TechTip I5 – SPF Adhesion to Engineered Wood

Summary

Based on results from an experimental study conducted on a single laminated veneer lumber (LVL) beam substrate, SPFA suggests using adhesion primers to improve adhesion of SPF to engineered wood products (EWP) substrates where adhesion is a problem. Other mechanical surface preparations to the LVL beam in this study show no statistical improvements and the use of stapled fabrics appear to lower adhesive strength. The details of this study are provided in this document.

Background

Proper adhesion of SPF to substrate materials is key to achieving proper air sealing and prevention of foam shrinkage and cracking. As contractors and installers of SPF, we know that SPF will adhere extremely well to almost any clean, dry surface. There may be some exceptions, however, when it comes to certain types of engineered wood products (EWP). Engineered wood products include oriented strand board (OSB) sheathing, laminated veneer lumber (LVL) beams, and wood I-joists shown in Figure 1.

Figure 1: OSB sheathing (left) and LVL beam and wood I-joists (right)

These engineered wood products all have one thing in common. They are constructed using panels made from wood strands or veneers bonded together with a synthetic resin adhesive. These products are made by application of pressure using a large hydraulic plate press. To promote release of the cured OSB panels from the press, a wax or wax-like release agent is often used on one side of the press plates. The other side of the panel is pressed against a textured

forming belt. The result of this manufacturing process leaves one smooth side (waxy side) and one rough side on the front and back of each panel. LVL beams are manufactured by gluing multiple panels together and to final length and depth. Some LVL beams are completely coated as a last manufacturing step. This coating provides weather resistance during construction. Some LVL manufacturers offer uncoated LVL panels, which could be considered during the design phase when SPF is to be applied.

EWP and Foam Adhesion

When foam is applied to the rough side of the panel, proper adhesion is achieved, however, the smooth waxy side of these materials can reduce adhesion of SPF insulation, sometimes (based on the data) below the foam's rated tensile strength. Depending on the amount of wax used, heat from the SPF reaction re-activates the wax, preventing a good bond between the foam and panel. Poor adhesion of the foam, once cooled and cured, can result in unwanted delamination or separation of the foam from the framing.

EWP substrates can create challenges for SPF installation. OSB sheathing has a rough side to improve traction for roofing contractors, however it is sometimes installed with the smooth side to exterior for improved water resistance, so that SPF applied in the cavity is applied to rough surface. However, not all framing contractors install the OSB sheathing in this manner.

LVL beams are typically made by adhesively stacking panels of OSB or plywood to form a beam. Like OSB, release films may exist on one or both sides of the LVL. Some LVL manufacturers have no wax on any of the panel surfaces. Wood I-beams typically use a sheet of OSB for the web or center, and solid softwood for the flanges at the top and bottom. There will always be one side of the web that may have a shiny, waxy surface.

The bottom line is that it is not always impossible to avoid application of SPF to the smooth or waxy surface(s) of engineered wood products. There are ways that SPF contractors can deal with the issue.

First, is to check the adhesion of the foam to surfaces of engineered wood products. Using LVL or OSB scraps, apply the SPF in small areas and allow to cool. Once cooled, use your hand or tool to remove the foam If the removed foam leaves behind a visible residue, this indicates a cohesive failure, where the bond between the foam and substrate is stronger than the foam itself. This is the result you want assuming you aren't building a stressed-skin panel or performing some other structural function. If the foam removes cleanly from the substrate, this indicates an adhesive failure, meaning the foam is pulled off at a load below its tensile strength. This may not be an ideal situation and could lead to delamination of the foam over time.

ABAA and CUFCA require a quantitative substrate adhesion check at regular intervals using a calibrated pull-tester so that the adhesive strength is 16 psi or greater. If a contractor can perform a ABAA/CUFCA adhesion test and adhesion is 16 psi or greater, no additional surface treatments may be needed. If below 16 psi, a surface treatment to improve adhesion is needed.

