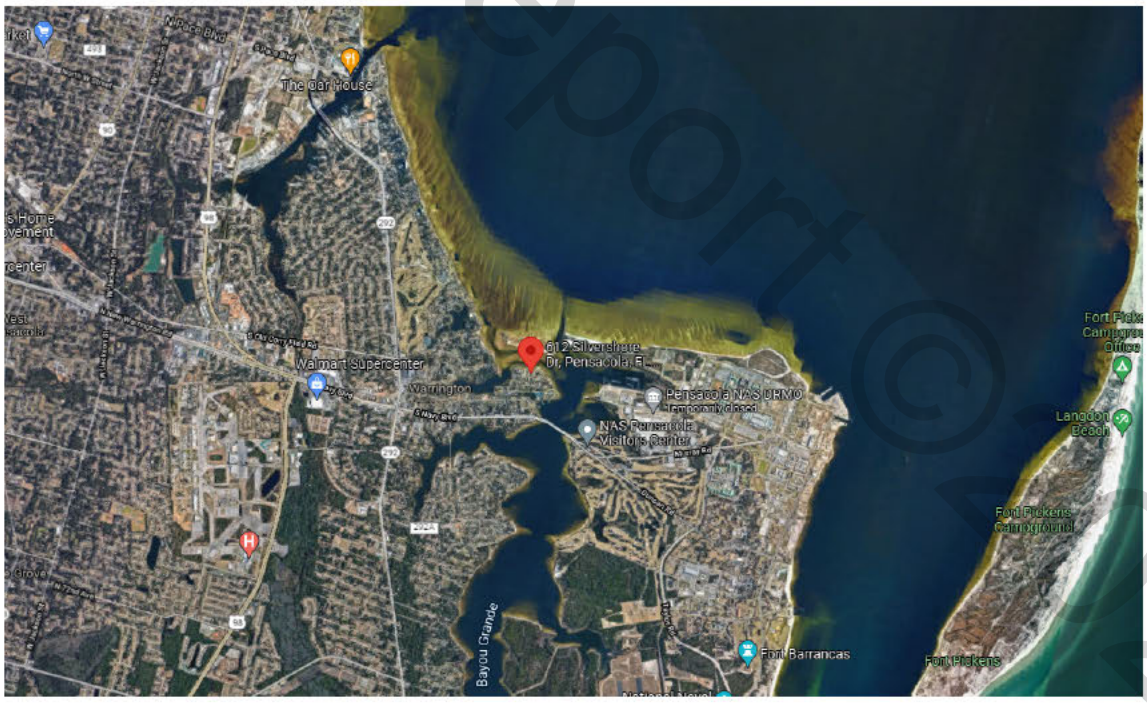
The [redacted] Residence is a one-story single-family home located at [redacted] Florida 32507.

