Span Rating of Solid-Sawn Deck Boards

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Abstract

Deck boards are key components in outdoor decks and balconies. The deck board market is shared primarily between solid-sawn and composite products. The focus of this article is solid-sawn wood deck boards, which are manufactured in North America as span-rated products following a policy promulgated by the American Lumber Standard Committee (ALSC). The latest revision of the ALSC span rating policy was approved in November 2020, and this article describes the technical basis for the changes. Distributed and concentrated design loads specified in the policy exceed building code minimum requirements. In addition, dynamic load amplification due to deck occupants is included in the new policy. Testing was performed to characterize the effects of partial fixity at joist supports caused by screw fasteners and was incorporated into the span rating methodology.

Solid-sawn deck boards are typically marketed as span-rated products. The American Lumber Standard Committee (ALSC) promulgates the *Policy for Evaluation of Recommended Spans for Span Rated Decking Products* (ALSC 2004, 2020). Span ratings for solid-sawn deck boards can be done in two ways: by calculation using allowable design values derived from the clear wood approach or through in-grade testing. Calculation of span ratings requires assumptions regarding design loads, structural analogs, and deflection limits. Codes and standards regarding decks and balconies have constantly evolved, which prompted the review of the 2004 version of the ALSC policy.

The goal of this study was to update 2004 ALSC *Policy for Evaluation of Recommended Spans for Span Rated Decking Products* to ensure a more uniform safety margin for resisting foreseeable live loads stemming from occupant use. For the 2018 IRC (one- and two-family dwellings and townhouses) decking applications, the required design live load for balconies on single-family homes and townhouses is 40 pounds per square foot (psf), whereas for a 2018 IBC (ICC 2018a) application, such as an apartment building, the design live load for a balcony is 1.5 times the live load for the areas served, not required to exceed 100 psf, which is 50 percent higher than the required live load for a balcony on a single-family residence or townhouse. Design live load discrepancy between apartments and townhouses creates a substantial difference in the effective safety factor of decking when the populations of occupants are essentially the same.

In addition, for stairs, Table 301.5 of the 2018 IRC (ICC 2018b) recognizes and requires a 300-pound concentrated load check for stair treads: ''Individual stair treads shall be designed for the uniformly distributed live load or a 300-pound concentrated load acting over an area of 4 square inches, whichever produces the greater stresses.'' For apartment stair treads, Table 1607.1 of the 2018 IBC (ICC 2018a) requires a minimum concentrated load of 300 pounds applied on an area of 2 by 2 inches. The authors were not able to locate the technical basis for the 300-pound load, but it could be speculated that it is to account for additional dynamic loading on the stair treads stemming from occupant traffic. By recognizing that deck and balcony floors are also subjected to a dynamic type of loading addressed by the current codes for stairs, we investigated a testing protocol for solid-sawn deck boards that included considerations for different uniform and concentrated live load requirements found in the current codes for different residential categories.

Deck boards typically span more than two joists. A two-span continuous beam analog is assumed in the ALSC policy as well as in ASTM D7032 (ASTM International 2017b) used by the composite decking industry. A two-span continuous beam versus a single-span beam results in a 23 percent difference in moment demand, so the choice of structural analog (or model) is important. When analyzing beams, engineers often assume ideal pin and roller conditions at the supports. In reality, deck boards that are fastened to joists with screws have additional capacity due to the partial fixity that occurs at these supports. It is difficult to characterize this partial fixity using engineering

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theory, so experimental testing is needed. This need prompted the experimental portion of this study.

Specific objectives of this study were the following:

1. Critically review the span rating methodology in the 2004 ALSC deck board span rating policy and provide technical rationale for the new 2020 policy
2. Characterize partial fixity at the deck board-to-joist connections for use in desk span rating calculations

Load and Deflection Criteria

In this article, we limit our scope to live loads, such as those produced by people. It will be shown that *concentrated* loads will control design of deck boards rather than uniform loads. On the other hand, deck and balcony substructure, such as joists, girders, posts, and ledgers, are controlled by *uniform* loads, but the focus of this article is deck boards. Of course, special loads, such as from hot tubs and large planters, require special attention by the design professional.

