EFFECT OF GAP SIZE ON PERFORMANCE OF METAL-PLATED JOINTS IN COMPRESSION

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ABSTRACT

Metal-plate splice joints with gaps between butting pieces of 2 × 4 lumber were tested in compression to evaluate the effect of gap size on joint serviceability performance. The current design methodology for compression splice joints was also evaluated. Specimens representing floor and roof truss compression joints, with 16- and 20-gauge plates of staggered and aligned tooth configurations, were tested for each of two gap sizes.

Generally, 20-gauge and 16-gauge plates on joints with ⅛ in. nominal maximum gaps buckled under compression loads while 16-gauge plates on joints with nominal $\frac{1}{16}$ in. maximum gaps did not buckle before the gap closed. Gap closure with the latter joints was due principally to slip between the teeth nearest the splice and the wood. Joints with 16-gauge plates generally outperformed those with 20-gauge plates, based on the serviceability performance indicators of the test compression splice joints. Furthermore, gap size had less of an influence on joints with 16-gauge plates than on joints with 20-gauge plates.

The current practice of sizing plates for compression splices to withstand one-half of the calculated chord force could not be physically confirmed using joint serviceability criteria. The test results indicated that basing allowable plate ratings on a surface-area basis derived from tension tests is misleading.

Keywords: Truss plates, compression, joint gaps, serviceability.

INTRODUCTION

Metal-plate-connected wood trusses are used extensively in residential, industrial, and commercial construction. They evolved as an economical way of covering long clear spans while providing the efficiency and quality control of prefabrication. By far the least understood aspect of truss behavior is the performance of metal-plate-connected joints. Research has been conducted on metal-plated joints in tension and bending, and computer programs have been developed to model joint behavior. However, little effort has been devoted to the behavior of metal-plated joints in compression. The purpose of this study was to characterize the behavior of typical floor and roof truss plated joints in compression and to

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assess the effect of current manufacturing tolerances and design procedures on joint performance.

Quality standards for compression splice joints

The manufacture of many trusses requires that two or more pieces of lumber be spliced. Splices in the upper chords of trusses are typically positioned to be stressed primarily in compression and to experience minimum bending moment. When designing a joint for pure compression, it would be ideal to have full wood-to-wood contact between the ends of the two butted pieces. However, this goal may not always be practically achievable. For example, it is difficult to get a perfectly square end on a piece of lumber that is not perfectly straight. Additionally, insertion of plates by rolling rather than pressing may adversely affect joint alignment.

In early versions of Truss Plate Institute (TPI) specifications for the manufacture of metal-plate-connected wood trusses, QCM-77 (TPI 1977), the requirement for compression splice joints was "good bearing." More recent specifications, QST-86 (TPI 1986) and QST-88 (TPI 1988), define allowable manufacturing tolerances assuming the geometry of Fig. 1 for compression splices. One side of the joint is assumed to be in contact, and the maximum gap on the opposite side is $\frac{1}{16}$ in. Average gap is thus $\frac{1}{32}$ in. There is concern that these tolerances are too stringent and not always practically obtainable.

Design methodology for compression splice joints

Metal-plated joints in compression may be designed using a "one-half rule," stated as: "Splices resisting compressive forces shall be designed to transmit 50% of the component of any compressive force normal to the line of contact of adjacent compressive web members and/or adjacent chord members" (TPI 1985). Plates for chord splices are sized by considering only one-half the axial force calculated for the chord. This rule assumes that the wood-to-wood bearing resists one-half of the axial force and the plates resist the other one-half. While this rule has been in existence for many years, it has not been tested. One difficulty in sizing plates for compression splices is that truss plates have an allowable plate rating based on results from tension tests as defined in TPI-85 (TPI 1985). The joint actions in compression are significantly different than those in tension, a fact not reflected by using tension tests as a basis for compression design.

Objectives

The objectives of this research are to: 1) evaluate the influence of gap size and plate geometry on the load-slip behavior of compression splice joints, and 2) assess the validity of the "one-half rule." Specifically, the two gap sizes considered are: 1) a maximum gap of $\frac{1}{16}$ in., the allowable gap as defined in QST-88 (TPI 1988) and shown in Fig. 1; and 2) a maximum gap of $\frac{1}{8}$ in.

