THE BOARD FOOTAGE MYTH
DEBUNKED

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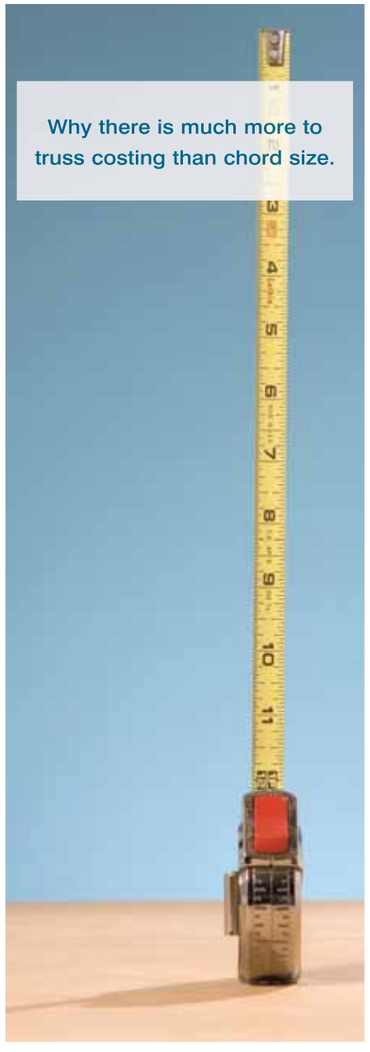

Why there is much more to truss costing than chord size.

at a glance

- It is not correct to assume that a truss designed with the least amount of board footage will always result in the most economic option.
- There is a point where the board footage cost of the high grade smaller member equals the cost of a larger, lower grade board.

The answer mirrored one heard many times—the 2x4 truss is more economical because it contains less board footage than the 2x6 truss. Is this true? Are 2x4 truss chords always more economical than a truss with 2x6 chords? Or is it a common misconception that the most cost-effective truss always uses the smallest size chord material? After many years of experience, I believe this is a myth that has been created over time which must be explored to prove or disprove optimal truss cost is more than comparing chord sizes.

I think we can all agree that lumber, plates, and labor are the three main components contributing to finished truss cost. Since material size is the primary basis behind the board footage argument, beginning our search with lumber is appropriate. Relating truss cost to chord size is a presupposition that fails to recognize raw material price differences that occur between different grades and lengths. Typically, low grade lumber can be purchased at a lesser price than a higher grade member of the same size. Price differentials may also occur between different lumber lengths with the same size and grade. When a truss is designed, a higher grade lumber of the same size is required as chord stresses increase. There is a point, however, where the board footage cost of the high grade smaller member equals the cost of a larger, lower grade board.

Comparing two different lumber sizes with different grades requires adjusting the purchase price by the board footage. These two key points are demonstrated in Table 1.

Size	Length	BF	Grade	Price	Cost (BF x Price)
2x4	12'	0.67	SS	375	252
2x6	12'	1	#2	290	290
2x4	14'	0.67	SS	480	322
2x6	14'	1	#2	290	290

Table 1.
Note: Prices listed are per thousand bd. ft., and are not meant to represent actual prices in all regions of the United States and Canada.

As you can see, there is no cost benefit of replacing a 12' 2x4 SS member with a #2 grade 2x6 of the same length; therefore, the most economical truss likely contains 2x4 lumber. However, if the truss uses 14' members, there is an economical benefit the truss is designing with 2x6 members. Adjusting lumber price by the board footage (as in Table 1) identifies cases where replacing high grade lumber with a larger board of a lower grade is likely to reduce truss cost. This can be proven by comparing two identical 42' trusses, one with a 2x4 Select Structural (SS) bottom chord and one with a 2x6 #2 grade bottom chord (Figures 1 and 2). The lumber cost for each truss is summarized in Table 2 indicating the 2x6 bottom chord is

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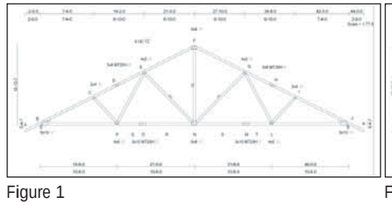

Figure 1

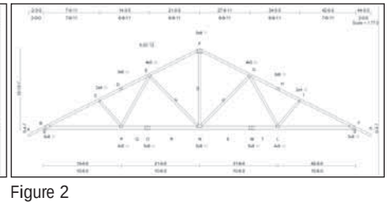

Figure 2

The Board Footage Myth...

