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Load Tests for Metal-Clad Wood-Frame Diaphragms

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Developed by the ASAE Wood Construction & Engineering Committee; approved by the Structures and Environment Division Standards Committee; adopted by ASAE December 1998; reaffirmed February 2004, February 2009; revised February 2014.

Keywords: Diaphragms, Structure, Tests

1 Purpose and Scope

1.1 The purpose of this Engineering Practice is to define a test method for determination of the in-plane strength and stiffness of a metal-clad wood-frame diaphragm assembly. The design values determined by this method shall be used in accordance with ANSI/ASAE EP484 or other acceptable standards to design buildings or structural systems to resist in-plane shear forces.

1.2 This method shall be used for diaphragm assemblies constructed with roll-formed metal sheeting (e.g., steel, aluminum) attached to any type of wood framing system. If rigid or blanket insulation is to be installed between the metal sheeting and wood framing in the building being designed, identical insulation shall be installed in a similar fashion in the test assembly.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies unless noted. For undated references, the latest approved edition of the referenced document (including any amendments) applies.

AF&PA, National Design Specification (NDS) for Wood Construction

ANSI/ASAE EP484, Diaphragm Design of Metal-Clad Wood-Frame Rectangular Buildings

ASTM E455, Standard Method for Static Load Testing of Framed Floor or Roof Diaphragm Construction for Buildings

ASTM E4, Standard Practices for Force Verification of Testing Machines

3 Definitions

3.1 adjusted load-point deflection, D_T: Load-point displacement of a test assembly after adjustment for rigid body rotation/translation of the test assembly.

3.2 cantilever test: A load test arrangement in which the test assembly is supported along one edge and the shear load is applied at a corner of the opposite edge and in the direction parallel to the direction of the line of action of the supports (Figures 1 and 2). Cantilever tests can be used to evaluate roof, ceiling, and wall assemblies.

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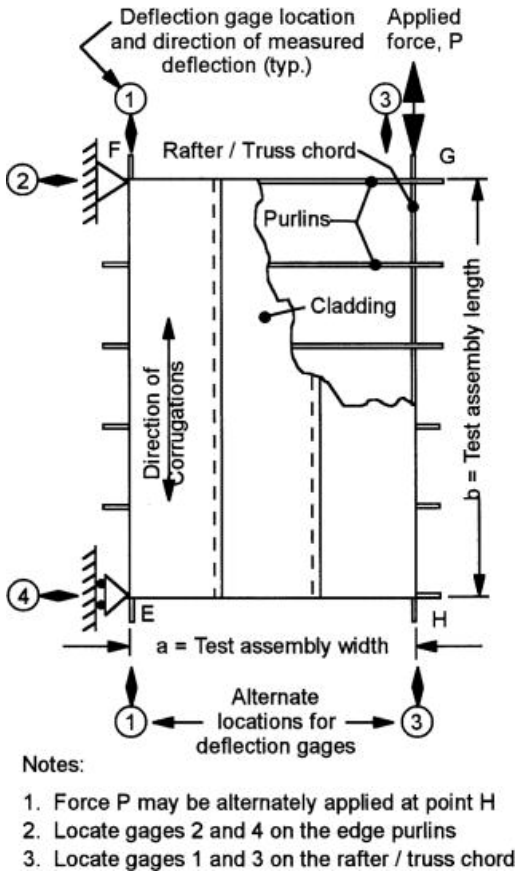

