SFIA
STEEL FRAMING INDUSTRY ASSOCIATION

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DOWNGRADE OF SOUTHERN PINE DESIGN VALUES INCREASES COST OF BUILDING WITH WOOD

Steel can be manufactured to tight tolerances, and its properties don't change as environmental conditions change. You get what you specify. The same can't be said for all building materials.

15% to 30% Reduction in Structural Values Drive Up Wood Framing Costs by 5% Or More

- SFIA Evaluation

This fact is finally being recognized, most recently with the January 2013 decision by the American Lumber Standard Committee (ALSC) Board of Review to reduce the structural properties of visually graded Southern Pine (SP) – one of the most commonly used species and types of wood used in construction. The downgrading is significant, with reduction in values from 15% to 30%, resulting in higher costs for SP and boosting the competitiveness of cold-formed steel framing.

A Change in the "Resource Mix" Triggers Re-Assessment

Southern Pine is actually a grouping of commercial species of pine, with some being stronger than others. The previous design values in effect until recently were developed back in the 1980s and 1990s when the mix of species was different than it is today. This evolution in products was acknowledged by the Southern Pine Information Bureau (SPIB) in October 2011, triggering the requirement in ASTM 1990 that design values be reassessed in the event of a resource change. The SPIB subsequently participated in a test program designed to specifically collect an expanded set of design values on SP and revised design values for most southern pine were approved in January and implemented on June 1 of this year. The American Wood Council (AWC) has also published an addendum to their National Design Specification for Wood Construction (2012 edition) that is available at http://www.awc.org/publications/update/index.html.

Widespread Impact

Softwood lumber is the material of choice for framing in housing construction in the United States, so the scope of the impact is enormous. According to data from the U.S. Census, SP accounts for more than 50% of US softwood production each year. Most of that lumber makes its way into homes in the southeastern United States, making SP a major factor in more than half of all housing starts in this region

Table 1: Softwood Lumber Production in the United States
(million board feet)

Year	Total Softwood Lumber *(US)*	Southern Yellow Pine *(US)*	% SP
2009	21,774	10,972	50%
2008	27,363	14,050	51%
2007	33,751	18,791	56%
2006	37,718	20,101	53%
2005	39,770	21,646	54%

each year. Nationally, when net imports from Canada are considered, 36% of framing lumber is Southern Pine.

Lumber grades and applications

Southern Pine typically bears the grade mark that is placed on both nominal 2 and 4 inch thick members.

Properties are determined by either mechanical grading (testing) or visual grading. Most is visually graded even though machine or mechanical grading is more reliable. Visual grading is based on inspections of lumber for various characteristics and imperfections like knots and wane that impact structural performance.

There are a variety of grades assigned through the grading process. No. 1 lumber and SS (Select Structural) are not often used for framing. More typical in construction is the use of No. 2 due to its combination of mechanical properties and price for structural applications. However, No. 3 is permissible for use by building codes for floors and rafters, although the spans are significantly shorter than other grades. Non-load bearing members are permitted by most codes to be any of the above grades plus the lesser "utility" or 'stud" grades.

Impacts of reductions on building designs

According to the AWC addendum, for most wall studs, the major impact from the 15% to 30% reduction in design values will be a move to the next higher grade of stud for many applications. The issues become more significant for other components in a building such as floor joist spans.

Table 2 compares selected entries from the Wood Frame Construction Manual (WFCM), Addendum effective June 1, 2013 versus the 2012 International Residential Code. The table is for 2x10 joist spans at 16 inches on center under a live load of 40 psf, dead load of 10 psf, and a maximum deflection of l/360, which represents commonly-encountered spans in the residential market. The same entries are shown in Table 3 for 24 inch spacing of 2x12 joists, also a common size and spacing in residential construction.