Background Information

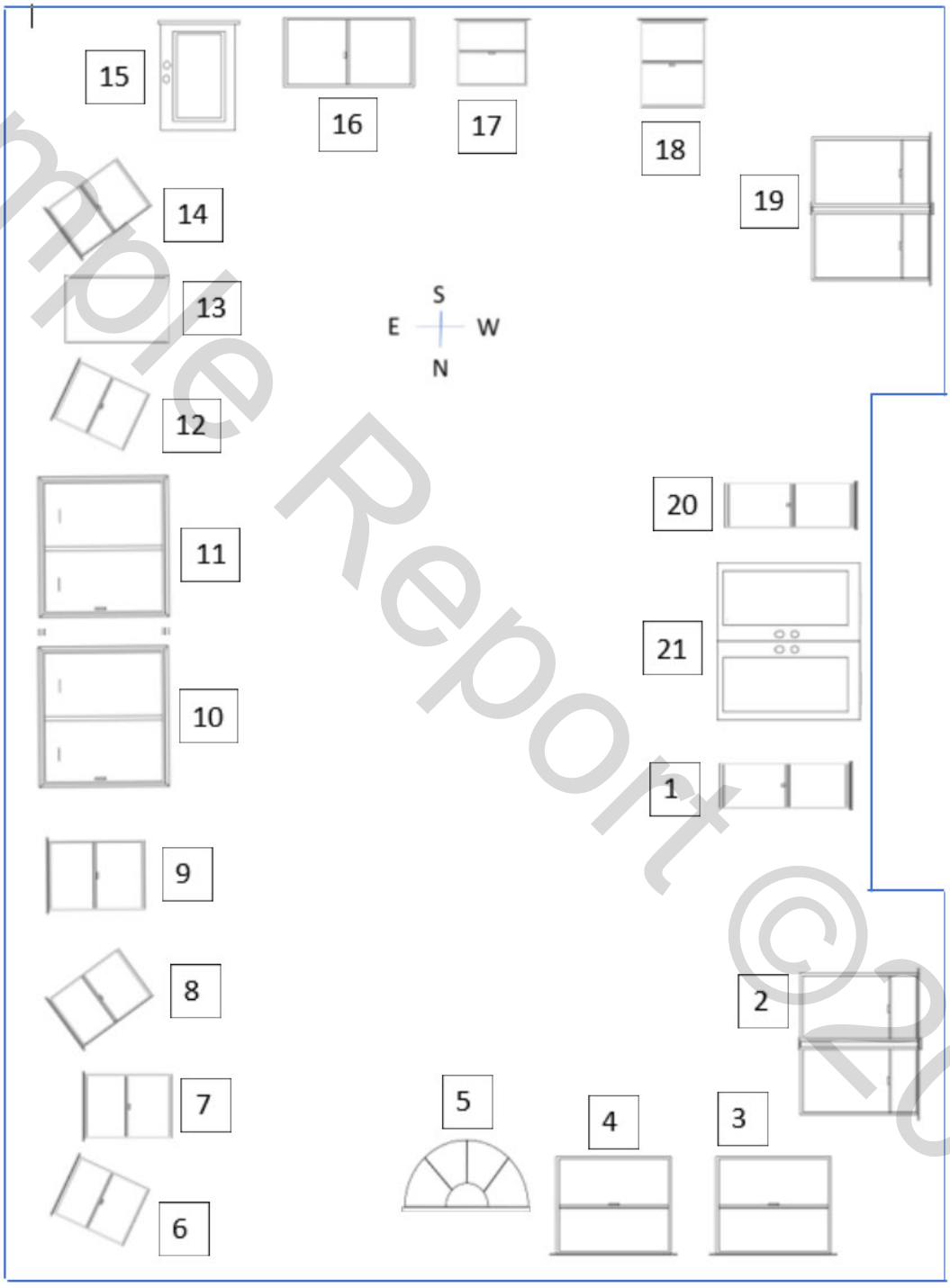
The two-story structure was constructed via a coastal elevated "stilt" method with a slab on grade foundation and wood columns supporting the upper floor. The structure is framed with a wood framing system, wood lateral support beams, and wood beams with wood siding exterior cladding. According to the [redacted] County Property Appraisers Office, the two-story family house was built in 1992 with a total gross square footage of 5,752 (2,010 sq. ft. under air conditioning.)

[redacted] Residence - [redacted]