EXPERIMENTAL MATERIALS AND METHODS

Experimentally, two categories of study variables were considered. "Truss design variables" are related to factors that vary with the design and manufacture of any given truss. These include joint configuration, plate thickness or gauge, and tooth alignment. Specifically considered were specimens representing compression

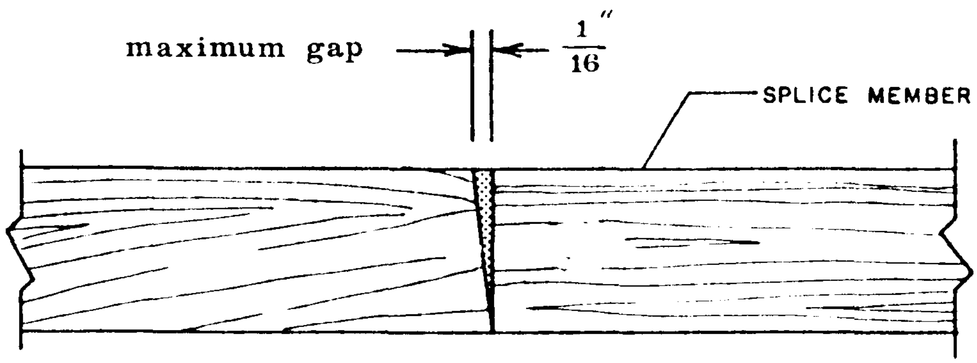

FIG. 1. Allowable manufacturing tolerance for compression splices per TPI QST-88.

joints in a 28 ft span, pitched Fink roof truss and a 22 ft span, parallel-chord floor truss. Two plate thicknesses, 16- and 20-gauge (approximately 0.060 in. and 0.038 in., respectively) with staggered and aligned tooth patterns were evaluated. The "research variable" was gap size and focused on the specific objective of this study. Two levels of each of the four factors were included in the experimental design, as outlined in Table 1. This design yields 16 cells or distinct combinations of these factors. Ten replicates were tested for each cell.

Materials and specimen dimensions

Since little research has been done with metal-plated compression splice joints, there is no established method for the manufacture and testing of specimens. Therefore, the specimen configuration was determined by assessing the type of specimen that simulates in-use conditions and best facilitates data collection. Compression joints are found in the upper chords of trusses and often have roof or floor sheathing nailed to them. This sheathing provides lateral stability and adds to the axial stiffness of the plated joint. The selected test specimens were constructed by splicing two 21 in. pieces of 2 × 4 southern pine lumber with two metal-plates. The end of one piece in the splice was tapered to provide the desired gap while keeping the entire specimen straight. Strips of sheathing, 5.75 in. by 38 in., were nailed to the 2 × 4s with the face grain running perpendicular to the length of the specimen. The roof truss specimens used $^{15}/_{32}$ in. thick $^{32}/_{16}$ APA Rated Sheathing, Exposure 1, and the floor truss specimens used $^{23}/_{32}$ in. thick APA Rated Sturd-I-Floor. The sheathing was nailed per American Plywood As-

TABLE 1. *Experimental design factors for compression joint tests.*

Factor	Level
Joint type	Roof
	Floor
Plate gauge	16
	20
Tooth alignment	Aligned
	Staggered
Gap size	$^{1}/_{16}$" max.
	$^{1}/_{8}$" max.

