INTERNATIONAL STANDARD

ISO 18402

First edition
2016-09-01

Timber structures — Structural insulated panel roof construction — Test methods

Structures en bois — Panneaux sandwich porteurs isolants pour toitures — Méthode d'essais

Reference number
ISO 18402:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 165, *Timber structures*.

Introduction

This International Standard includes tests for tensile bonding strength of the panels, ageing, shear, creep performance, horizontal in-plane performance and out-of-plane bending performance. The tests applicable to panels for particular applications are indicated, while the test requirements include laboratory conditions, some advice is given in notes on the numbers of samples to be tested and the reporting of results.

This International Standard is not intended for quality control testing or for conformity assessment.

Timber structures — Structural insulated panel roof construction — Test methods

1 Scope

This International Standard specifies test methods for determining, for use in roofs, the structural properties of double-sided load bearing structural insulated panels having

— two face layers, at least one of which is a wood-based structural panel, and

— a core made of a thermally insulating material having sufficient shear strength to cause the face layers to act together structurally.

NOTE 1 Gypsum-based structural boards can be used as one face layer.

NOTE 2 Panels can contain internal framing or bracing.

NOTE 3 The performance of panels with non-structural insulation is generally calculable according to design codes such as EN 1995–1-1, or tested according to appropriate standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM D7446-09, *Standard Specification for Structural Insulated Panel (SIP) Adhesive for Laminating Oriented Strand Board (OSB) to Rigid Cellular Polystyrene Thermal Insulation Core materials*

ASTM D1183, *Standard Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

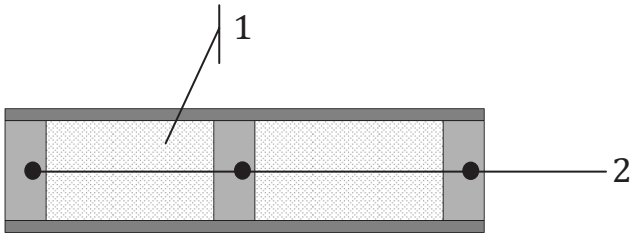
3.1
structural insulated panel
SIP
panel with two load bearing skins, one *bonded* (3.4) to each face of a rigid, lightweight, homogenous core material with sufficient shear strength to cause the face layers to act together structurally

Figure 1 — Cross section of a structural insulated panel

Note 1 to entry: Homogenous core is made of one material with no internal joints requiring bonding.

3.2
double skin box with structural core type structural insulated panel
panel with a rigid core surrounded by a structural frame, with or without internal ribs, and two skins mechanically fastened and/or *bonded* (3.4) to the frame and core forming a closed box

Note 1 to entry: The skins, core and frame all contribute to the load bearing capacity of the panel.



Key
1 core
2 internal structural frame

Figure 2 — Structural insulated panel with internal structural frame

3.3
slabstock
core material pre-formed into slabs of thickness equal to the required depth of the core and then *bonded* (3.4) with a suitable adhesive

Note 1 to entry: When the length and width of a slab of core material is less than or equal to the length and width of the SIP, they may be internally bonded.

3.4
bonded
components of a *structural insulated panel* (3.1) that have been joined together, usually by adhesive

Note 1 to entry: Alternatively, some foams used for cores are foamed *in situ* and are self-adhesive whilst expanding and curing, thus, bonding automatically to the enveloping components.

4 Symbols

$A_{F1} A_{F2}$	area of cross-section of the faces of the test panel, in square millimetres
a, b, c	distance, in mm
B	width of full panel, in mm
$E_{F1} E_{F2}$	Young's modulus of faces of the test panel, in N/mm^2
F	load, in N
F_{max}	maximum load, in N
F_u	ultimate load, in N
$F_{max,est}$	estimated maximum load, in N
F_V	applied vertical load, in N

D	panel thickness, in mm
Δs	real shear deformation, in mm
$\Delta s'$	apparent shear deformation, in mm
Gc	shear modulus of core, in N/mm^2
G'	apparent shear stiffness, in N/mm^2
F_g	self weight of loading element
F_{g_1}	self weight of the panel in N
F_{g_2}	applied permanent load, in N
F_{lever}	weight of lever arm, in N
F_{plate}	weight of loading plate and rod, in N
F_Q	variable load, in N
H	height of full panel, in mm
L	span, in mm
l	length of panel sample, in mm
M	mass, in kg
M_U	ultimate moment capacity, in kNm
P	load, in kN
R	stiffness, in N/mm; strength, in N/mm
R_U	maximum reaction at failure, in kN
S_U	ultimate shear strength, in N/mm
T	loading time, in seconds
T_r	recovery time, in seconds
W	impact energy, in J
b	width of panel sample, in mm
d_c	depth (thickness) of core, in mm
e	depth between the centroids of the faces, in mm
f_{cv}	shear strength of core material, in N/mm^2
f_{ct}	tensile strength of core material, in N/mm^2

t_1, t_2, t_3 overall thickness of the face in mm

Δt total deflection under vertical diaphragm load, in mm

w deformations, in mm;

w_u ultimate deformation, in mm

w_t total deflection under constant load at time t, in mm;

w_0 initial static deflection under constant load and temperature, in mm;