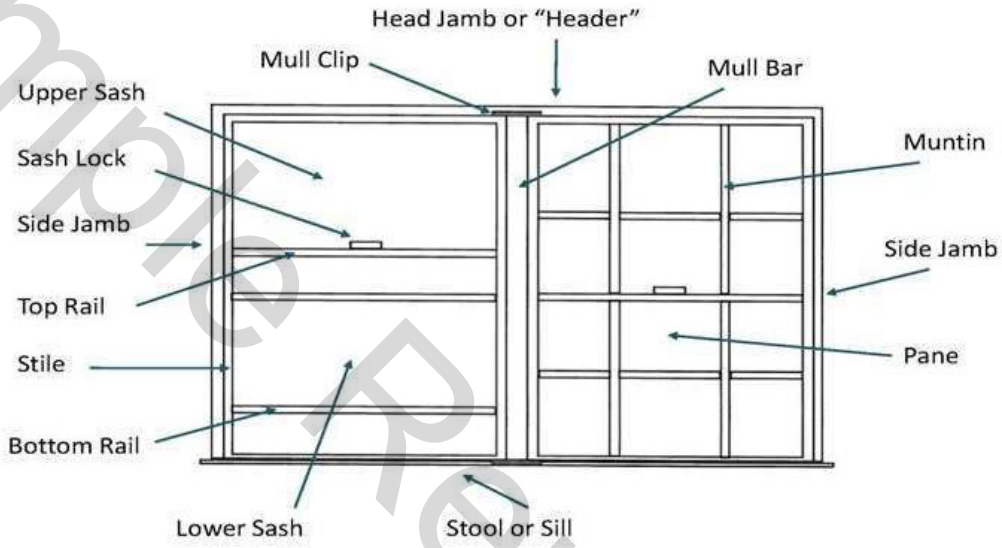


[redacted] Residence – Wall Map

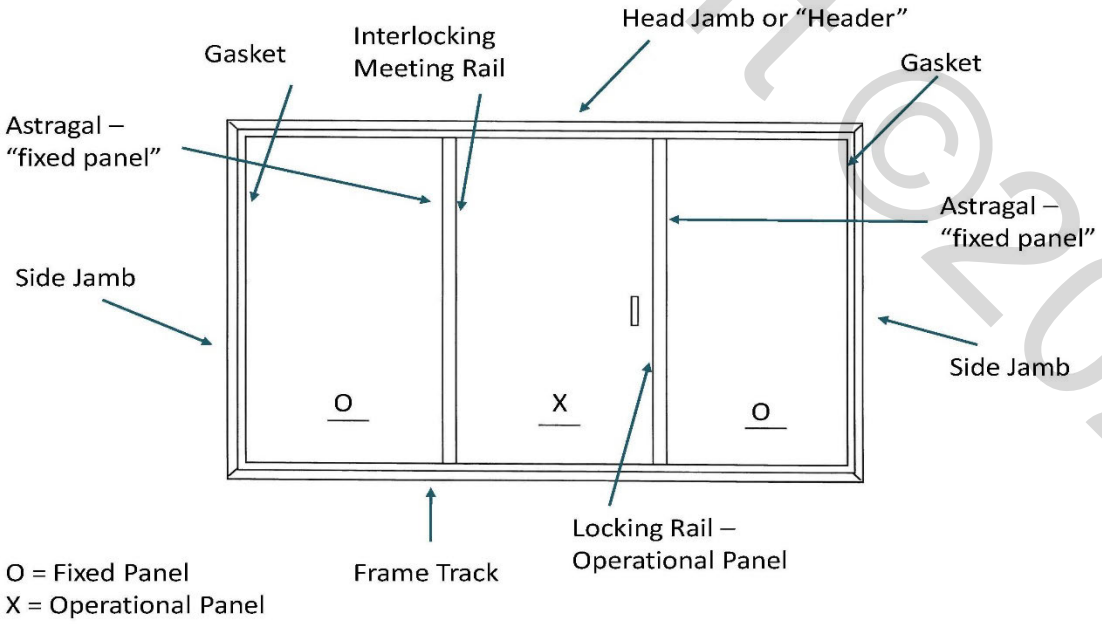


Manufacturer's Installed and System Nomenclature:

Single Hung Window System



Sliding Glass Door System



[redacted]
[redacted] Florida 32507

Number of Systems Inspected:

There are 21 glazed openings in the [redacted] Residence consisting of the following Window Types:

Single Hung Window System
Picture Window System
Entry Door
Horizontal Roller Window System
Double Mulled Single Hung Window System
French Entry Door
Geometric Arch with Col Grid

TSSA was able to investigate each type of window and door system installed in the structure.

TSSA inspectors were able to physically inspect 21 out of the 21 (100%) or the glazing openings in the [redacted] Residence, and the following was observed:

Explanation of Major Damages Identified -

The purpose of the following section is to identify and explain the Major Repeated Damage types that were witnessed throughout the entire campus of the [redacted] Residence inspection. In our professional opinion, TSSA Storm Safe DAC Inc. defines Major Damage as damage identified on the glazed system, which jeopardizes the structural integrity of the building envelope. The following explanations of physical damage (Frames out of Alignment, Frame Separation, Frame Rotation, Interior Finish Distress, Exterior Finish Distress, Deglazing, Spacer Damage, and Glass Stop Damage) were discovered repetitively on all the major directional facings, elevations, and exposures of the campus.