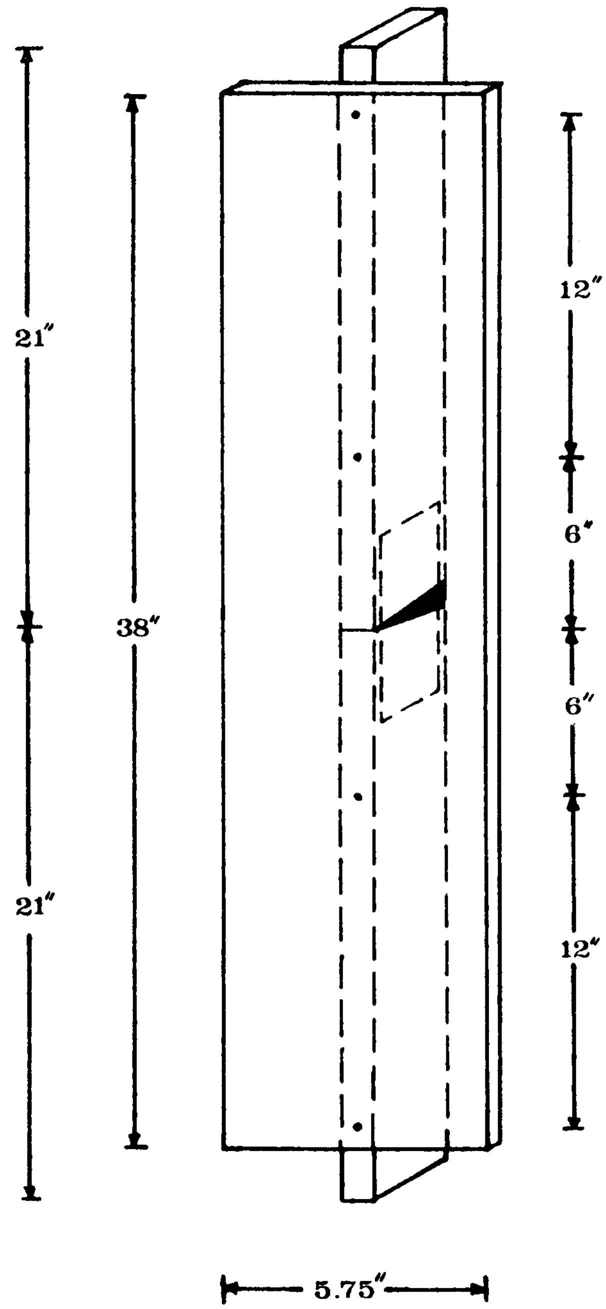

FIG. 2. Roof truss joint specimen. Gap is shown out of scale for clarity.

sociation (APA 1987) specifications with a total of four nails in each specimen, centered around the joint. Roof truss specimens contained 6d common nails spaced 12 in. on center, and floor truss specimens incorporated 8d common nails spaced 10 in. on center, as shown in Figs. 2 and 3, respectively. Overall specimen

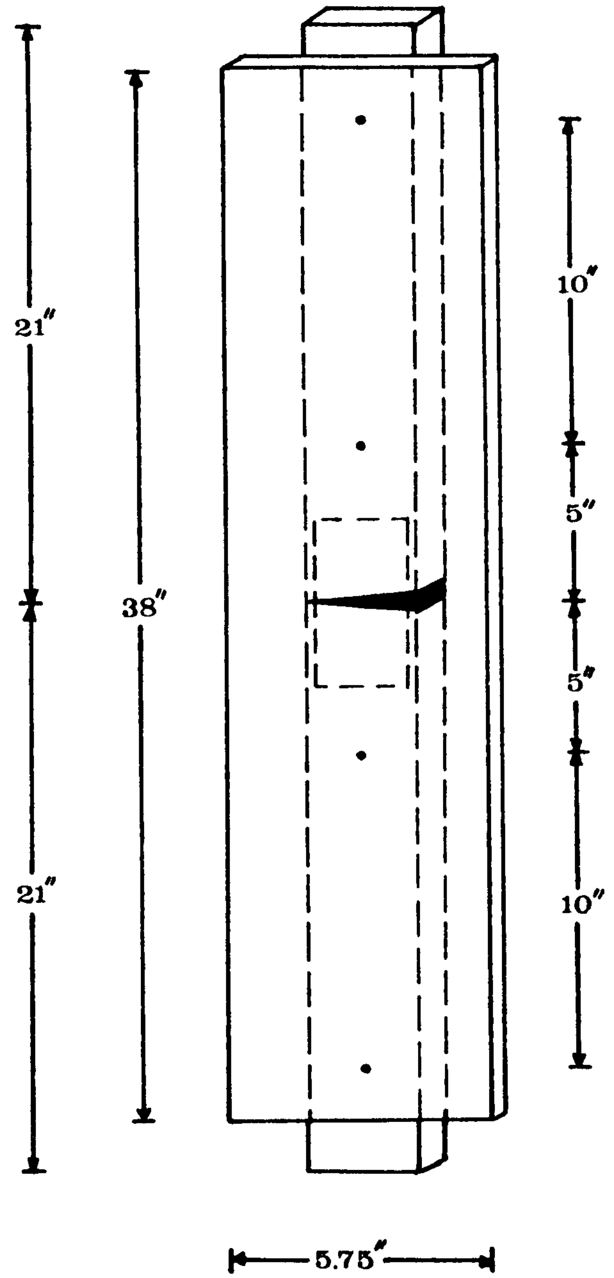

FIG. 3. Floor truss joint specimen. Gap is exaggerated for clarity.

length was chosen to allow for two nails on each side of the joint. This provides maximum in-plane stability.

The lumber used was a mixture of 2 × 4 No. 2 Dense, No. 2, and No. 1 Dense KD15 Southern Pine. The lumber grade selection was for convenience since each piece was cut into 21 in. long sections such that no defects were in the plated

TABLE 2. *Properties of plates used in the compression joint study.*

Plate style	Gauge	Pattern	Tooth density (teeth/in.²)	Thickness (in.)	Tooth length (in.)	Plate length[1] (in.)	Joint design load (lb)
A	20	Aligned	8.0	0.038	0.39	roof—5	6,210
						floor—5	6,210
B	20	Staggered	8.0	0.039	0.33	roof—5	5,550
						floor—8	8,880
C	16	Aligned	3.2	0.060	0.56	roof—5	4,950
						floor—8.3	8,250
D	16	Staggered	4.8	0.060	0.40	roof—5	6,210
						floor—7.5	9,315

[1] All plates 3.0″ wide.

area. The lumber sections were distributed to experimental groups so as to insure a reasonably common average specific gravity in all cells. Specimens were manufactured in groups prior to test so as to minimize the time between assembly and test. On the average, all specimens were tested within 48 hours of assembly.

