



**Minimum Testing Guidelines for Evaluating Structural
Damage in Buildings with Respect to Florida Statute
§627.706**

SDA-13



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1. Title

Minimum Testing Guidelines for Evaluating Structural Damage in Buildings with Respect to Florida Statute §627.706

2. Designation

These assessment guidelines are issued under the fixed designation SD; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates an editorial. This standard has been peer reviewed and approved for use throughout this industry.

END OF SECTION

3. Scope

- 3.1** These assessment guidelines provide an outline of a recommended minimum investigation protocol for evaluating structural damages in buildings related to ground subsidence to fulfill the requirements of Florida Statute §627.706. Specifically, this guideline discusses numeric and rational analyses for the evaluation of post-construction settlement-related distress with respect to thresholds established within the definition of Structural Damage as found within Florida Statute §627.706, revised May 2011 (Sinkhole Insurance; Catastrophic Ground Cover Collapse; Definitions).
- 3.2** This standard does not provide or specify all of the quantitative testing and/or evaluation criteria called for within Florida Statute §627-706. It is the responsibility of the user of this standard to verify compliance with all applicable Florida Statutes and outside referenced standards such as ACI 117-90, ACI 318-95, and the Florida Building Code.
- 3.3** This standard does not purport to address potential safety concerns associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory requirements and limitations prior to use.

END OF SECTION

4. Referenced Documents

- 4.1 FAS3 HS08: Standard Test Method for Determining the General Levelness of a Floor System
- 4.2 Florida Building Code – Building
- 4.3 Florida Building Code – Existing Building
- 4.4 ACI 117-90: Standard Specification for Tolerances for Concrete Construction and Materials
- 4.5 ACI 318-95: Building Code Requirements for Structural Concrete
- 4.6 ACI 530/ASCE 5/TMS 402: Building Code Requirements for Masonry Structures
- 4.7 Florida Geological Survey, Special Publication No. 57: Geological and Geotechnical Investigation Procedures for Evaluation of the Causes of Subsidence Damage in Florida (2005)
- 4.8 Guideline for Structural Condition Assessment of Existing Buildings (11-99), American Society of Civil Engineers
- 4.9 Forensic Geotechnical and Foundation Engineering, Robert W. Day, 1999, McGraw-Hill, 460 pp.

END OF SECTION

5. Terminology

- 5.1 Analysis:** [FBC 1604.4] “Load effects on structural members and their connections shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility, and both short- and long-term material properties.”
- 5.2 Collapse:** [FBC 201.4 & Webster’s Third New International Dictionary of the English Language, Unabridged] “To fall or shrink together abruptly and completely,” or “To cave or fall in or give way.”
- 5.3 Dangerous:** [FBC: Existing Building 202] “Any building, structure or portion thereof that meets any of the conditions described below shall be deemed dangerous:
- 5.3.1 The building or structure has collapsed, partially collapsed, moved off its foundation or lacks the support of ground necessary to support it.
 - 5.3.2 There exists a significant risk of collapse, detachment or dislodgment of any portion, member, appurtenance or ornamentation of the building or structure under service loads.”
- 5.4 Imminent:** [FBC 201.4 & Webster’s Third New International Dictionary of the English Language, Unabridged] “Ready to take place.”
- 5.5 Limit State:** [FBC 1602] “A condition beyond which a structure or member becomes unfit for service and is judged to be no longer useful for its intended function.”
- 5.6 Primary Structural Member:** [F.S. §627.706] “A structural element designed to provide support and stability for the vertical or lateral loads of the overall structure.”
- 5.7 Primary Structural System:** [F.S. §627.706] “An assemblage of primary structural members.”
- 5.8 Substantial Structural Damage:** [FBC: Existing Building 202] “A condition where:
- 5.8.1 In any story, the elements of the lateral force-resisting system have suffered damage such that the lateral load-carrying capacity of the structure in any horizontal direction has been reduced by more than 20 percent from its pre-damaged condition, or

- 5.8.2 The capacity of any vertical load-carrying component, or any group of such components, that supports more than 30 percent of the total area of the structure's floor(s) and roof(s) has been reduced more than 20 percent from its pre-damaged condition and the remaining capacity of such affected elements, with respect to all dead and live loads, is less than 75 percent of that required by the Florida Building Code, Building for new buildings of similar structure, purpose, and location.”