The glazed systems installed were stressed, buffeted, and exposed to the intense Hurricane created wind force and came to rest in a damaged state showing a diminishment of capacity to keep a congruent glazed envelope of protection and a weather-tight barrier

These physical damages are an example of what occurs when windows that share the characteristics of assembly and installation, such as the systems installed in the [redacted] Residence, are overstressed and affected by intense Hurricane-created wind pressure.

Summary of Glazing Damages Observed

Frames Out of Alignment

During our investigation of the [redacted] Residence TSSA Storm Safe DAC Inc. inspectors witnessed misaligned frames, and entry door panels. Window and Door components move out of alignment when they are acted upon by high wind created buffeting and pressure. The window and door components are forced to move within their locked position creating stress on the hinges and locking mechanisms causing these operational components to become misaligned within their installed position. This physical damage creates binding and difficulty during operation, but more importantly create separate between adjoining frame members causing a diminishment of the system's capacity to keep a congruent envelope of protection. The systems currently sit in a diminished state and are susceptible to moisture intrusion between the opened joints.

Frame Separation

During our investigation of the [redacted] Residence, TSSA Storm Safe DAC Inc. inspectors witnessed frame separation seen at adjoined framing components of the installed Single Hung Window Systems. High wind created buffeting of the glazed systems and adverse framing system movement allowed the assembly systems to separate between adjoining frame members causing a diminishment of the window's capacity to keep a congruent envelope of protection. The glazed systems currently sit in a diminished state and are susceptible to moisture intrusion between the opened joints.

Frame Rotation

During our investigation of the [redacted] Residence, TSSA Storm Safe DAC Inc. inspectors witnessed frame rotation seen at adjoined framing components of the installed Single Hung Window Systems. High wind created buffeting of the glazed systems and adverse framing system movement allowed the assembly systems to separate between adjoining frame members causing a diminishment of the window's capacity to keep a congruent envelope of protection. The glazed systems currently sit in a diminished state and are susceptible to moisture intrusion between the opened joints.

INTERIOR FINISH DISTRESS

Throughout the TSSA Storm Safe Inc. Glazing Damage Assessment of the [redacted] Residence, our inspectors witnessed interior finish. The buffeting of the systems during a high wind event allowed the glazed systems to vibrate and move within their installed position. This movement affected the installation fastening system and created system movement which disrupted the interior finish between the systems framing and its interior finish reveal.

EXTERIOR FINISH DISTRESS

Throughout the TSSA Storm Safe Inc. Glazing Damage Assessment of the [redacted] Residence, our inspectors witnessed exterior finish. The buffeting of the systems during a high wind event allowed the glazed systems to vibrate and move within their installed position. This movement affected the installation fastening system and created system movement which disrupted the exterior finish between the systems framing and its exterior finish.

Deglazing

Throughout the TSSA Storm Safe Inc. Glazing Damage Assessment of the [redacted] Residence, our inspectors witnessed widespread deglazing observed between the glazing channel and glass panes of the installed window systems. The sealant edge between the framing system and the glass pane was used to set the primary glazing seal in the same manner the primary seal is set around the installation flange of the window framing system. When a window system's glass pane is acted upon by cyclical movement such as during an interaction with a high wind event, the glass pane moves violently within the glazing channel severely weakening if not completely separating its adherence to the framing system. This is a dangerous combination which leaves the envelope of protection in a state that is no longer performing its function to protect the interior living space from the exterior elements.

(NOTE – the depth gauge is used only to show the deglazed panel and is not depicting a depth of penetration between the glazing stile and glass lite.)

Spacer Damage

During our investigation of the [redacted] Residence our inspectors witnessed disruption of the Spacer found within the Insulating Glazing Units installed on site. Wind Buffeting and Pressure created during a high wind event effects the IGU Air Space, as well as the adherence of the IGU within its glazing pocket. Spacer Migration, Spacer Sealant Disruption, and Deglazing are all indicative of IGU glass movement and damage created during a high wind event.