The study metal-plates are currently manufactured 16- and 20-gauge plates and were obtained directly from the manufacturers. Each manufacturer was supplied with the truss design parameters; that is, lumber, loading, spacing, and load duration factor. The roof truss had a $^3/_{12}$ pitch and a 28 ft span. The floor truss was top-chord bearing, and the manufacturers were asked to maximize the span of the floor truss to meet the given parameters. The actual spans ranged from 22 ft-0 in. to 22 ft-6 in. Participating plate suppliers were asked to perform their own analysis of each truss under the given loading condition and then supply plates of the sizes they recommended. All plates were three inches wide, but did vary in length by supplier. A design load for each plate was calculated by multiplying the surface area of the plate by the manufacturer's stated design rating, given on a surface-area basis. The properties of each plate type are summarized in Table 2.

The joints were carefully manufactured using shims to maintain proper gaps, and all plates were pressed hydraulically. A nominal $^1/_{16}$ in. maximum gap reflects the current TPI QST-88 compression splice joint tolerance. The nominal $^1/_8$ in. maximum gap reflects the published joint tolerance for tension joints. The actual gap size was measured prior to testing and averaged within 5% of the target values.

Test method

The specimens were tested in either a 12,000 pound capacity Tinius Olsen screw-driven machine or a 20,000 pound capacity MTS hydraulic machine under stroke control. The assembled specimen was placed in the testing machine, and two linear variable differential transducers (LVDTs) were attached on either side of the joint to measure relative displacement. The LVDTs were placed on the narrow faces of the 2 × 4 in the floor truss joint samples. Outputs from both LVDTs were averaged to represent the average joint deflection across the width of the 2 × 4. To measure average joint deformation in the roof truss joint, the LVDTs were located in diametrically opposite positions on the wide faces of the 2 × 4, as near to the edge as possible. One end of the specimen was placed on a

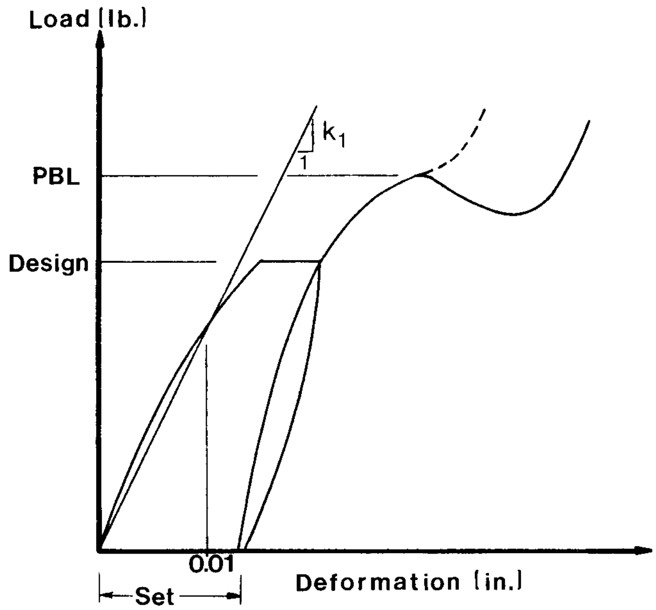

FIG. 4. Typical compression load-deformation curve for a splice joint. The solid line indicates the behavior of joints with ⅛ in. gap. The dotted line indicates post-buckling behavior of joints with $\frac{1}{16}$ in. gap.

spherically-seated block. On the other end, a ½ in. metal-plate was placed between the specimen and a load cell to distribute the load. Prior to loading, each specimen was checked with a level to assure it was centered and straight.

Load was applied at the ASTM standard rate of 0.01 in./minute (ASTM 1985) and the outputs from the load cell and LVDTs were recorded as a load-deformation graph. Each specimen was loaded to the design load level for the given plate, and the load was held for five minutes to observed creep deformation. The specimen was then unloaded and permanent deformation, or set, observed. If the plates had not buckled, the specimen was reloaded until they did buckle. "Typical" load-deformation curves are shown in Fig. 4.

A moisture content/specific gravity sample was taken from each specimen, near the joint, and these properties were determined. Specific gravity was computed on an oven-dry volume basis.

PERFORMANCE INDICATORS

Plated-joint performance in compression was evaluated using several performance indicators. These indicators are divided into three categories: buckling, deformation, and stiffness.

