STRUCTURAL STEEL

Steel Types and Sizes

	Shape & Type	Symbol	Stock Size Specs	Lengths	Finish	Uses
I-BEAMS	Junior *	M	Height in inches x pounds/LF (Ex: W8x24)	20, 40, 50, and 60 feet	Hot-rolled, mill finish	Carrying beams, headers, ridge beams, cantilevered beams
	Standard	S				
	Wide Flange	W or WF				
CHANNELS	Stringer *	MC	Height in inches x pounds/LF (Ex: C5x9)	20 and 40 feet	Hot-rolled, mill finish	Carrying beams, flitchplates, headers, ridge beams, columns
	Standard	C				
	Ship & Car **	MC				
TEES	Tee †	T	Height in inches x width in inches (Ex: T6x8)	20 feet	Hot-rolled, mill finish	Lintels, ledgers, light-load columns
ANGLES	Equal Legs	Angle in degrees or L	Leg x leg x thickness (Ex: 3x6x1/4")	20 and 40 feet	Hot-rolled, mill finish	Lintels, ledgers, web and flange reinforcements, joint clips
	Unequal Legs					
BAR STOCK	Flats	N/A	Thickness x width (Ex: 1/2x8)	20 feet	Hot-rolled, mill finish	Column plates, splice plates, machinist parts, tools
	Rounds		Diameter (Ex: 2")	12 feet	Cold-rolled, pickled and oiled	
	Squares		Width of one side (Ex: 1")	and random		
PIPE	Sch. 10 *	BPPE (black pipe plain end) or BPTC (black pipe threaded coupling)	Inside diameter x schedule weight (3" Sch. 40 BPPE)	21 to 24 feet	Hot-rolled, mill finish, painted, hot galv.	Columns
	Sch. 40					
	Sch. 80 **					
TUBING	Round	ERW (elec.-res. welded) DOM (drawn over mandrel)	Outside dim. or diameter x wall thickness (Ex: 2x1/8" round; 2x4x1/4" rectangle)	20 and 40 feet	Hot- or cold-rolled, pickled and oiled	Handrails, balusters, specialties
	Square					
	Rectangular					

* Also called "Lightweight" ** Also called "Heavyweight" † Made by splitting I-beams in half

Each grade of structural steel has a specific quality as described by the American Society for Testing & Materials (ASTM) standards. ASTM A-326 is the predominant grade in the structural steel market. It has a carbon content of .26%, which gives it relatively high strength (60,000 psi tensile), yet it is easy to weld and fabricate. It is produced in several different shapes, each of which has its own descriptive nomenclature, typical finishes, and stock lengths. ("Steelwork in Wood Frames," 4/92)

Structural Steel Headers

Point load, lb.	Span 3'	4'	5'	6'
5,000	T3x3x5/16 (1.88)	T4x4x3/16 (2.50)	T4x3x1/4 (3.13)	C6x8.2 (3.75)
10,000	C6x8.2 (3.75)	C6x10.5 (5.00)	W6x12 (6.25)	T6x3x3/8 (7.50)
15,000	C6x13 (5.63)	T6x3x3/8 (7.50)	T7x3x3/8 (9.38)	W8x15 (11.25)
20,000	T6x3x3/8 (7.50)	W6x16 (10.00)	W10x15 (13.00)	W10x17 (15.00)

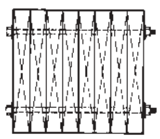
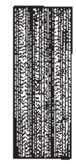
W

T

C

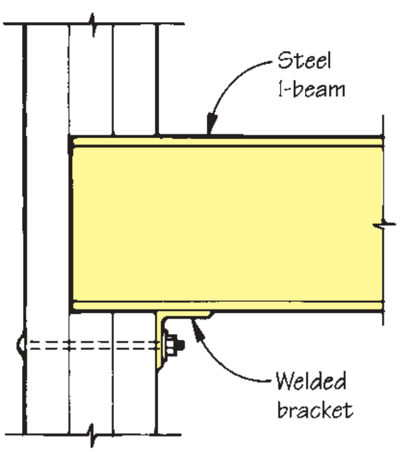
This table gives examples of standard steel (A36) shapes and sizes that will work as headers to carry heavy point loads where height is limited. Each of these pieces of steel can be worked into a 2x4 wall, although the W beams are a full 4 inches wide and require a little work to fit. The number in parentheses is the section modulus required for the given load and span; the steel section above it is the shallowest and lightest piece of steel that will work. Substitutions may have to be made because most steel yards do not carry every size and shape. (*Practical Engineering*, 1/95)