Glass Stop Damage

During our investigation of the [redacted] Residence our inspectors witnessed disruption of the exterior Glass Stop system components. A Glass Stop a molding used to hold glazing infills in position. When high wind created buffeting vibrates a glass infill within its installed position, the exterior glass stops become avulsed from their installed position and are no longer protecting the glazing channel and glass lite from the exterior elements. This damage will eventually lead to deglazing and moisture damage leaving the exterior envelope in a diminished and compromised state.

Repair Replace Analysis

After Analyzing the inspection data collected onsite, the following recommendations to repair or replace have been determined.

Window Map Location	SPECIMEN	FACING	ROOM	SPECNUM	Damages Identified	Reccomendation to Correct
1	SH_35X58	E	DR	1	,O,DS,MI,FOA,GSD,OS,FS,EFD,	REPLACE
2	DL_70X58	E	DR	2	,IFD,HM,JM,NSI,	REPLACE
3	SH_35X58	E	DR	3	,NO,BM,MI,DS,GSD,FOA,JM,IFD,DG,FS,ED,	REPLACE
4	EDRES_36X80	S	DR	4	,O,FOA,C,MI,OS,	REPAIR
5	HR_58X33	S	K	1	,O,NSI,ND,	REPAIR
6	SH_35X35	S	LA	1	,O,GSD,DS,IFD,OS,EFD,FS,DG,	REPLACE
7	SH_35X58	S	3BR	1	,O,GSD,DS,LA,FS,OS,EFD,DG,SM,	REPLACE
8	2SH_72X70	W	3BR	2	,O,LA,HM,MM,MS,GSD,DS,IFD,	REPLACE
9	SH_26X72	W	F	2	,O,GSD,DS,FS,OS,DG,EFD,	REPLACE
10	ED-FD_72X80	W	F	3	,O,IFD,BM,FOA,IO,MI,OS,FS,AD,	REPLACE
11	SH_23X70	W	F	1	,IFD,DS,FS,O,MI,FOA,OS,SF,EFD,DG,	REPLACE
12	2SH_72X70	W	2BR	1	,O,DS,FS,MI,IFD,GSD,FOA,OS,EFD,	REPLACE
13	SH_35X58	N	2BR	2	,O,GSD,IFD,DS,FS,OS,EFD,DG,	REPLACE
14	SH_23X35	N	MBA	1	,O,FS,GSD,DS,MI,IFD,OS,HM,FOA,DG,EFD,SM	REPLACE
15	GEO-ARCH-CG_36X18	N	MBA	2	,DG,OS,EFD,SM,MI,IFD,	REPLACE
16	SH_23X51	E	MBR	1	,O,ASD,GSD,DS,MI,IFD,FS,OS,EFD,	REPLACE
17	SH_35X51	S	MBR	2	,O,GSD,IFD,MI,DS,FS,OS,FOA,DG,EFD,	REPLACE
18	SH_23X51	S	MBR	3	,O,IO,DS,GSD,MI,IFD,FS,OS,FOA,DG,EFD,OR,	REPLACE
19	SH_35X51	S	MBR	4	,NO,FS,DS,DG,FOA,IFD,OS,EFD,GSD,SM,	REPLACE
20	2SGD_72X80	E	LR	1	,O,IFD,FS,	REPLACE
21	2SGD_72X80	E	LR	2	,O,FS,IFD,HM,OS,	REPLACE
					REPAIR	10%
					REPLACE	90%
					NA	0%

Replace Determination –

Determination to Replace has been created based on excessive Frames out of Alignment, Frame Separation, Frame Rotation, Interior Finish Distress, Exterior Finish Distress, Deglazing, Spacer Damage, and Glass Stop Damage witnessed on the systems inspected. The combination of these physical damages is indicative of the effects of [redacted] created buffeting wind force, which has left these systems in a compromised state.

Repair Determination –

Determination to Repair has been created based on the fact that these systems did not show the same structural diminishment of capacity as the windows placed in the Replace group. Therefore, it is possible for an Engineered Approved Repair Protocol to be created to repair these specimens.