Plate buckling

Plate buckling load (PBL) is defined as the load that causes visible buckling of the plate and/or a definite change in the slope of the axial compression load vs. deformation curve. Typical plate buckling is shown in Fig. 5. While plate buckling is undesirable, it does not result in catastrophic failure of the chord specimen. In general, the gap closes due to wood crushing rather than rotation because of the

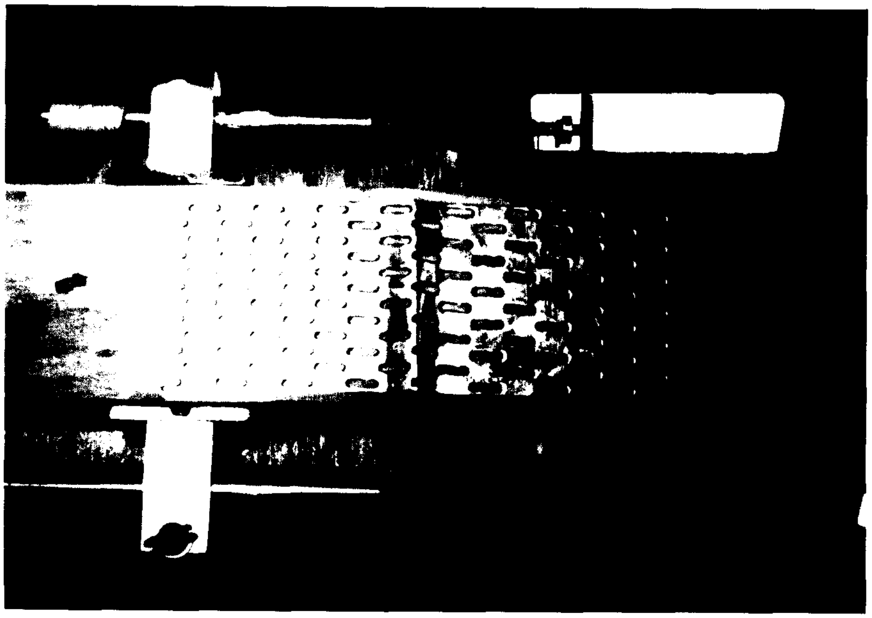

FIG. 5. Typical plate buckling of a 20-gauge-plate on floor truss specimen.

plywood restraint. After the gap has closed, the joint can continue to sustain load. Therefore, PBL may be viewed as a serviceability indicator since: 1) buckled plates may be perceived to be unsafe, 2) a permanent set is induced, and 3) the buckled joint may have questionable strength if subjected to future stress reversals.

A second variable, RATIO, was defined as the ratio of the observed plate buckling load to the prescribed plate design load. A RATIO of less than 1.0 results when the plates buckle at a load level below the specified design load. If the one-half rule is technically valid and plate buckling is the implied criteria, then a RATIO greater than 2.0 should be observed. RATIO provides a common basis for comparing plates with different tooth densities, lengths, etc. Using RATIO for comparisons assumes that the stated plate design loads were developed on a common basis from the performance of the plate in the tension tests. This assumption may or may not be valid.

Deformation

Deformation is an important consideration in truss design, and joint deformation contributes significantly to overall truss deformation. Two joint performance indicators related to deformation were investigated. The first, D1, was defined as the deformation observed when the specimen reached joint design load. Secondly, SET was defined as the permanent deformation observed after the five-minute period that the specimen was held at design load.

Joint axial stiffness

The load observed at an initial deformation of $\Delta = 0.01$ in. was used to calculate an initial stiffness of the joint, k_1, in the form of a secant modulus, as shown in Fig. 4.

TABLE 3. *Adjusted mean values for floor truss joints.*

	16 Gauge				
	Aligned		Staggered		
	Mean[1]	Cov (%)	Mean[1]	Cov (%)	Sig.[2]
PBL (lb)					
1/16″ Gap	—	—	—	—	—
1/8″ Gap	11,550	(3.5)	11,300	(3.6)	ns
Sig.[2]					
RATIO					
1/16″ Gap	—	—	—	—	—
1/8″ Gap	1.40	(3.3)	1.21	(3.8)	*
Sig.[2]					
D1 (in.)					
1/16″ Gap	0.0144	(4.5)	0.0165	(4.5)	*
1/8″ Gap	0.0150	(4.3)	0.0174	(3.9)	*
Sig.[2]	ns		ns		
SET (in.)					
1/16″ Gap	0.0053	(8.1)	0.0056	(8.8)	ns
1/8″ Gap	0.0064	(6.7)	0.0073	(6.0)	*
Sig.[2]	*		*		
k_1 (lb/in.)					
1/16″ Gap	655	(3.0)	642	(3.1)	ns
1/8″ Gap	637	(3.0)	674	(2.9)	*
Sig.[2]	ns		ns		

[1] Means adjusted for moisture content and specific gravity.
[2] ns = not significant; * = significant at the 0.20 level.