Uniform loads

Uniform live loads for decks vary from 40 psf in the 2018 IRC (ICC 2018b) to a maximum of 100 psf in the 2018 IBC (ICC 2018a) and ASCE 7-16 (American Society of Civil Engineers 2016). It is common for composite decking products to advertise board span ratings for a 100-psf uniform load. This may appear conservative, but consider the common case of a 6-inch-wide board, spanning three joists spaced 16 inches on center. This is a two-span continuous beam. The bending moment demand caused by 100 psf is 133 in.-lb. Now solve for the equivalent concentrated load that would cause the same bending moment, and the answer is only 41 pounds. Clearly, uniform load does not control the design of deck boards. By comparison, a 300-pound concentrated load applied at one span of the two-span board would cause a bending moment of 975 in.-lb. Hence, the concentrated load causes over seven times the moment demand as the uniform load. In other words, a deck board that was designed to carry a 300-pound concentrated load could carry over a 700-psf uniform load.

ALSC policy (2004) requires two loading conditions to be checked separately: 70-psf uniform load and 220 pounds at mid-span. The 70-psf uniform load meets the minimums specified by ASCE 7-16 and the model building codes; however, the uniform load will not control the design of deck boards as previously shown. Even so, in the 2020 ALSC Policy, the uniform load of 70 psf was increased to 100 psf, which represents the maximum required by the ASCE 7 standard for balconies and decks. The 100-psf load will not control deck board span ratings but adds credibility to the ALSC policy by using the ASCE 7 maximum uniform load for decks. The concentrated load requirement of 220 pounds exceeds the code minimum value of zero, but we will present the case for increasing to 300 pounds, which would bring consistency with load requirements for stair treads.

Concentrated loads

Concentrated live loads are variable over the service life of a structure, so selecting a design load requires judgment informed by data. The Anthropometric Reference Data for Children and Adults: United States, 2011–14 (U.S. Department of Health and Human Services 2016) lists the 75th percentile weight for males as 220 pounds, which is the current concentrated load requirement of the ALSC policy. Static body weight is one issue to be considered; the other is dynamic amplification.

Since people move on decks, it is reasonable to account for dynamic amplification of the occupant loads. Studies have shown that walking dynamically amplifies a person's static body weight by amounts ranging from 0 to 50 percent (e.g., Nilsson and Thorstensson 1989, Keller et al. 1996, Pavei et al. 2019). Motions such as running, jumping, and bouncing can cause even greater dynamic amplification than that of walking. Taking a static body weight of 220 pounds and applying a dynamic amplification of 1.35 results in approximately 300 pounds—the same load required for stair treads.

In addition to the magnitude of a concentrated design load, it is also necessary to know to what bearing area it should be applied. For example, the 300-pound concentrated load in ASCE 7-16 and the 2018 IBC (ICC 2018a) have a bearing area of 2 by 2 inches for stair treads to simulate a heel drop. For the case of deck boards, an area of 5 by 5 inches was chosen to simulate the foot contact area of a large adult. For deck board products with widths less than 5 inches, it is permitted that the concentrated load be shared between the two adjacent boards with a 60/40 distribution.

The load duration factor used in the 2004 ALSC policy was 1.25, which corresponds to a cumulative duration of full design load of 7 days (Appendix B, NDS-2018). A more conservative value of 1.15 was chosen for the 2020 ALSC policy, corresponds to a cumulative duration of 2 months. This choice is linked to using a conservative 300-pound concentrated load that is adjusted for dynamic amplification. Over a typical 25-year life of a deck, it is assumed that such an amplified load on an individual deck board would occur no more than a cumulative period of 2 months. For buildings, a load duration factor of 1.0 is typically used for occupant loads. However, buildings are designed for service lives much longer than that of an outdoor deck and hence have a greater time period to accumulate duration of full design load.

In summary, a concentrated load of 300 pounds applied over a 5 by 5-inch area and load duration factor of 1.15 assumed in the 2020 ALSC policy would account for weight variability of the adult population and dynamic amplification caused by occupant movement on a deck. Boards that are span rated for 300 pounds would have the advantage of being applicable to stair treads in addition to decks and balconies.