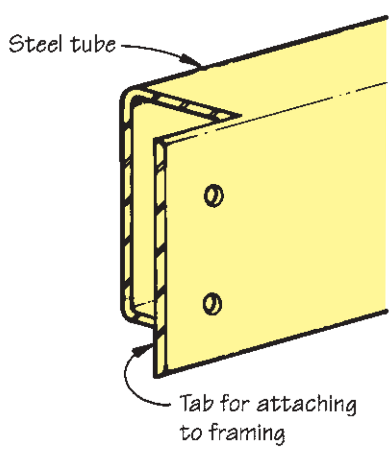
Garage Door Header Comparison

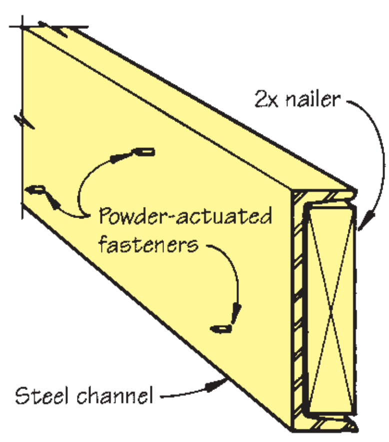
	Dimensional lumber	Glulam	LVL	I-beam
				
SIZE	8 - 2x12 SPF with pairs of through-bolts 16" o.c.	1 - $5\frac{1}{8}$x$13\frac{1}{2}$ glulam	3 - $1\frac{3}{4}$x14 LVL	1 - W12x14 I-beam
WEIGHT	24 lbs./LF	$17\frac{1}{2}$ lbs./LF	21 lbs./LF	14 lbs./LF
COST	$8.80/LF	$15/LF	$14.25/LF	$6.75/LF

The beams shown here in section represent four ways to span a 16-foot door opening on the eaves end of a 24-foot-square garage. (Beam supports 780 lbs./LF.) Not only is the steel beam less expensive than the others, it is also the lightest. (“Steelwork in Wood Frames,” 4/92)

Steel-to-Wood Connections







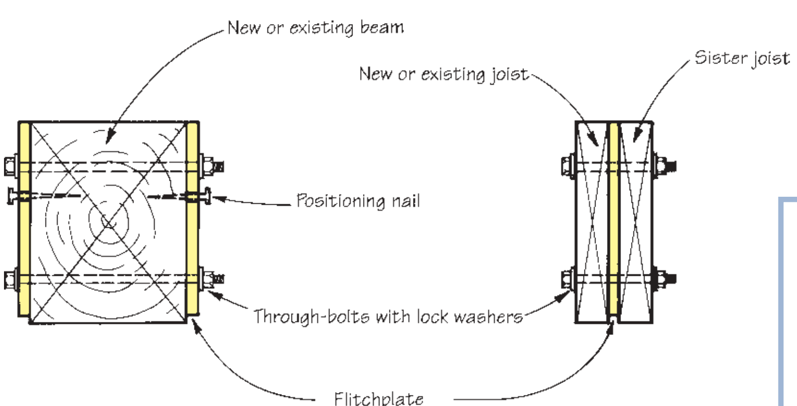
A common way to attach a steel header to wood framing is to have the steel yard weld on an attachment angle bracket (above left). The steel cutter can also leave an attachment tab on the ends of a piece of steel, as with the tube shown here (middle). On site, the quickest method is to fasten a 2x nailer to the steel using powder-actuated nails (right). (*Practical Engineering*, 1/95)