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more economical due to lumber price difference between grades and eliminating a wedge block. So, understanding the interdependence of lumber size, grade, and price begins to displace the illusion that smaller truss chords are always the most cost effective.

Insights into the truss design process and fabrication enlighten us to other cost efficiencies obtainable with larger lumber sizes. For example, total truss board footage must also take into account the number of webs required for structural integrity. Structural analysis proves the maximum truss panel is influenced by the chord size. Generally speaking, trusses built with 2x4 chords have top and bottom panels in the 8'-6" to 10' range respectively, whereas maximum panels for 2x6 chords are in the 10' to 13' neighborhood. Again, a simplistic example helps us to visualize the much larger picture. A 45' common truss using 2x4 grade chords is designed as a 6/6 Howe (Figure 3) with nine webs and 12 panel points. The quantity of webs maintains #2 grade chords and eliminates variance caused by different lumber grades; in essence, an “apples-to-apples” comparison is being made. The same 45' truss span with 2x6 chords can be designed as a 4/4 Howe consisting of five webs and eight panel points (Figure 4). Assuming all other variables are constant, it becomes immediately apparent that the board footage saved by removing webs helps offset the 2x6 chords (Table 3).

42' Common w/ 14' 2x4 Bottom Chord Lengths (Figure 1)						
Lumber						
Quantity	Size	Length	Grade	BF	Price	Cost (BFxPrice)
3	2x4	14	SS	28.000	480	13.44
2	2x4	12	No. 2	16.000	320	5.12
2	2x4	5	No. 3	6.667	265	1.77
2	2x4	8	No. 3	10.667	260	2.77
2	2x4	10	No. 3	13.333	265	3.53
1	2x4	12	No. 3	8.000	275	2.20
2	2x4	14	No. 2	18.667	320	5.97
1	2x6	1	No. 2	2.000	290	0.58
Total cost						$35.39

42' Common w/ 14' 2x6 Bottom Chord Lengths (Figure 2)						
Lumber						
Quantity	Size	Length	Grade	BF	Price	Cost (BFxPrice)
3	2x6	14	No. 2	42.000	290	12.18
2	2x4	12	No. 2	16.000	320	5.12
2	2x4	5	No. 3	6.667	265	1.77
2	2x4	8	No. 3	10.667	260	2.77
2	2x4	10	No. 3	13.333	265	3.53
1	2x4	12	No. 3	8.000	275	2.20
2	2x4	14	No. 2	18.667	320	5.97
Total cost						$33.55

2x6 Cost Savings: 5.48%

Table 2

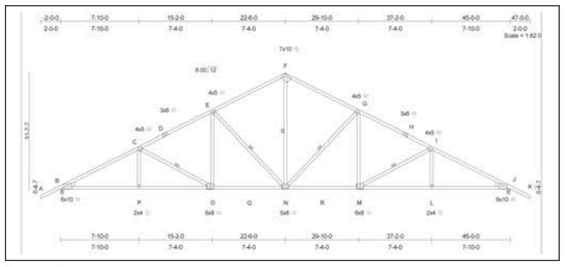

Figure 3

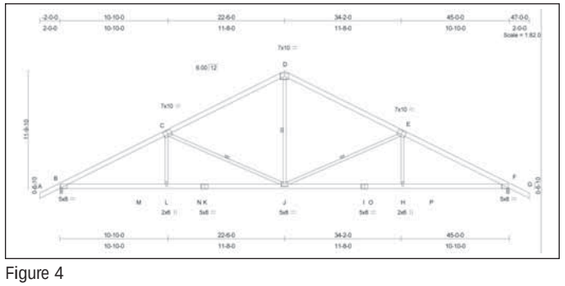

Figure 4

45' Common w/ 2x4 Chords (Figure 3)				
Lumber				
	Quantity	Size	Length	BF
Webs	2	2x4	4	5.333
	4	2x4	8	21.333
	3	2x4	12	24.000
			Total BF	50.666

45' Common w/ 2x6 Chords (Figure 4)				
Lumber				
	Quantity	Size	Length	BF
Webs	2	2x4	5	6.667
	1	2x4	12	8.000
	2	2x4	14	18.667
			Total BF	33.33

Table 3

2x6 Material Savings: 34.21%

There appears to be some benefit to relating lumber size and grade and maximizing panels for the chord size. But because eliminating webs and lumber price variation does not make up the entire truss cost picture, we must take into account the other two cost components: labor and plates. Intuitively, increased labor can be associated with the 2x4 chord truss due to the number of webs and installed plate pairs. (Plate pairs are selected because the number of joints to be set up and plated does not account for additional plates that may be required for wedges, sliders, stacked chords, etc.) The smaller chord truss also requires more plates (plate area) for fastening additional webs.