Deflection limits

The 2004 ALSC policy limits deck board deflection to L/180 when developing span ratings by calculation, where L is the span between joists. ASTM D7032 also has a deflection limit of L/180 for composite decking.

No change to the L/180 deflection limit was made; however, a static concentrated load of 220 pounds was chosen for calculating deflection. In general, deflection of structural members is a limit state used for members that have brittle finishes (such as a rafter with gypsum board) and annoying vibration of floor joists. Neither of these conditions are present for a deck board. Furthermore, deflection of a deck board from a footfall does not present a trip hazard because the next footstep will land on an unoccupied board. As a person walks and removes the load from a given board, it will return to its original unloaded position. According to representatives of the lumber grading agencies listed in the ''Acknowledgments'' section, solid-sawn deck boards have a long history of customer acceptance using a deflection limit of L/180 calculated for a concentrated load of 220 pounds on the two-span beam condition; hence, no change was made to this limit state check.

Partial Fixity at Deck Board-to-Joist Connections

It is important to use an accurate structural analog when calculating span ratings for deck boards. Deck boards typically span multiple joists and are fastened at each joist; hence, a two-span continuous condition with the concentrated load applied at mid-span of one span is assumed for solid-sawn decking (ALSC 2004) and composite decking (ASTM D7032). When adding a second span, there is an increase in the moment capacity of 23 percent from simple statics compared to that of a single-span condition, as shown next.

A single-span system with a point load at mid-span has a max moment at mid-span given in by

$$M_1 = \frac{PL}{4} \tag{1}$$

For the same point load applied at mid-span of one span in a two-span continuous beam, the resulting max moment is less than that for the single span case, as shown by

$$M_2 = \frac{13PL}{64} \tag{2}$$

Combining Equations 1 and 2, we solve for M_2. For the same load and span length, the maximum moment demand decreases, as shown in Equation 3. In other words, 23 percent higher loads can be carried for the two-span case ($1/0.8125 = 1.23$). This adjustment is based on beam theory and does not account for partial fixity at board-to-joist connections:

$$M_2 = \frac{4 \times 13M_1}{64} = 0.8125M_1 \tag{3}$$

By fastening deck boards to joists, partial fixity is introduced at the supports, which is expected to further increase load-carrying capacity. We will represent this partial fixity through a *boundary condition factor*. Compared to a single span, pin-roller beam, a two-span screwed-down beam would realize increased load capacity due to a combination of the partial fixity and the two-span condition. Hence, to quantify the influence of a boundary condition factor, we need to partition the 23 percent increase that is defined from statics. Our methodology was as follows:

1. Compute the ratio of ultimate loads from the two-span to single span conditions. For example, a ratio of 1.4 would represent a 40% total increase.
2. Divide the ratio from step 1 by 1.23, which is the increase we would expect from statics. The result would be the increase from partial fixity. For example, 1.4/1.23 = 1.14, or a 14 percent increase in load-carrying capacity due to partial fixity.

The proposed boundary condition factor should be applied only for fastening systems that provide partial fixity at the joists (such as the screws that were tested). Clip fasteners that fit into slots on the sides of deck boards are designed to allow slip and hence would likely not provide added capacity.

The hypothesized boundary condition was characterized for two species and two different testing configurations. One configuration was a single-span, pin-roller condition, while the other was a more realistic condition of two-span continuous with deck boards attached with screws to simulated joists. Species groupings (Southern pine and redwood) were selected to represent the range of specific gravities for common deck applications, with specific gravity values for southern pine and redwood being 0.55 and 0.37, respectively. Specific gravity is the wood property that has the greatest influence of fastener performance.

Materials

Three batches of materials were tested using this method: two preservative-treated southern pine and one redwood. In all batches, 5/4- by 6-inch, 8-foot-long boards were each cut to provide two test specimens at 3- and 5-foot lengths.