END OF SECTION

6. Significance and Use

6.1 General

- 6.1.1 This standard is intended to provide a set of recommended guidelines for conducting a range of specific testing protocol. This document cannot replace education or experience and should be utilized in conjunction with professional judgment. This standard is not intended to represent or replace the standard of care of a given professional service, nor should it be applied without consideration of the unique aspect of each project.
- 6.1.2 The term “*standard*” as utilized in this document means that the document has been peer reviewed and approved through a consensus process for use by this industry.

6.2 With Respect to Florida Statute §627-706:

- 6.2.1 The purpose of this assessment protocol is to determine whether Structural Damage as defined within Florida Statute §627.706 exists at a building structure under investigation. The need for such a protocol arises from the fact that neither the Florida Building Code nor other standards envisaged the evaluation of post-construction deflection or settlement of building structures for purposes of defining or determining the presence of structural damage with respect to Florida Statutes.
- 6.2.2 Results of these tests, measurements, assessments, and surveys are to be used primarily as a means of determining the existence of structural damage at a particular property as defined within Florida Statute §627.706.
- 6.2.3 The results and findings of these tests, measurements, assessments, and surveys do not address whether a sinkhole loss has occurred as defined within Florida Statute §627.706. Therefore, if one of the five (5) Structural Damage Criterion has been met and structural damage has been found to exist, a determination should be made as to whether sinkhole activity exists and should be included as a cause of damage in accordance with Florida Statute §627.7073.

END OF SECTION

7. Summary of Assessment Protocol

7.1 Surveys and Assessments: These surveys and assessments are intended to collect data in order to determine integrity of the building's systems and components and to evaluate apparent settlement distress caused by possible displacement or deflection of the building structure resulting from movement or instability of the underlying soils.

7.1.1 **Horizontal Surface Survey:** The horizontal surface survey is to collect data by way of measuring to identify and report on the relative state of levelness of the interior floor system(s) and/or components to assist in evaluating the magnitude of post-construction displacement or deflection.

7.1.2 **Foundation Survey:** The foundation survey is intended to supplement the horizontal surface survey and is to be performed when post-construction displacement or deflection-related damage to primary structural members or primary structural systems is apparent; thereby indicating a survey is warranted. The foundation survey is to collect data by way of measuring to report on the relative state of levelness of the foundation systems and/or components necessary for the purpose of supporting the building.

7.1.3 **Wall Plumb Survey:** The wall plumb survey is intended to evaluate listing, leaning, or buckling of load-bearing walls or vertical systems and/or components for the purpose of evaluating the magnitude of displacement and/or rotation that may have resulted from post-construction displacement or deflection.

7.1.4 **Load Path Identification Survey:** The load path identification survey is intended to collect data by way of observation and documentation to identify and report on the building type, its primary structural systems and/or members, and their primary load paths.

7.1.5 **Soils Geotechnical Survey:** The soils geotechnical survey is to be performed when post-construction displacement or deflection-related damage within the building or any portion of the building containing primary structural members or primary structural systems indicates this survey is warranted. The soils geotechnical survey is intended to collect data by way of geophysical and geotechnical testing in order to evaluate the stability of soils and/or the presence of voids within the influence zone of the supporting ground within the shear plane necessary for the purpose of supporting the building or any portion of the building containing primary structural members or primary structural systems.

- 7.1.6 Serviceability and Safety Assessment: The serviceability and safety assessments are to be based on observations and data collected with respect to the current serviceability of the interior building structure or members and whether they evidence damage or distress which may render the structure unfit for service or present a safety hazard.
- 7.1.7 Structural Assessments: The structural assessments are to be based on observations and data collected with respect to displacement and/or deflection-related damage. These assessments are to examine the building as a whole and those portions of the building containing primary structural members or primary structural systems.

END OF SECTION

8. Procedures

8.1 Horizontal Surface Survey

Testing Criteria: The horizontal surface survey observations are to consist of relative elevation readings taken with the use of a calibrated manometer, calibrated gas level, or equivalent apparatus and are then to be used to develop a topographic map in accordance with FAS³ standard **HS08: Standard Test Method for Determining the General Levelness of a Horizontal Surface.**

Evaluation Criteria:

1. Concrete Slabs on Grade: the extent of interior floor surface displacement resulting from settlement must exceed $\pm \frac{3}{4}$ inch (ACI 117-90 Section 4.3.1.1) over the entire surface of the concrete slab on grade, or the gap between the floor and a 10-foot straightedge (placed on high spots) must exceed $\frac{1}{2}$ inch (ACI 117-90 Section 4.5.7).
2. Elevated Flooring System: the extent of interior floor surface displacement resulting from settlement must exceed the deflected limits listed in Table 1604.3 (Florida Building Code) for an elevated flooring system:

CONSTRUCTION	L	S or W	D+L
Floor members	L/360	--	L/240

Commentary: Considering that floor surfaces can exhibit a range of geometries based on the original construction and post-construction load-induced distortion, elevation measurements of the levelness of a floor surface cannot be utilized to directly determine displacement of the floor system. In order to properly evaluate potential floor displacement, the elevation data from the survey must be analyzed in conjunction with visible interior distress that may reflect differential movement of the floor surface. The distress will be identified and documented in the structural assessment of the building.