Assuming that the cost of a truss is comprised of 50 percent lumber, 10 percent plates, and 40 percent labor (equally split between number of plate pairs and number of pieces handled and cut), each cost element can be weighed accordingly and investigated. We have learned that one key contribution a truss technician can make during the design process is understanding the benefit larger truss panels offer with 2x6 chords. This principle, long associated with longer span trusses, may be a viable alternative for shorter span too. We can explore board footage and labor while keeping plate area and lumber grade constant in a 12' common truss. The King Post in a 2x4 chord (Figure 5) truss can be removed with a 2x6 bottom chord (Figure 6). Although removing the 2x4 web provides some compensation for the 2x6 bottom chord, a majority of the benefit is derived from labor (Table 4).

We can begin to create a total truss cost picture by investigating board footage, plate area, number of webs, and number of joint pairs. Optimizing Figure 3 to create Figure 7 provides a more true comparison to Figure 4. Even when lumber cost adjusted for size, grade and length results in more board footage, it is the labor savings as a result of fewer webs (larger panels) and plate pairs installed that make the 2x6 chord truss more economical. Again, web board footage, labor, and plates all contribute to the economical advantage as summarized in Table 4.

There are advantages to using 2x6 chords in “short” and “intermediate” span trusses. Our final board footage exploration is 60' trusses with 2x4 chords which are requested in some markets. A 2x4 chord and 2x6 chord trusses are shown

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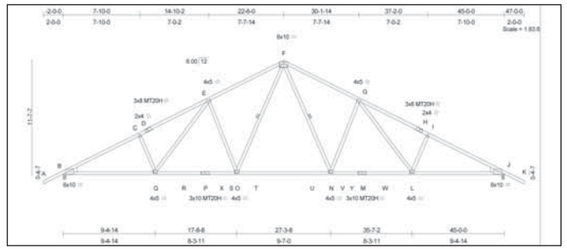

Figure 7

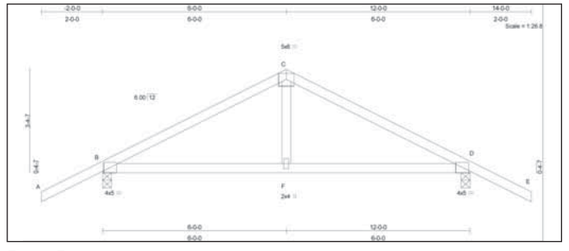

Figure 5

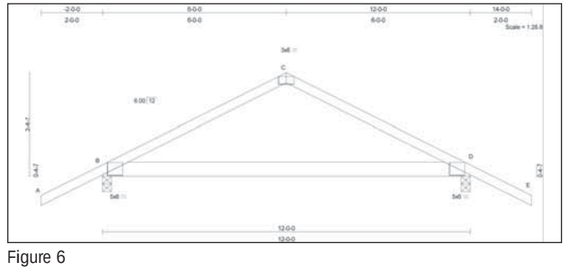

Figure 6

Assumed Factors of Truss Cost	Lumber/BF		Plate Area		Labor Pcs.	Labor Plate Pairs
	50%		10%		20%	20%
	12' Common (Figures 5 & 6)					
Chord Size	Lumber/BF		Plate Area		Labor Pcs.	Labor Plate Pairs
2x4	23.333		156		4	4
2x6	25.333		156		3	3
% Diff	8.57%		0.00%		-25.00%	-25.00%
% Cost Diff	4.286%		0.000%		-5.000%	-5.000%
% Save	-5.714%					
	45' Common (Figure 7 & 4)					
Chord Size	Lumber/BF		Plate Area		Labor Pcs.	Labor Plate Pairs
2x4	122.000		916		17	15
2x6	141.333		868		12	10
% Diff	15.85%		-5.24%		-29.41%	-33.33%
% Cost Diff	7.923%		-0.524%		-5.882%	-6.667%
% Save	-5.150%					

