Designation: E 564 – 00$^{\epsilon 1}$

An American National Standard

Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings[1]

This standard is issued under the fixed designation E 564; 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 the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—An editorial change was made in 6.3.3.2 in March 2001.

1. Scope

1.1 This practice describes methods for evaluating the shear capacity of a typical section of a framed wall, supported on a rigid foundation and having load applied in the plane of the wall along the edge opposite the rigid support and in a direction parallel to it. The objective is to provide a determination of the shear stiffness and strength of any structural light-frame wall configuration to be used as a shear-wall on a rigid support.

1.2 *Limitations*—This practice is not intended to be used as a basis for classifying sheathing shear capacity or as an evaluation of combined flexure and shear resulting from the wall being loaded on a flexible foundation.

1.2.1 The effect of sheathing variations is assessed by holding all other variables constant. Permitted variations in framing configuration and boundary conditions, however, require accurate documentation of the test setup to validate across-study comparisons of sheathing contribution to wall shear capacity.

NOTE 1—A wall tested on a flexible foundation is evaluated by comparing shear stiffness and strength results to those of an identical wall tested on a rigid foundation, following this practice. However, no methods are given for the measurement of wall bending displacements or assessment of stress distribution resulting from foundation flexure. Any extrapolation of wall racking behavior from the foundation conditions specified by this practice to flexible conditions shall be done with the support of a comparative test on a representative foundation.

1.3 *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:*

E 4 Practices for Force Verification of Testing Machines[2]

E 72 Test Methods of Conducting Strength Tests of Panels for Building Construction[3]

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process[4]

E 575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *racking*—when applied to shear walls, refers to the tendency for a wall frame to distort from rectangular to rhomboid under the action of an in-plane force applied parallel to the wall length.

3.1.2 *shear wall*—structural subassembly that acts as a cantilever/diaphragm to transfer horizontal building loads to the foundation in the form of horizontal shear and an overturning moment.

3.1.3 *uplift*—the vertical displacement measured at the loaded end stud with respect to the test apparatus.

3.2 *Symbols:*

3.2.1 a—height of cantilevered shear wall, in metres (feet).

3.2.2 b—length of cantilevered shear wall, in metres (feet).

3.2.3 C—initial length of the diagonal $\sqrt{a^2 + b^2}$, in metres (feet).

3.2.4 δ—diagonal elongation, in millimetres (inches).

3.2.5 Δ—total horizontal displacement of the top of the wall measured with respect to the test apparatus, in millimetres (inches). This value includes effects due to panel rotation, translation, and shear.

3.2.6 G'—global shear stiffness of the assembly, includes rotation and translational displacements as well as diaphragm shear displacement.

3.2.7 G'_{int}—internal shear stiffness of the assembly, includes only the shear displacement of the wall in calculation.

3.2.8 P—concentrated load applied at the top edge of the wall at the selected reference displacement, in newtons (pound-force).

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.11 on Horizontal and Vertical Structures/Structural Performance of Completed Structures.

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[2] *Annual Book of ASTM Standards*, Vol 03.01.

[3] *Annual Book of ASTM Standards*, Vol 04.11.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

3.2.9 P_u—highest load level held long enough to record gage measurements, in newtons (pound-force).

3.2.10 S_u—ultimate shear strength of the assembly, in newtons per metre (pounds per foot).

4. Summary of Practice

4.1 The shear strength and stiffness of a wall assembly and its connections are determined by forcing a racking deformation. This is accomplished by anchoring the bottom edge of the wall assembly and applying a force to the top edge oriented perpendicular to the wall height dimension and parallel to the wall length dimension. Wall distortion is restricted to the plane of the unstressed wall. The forces required to rack the wall and the corresponding displacements at each load interval are measured.

5. Wall Test Assembly

5.1 *General*—A wall assembly consists of frame elements including any diagonal bracing members or other reinforcements, sheathing elements, and connections. The wall assembly tested in accordance with this practice shall represent the minimum acceptable stiffness using the targeted frame and sheathing materials.