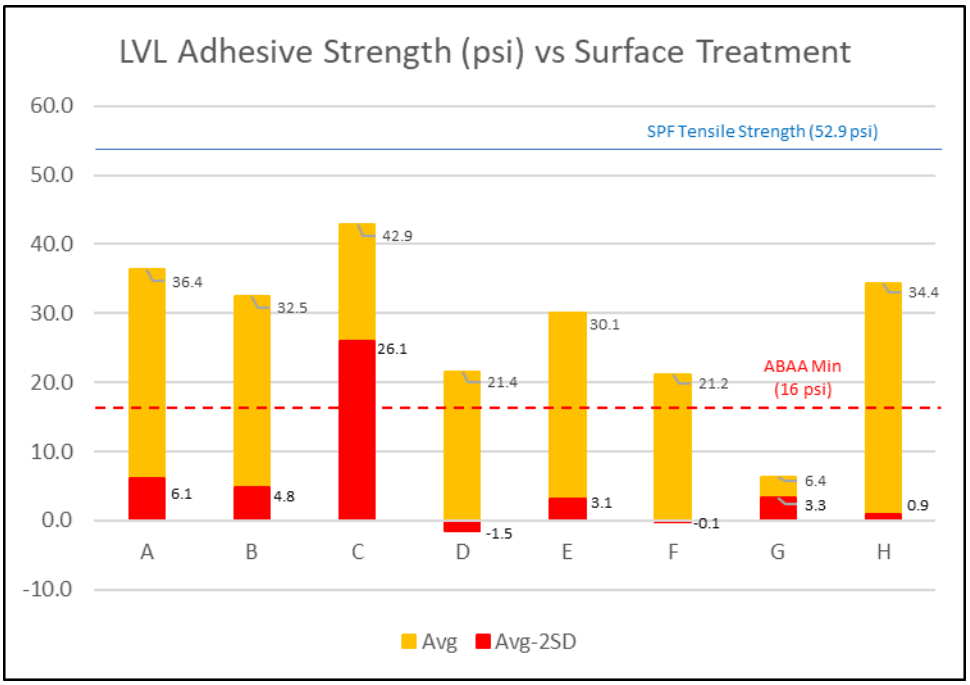
Options to Maximize SPF Adhesion to EWP

SPF contractors have tried numerous surface treatments to improve adhesion to EWP, including sanding, priming, stapling of fabrics and sacrificial flash coats. SPFA completed a comprehensive study of seven different surface treatments. The results are shown in the bar chart below. For each surface treatment, the yellow bar represents the average adhesive strength measured from five tests; the red bar represents negative two standard deviation from the average of five tests. The full lab report from R&D Services is available to SPFA Members upon request.

A simple definition of average mean any given adhesion test has a 50% chance of failing above and a 50% change of falling below the average adhesive strength for each surface treatment. A minus two standard deviation from the same test means any give test has less than a 3% chance of failing below minus two standard deviation strength, and greater than 97% chance of failing above this value. For reference in this paper, the minus two standard deviations will be called the '97% failure strength'. If you want to consistently have an adhesive strength measured above the ABAA 16 psi minimum (>97% of the time), surface treatments should have a 97% failure strength above 16 psi.

Most treatments showed no significant improvement in adhesion and the use of the 50% scuff and stapled fabrics lowered adhesion. The only treatment showing a notable improvement was the use of a modified acrylic adhesion primer (e.g., Kilz® Adhesion Primer, Zinsser Extreme Adhesion Primer, among others) which showed cohesive failure of the foam without adhesive failure and a 97% failure strength above the ABAA minimum of 16 psi. **Based on these results, SPFA suggests using only adhesion primers to improve adhesion of SPF to EWP substrates that exhibit adhesion problems.**

Finally, it should also be noted that some EWP manufacturers offer products with little or no waxy surfaces. You may want to discuss this with your customer's specifier of these EWP products prior to construction.



ID	Name	Substrate Condition
A	Control #1	Smooth (waxy) LVL Surface
B	Control #2	Rough OSB Surface
C	Primer #1	Modified Acrylic Adhesion Primer (off-the-shelf e.g., Kilz® Adhesion)
D	Mech #1	80 grit sandpaper on belt sander; ~50% scuff.
E	Mech #2	Curry comb scuff
F	Fabric #1	BIBS fabric (non-woven PE), T-50 x ½" staples on 2" grid
G	Fabric #2	Weather Resistant Barrier (Tyvek), T-50 x ½" staples on 2" grid
H	Flash Coat	Apply ½" SPF sacrificial pass and remove; Apply final pass of SPF

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