8.2 Foundation Survey

Testing Criteria: The foundation survey, when conducted, includes collecting relative elevation readings taken with the use of a calibrated manometer, calibrated gas level, or equivalent apparatus along the top of adjacent integral slabs or along the horizontal mortar joint lines at the top of the first or second course of exposed masonry. Evidence of discontinuities, unusual structural and/or topographic features, and original construction deficiencies are to be noted when encountered and further evaluated as deemed necessary.

Evaluation Criteria:

1. Concrete and Masonry Bearing Systems: the extent of foundation deflection resulting from settlement must exceed $L/480$ for foundations supporting primary structural members or systems likely to be damaged by large deflections (ACI 318 Table 9.5(b)), or
2. Wood and Steel Bearing Systems: the extent of foundation deflection resulting from settlement must exceed $L/240$ for primary structural members or systems not likely to be damaged by large deflection (ACI 318 Table 9.5(b))

Type of Member	Deflection to be considered	Deflection Limitation
<u>Foundation construction:</u> supporting or attached to elements likely to be damaged by large deflection	The total deflection occurring after attachment of the elements	$L/480$
<u>Foundation construction:</u> supporting or attached to elements not likely to be damaged by large deflection		$L/240$

8.3 Wall Plumb Survey

Testing Criteria: The wall plumb survey observations are to consist of relative plumb readings or readings taken with the use of a calibrated level or equivalent apparatus. The goal of the wall plumb survey is to check for listing, leaning, or buckling of the exterior load-bearing walls or other vertical primary structural members. Distress consistent with rotation and displacement of the structure will be identified and documented in the structural assessment of the building.

Evaluation Criteria: Related critical angle measurements and displacement and rotation criteria for typical bearing wall structures are listed below.

Maximum Listing/Leaning Tolerances								
			8-inch masonry		Wood frame (2X4)		Wood frame (2X6)	
Wall Height			8		4		6	
Masonry Courses	feet	inches	degrees	inches	degrees	inches	degrees	inches
	10		80	89.05	1 $\frac{1}{3}$	89.52	$\frac{2}{3}$	89.28
11		88	89.13	1 $\frac{1}{3}$	89.57	$\frac{2}{3}$	89.35	1
12	8	96	89.20	1 $\frac{1}{3}$	89.60	$\frac{2}{3}$	89.40	1
13		104	89.27	1 $\frac{1}{3}$	89.63	$\frac{2}{3}$	89.45	1
14		112	89.32	1 $\frac{1}{3}$	89.66	$\frac{2}{3}$	89.49	1
15	10	120	89.36	1 $\frac{1}{3}$	89.68	$\frac{2}{3}$	89.52	1
16		128	89.40	1 $\frac{1}{3}$	89.70	$\frac{2}{3}$	89.55	1
17		136	89.44	1 $\frac{1}{3}$	89.72	$\frac{2}{3}$	89.58	1
18	12	144	89.47	1 $\frac{1}{3}$	89.73	$\frac{2}{3}$	89.60	1
19		152	89.50	1 $\frac{1}{3}$	89.75	$\frac{2}{3}$	89.62	1
20		160	89.52	1 $\frac{1}{3}$	89.76	$\frac{2}{3}$	89.64	1
21	14	168	89.55	1 $\frac{1}{3}$	89.77	$\frac{2}{3}$	89.66	1
22		176	89.57	1 $\frac{1}{3}$	89.78	$\frac{2}{3}$	89.67	1
23		184	89.58	1 $\frac{1}{3}$	89.79	$\frac{2}{3}$	89.69	1
24	16	192	89.60	1 $\frac{1}{3}$	89.80	$\frac{2}{3}$	89.70	1
25		200	89.62	1 $\frac{1}{3}$	89.81	$\frac{2}{3}$	89.71	1
26		208	89.63	1 $\frac{1}{3}$	89.82	$\frac{2}{3}$	89.72	1
27	18	216	89.65	1 $\frac{1}{3}$	89.82	$\frac{2}{3}$	89.73	1
28		224	89.66	1 $\frac{1}{3}$	89.83	$\frac{2}{3}$	89.74	1
29		232	89.67	1 $\frac{1}{3}$	89.84	$\frac{2}{3}$	89.75	1
30	20	240	89.68	1 $\frac{1}{3}$	89.84	$\frac{2}{3}$	89.76	1
31		248	89.69	1 $\frac{1}{3}$	89.85	$\frac{2}{3}$	89.77	1
32		256	89.70	1 $\frac{1}{3}$	89.85	$\frac{2}{3}$	89.78	1