The first batch tested was 10 southern pine standard-grade radius edge decking boards with 5/4- by 6-inch nominal, 1- by 5-½-inch dressed dimensions. The product was arranged through the Southern Pine Inspection Bureau. The second batch was 10 premium and 10 standard and better-grade SP deck boards arranged through Timber Products Inspection of the same dimensions as the first batch. The third batch was 40 surfaced four sides, eased edge (S4SEE) Patio 2 and better redwood arranged through Western Wood Products Association. The dressed thickness of redwood boards was greater than the SP boards at 1-5/32 inches versus 1 inch.

There were two loading scenarios: one for the 3-foot boards and one for the 5-foot boards. The 3-foot boards, or short boards (S/b), were the single-span condition with pin and roller supports with a 24-inch span and 6 inches of total overhang and tested using a universal testing machine at the WSU Composite Materials and Engineering Center, an IAS-accredited laboratory.

For the 5-foot boards, or long boards (L/a), the two-span continuous condition was used. This condition included two 24-inch spans with 12 inches of total overhang and three simulated joist supports screwed down with two 9- by 2½-inch flathead coated wood deck screws at each of the three simulated joist supports. This procedure used a 7-kip actuator and 5-kip load cell, both with current calibration certificates. A test frame was constructed to simulate the joists according to ASTM D7032-A1.1. Joists were nominal 2 by 6 treated hem-fir, which was selected because it has the lowest specific gravity (SG) of common treated lumber products (SG = 0.43). In this way, other treated lumber, such as southern pine (SG = 0.55), could be conservatively substituted. The test configurations are shown in Figures 1 and 2.

Test Methods

Flexural test

Testing procedures followed ASTM D7032 and D4761 (ASTM International 2013) Section 7 Bending Flat-Wise

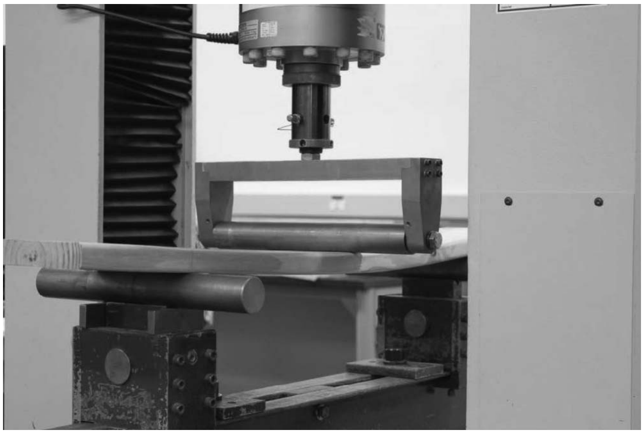

Figure 1.—Single-span load setup with southern pine short boards.

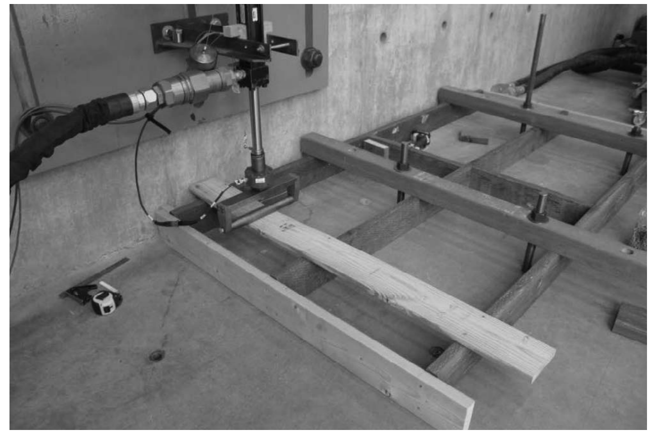

Figure 2.—Two-span load setup with southern pine long boards.

Center-Point Loading, with displacement rates that resulted in failure in 5 to 10 minutes. All boards were received in the dry condition, and the long boards and short boards were labeled 1L-10L and 1S-10S, respectively, for the first batch of SP boards; SP1a-SP20a and SP1b-SP20b, respectively, for the second batch of SP; and, finally, R1a-R40a and R1b-R40b, respectively, for the redwood boards, where 1L/a and 1S/b were cut from the same original 8-foot board. By cutting matched specimens from the same board, positive correlation is induced, which minimizes the variance of the boundary condition factor.