Equivalent Strengths: Flitch Beams vs. Built-Up Wood Beams & Steel I-Beams

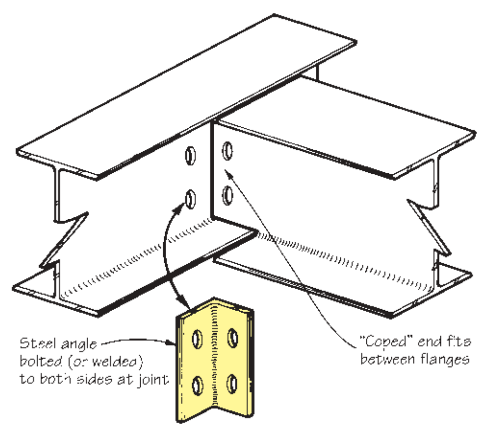
Single Steel Flitch Beam		Built-Up Lumber Equivalents*	Steel I-Beam Equivalents	Double Steel Flitch Beam		Built-Up Lumber Equivalents*	Steel I-Beam Equivalents
Wood	Steel			Wood	Steel		
2x6	5" x 1/4"	2.3 - 2x6s	–	2 x 6	5" x 1/4"	4.7 - 2x6s	–
	5 x 3/8	3.5 - 2x6s	–		5 x 3/8	7 - 2x6s	–
	5 x 1/2	4.7 - 2x6s	–		5 x 1/2	9.4 - 2x6s	–
2x8	7 x 1/4	2.8 - 2x8s	–	2 x 8	7 x 1/4	5.6 - 2x8s	W6x9
	7 x 3/8	4.2 - 2x8s	–		7 x 3/8	8.4 - 2x8s	W8x10 or W6x12
	7 x 1/2	5.6 - 2x8s	W6x9		7 x 1/2	11.3 - 2x8s	W8x13
2x10	9 x 1/4	2.9 - 2x10s	–	2x10	9 x 1/4	5.6 - 2x10s	W8x10
	9 x 3/8	4.3 - 2x10s	–		9 x 3/8	8.4 - 2x10s	W8x15
	9 x 1/2	5.8 - 2x10s	W8x10		9 x 1/2	11.5 - 2x10s	W8x18
2x12	11 x 1/4	2.9 - 2x12s	–	2x12	11 x 1/4	5.8 - 2x12s	W10x12
	11 x 3/8	4.4 - 2x12s	–		11 x 3/8	8.8 - 2x12s	W10x17
	11 x 1/2	5.8 - 2x12s	W10x12		11 x 1/2	11.7 - 2x12s	W10x22

* *The strength equivalent shown for built-up lumber beams assumes Doug-fir-larch (E=1.6, Fb=1,200).* ("Flitchplates," 9/92)

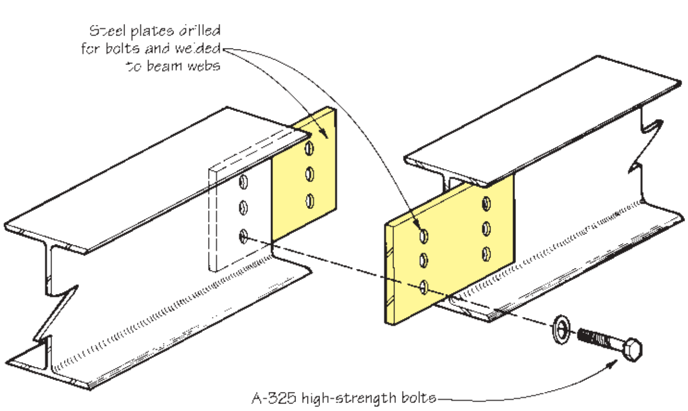
Attaching Flitchplates



Flitchplates are particularly useful in renovation to reinforce sagging or broken wood beams. Use pairs of through-bolts spaced 16 to 24 inches on-center to make the connection. ("Steelwork in Wood Frames," 4/92)