8.4 Load Path Identification Survey

The purpose of the load path identification survey is to identify the various bearing wall and frame systems and components, as well as their respective primary axial and lateral load paths running from the roof structure through the superstructure down to the substructure or foundation.

8.5 Soils Geotechnical Survey

In consideration of the evidence of displacement or settlement-related distress to the building, geophysical and/or geotechnical testing may be required for the purposes of identifying subsurface conditions within the influence zone likely to affect the structure.

Surface geophysical testing, when conducted, may be utilized in the vicinity of the building to assist in characterizing subsurface soil conditions and identifying anomalous subsurface features. The geophysical method employed should be capable of providing the necessary resolution and depth of investigation necessary to adequately characterize subsurface conditions or features affecting the building structure.

Applicable geophysical testing methods may include:

1. Ground Penetrating Radar (GPR)
2. 2-D or 3-D Electrical Resistivity Imaging (ERI)
3. Capacitive-coupled Resistivity (CCR, Ohm-Mapper)
4. Seismic Methods including Multispectral Analysis of Surface Waves (MASW)
5. Micro Gravity Survey (MGS)
6. Magnetometer, Metal Detector, or EM31 measurements

The geophysical testing methods and data reduction/analysis techniques should be conducted in accordance with relevant ASTM and industry standards and be appropriate to account for local geological and hydrogeological conditions and cultural features.

Subsurface geotechnical testing, when conducted, may be utilized for the purposes of identifying subsurface soil conditions and engineering properties. Applicable test methods may include Standard Penetration Test (SPT) borings or Cone Penetrometer Soundings (CPT) methods, hand auger borings, test pit excavations, penetrometer probings, static cone penetrometer probings, or dynamic cone penetrometer probings.

Laboratory soils testing may be conducted as deemed necessary to determine soil engineering properties and deleterious conditions with a potential to affect the building.

Evaluation Criteria: When post-construction displacement or deflection-related damage exists within the building or any portion of the building containing primary structural members or primary structural systems indicates that this survey is warranted, the following evaluation criteria shall be considered:

1. The shear plane is determined by the coefficient of friction for the type of soil(s) found beneath the subject structure. The influence zone shall be based on a rational analysis in accordance with well-established principles of soil mechanics.
2. The soils within both the influence zone and the shear plane that are likely to affect the structure should display a profile whereby imminent collapse could occur.

8.6 Serviceability and Safety Assessment

Testing Criteria: The serviceability and safety assessment shall examine the interior building structure or members consisting of its walls, ceilings, and floors. Evidence of any obvious safety concerns are to be noted when encountered.

Evaluation Criteria: The serviceability and safety assessment does not apply to interior fixtures or finishes. Therefore, when evaluating serviceability and safety, the minimum criteria as set forth by the Florida Building Code should be followed.

1. Walls: The serviceability requirement for walls is that they are expected to stay in place and have the ability to support applied finish membranes and/or fixtures in a safe manner.
2. Ceilings: The serviceability requirement for ceilings is that they are expected to support the loads placed on them and remain attached to their substrate with no safety issues being evident.
3. Interior Floor Slabs: The serviceability requirement for interior floor slabs is that they are expected to simply support the loads placed on them in a safe manner.
4. Safety: With respect to safety, egress should also be examined with respect to post-construction displacement related safety hazards.

8.7 Structural Assessment

The structural assessment should be based on observations and data collected with respect to displacement and/or deflection related damage. The assessment shall examine the building and those portions containing primary structural members or primary structural systems and focus on whether any of the following conditions existed or were judged to exist:

1. Damage rising to the level of Substantial Structural Damage as defined within the Florida Building Code
2. Damage which could possibly prevent primary structural members or primary structural systems from supporting the loads and forces that they were designed to support while being overstressed by a factor of one and one-third, or
3. Damage to the building or any portion of the building containing primary structural members or primary structural systems such that the building or any a portion of the building containing primary structural members or primary structural systems is likely to collapse because of the movement or instability of the ground within the influence zone of the supporting ground within the shear plane necessary for the purpose of supporting such building.

END OF SECTION