Table 2: **2x10** floor joists at **16 inch** spacing
(40 PSF Live Load and 10 PSF Dead Load)

Grade	IRC* Maximum Floor Span (previous values)	WFCM* Maximum Floor Span *(effective June 2013)*	**Reductions in Allowable Spans**
SS	17'-0"	17'-0"	**None**
No. 1	16'-9"	16'-1"	**0'-8"**
No. 2	16'-1"	14'-0"	**2'-11"**
No. 3	12'-2"	10'-10"	**1'-4"**

** International Residential Code ** Wood Frame Construction Manual*

Table 3: **2x12** floor joists at **24 inch** spacing
(40 PSF Live Load and 10 PSF Dead Load)

Grade	IRC* Maximum Floor Span *(previous values)*	WFCM* Maximum Floor Span *(effective June 2013)*	**Reductions in Allowable Spans**
SS	18'-1"	18'-1"	**None**
No. 1	17'-5"	15'-7"	**1'-10"**
No. 2	15'-5"	13'-6"	**1'-11"**
No. 3	11'-10"	10'-5"	**1'-5"**

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In these examples, the effect will be maximum allowable spans that range from about 8 inches to just over 2 feet shorter than has been permitted in the past. Most will fall over a foot shorter, requiring a change to the next higher grade of lumber, closer spacing, or deeper joists.

The cost impact of the new SP values when applied to a real project also was evaluated by the SFIA (see the *Technical Application and Evaluation* section on pages 4 and 5 of this document). As suggested by Tables 1 and 2, the grade of studs had to be increased in many cases and in this example would result in roughly a 5% increase in costs for the framing system. This is a significant issue for all builders, but especially for those who have large investments in plans that are used repeatedly.

Conclusion

The downgrading of design values of visually-graded Southern Pine will present a challenge to the wood industry at a time when there are growing signs of a rebound in housing market. Starting soon, we can anticipate that state and model codes will be revised to reflect these changes. As production builders begin to redesign plans based on the new design values or span tables, the higher cost of moving to deeper members or higher grades of Southern Pine will drive up their costs for wood framing.

Beyond the immediate cost impacts, these changes also raise other legitimate questions:

- Have there been similar changes to the resource mix of other wood products that warrant reassessment?
- Will builders, insurers and consumers accept structures framed with substandard materials while the building codes and design standards are changed in their area?

Finally, the steel industry can take pride in their products and the consistency in design it provides. We have known of steel's benefits in resisting termites, high strength to weight ratio, its preference in high risk fire situations as a noncombustible material, and its dimensional stability. The issues with southern pine only further support the use of CFS as a superior product for buildings.

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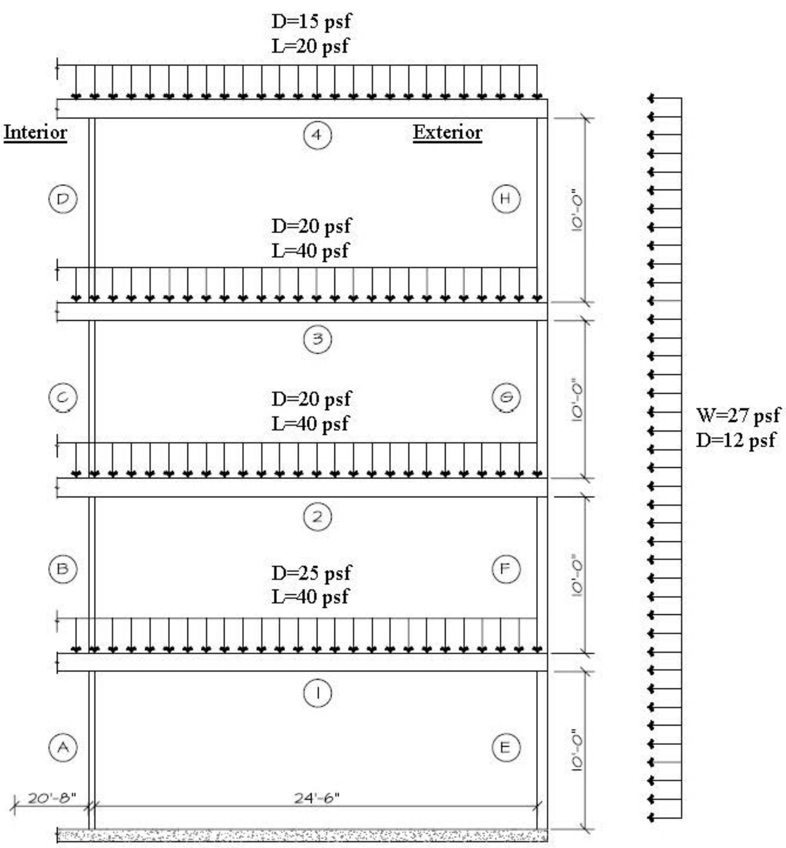
TECHNICAL APPLICATION AND EVALUATION

The effect of the new SP values were further studied by the SFIA, using a building under construction in a Southern US market with wood and cold-formed steel alternatives used in the design. The wood design incorporated wood I-joists (also, could be done with floor trusses) and conventional sawn lumber studs at 16 inches on center. The cold-formed steel alternative used C shaped joists and studs also at 16 inches on center.