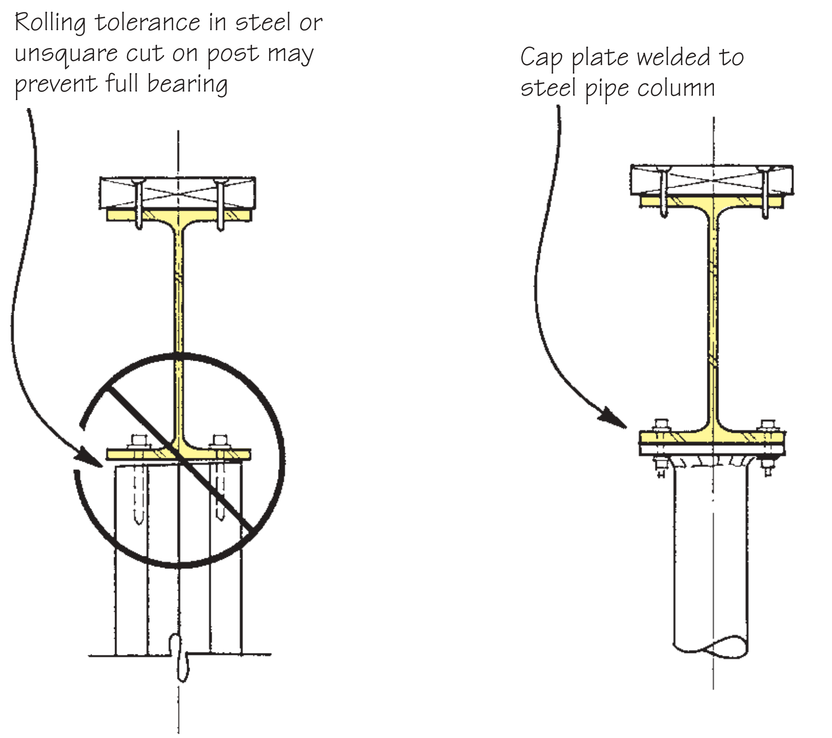
Splicing I-Beams



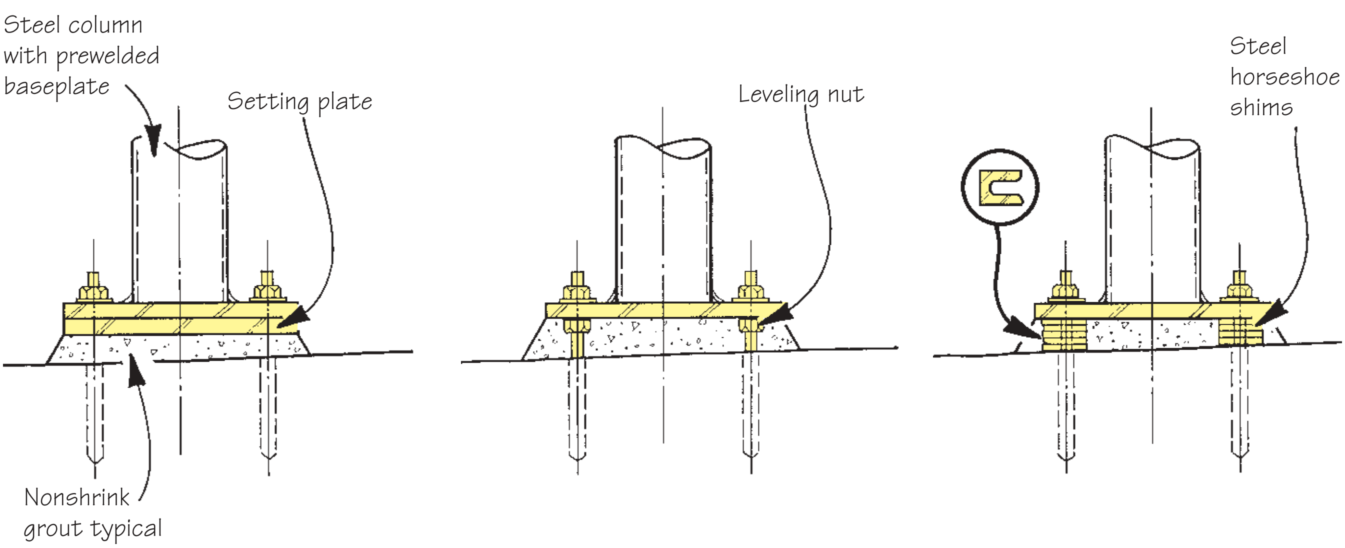
In an in-line beam splice (left), the ends of the beams butt together with welded plates on each side. In both cases, high-strength (A-325) bolts placed in predrilled holes complete the connection on site. Steel angles or "clips" are used to bolt beams together at right angles (above). Note that the flanges have been cut back ("coped") from the web at the butt end of one beam so that it fits the profile of the other beam. The fit does not have to to be perfect because the bolts handle the load. ("Steelwork in Wood Frames," 4/92)

Column Cap Connection

The author recommends against supporting steel beams on wood posts (left). Rolling tolerances in the steel or an unsquare cut on the post could result in uneven bearing. Also, the lag screw into the post's end grain is a weak connection, while the blocking required to make a strong connection is much more time-consuming than simply bolting a steel column's cap plate to the bottom flange (right). (*Practical Engineering*, 2/97)