η factor of less than unity modifying $F_{max,est}$

v panel racking deformation, in mm

5 Product evaluation

5.1 Tests applicable to the panel construction

The following test regimes described in this International Standard relate to tests applicable to the panel construction:

a) tensile test on core and its bond to faces;

b) shear strength of solid core and its bond to faces.

5.2 Tests applicable to roof panels

The following test regimes described in this International Standard relate to tests applicable to the roof panel:

a) out of plane bending (stiffness and strength);

b) horizontal in-plane loading (racking stiffness and strength);

c) creep test;

d) long-term ageing/durability.

6 Structural testing

6.1 Conditioning

6.1.1 Standard conditioning

With the exception of 6.1.2, all test pieces in 6.2 to 6.6 shall be conditioned to constant mass in an atmosphere of relative humidity (65 ± 5) % and temperature (20 ± 2) °C. Constant mass is deemed to be attained when the results of at least three successive weighings indicate the moisture content has stabilized to within ±0,5 % for at least 48 h period.

If the conditions of the testing room are not the same as those in the conditioning chamber, test pieces shall remain in the conditioning chamber until testing and the test completed within 4 h.

6.1.2 Alternative conditionings

Test pieces may be differently conditioned and/or unconditioned.

Unless otherwise noted in the test report, results shall be corrected to reflect conditioning in accordance with 6.1.1. The procedure for correcting structural properties shall be technically sound and shall be recorded in the test report.

6.2 Tensile test on the core material and bonding between faces and core

6.2.1 Specimen size and sampling

The depth of the specimen shall be equal to the thickness of the panel (D). The width (b) shall be 150 mm and the length (l) shall be 150 mm.

NOTE The purpose of the test is to determine the tensile strength and critical failure mechanism, in the core or glue line, of the SIP.

The test specimens should be sampled from a range of positions covering the width and length of the panel, including the middle and the outer 10 % of the panel perimeter, as shown in Figure 3 below.

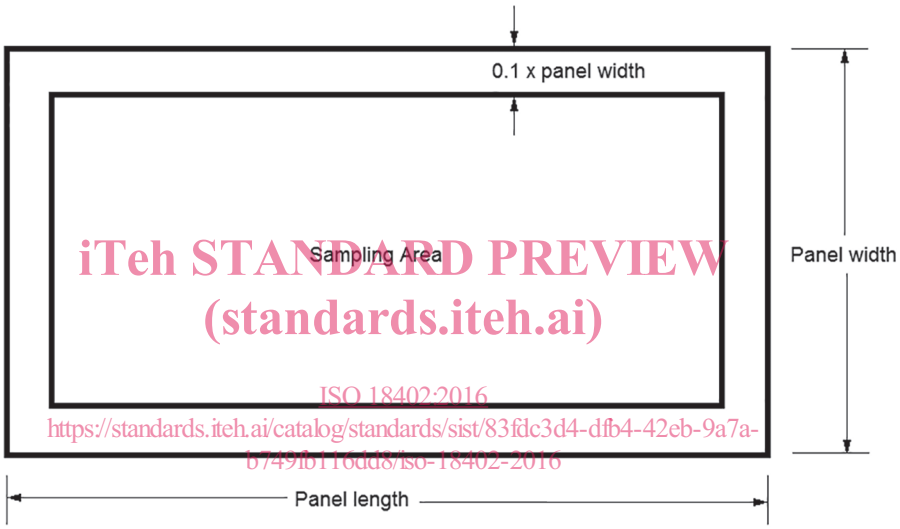


Figure 3 — Specimen sampling from panel

6.2.2 Conditioning

Specimens shall be conditioned in accordance with either 6.1 or to a specified elevated temperature conditioning. Specimens shall be tested immediately after removal from the conditioning chamber when performing an elevated temperature test.

Testing at elevated temperature may be appropriate for certain SIP applications. The performance of the panel unit should be verified at these conditions. If uncertain of in-service temperature levels, elevated temperature test specimens should be conditioned at 80 °C for at least 4 h. No further temperature measurement is required after conditioning.

6.2.3 Loading method and test procedure

Specimens shall be bonded, using a suitable adhesive, to platens of sufficient stiffness to ensure a uniform tensile stress over the area of specimen. When conditioned in accordance with 6.1, platens shall be bonded to the specimen after conditioning. Specimens of square cross-section shall be prepared as shown in Figure 4.