Comparisons with the indicators

Some performance indicators provide absolute comparisons of joint performance while others are better suited for relative comparisons within one plate style and size. D1 was measured relative to the plate design load, and design load varied with plate style and size. Hence, in one sense, it can be misleading to compare deformations of joints loaded to different design loads. One may observe that joints with one plate style and size always exhibited larger deformations at design load than joints with another plate, but the design loads can be quite different. RATIO is also directly tied to the design load for the plate, but is a better relative measure of plate efficiency. The PBL and k_1 are relatively independent of the actual plate rating. There may be some size effect on these indicators, but the actual design load is not a direct factor.

Statistical analysis

Statistical analysis was performed using Statistical Analysis System (SAS) software (1985). Both moisture content and specific gravity were used as covariates in the analysis of covariance to essentially remove the effects of variation in dependent variables on the response variable.

An analysis of covariance showed there were significant multiple interactions when the entire data set was considered. Because of the fundamental differences in geometry and governing design criteria, the data were separated by truss joint type for further analysis. Again, when either floor or roof truss joints were con-

TABLE 3. *Extended.*

20 Gauge				
Aligned		Staggered		
Mean[1]	Cov (%)	Mean[1]	Cov (%)	Sig.[2]
6,700	(4.5)	7,700	(4.0)	*
5,850	(5.7)	6,950	(4.2)	*
*		*		
1.08	(3.9)	0.86	(5.0)	*
0.95	(4.9)	0.78	(5.2)	*
*		*		
0.0178	(20.7)	0.0310	(11.6)	*
0.0341	(12.0)	0.0788	(5.0)	*
*		*		
0.0091	(30.1)	0.0198	(13.4)	*
0.0207	(15.8)	0.0560	(5.3)	*
*		*		
495	(3.0)	611	(2.3)	*
458	(3.5)	569	(2.5)	*
*		*		

sidered, significant three-way interactions were found between plate gauge, tooth alignment, and gap size. Because gauge was seen to influence buckling, the data were further divided by gauge.

For the 16-gauge plates, there was no significant interaction between gap size and tooth alignment. Therefore, conclusions regarding the effect of the two alignments are valid for both gap sizes, and conclusions regarding the effect of gap size are valid for both alignments. This was not generally the case for joints with 20-gauge plates, where significant interaction between gap size and tooth alignment was often found. Hence, conclusions about the effect of gap size may be valid for only one alignment, and vice versa.

The design of parallel-chord floor trusses is often limited by a deflection criterion. However, with triangular roof trusses, deflection is a less critical issue and axial deformation of the compression joint may not be as important from a serviceability perspective. Therefore, different significance levels (or, α-levels) were chosen for floor truss joints and roof truss joints. Because plate buckling and deformation are important with floor trusses, a relatively high α-level and the associated high power assure that, if differences exist between mean performances indicators being compared, these differences can be detected. A high α-level does increase the chances of saying there is a significant difference even if there isn't one, but because the differences are so critical, the higher power is of greater importance. Therefore, for floor truss joints, an α-level of 0.20 was chosen. Alternately, with roof trusses, where deformations are potentially of less importance, an α-level of 0.01 was chosen; thus, differences in performance indicators must be more substantial before they are considered significant.

TABLE 4. *Adjusted mean values for roof truss joints.*

	16 Gauge				
	Aligned		Staggered		
	Mean[1]	Cov (%)	Mean[1]	Cov (%)	Sig.[2]
PBL (lb)					
1/16" Gap	—	—	—	—	—
1/8" Gap	9,400	(1.5)	9,350	(1.5)	ns
Sig.[2]					
RATIO					
1/16" Gap	—	—	—	—	—
1/8" Gap	1.90	(1.2)	1.50	(1.6)	*
Sig.[2]					
D1 (in.)					
1/16" Gap	0.0109	(8.8)	0.0133	(6.4)	ns
1/8" Gap	0.0130	(6.7)	0.0142	(5.8)	ns
Sig.[2]	ns		ns		
SET (in.)					
1/16" Gap	0.0036	(16.2)	0.0051	(10.1)	ns
1/8" Gap	0.0060	(8.9)	0.0057	(8.8)	ns
Sig.[2]	*		ns		
k_1 (lb/in.)					
1/16" Gap	497	(4.3)	550	(3.5)	ns
1/8" Gap	439	(4.4)	519	(3.6)	*
Sig.[2]	ns		ns		

[1] Means adjusted for moisture content and specific gravity.
[2] ns = not significant; * = significant at the 0.01 level.