The boards were conditioned until the moisture content (MC) reached approximately 23 percent. Before testing, each specimen's width and depth were measured at three locations along the length and averaged. Additionally, the specimen mass and length were measured. Density of each board was calculated.

Both conditions utilized an actuator at mid-span of one span only as a concentrated load, as shown in Figures 1 and 2. Note that the load was placed at mid-span for the two-span case according to ASTM D7032. A slightly higher moment (approximately 2%) would be realized if the load point were slightly shifted from mid-span, but mid-span loading was judged acceptable for the purposes of this study. The boards were loaded in the flatwise direction to failure. During the loading, displacement and load were recorded at a sampling rate of 2 Hz for the short boards and 5 Hz for the long boards. For the two-span tests, deck boards were shifted along the length of the hem-fir joists to avoid previous test holes.

After the testing, the ultimate load for each specimen was recorded, modulus of elasticity (MOE) was calculated from the load deflection plot over the range of 20 to 40 percent of ultimate load, and apparent modulus of rupture (MOR) was calculated. Additionally, the load at span over 180 (L/180) was determined. Then, for each parameter of density, MOE, MOR, load at L/180, and ultimate load, the average and coefficient of variation of the specimens were determined.

Specific gravity and moisture content

ASTM D2395-17 (ASTM International 2017a) and ASTM D4442-16 (ASTM International 2016)were followed to determine MC and SG. A small sample was cut from each board after the test, and the wet mass, length, width, and depth of the samples were recorded. The samples were then oven-dried following ASTM D4442. After oven-drying, the ovendry mass was recorded for each sample. Then the MC was calculated using ASTM D4442 Section 5.5.1. From here, ASTM D2395 Section 15.3.1.1 was used to calculate the SG at the initial MC followed by calculating the ovendry SG using ASTM D2395 Section X2.1.5 (Eqn. X2.6). Note that the maximum MC used in Eqn. X2.6 was fiber saturation (approximately 30%), above which dimensional changes do not occur. From here, summary statistics were calculated on the MC and ovendry SG values.

Results and Discussion

Table 1 shows a summary of batch 1 SP boards, including MOE and ultimate load values. Additional parameters that were recorded include load at deflection of L/180, MC, SG at oven-dry, density, MOR, and average width and average depth and are available from the authors. Average MC for the simple span boards was 23.9 percent, and average SG at ovendry volume was 0.52. Note that MC values above fiber saturation (~30%) were set to 30 percent since mechanical and physical properties do not change above fiber saturation.

Table 1.—Summary of southern pine batch 1 testing.[a]

	Short (single-span)		Long (two-span)		
Specimen no.	MOE (10^6 psi)	Ultimate load (lb)	MOE (10^6 psi)	Ultimate load (lb)	Ratio (long/short ultimate loads)
1	0.830	1,053	0.797	1,731	1.64
2	0.862	888	0.866	1,566	1.76
3	1.199	1,407	0.778	2,279	1.62
4	0.659	967	0.724	1,376	1.42
5	0.949	1,048	0.950	1,583	1.51
6	1.033	1,281	0.768	2,260	1.76
7	0.542	1,238	0.677	2074	1.67
8	0.874	1,066	0.787	1,546	1.45
9	1.019	1,470	0.667	1,866	1.27
10	0.743	1,349	0.650	1,166	0.86
Average	0.871	1,177	0.766	1,745	1.50
Coefficient of variation (%)	22.1	16.9	12.2	21.3	18.2

[a] MOE = modulus of elasticity.

On average, the ultimate load of the two-span continuous boards was 50 percent higher than the single-span boards. This increase is a combination of two factors: the statics of a two-span continuous system versus a single-span condition as well as the fixity condition of screwing down the board to the supports. Dividing this 1.50 factor by the 1.23 factor from statics yields a 1.22 factor due to the fixity. This boundary condition factor provides an increased capacity of 22 percent. This is expected, as the screws help resist deflection and bring the member into a combined state of flexural and tensile stress.