Figure 1 – Roof and ceiling assemblies, cantilever test

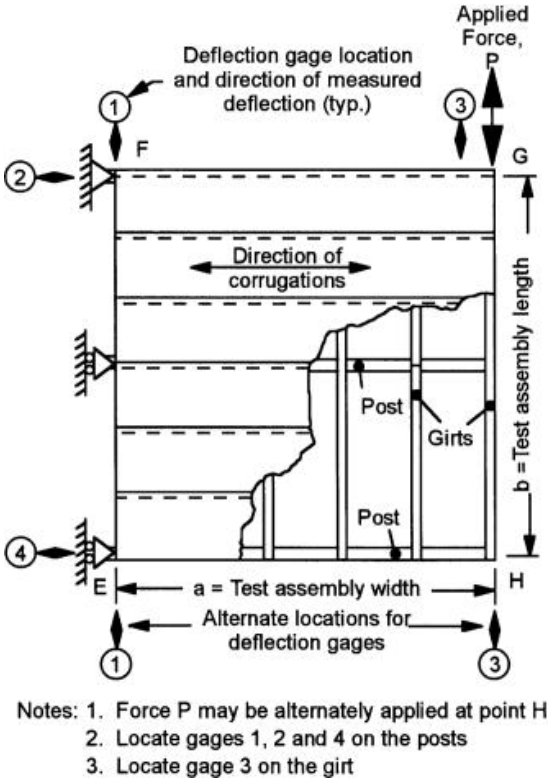

Figure 2 – Wall assembly, cantilever test

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3.3 diaphragm: A structural assembly comprised of wood or wood product framing, metal cladding, and fasteners capable of transferring in-plane shear forces through the cladding and framing members.

3.4 diaphragm design: Design of roof and ceiling diaphragm(s), wall diaphragms (shearwalls), primary and secondary framing members, component connections, and foundation anchorages for the purpose of transferring lateral (e.g., wind) loads to the foundation structure.

3.5 diaphragm fasteners: The various fasteners and fastener patterns used to connect the several components of the diaphragm. These include fasteners between cladding and purlins, between cladding and girts, between diaphragm framing members, and between individual sheets of cladding (stitch fasteners).

3.6 effective shear stiffness, *c*: The in-plane shear stiffness of a diaphragm as determined by test. Defined as the slope of a line drawn between the two points on a shear load-deflection curve that correspond to zero load and the allowable design shear strength.

3.6.1 effective shear modulus, *G*: the arithmetic product of the effective shear stiffness and the aspect ratio (a/b) of the test assembly.

3.7 frame spacing, *s*: The distance between post-frames (see *post-frame* and *post-frame building*). In the absence of posts, the frame spacing is generally equated to the distance between adjacent trusses (or rafters). Frame spacing may vary within a building.

3.8 load, *P*: The force applied to a test assembly. For simple beam tests, P equals the sum of the forces applied at the two load points.

3.8.1 ultimate load, P_u: The maximum load that a test assembly will support.

3.9 metal cladding: The metal exterior and interior coverings, usually cold-formed aluminum or steel sheet, fastened to the wood framing.

3.10 post-frame: A structural building frame consisting of a wood roof truss or rafters connected to vertical timber columns or side-wall posts.

3.11 post-frame building: A building system whose primary framing system is principally comprised of post-frames.

3.12 primary framing: The main structural framing members in a building. The primary framing members in a post-frame building include the columns, trusses/rafters, and any girders that help transfer load between columns and trusses/rafters.

3.13 seam: Lap joint formed by adjacent pieces of metal cladding.

3.14 secondary framing: Structural framing members that are used to (1) transfer load between exterior cladding and primary framing members, and/or (2) laterally brace primary framing members. The secondary framing members in a post-frame building include the girts and purlins.

3.15 shear strength, *V*: The in-plane shear (expressed on a unit length basis) that is present in a test assembly. Calculated by dividing the force applied at an assembly load point by the length, b, of the assembly.

3.15.1 allowable design shear strength, V_a: The maximum in-plane shear that a unit length of diaphragm is permitted to transfer under allowable stress design procedures in the AF&PA standard.

3.15.2 ultimate shear strength, V_u: The in-plane shear (expressed on a unit length basis) that is present in a test assembly at the point of maximum loading.

3.16 shearwall: A vertical diaphragm in a structural framing system. A shearwall is any endwall, sidewall, or intermediate wall capable of transferring in-plane shear forces.

3.17 simple beam test: A load test arrangement for a test assembly in which the assembly is loaded as a simple beam (Figure 3). Simple beam tests are only used to evaluate the strength and stiffness of roof and ceiling diaphragm assemblies.

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