Table 4

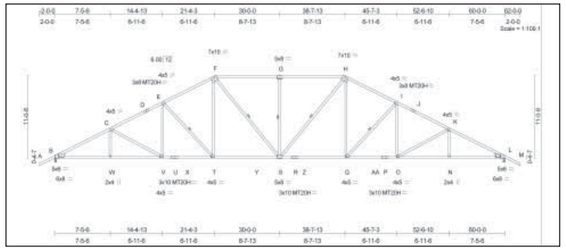

Figure 8

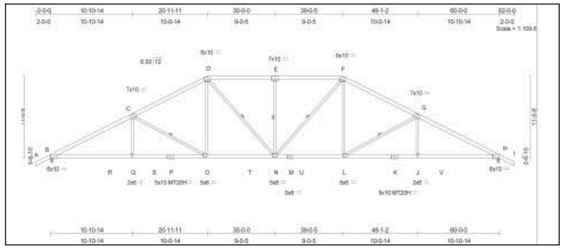

Figure 9

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in Figures 8 and 9, and the lumber, plates and labor tabulated in Table 5. The "board footage cost" when adjusted for size, grade, and length and plate area are virtually identical! The cost benefit can be found in labor associated with fewer members to cut, handle, and install. This remains true even adjusting the lumber cost factor upward from 50 percent while reducing the labor factor. The overall conclusion is that maximizing panel size to minimize webs and reducing the number of plates installed is critical to truss cost, not chord size.

How can we apply these findings to the "real world" where chords consist of multiple lumber grades, the top chord may be a different lumber size than the bottom chord, and lumber sizes may change within the same chord? Although these concepts apply across all lumber sizes, the typical application is transitioning from 2x4 to 2x6 chords. First and foremost, it is imperative that a truss technician have lumber price knowledge to make chord size and splice decisions. Additional clues include high grade lumber presence with combined stress index (CSI) above 0.8 which can be replaced with a larger size, lower grade member. The existence of wedges or sliders may be eliminated by upsizing a chord. Truss spans in the mid-40' range are more conducive to 2x6 lumber especially when considering intangibles such as handling, delivery, installation, and perceived quality. Finding the ideal changeover point will vary between component plants based on truss design loads, lumber size, grade, and length inventoried, labor cost, plate inventory, and truss technician design ability.

Board footage does and will continue to have a vital role in the building component industry. The tools available today allow numerous variables to be quickly tested when designing and pricing trusses. Expanding the focus beyond comparing truss chord size, or "board footage," may create truss designs not previously considered with inherent cost and marketing benefits. SBC

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60' Truss w/ 2x4 Chords (Figure 8)						
Lumber Adjustment for Length and Grade						
Quantity	Size	Length	Grade	BF	Price	Cost (BFxPrice)
2	2x4	12	No. 1	16.000	350	5.60
2	2x4	10	SS	13.333	335	4.47
3	2x4	16	SS	32.000	480	15.36
2	2x4	4	No. 2	5.333	320	1.71
4	2x4	8	No. 2	21.333	290	6.19
2	2x4	10	No. 2	13.333	290	3.87
3	2x4	12	No. 2	24.000	320	7.68
2	2x4	14	No. 2	18.667	320	5.97
2	2x4	16	No. 1	21.333	375	8.00
1	2x4	12	SS	8.000	375	3.00
2	2x6	1	No. 2	2.000	290	0.58
				Total BF cost:		$62.42

Plate Adjustment for Gauge				
Gauge	Plate Area			
Std	1104		1.00	1104
HS*	276		1.10	303.6
			Total:	1407.6

Table 5. *A 10% area increase is assumed for high strength steel.

60' Truss w/ 2x6 Chords (Figure 9)						
Lumber Adjustment for Length and Grade						
Quantity	Size	Length	Grade	BF	Price	Cost (BFxPrice)
2	2x6	12	No. 2	24.000	290	6.96
2	2x6	10	No. 2	20.000	285	5.70
4	2x6	16	No. 2	64.000	305	19.52
2	2x4	6	No. 2	8.000	290	2.32
5	2x4	12	No. 2	40.000	320	12.80
2	2x4	14	No. 2	18.667	320	5.97
2	2x6	14	No. 2	28	290	8.12
				Total BF cost:		$61.39

Plate Adjustment for Gauge				
Gauge	Plate Area			
Std	1228		1.00	1228
HS*	200		1.10	220
			Total:	1448

Assumed Factors of Truss Cost	Lumber		Plate		Labor	
					Pcs.	Joint Pairs
	50%		10%		20%	20%

Chord Size	Adj. Lumber		Adj. Plate		Labor	
					Pcs.	Joint Pairs
2x4	62.42		1407.6		25	23
2x6	61.39		1448		19	15
% Diff	-1.65%		2.87%		-24.00%	-34.78%
% Cost Diff	-0.825%		0.287%		-4.800%	-6.957%
Potential % Save	-12.295		(% Cost Diff for Lumber+Plate+Labor)			

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