Research in Progress

Advanced Housing Research Center
Forest Products Laboratory
Madison, Wisconsin

Phase II: Creep Response of Structural Insulated Panels

Introduction

A structural insulated panel (SIP) is an engineered composite product composed of an insulating foam core sandwiched between two face sheathings (skins). The core provides the insulation and rigidity; the face materials provide durability and strength. Panels with expanded polystyrene (EPS) core and oriented strandboard (OSB) skins are the most popular in residential applications for load-bearing walls, floor panels, and roof panels. SIPs are finding increasing popularity as an alternative to the conventional framing system in construction because of their energy efficiency, ease and speed of construction, cost effectiveness, and interest in utilizing small-diameter logs.

Background

Creep and creep–rupture are time-dependent phenomena under sustained load and have been the subject of extensive research on wood-based products. Traditionally, creep–rupture has been accounted for in wood engineering through duration-of-load (DOL) factors. The Acceptance Criteria for Sandwich Panels AC04 does not require creep testing for product acceptance. Several researchers have looked into the creep behavior of the individual components (EPS core and OSB sheathing) of the SIPs under consideration in this study. Expanded polystyrene is used in many applications, from packaging to structural. Likewise, many investigators have studied the mechanical response of OSB. However, only Taylor and others (1997) investigated the creep performance of SIPs.

Objective

The objectives of this research are to

- evaluate and model the creep and creep–rupture behavior of OSB sheathing and EPS core under compressive, tension, and shear loads,
- evaluate and model the flexural creep and creep–rupture behavior of SIPs, and
- develop a simplified method to account for the creep effect in the design of SIP structures.

The scope of the project will be limited to the flexural creep response of SIPs with EPS core and OSB sheathing at ambient conditions. The basis of this approach is to predict the global behavior of the SIP based on the behavior of the constituent material.

Approach

Creep modeling of the structural insulated panels can be accomplished in three stages:

1. Establish the creep behavior of the panel components—OSB sheathing and EPS core—through component testing (Figures 1 and 2)
2. Incorporate the creep response of the components in the finite element model and predict the response of the test panel specimen
3. Verify the model with the flexural test data of the panel specimens and propose a simplified design method that adequately incorporates the creep response of the panel

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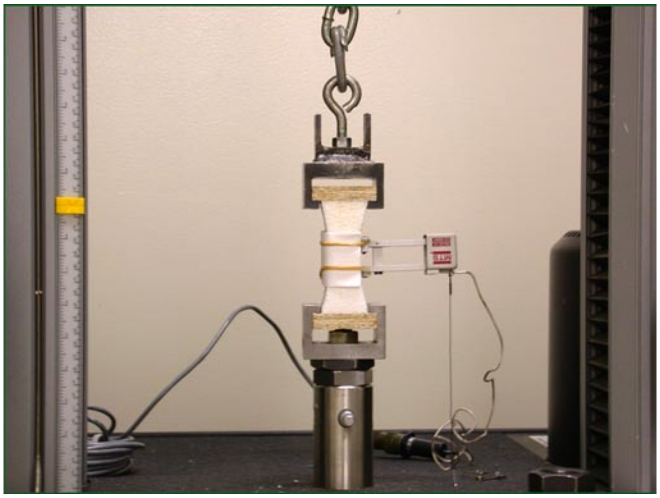

Figure 1. Tension testing of the foam core.

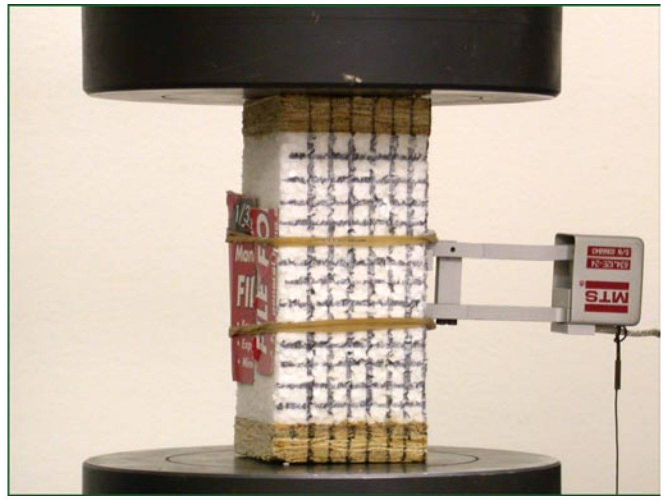

Figure 2. Compression testing of the foam core.

Expected Outcomes

This research will provide an understanding of the viscoelastic properties of SIPs based on the viscoelastic properties of the constituent components. Data from these tests will be used to develop simplified design criteria that include the influence of time on the mechanical response. Producers will benefit by having simplified design equations for developing new products, and designers will have tools for using SIPs in new applications. Finally, this information will also be useful for developing creep testing procedures to evaluate the creep behavior of structural panels for code approval.

Timeline

This study will be completed by mid-2006.

Cooperators

USDA Forest Service, Forest Products Laboratory
Wood Materials and Engineering Laboratory, Washington State University

References

Acceptance criteria for sandwich panels AC04. ICBO Evaluation Service, Inc., Whittier, California. 2004.

Taylor, S. B.; Manbeck, H.B.; Janowiak, J.J.; Hitunen, D.R. 1997. Modeling structural insulated panel (SIP) flexural creep deflection. J. Structural Engineering. 123(12): 1658–1665.

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