

SPF vs SPF_s Adjusting Fastener Design for Different Species of SIP Edge Blocking

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INTRODUCTION

The kiln-dried (KD) lumber species available in the Northeast US is changing. SPF lumber is becoming more rare and SPF_s is becoming more common. These two species categories have different structural properties, particularly with respect to fastener capacity. This bulletin describes the adjustments made to Foard's internal SIP design process to address the species change and the rationale behind those adjustments.

MATERIAL AVAILABILITY

For more than a year, sourcing SPF lumber has become increasingly difficult. Spruce-Pine-Fir-southern (SPF_s) has become the most available species. At the time of writing, purchasing 2x4 and 2x6 KD lumber that is "SPF-no-S" has become quite difficult.

Adding to this purchasing challenge is the fact that many lumber yards and lumber distributors treat SPF and SPF_s as interchangeable, including using the same part numbers for SPF and SPF_s. In many cases, the distributor doesn't know whether they'll be receiving SPF or SPF_s until the rail car arrives and someone reads the mill mark on the lumber.

There is no sign that the availability of "SPF-no-S" will improve any time soon.

KD LUMBER PROPERTIES FOR SIPs

Foard's evaluation report lists values for in-plane shear strength based on testing that used KD lumber edge blocking with a specific gravity of 0.42.¹ The other SIP properties and capacities listed in the evaluation report are independent of edge blocking specifications. 0.42 matches the specific gravity of SPF (spruce, pine, fir) in the NDS.² Predictably, Foard's default KD lumber specification for edge blocking, shoes, plates, etc has been "KD SPF #2".

¹ NTA Listing Report FRD031609-25, dated 3/9/17

² American Wood Council (AWC) "National Design Specification for Wood Construction" ("NDS"), 2015 edition, Table 12.3.3A

DESIGN ADJUSTMENTS

The difference between the structural properties of SPF's and SPF are certainly large enough to prevent them from being used interchangeably. The reduced properties of SPF's can play a role in a great many design elements. Predictably, the design of SIP joinery depends on the capacity of nailed connections, so the impact of the different species groups on nail capacity is critical.

This bulletin discusses nailed connection capacity, but other design elements may need examination. It is the responsibility of the project's qualified design professional to consider the impact of KD lumber properties on all structural elements.

FASTENER SHEAR CAPACITY ADJUSTMENTS

In the NDS, design shear capacity (Z) of a fastener is a function of the wood's specific gravity (G). The G of SPF's is 0.36 and G required by Foard's evaluation report for in-plane shear values is 0.42, the same G value as SPF.^{3,4} The lower specific gravity of SPF's decreases the Z capacity of the nailed connection by some amount. Foard's internal design standard is patterned after the shear wall Specific Gravity Adjustment Factor used in SDPWS.⁵

$$SGAF = (1 - (0.50 - G)) \tag{Eq. 1.0}$$

Where:

SGAF = Specific Gravity Adjustment Factor, must be ≤ 1.0

G = specific gravity of framing lumber ⁶

Because the testing that underpins Foard's evaluation report was done with 0.42 specific gravity lumber, not the 0.50 specific gravity used in SDPWS, we assume that the published values have already taken the G of 0.42 into account.

$$G_{SPF} = 0.42$$

$$SGAF_{SPF} = (1 - (0.50 - G_{SPF})) = (1 - (0.50 - 0.42)) = 0.92 \tag{Eq. 1.1}$$

Using the same computation for SPF's yields:

$$G_{SPF's} = 0.36$$

$$SGAF_{SPF's} = (1 - (0.50 - G_{SPF's})) = (1 - (0.50 - 0.36)) = 0.86 \tag{Eq. 1.2}$$

Thus:

$$\frac{SGAF_{SPF's}}{SGAF_{SPF}} = \frac{0.86}{0.92} = 0.93 = 93 \% \tag{Eq. 2.0}$$

Therefore, it is Foard's design standard to credit SIP shear assemblies built using SPF's lumber with 93% of the capacity listed in the evaluation report. In cases where full capacity listed in the evaluation report is required, the nail spacing should be reduced proportionally. For example, when 6" O.C. nail spacing had been specified in SPF, the nail spacing in SPF's now needs to be 5.5" or less.

3 AWC "NDS Supplement", 2015 edition, Table 4A

4 NTA Evaluation Report FRD031609-25, dated 3/9/17, Tables 10 - 12

5 AWC "Special Design Provisions for Wind & Seismic" ("SDPWS"), 2015 edition, Tables 4.3A & 4.3B

6 Foard does not increase strength for SIP shear assemblies beyond the evaluation report's values when using KD lumber with specific gravity higher than 0.42.

FASTENER WITHDRAWAL CAPACITY ADJUSTMENTS

Foard's internal design standard for withdrawal capacity (W) is based on the NDS withdrawal design values.⁷ Using Foard's standard 0.131" dia. x 2.5" long nails as an example, the design W values of SPF and SPF's are computed as follows:

$$W = 1380 \times G^{5/2} \times D \tag{Eq. 3.0^8}$$

Where:

W = Withdrawal design value in lb/inch of penetration into side grain

G = Specific gravity of framing lumber

D = Nail diameter in inches

Computing W for the two different species groups yields:

$$W_{SPF} = W_{G=0.42} = 1380 \times 0.42^{5/2} \times 0.131 = 21 \frac{\text{lb}}{\text{in}} \tag{Eq. 3.1}$$

$$W_{SPF's} = W_{G=0.36} = 1380 \times 0.36^{5/2} \times 0.131 = 14 \frac{\text{lb}}{\text{in}} \tag{Eq. 3.2}$$

Comparing those values:

$$\frac{W_{SPF's}}{W_{SPF}} = \frac{14 \frac{\text{lb}}{\text{in}}}{21 \frac{\text{lb}}{\text{in}}} = 0.67 = 67\% \tag{Eq. 4.0}$$

Therefore, the fastener spacing must be decreased with SPF's in order to retain the same withdrawal capacity as SPF.

$$\text{NailSpacing}_{SPF's} = 0.67 \times \text{NailSpacing}_{SPF} \tag{Eq. 5.0}$$

For example, when 6" O.C. nail spacing had been specified in SPF, the nail spacing in SPF's must now be reduced to 4".

⁷ AWC "NDS", 2015 edition, Section 12.2.3

⁸ AWC "NDS", 2015 edition, Equation 12.2-3