Findings – Our professional opinion is that the physical damages witnessed on the glazed systems are consistent with an interaction with Hurricane-created wind force, extensive buffeting, stress, and not common age, condition, or poor maintenance issues.

The list below highlights the physical damage profile witnessed during our Non-Invasive Physical Evaluation:

Frames out of Alignment
Frame Separation
Frame Rotation
Interior Finish Distress
Exterior Finish Distress
Mullion Separation
Deglazing

These physical damages dimmish a glazed system's ability to keep a congruent envelope of protection. This diminishment of capacity is a primary reason water would be allowed to penetrate through the damaged glazed systems framing members, glazing material, primary seal, and adherence to the building substrate.

Failure Analysis:

Storm Created Pressure Damage on Glazed Systems

[redacted] created wind speed, and subsequent pressure damage to the glazed systems installed at the [redacted] Residence was exacerbated by the glazed systems' rapid wind buffeting and cyclic movement.

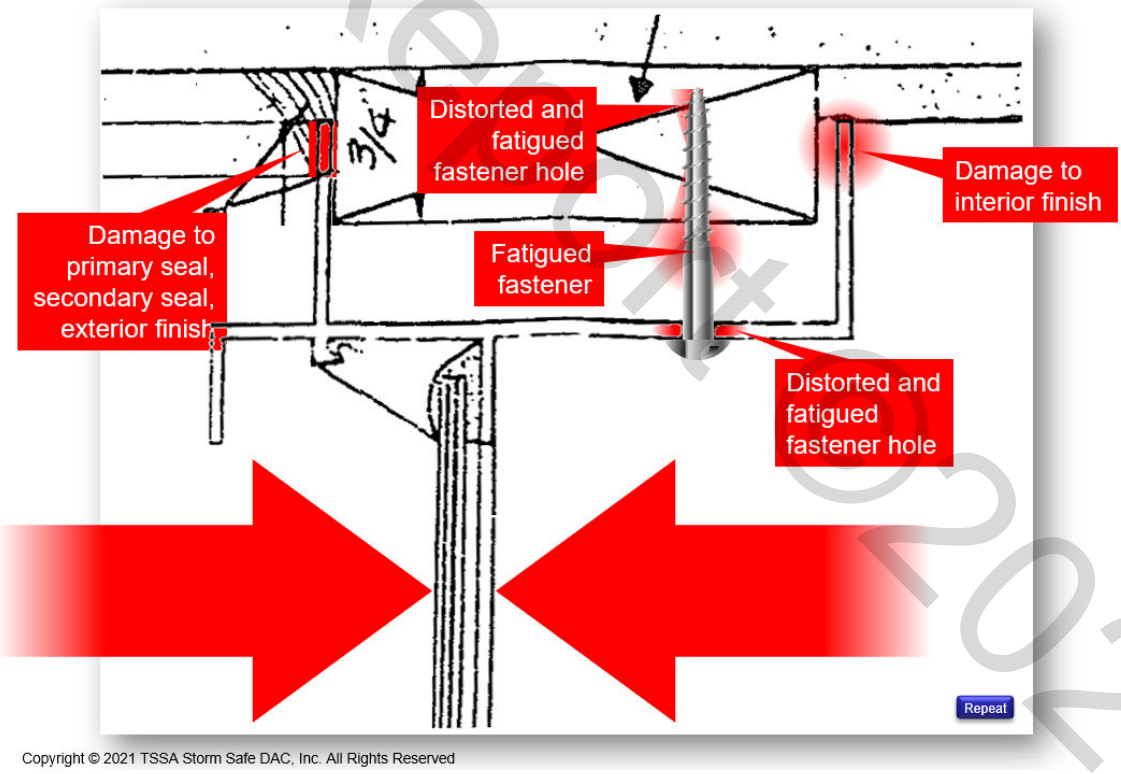
> [redacted] defines Wind buffeting as a "rapid change in either direction or magnitude such that the change is dramatically different from the immediately prior time step direction or immediately prior time step average wind speed."