5.2 *Connections*—The performance of the wall test assembly is influenced by the type and spacing of framing connections, sheathing-to-frame connections and the wall assembly anchorage connection to the test fixture, floor, or foundation.

5.2.1 All connections used in the test shall be representative of those used in the actual building construction.

5.2.2 Connector size and location on the frame shall correspond to specifications.

5.3 *Frame Requirements*—The frame is an integral part of the wall test assembly. The test wall shall consist of the same number, size, and grade of framing members as are intended to be used in service.

5.4 *Test Setup*—Provisions shall be made to resist rigid-body rotation in the plane of the wall where this reflects the use of the assembly in actual building constructions. This shall be done by application of relevant gravity or other loadings simultaneously with the racking loads. The bottom of the assembly shall be attached to the test base with anchorage connections simulating those that will be used in service. Load distribution along the top edge of the wall shall simulate floor or roof members that will be used in the actual building construction. When required to minimize distortion, reinforcement, such as a strong-back attached along the length of the top plate or a steel bearing plate attached to the end of the top plate shall be installed. The wall test assembly shall be laterally supported along its top with rollers or equivalent means so as to restrict assembly displacement outside the plane of loading. Lateral support rigidity shall not exceed that provided in the actual building construction.

5.5 *Wall Size*—Test wall size will vary with the study objectives. Tests conducted to assess the structural performance of actual building construction shall have dimensions commensurate with those of the shear walls being simulated.

5.6 *Curing and Conditioning*—For framed wall constructions containing elements whose structural performance is a function of age, curing conditions, moisture content, or temperature, the wall test assembly shall be conditioned prior to the test in accordance with the appropriate voluntary consensus standards, manufacturer specifications, or industry curing practices for the various products used, or as needed to meet the intent of the test. Care shall be taken to ensure that curing and conditioning are representative of that expected in the actual building construction and that all elements of the wall test assembly at the time of the test are approximately at the equilibrium conditions expected in service.

5.7 *Environmental Effect*—When required to evaluate wall assembly performance for simulated environmental conditions, preconditioned specimens shall be tested in an environmental chamber.

6. Procedure

6.1 *Number of Tests*—Test a minimum of two wall assemblies to determine the shear capacity of a given construction. For unsymmetrical shear walls, run the second test with the specimen orientation reversed with respect to the direction of the load application used in the first test. If the strength or shear stiffness of the second test is not within 15 % of the results of the first test, test a third wall assembly with the wall oriented in the same manner as the weaker of the two test values. The strength and stiffness values reported shall be the average of the two weakest specimen values if three or more tests are performed.

6.2 *Loading Procedure*:

6.2.1 *General*—Racking loads shall be applied parallel to and at the top of the wall, in the central plane of the frame, using a hydraulic jack or similar loading device capable of maintaining a constant displacement rate for continuous load to failure or holding a static load in the case of incremental loading. Loads shall be applied at a constant rate of displacement to reach the target limit (that is, limiting displacement of ultimate load) in no less than 5 min.

6.2.2 Gravity loads, when required, shall be applied along the top of the wall in a manner consistent with floor or roof frame loading.

6.2.3 *Static Load Test*—Maintain the duration of load application at each increment at least 1 min before load and deflection readings are recorded. Apply preload of approximately 10 % of estimated ultimate load and hold for 5 min to seat all connections. Remove the load, wait 5 min, and read all gages as the initial readings. At load levels approximately one third and two thirds of the estimated ultimate load, remove the load and record the recovery of the wall after 5 min. Reload to the next higher load level above the backoff load. Continue loading and unloading in this manner until ultimate load is reached.

6.3 *Data Acquisition*—The objectives of a study determine the data required from this test. These generally include quantification of the shear strength and stiffness of the wall diaphragm. Shear strength is denoted as the maximum load per unit length of the wall. Shear stiffness requires measurement of the racking load and corresponding shear displacement. Shear strain is determined as the angular displacement (Δ/a Fig. 1).

6.3.1 Racking load shall be monitored using either the line pressure to a calibrated loading ram or a load cell mounted in series with the loading device. When load measurement is