Table 2 shows a summary of batch 2 SP boards. The average ultimate load of the short SP boards was 1,233 pounds, and the average MC was 26.1 percent. The same values for the long boards were 1,720 pounds, 25.3 percent, and 0.52, respectively. Again, more detailed data are available from the authors. The ratio of ultimate loads for the long to short boards was 1.40. After adjusting for the effects of statics, the boundary condition factor was 14 percent.

Table 3 shows a summary of redwood boards. The average ultimate load, MC%, and SG for the short RW boards were 1,486 pounds, 26.9 percent, and 0.38, respectively. The same parameters for the long boards were 1940 pounds, 22.1 percent, and 0.38, respectively. The ratio of long to short board ultimate load was 1.32, and when adjusted for statics, the boundary condition factor was 7 percent. This value is lower than for the SP groups, likely because of two specimens that had lower ultimate loads for two-span than for single-span due to knot locations.

Table 2.—Summary of southern pine batch 2 testing.[a]

	Short (single-span)		Long (two-span)		
Specimen no.	MOE (10^6 psi)	Ultimate load (lb)	MOE (10^6 psi)	Ultimate load (lb)	Ratio (long/short ultimate loads)
1	0.999	1,102	1.015	1,540	1.40
2	1.733	1,845	1.378	2,617	1.42
3	0.943	1,000	1.106	1,525	1.52
4	1.509	1,529	1.265	1,956	1.28
5	1.251	1,211	1.093	1,694	1.40
6	0.836	864	1.016	1,446	1.67
7	1.323	1,358	1.389	2,121	1.56
8	0.931	1,384	1.022	1,960	1.42
9	1.048	1,139	0.973	1,219	1.07
10	1.100	1,169	1.150	1,650	1.41
11	0.720	834	0.693	1,247	1.50
12	1.057	1,276	1.136	1,837	1.44
13	1.087	1,073	1.242	1,807	1.68
14	1.409	1,567	1.566	2,481	1.58
15	0.830	1,032	0.932	1,666	1.61
16	1.118	1,221	1.156	1,616	1.32
17	0.953	1,169	0.889	1,474	1.26
18	1.104	1,215	0.774	1,257	1.03
19	0.918	1,332	1.045	1,794	1.35
20	0.910	1,334	0.903	1,492	1.12
Average	1.089	1,233	1.087	1,720	1.40
Coefficient of variation (%)	22.9	19.4	19.5	21.7	13.2

[a] MOE = modulus of elasticity.

The lowest ultimate load value recorded for all three groups for the single-span condition was 834 pounds. The lowest ultimate load for the two-span condition was 1,136 pounds. Hence, all of the test values exceeded the target of 750 pounds (300 lb × 2.5 safety factor) given in ASTM D7032 to design stair tread span ratings. Additionally, the average loads for the two-span condition corresponding to a deflection of L/180 were 325, 332, and 397 pounds for the three groups tested, all exceeding the target design load of 300 pounds found in ASTM D7032. The boundary condition factor averaged over all three groups was 11.2 percent; hence, a boundary condition factor of 10 percent was permitted when determining span ratings using the calculation method of the 2020 ALSC policy.

Table 3.—Summary of redwood testing.[a]