RESULTS AND DISCUSSION

General observations

The dominant factor contributing to gap closure was buckling of the metal plate across its width at the point of the splice on both sides of the joint. Associated with buckling was slippage between the teeth and the wood near the splice, as well as tooth withdrawal. Tooth-slip played a greater role in joints with a 1/16 in. gap, whereas actual plate buckling was more prevalent in joints with 1/8 in. gap. With the smaller gaps, the gap often nearly closed primarily due to tooth-slip.

Generally, the load-deformation curves for the 1/8 in. gap specimens resembled the solid line in Fig. 4, while the post-buckling behavior of the 1/16 in. gap specimens resembled the dotted line in Fig. 4. The two curves are very similar except for post-buckling behavior. Because joints with 1/8 in. gap could sustain greater deformation, the load often fell off after buckling until the gap closed, and then the joint continued to support load. Joints with a 1/16 in. gap generally did not exhibit this behavior since there was less available space for deformation. Joints with 20-gauge plates generally exhibited more pronounced buckling than did those with 16-gauge plates.

Influence of experimental design factors

The mean values of the performance indicators for floor truss joints, adjusted for differences in moisture content and specific gravity, are shown in Table 3.

TABLE 4. *Extended.*

20 Gauge				
Aligned		Staggered		
Mean[1]	Cov (%)	Mean[1]	Cov (%)	Sig.[2]
6,050	(2.8)	6,350	(2.6)	ns
5,500	(2.9)	6,550	(2.5)	*
ns		ns		
0.98	(2.9)	1.14	(2.5)	*
0.89	(3.0)	1.18	(2.4)	*
ns		ns		
0.0235	(12.1)	0.0136	(19.7)	ns
0.0513	(5.2)	0.0127	(22.1)	*
*		ns		
0.0131	(17.8)	0.0063	(34.8)	ns
0.0371	(5.9)	0.0047	(48.7)	*
*		ns		
484	(2.1)	469	(2.0)	ns
474	(2.0)	469	(2.1)	ns
ns		ns		

Similar values for roof truss joints are in Table 4. The coefficients of variation are small, since use of moisture content and specific gravity as covariates considerably reduces the variability of the raw data. The tables also indicate whether the differences were judged by the study criteria to be significant.

Gap size

The effect of gap size on PBL and RATIO could not be evaluated for joints with 16-gauge plates, since joints with a $\frac{1}{16}$ in. gap did not buckle; rather, the gap closed due to slippage between the wood and the teeth. Gap size had little influence on the other performance indicators for the 16-gauge plated joints. Floor truss joints with 20-gauge plates and $\frac{1}{16}$ in. gap always outperformed joints with 20-gauge plates and $\frac{1}{8}$ in. gap. That is, joints with $\frac{1}{16}$ in. gap had a significantly greater mean PBL, RATIO, and stiffness, and exhibited smaller deformations, than did joints with $\frac{1}{8}$ in. gap. This trend was much less pronounced in roof truss joints with 20-gauge plates; gap size was shown only to influence SET and D1 in joints with 20-gauge, aligned plates.

Plate gauge

Joints with 16-gauge plates generally outperformed those with 20-gauge plates. That is, joints with 16-gauge plates generally had a greater mean PBL, RATIO, and stiffness and/or exhibited smaller deformations than did joints with 20-gauge plates. Gap size was found to have less influence on the performance of 16-gauge plated joints than on 20-gauge plated joints.

Tooth Alignment

It is difficult to attribute differences in joint performance between joints with aligned and staggered plates solely to tooth alignment. With the absolute indicators, significant differences could usually be attributed to differences in design loads. No consistent pattern of influence was seen with the relative indicators.

Joint configuration

Both roof and floor truss joints yielded similar qualitative results with respect to the effects of gap size, plate gauge, and tooth alignment. Gap size and tooth alignment on joints with 20-gauge plates more strongly influenced the performance of floor truss specimens compared to roof truss specimens. The detection of significant differences varied somewhat due to the different α-levels for the two joint configurations. The location of the sheathing with respect to the plates may have influenced joint performance in that the sheathing on floor truss joints was applied over a plate. With roof truss joints, plates were not covered. Based on some preliminary tests of joints without sheathing and the study observation, we feel that the principal influence of the sheathing was to improve joint stability. While some stiffness may be added by the sheathing, the nailed joints are inherently flexible (particularly after cycling) and any increase should not be counted on.

Implications for the quality standard

Little difference due to gap size was detected in the performance of either roof or floor truss joints with 16-gauge plates, indicating that the ⅛ in. gap size may be acceptable if 16-gauge plates are used.

Roof truss joints with 20-gauge plates were slightly affected by differences in gap size, while floor truss joints with 20-gauge plates and $^1/_{16}$ in. gap always outperformed similar joints with ⅛ in. gap. If serviceability performance of compression splice joints is indicative of overall truss safety and serviceability, then increasing the allowable gap size may adversely affect floor truss performance, where deflections are most critical. A ⅛ in. gap may be acceptable for roof truss joints with 20-gauge plates.