Buffeting wind force is understood to have the ability to damage glazing systems, as well as other building envelope components well below design wind speeds:

> According to Baskaran et al., frequently buffeting winds can cause materials and building envelope failures well below design wind speeds. [1]

Below is a pictural example of how a glazed system is damaged during an interaction with a prolonged cyclic high wind event.

This photograph was taken during a cyclic pressure test of a single hung window system. This photograph demonstrates how high wind speed, pressure, and buffeting force affects glazed systems during a High Wind Event with extensive wind created buffeting. The rapid positive and negative cyclic movement and high wind buffeting create separations and disruptions in a window system framing joints, installation fasteners, and glazing system causing failure in the components allowing water to penetrate through the exterior building envelope into the interior living space.



Physical damage created by

Conclusions – The professional opinion of TSSA Storm Safe DAC Inc. is that the glazed systems inspected at the [redacted] Residence have been damaged to the point of being unable to adequately protect the interior living space from the exterior elements.

Hurricane created High Wind Speed, Pressure, and wind buffeting force caused the windows framing, installation, and glazing components to separate. The post-storm condition of the windows installed at the [redacted] Residence now sit in a compromised state and with a diminished capacity to keep a congruent envelope of protection. It is also important to note that the glazed systems are now in peril of failing during a less powerful wind event.

It is the professional opinion of TSSA Storm Safe DAC Inc. that the glazed systems need to be repaired "by an engineered approved repair protocol" or replaced.

An engineer approved protocol of Repair would have to be developed, taking into consideration frame removal, internal system evaluation, dismantling and deglazing the existing system, re-assembling the system using new frame members, re-sealing frame corner coping, reinstallation of the frame system to recreate a proper weather-tight exterior primary seal following best installation practices laid out by FGIA. After the repaired system has been successfully re-installed, the performance of ASTM or FGIA nationally recognized quality assurance testing to certify the repairs have been completed and are successful. Additionally, replacing the systems would be necessary if the systems were not adequately repaired as per the engineer-approved method or the systems framing components can no longer sufficiently ensure a congruent exterior envelope of protection.

Limitations – The contents of this condition damage assessment letter are intended for the use of Mr. [redacted] and his representatives or clients. TSSA Storm Safe Inc. assumes no liability for the misuse of this information by others. The professional opinions and recommendations included within this condition damage assessment letter are based on the results and interpretations of the non-invasive testing and data collection activities performed at the site. TSSA Storm Safe Inc. reserves the right to update this letter should additional information become available.

MOISTURE METER TECHNOLOGY – The Ryobi Model # E49MM01 Moisture Meter Gauge and General 4-in-1 Pin/Pad RH Moisture Meter Model # MMH800 were utilized for the sole purpose of the TSSA Storm Safe Inc. inspector to document the presence of moisture in and around the Glazed System Specimen in order to validate his remarks on Moisture Intrusion, Damage, and Penetration. No Microbial, Bacterial, Environmental, or other scientific data was investigated, interpreted, and otherwise implied by the testing, data gathering, and investigation completed with the Ryobi Model # E49MM01 Moisture Gauge or General 4-in-1 Pin/Pad RH Moisture Meter Model # MMH800.

Closing Statement - The opinions authored in this condition damage assessment letter are a direct result of Ivan Browner (TSSA's President) and TSSA Storm Safe DAC Inc.'s background, training, and combined experience, which spans over 70 years in all facets of the glazing industry. TSSA Storm Safe DAC Inc. has inspected over 500,000 windows, sliding glass doors, curtain walls, storefront systems, and architectural products in multiple states.

As the author of this condition damage assessment letter, the basis for the opinions expressed herein are to a reasonable degree of professional certainty. However, TSSA Storm Safe DAC Inc. reserves the right to update this report should additional information become available.

The TSSA Storm Safe DAC Inc., glazed damage assessment investigation of the [redacted] Residence was performed by the TSSA Storm Safe Inc. Field Inspection Team under my direct supervision.