	Short (single-span)		Long (two-span)		
Specimen no.	MOE (10^6 psi)	Ultimate load (lb)	MOE (10^6 psi)	Ultimate load (lb)	Ratio (long/short ultimate loads)
1	0.770	1,211	0.870	1,815	1.50
2	0.751	1,472	0.806	1,915	1.30
3	0.968	1,914	0.863	2,165	1.13
4	0.866	1,652	0.815	1,815	1.10
5	0.775	1,512	0.741	2,036	1.35
6	0.739	1,472	0.694	1,905	1.29
7	0.546	908	0.885	2,123	2.34
8	0.665	1,356	0.626	1,555	1.15
9	0.863	1,490	0.792	1,726	1.16
10	0.721	1,217	0.733	1,690	1.39
11	0.906	1,594	0.914	2,251	1.41
12	0.614	1,128	0.735	1,697	1.50
13	0.713	1,326	0.655	1,850	1.40
14	0.691	1,417	0.721	1,764	1.24
15	0.684	1,397	0.697	1,890	1.35
16	0.836	1,527	0.752	1,485	0.97
17	0.944	1,392	0.927	2,104	1.51
18	0.872	1,490	0.799	2,023	1.36
19	0.943	1,967	0.818	2,613	1.33
20	0.808	1,424	0.795	1,269	0.89
21	1.031	1,802	0.980	1,891	1.05
22	0.927	1,760	0.853	2,547	1.45
23	0.840	1,533	0.702	1,761	1.15
24	0.711	1,409	0.836	2,094	1.49
25	0.898	1,521	0.882	2,201	1.45
26	0.911	1,545	0.913	2,437	1.58
27	0.698	1,262	0.644	1,481	1.17
28	0.771	1,331	0.833	1,481	1.11
29	0.972	1,589	0.886	2,391	1.50
30	0.620	1,562	0.860	2,059	1.32
31	0.974	1,569	0.727	2,048	1.31
32	0.768	1,525	0.743	1,853	1.22
33	0.764	1,499	0.771	2,170	1.45
34	0.654	1,243	0.823	1,730	1.39
35	0.796	1,384	0.793	1,773	1.28
36	0.641	1,003	0.695	1,136	1.13
37	0.930	1,711	0.889	2,201	1.29
38	0.661	1,365	0.644	1,527	1.12
39	1.053	1,897	0.898	2,510	1.32
40	1.158	2,044	0.958	2,608	1.28
Average	0.811	1,486	0.799	1,940	1.32
Coefficient of variation (%)	16.9	16.2	11.5	18.3	17.4

[a] MOE = modulus of elasticity.

Summary and Conclusions

The ALSC *Policy for Evaluation of Recommended Spans for Span Rated Decking Products* is used throughout North America to develop span ratings for solid-sawn deck board products. Codes and standards regarding decks and balconies constantly evolve, which prompted this review of the ALSC policy. Calculation of span ratings requires assumptions regarding design loads, structural analogs, and deflection limits. Each of these areas was evaluated herein.

The uniform load requirement in the 2004 ALSC policy is 70 psf. The maximum uniform live load given in the ASCE 7 and the model building codes is 100 psf. The uniform load is intended for design of substructure that collects loads, such as joists, girders, posts, and ledgers. Even though uniform load does not control design of deck boards, the 2020 ALSC policy specifies a 100-psf uniform load requirement.

The 2004 ALSC policy specifies a 220-pound concentrated load with load duration factor of 1.25 for analyzing span ratings. The 2020 ALSC policy specifies a dynamically amplified concentrated load of 300 pounds with a load duration factor of 1.15 to deck board strength checks. The 300-pound load is comprised of a 220-pound static load, amplified by a factor of 1.35 to account for normal occupant movement on a deck (e.g., walking). The proposed load is to be applied to a 5- by 5-inch bearing area to represent the foot contact area of a large adult. For narrow deck boards (less than 5 in.), the concentrated load may be distributed 60/40 between two adjacent boards. The deflection limit of L/180 under a static concentrated load of 220 pounds was retained for the 2020 ALSC policy.

The 2004 ALSC policy calls for deck boards to be analyzed in a two-span beam condition with the concentrated load applied to one span. The 2020 ALSC policy has this same two-span beam condition and further species that partial fixity at the reactions (caused by the deck-to-joist fasteners) may be included in the analysis. A boundary adjustment factor of 10 percent was experimentally derived in this study to account for the partial fixity. This boundary condition factor would be applied to bending strength values of screwed-down solid-sawn deck board products using the clear wood approach. It is important to note that the boundary condition factor was derived from tests of screw fasteners. Other fastening systems, such as clips, can allow slip, and a boundary condition factor of 1.0 should be used unless partial fixity can be justified through testing. Future research is needed to study the long-term effects of shrink–swell cycles and stress relaxation as well as torsional stiffness of supporting framing on the partial fixity factor.

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