Implications for design practice

Plate design ratings for use with compression splice joints are based on tension test results. This design rating is reported on a load per square-inch of surface area basis and may be considered as independent of plate size for any one plate type.

The test results expressed by the relative performance indicators (RATIO, SET, and D1) point out several inconsistencies in this design practice. Design ratings based on tension tests are often governed by a limiting deformation criterion (i.e., load at 0.03 in. slip). Hence, one might expect that the deformations of joints with various plate types to be similar when the joints are loaded to their respective design loads in tension. Likewise, the deformations of plates loaded to their tension-derived design loads in compression should be similar. This was generally not the case.

If PBL is an appropriate joint serviceability criterion and the design rating increases with area, then a RATIO greater than 1.0 should be sought. That is, that the plate buckling load equals or exceeds the design load for the plate. However, a RATIO less than 1.0 was generally observed for joints with 20-gauge plates. This result implies that the plate did not perform as expected based on the design load. Such a result is not surprising, since the design rating is based on results from tension tests where tooth-withdrawal is a common action. While tooth-withdrawal is a part of the action in a compression joint, the principal "failure" mode is buckling of the metal-plate across the joint, especially if a gap is present. Plate buckling is a localized phenomenon and can be treated similar to a tension net section design. Basing compression joint design on a per-area basis does not recognize that failure is localized at the splice. For a given plate width and gauge, there may be a limiting plate length beyond which any increase will not result in a corresponding increase in joint compressive strength. This transitional behavior is similar to the actions of a tension joint where the failure mode changes from tooth-withdrawal to plate tearing. If greater load-capacity is needed, then a thicker plate must be sought rather than increasing length.

The "half rule," as defined in TPI-85 (1985), allows sizing plates for chord splices considering only one half of the axial force calculated for the chord. If PBL is appropriate as the criterion to evaluate the "half rule," then the value of RATIO should exceed 2.0. That is, for a plated joint with a design load rating of 4,000 pounds, the actual design force in the chord could be as high as 8,000 pounds if the "half rule" is used. In all cases where PBL was defined, the parameter RATIO was less than 2.0. Based on the study results, the half rule could not be physically confirmed with serviceability criteria for compression splices using 20-gauge plates or 16-gauge plates and ⅛ in. gap. RATIO was not defined for joints with 16-gauge plates and $^1/_{16}$ in. gap since the plates did not buckle. It is likely that plate buckling would result in an overall increase in truss deflection as well as a localized visible anomaly. Whether this increased deformation impacts on the use of the truss, will have to be assessed on a case-by-case basis. For example, plate buckling in parallel-chord floor trusses may be important whereas it may be negligible with pitched roof trusses.

Often, the absolute indicators (PBL & k_1) did not identify differences between levels of study variables that were noted by the relative indicators. Therefore, either there may be a difference between plate efficiencies, and/or the method of determining and applying design ratings to compression splices is flawed. For example, compare joints with two plate types and similar PBLs, one with a RATIO of 1.6 and the other a RATIO of 1.1. The relative difference in RATIO indicates a difference in a "serviceability factor." A RATIO of 1.6 indicates a more conservative design load than for a plate with a RATIO of 1.1 This difference could be a function of the plate itself, or it could mean that the manufacturer altered the design rating to be more conservative.

CONCLUSIONS

The conclusions from this study are:

1) Generally, 20-gauge plates and 16-gauge plates on joints with ⅛ in. gaps buckled under compression loads while 16-gauge plates on joints with $^1/_{16}$ in. maximum gap did not buckle before the gap closed; rather, the gap closed primarily due to slippage between the teeth and the wood.

2) Joints with 16-gauge plates generally outperformed joints with 20-gauge plates based on serviceability performance indicators of the test compression splice joints. Furthermore, gap size had less of an influence on joints with 16-gauge plates than on joints with 20-gauge plates.

3) Plate tooth alignment did not consistently affect compression joint serviceability.

4) Gap size had little influence on joints with 16-gauge plates and roof truss joints with 20-gauge plates. In floor truss joints with 20-gauge plates, joints with $\frac{1}{16}$ in. gap were found to have a better serviceability performance than joints with $\frac{1}{8}$ in. gap. However, the significance of differences in joint performance on overall truss safety and serviceability is unknown.

5) Because of a localized plate buckling phenomenon, a practice of sizing compression splice plates on a surface-area basis derived from tension tests is questionable.

6) Using plate buckling load as a criterion, the half rule for compression splices could not be physically confirmed for all joints with 20-gauge plates or with joints using 16-gauge plates and a maximum gap of $\frac{1}{8}$ in.

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