In this example, the grade of studs had to be increased in many cases and in this example would have resulted in a 5% increase in costs for the framing system. This is a significant issue for all builders, but especially for those who have large investments in plans that are used repeatedly.



In addition to the loads shown above, 5 psf interior lateral pressure was applied to the studs. For serviceability, a floor joist deflection limit of L/480 for live load was used. Southern Pine was used for the wood studs.

The reference design values have changed as of the 2012 NDS. Therefore, the older design values (pre -2012 NDS values) and new reduced design values were used for comparison.

In some cases these values differ as much as 30 %. The results of the analysis are shown in the following tables.

Joists:

Load Case: Dead Load + Live Load		
Member	**Wood TJI Solution**	**Cold Formed Steel Joist**
1	16" TJI /L65	1400S200-68
2	16" TJI /L65	1400S200-68
3	16" TJI /L65	1400S200-68
4	14" TJI/L65	1200S200-54

Interior Studs:

Load Case: Dead Load + Live Load

Member	2012 NDS Southern Pine Grade	2005 NDS Southern Pine Grade	Cold Formed Steel Stud
A	Double 2 x 6, No. 3 or Stud Grade	Double 2 x 6, No. 3 or Stud Grade	362S200-97 or 600S162-68
B	2 x 6, Select Structural	2 x 6, No. 1	362S200-97 or 600S162-68
C	2 x 6, No. 3 or Stud Grade	2 x 6, No. 3 or Stud Grade	362S200-97 or 600S162-68
D	2 x 6, (D.O.)	2 x 6, No. 3 or Stud Grade	362S162-33 or 600S162-33

Notes:

- 2x4 wood studs and double 2x4 wood studs were also checked and were insufficient in all cases.
- For the wood studs, blocking is required at 1/3 points for members B, and C; blocking is required at the midspan for members A and D.
- All cold-formed steel studs require bridging at the 4 feet on center, except at member D that could be bridged at the midspan.

Exterior Studs:

Member	2012 NDS Southern Pine Grade	2005 NDS Southern Pine Grade	Cold Formed Steel Stud
E	Double 2 x 6, No. 3 or Stud Grade	Double 2 x 6, No. 3 or Stud Grade	600S162-54
F	2 x 6, No. 1 Dense	2 x 6, No. 1	600S162-54
G	2 x 6, Select Structural	2 x 6, No.1 Dense	600S162-43
H	2 x 6, No. 3 or Stud Grade	2 x 6, No. 3 or Stud Grade	600S162-33

Notes:

- For the wood studs blocking is required at 1/3 points for member F; blocking is required at the midspan for members E, G, and H.
- All cold-formed steel studs require bridging at the midspan with the exception if member E which required bridging at 4 feet on center.
- The wood studs were designed with the load combination D+L+W and the load duration factor of 1.6. The load combination D+0.75L+0.75W controlled the design for the cold-formed steel studs.

SUMMARY

In many cases the grade of the wood stud had to be increased as result of the 2012 reductions to the Southern Pine reference design values. In the case of member B, the grade changed from No.1 with the 2005 values to Select Structural with the 2012 values. In addition to the reduction in design stress values the Modulus of Elasticity and minimum Modulus of Elasticity were also reduced in the 2012 NDS. Had deflection limits been imposed on the wood studs, this would have additionally affected the design. For example, if member H were held to a deflection limit of L/600 the grade would have to be increased to a No. 2 Dense 2 x 6 with the 2012 Southern Pine values. With the previously published values a No. 2 grade would meet L/600 for member H. The cold-formed steel studs would have been able to meet the L/600 deflection limit with a minimum 33 mil thickness.