Attached to this Glazing Testing Report are the following exhibits:

Exhibit A – Field Inspection Notes and Photos
Exhibit B – Ivan Browner (TSSA President) Curriculum Vitae
Exhibit C – TSSA Storm Safe Inc. Curriculum Vitae
Exhibit D – TSSA Storm Safe Inc. Expert Witness Fee Schedule
Exhibit E - References

TSSA Storm Safe DAC Inc. appreciates this opportunity to have assisted Mr. [redacted] with this investigation. Please call if you have any questions concerning this information.

Sincerely,

Ivan Browner
President
TSSA Storm Safe DAC Inc.

Exhibit A

Field Inspection Notes and Photos

TSSA STORM SAFE — Damage Assessment Consultants

Structural Glazing Damage Assessment

Project: 1 Residence

Building #/Letter: 1 Stack: A

Floor: 2 Unit: [redacted] RESIDENCE

Room: Dining Room / Specimen #: 3 Facing: E / Corner Unit: No

SYSTEM DISPOSITION:

- ☐ (ND) - NO DAMAGE
- ☐ (R) – REMOVED
- ☐ (NA) - NOT ACCESSIBLE
- ☐ (LA) - LIMITED ACCESS
- ☐ (NSI) - NEW SYSTEM INSTALLED
- ☐ (O) - OPERATIONAL
- ☒ (NO) - NOT OPERABLE
- ☐ (IO) - IMPAIRED OPERATION
- ☒ (BM) - BROKEN MECHANISM
- ☒ (ED) - EXCESSIVE DAMAGE
- ☐ (S) - SHUTTERS

EXPOSURE DAMAGE:

- ☒ (IFD) - INTERIOR FINISH DISTRESS
- ☐ (EFD) - EXTERIOR FINISH DISTRESS
- ☒ (MI) - MOISTURE INTRUSION
- ☐ (C) - CORROSION
- ☐ (SD) - SEALANT DISRUPTION

PHOTO START # 42

PHOTO FINISH # 78

FRAME DAMAGE:

- ☒ (FOA) - FRAME OUT OF ALIGNMENT
- ☒ (FS) - FRAME SEPARATION
- ☐ (FR) - FRAME ROTATION
- ☐ (HM) - HEADER MOVEMENT
- ☒ (JM) - JAMB MOVEMENT
- ☐ (FM) - FOOTER MOVEMENT
- ☐ (SM) - SILL MOVEMENT
- ☐ (MS) - MULL SEPARATION
- ☐ (MM) - MULL MOVEMENT
- ☐ (MR) - MULL ROTATION
- ☐ (AD) - ASTRAGAL DAMAGE
- ☐ (LP) - LOOSE PANEL
- ☐ (FD) - FRAME DEFLECTION

RELATIVE MOISTURE LEVEL:

(L JAMB) - _____% (R - JAMB) - _____%

(HEADER) - _____% (SILL) - _____%

(REFERENCE) - _____%

SYSTEM DAMAGE:

- ☒ (DG) - VISUAL SIGNS OF DEGLAZING
- ☐ (GI) - GASKET INGESTED
- ☐ (GNS) - GASKET NOT SEATED
- ☒ (DS) - DAMAGED SPACER
- ☐ (DF) - DAMAGED FASTENER
- ☐ (MF) - MISSING FASTENER
- ☒ (GSD) - GLASS STOP DAMAGE
- ☐ (ASD) - ASSEMBLY SYSTEM DISTRESS
- ☐ (BL) - BROKEN LITE
- ☐ (WD) - WEATHER STRIP DAMAGE
- ☐ (SF) - SEAL FAILURE
- ☐ (CPD) - COVER PLATE DAMAGE

TEMPORARY REPAIRS:

- ☐ (FP) - FRESH PAINT
- ☐ (PF) - PAINTED FRAMES
- ☐ (WP) - WALLPAPER
- ☐ (SR) - SEALANT REPAIR
- ☐ (RG) - RE-GLAZED
- ☐ (NG) - NEW GASKET
- ☐ (NF) - NEW FASTENER
- ☐ (OR) - OTHER REPAIR

WINDOW TYPE: Single Hung **WINDOW CODE:** SH_35X58

(OS) = OUTSIDE VIEW