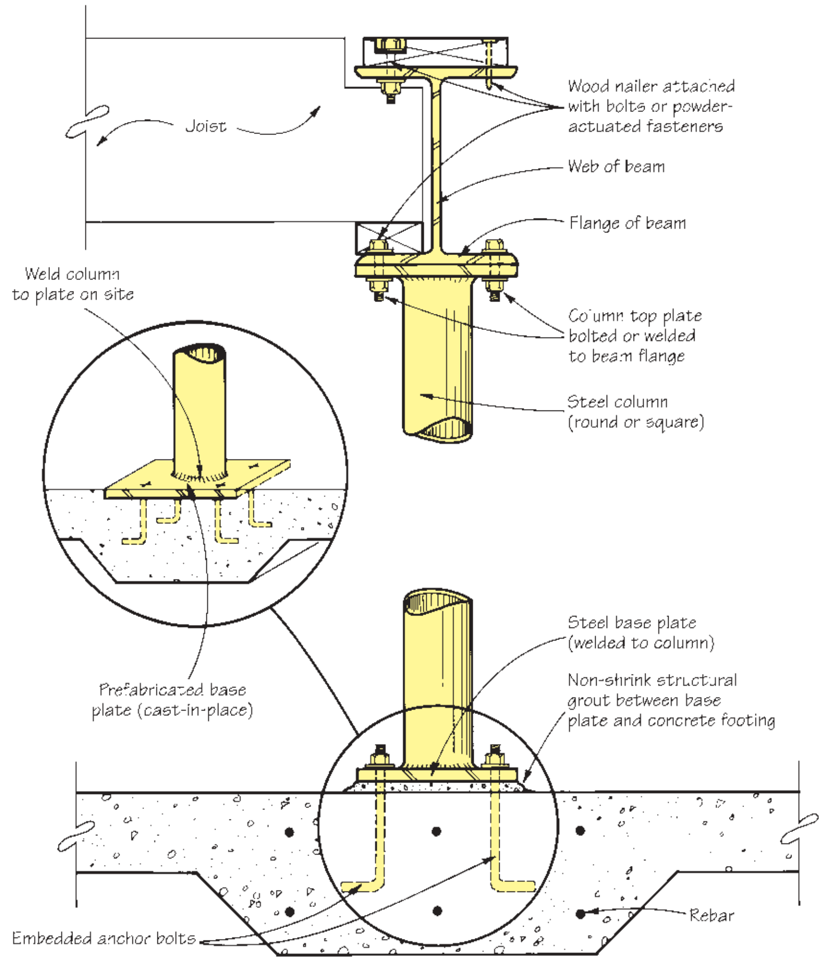
Baseplate Options

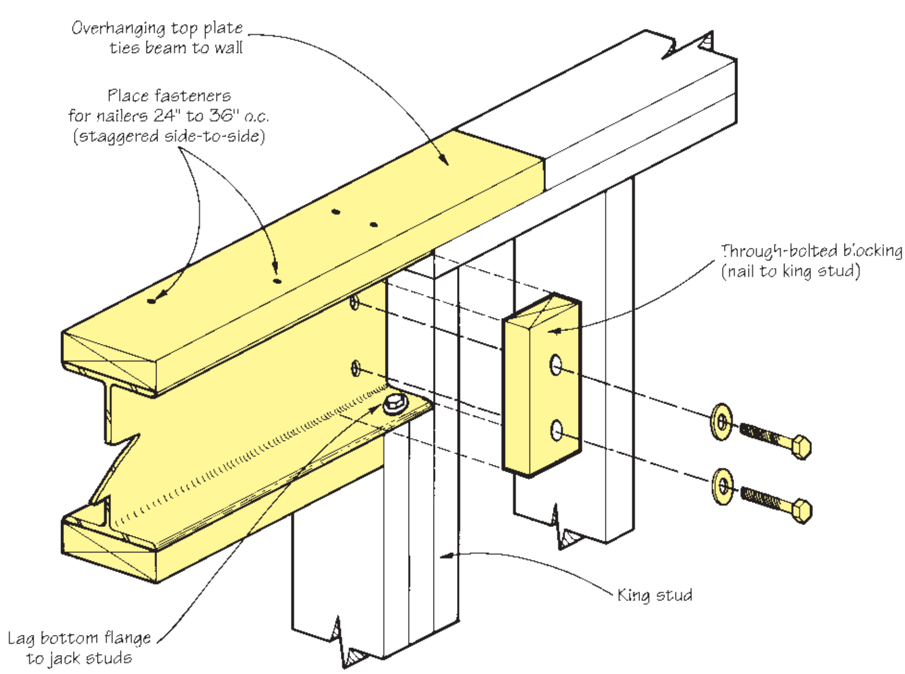


On large jobs where there are a lot of columns, it may be fastest to level a separate loose setting plate in a bed of nonshrink structural grout (left). Then, after the grout has set, the column can be quickly set in place. On smaller jobs, you can plumb the column as it is installed, using either leveling nuts (middle) or shims (right). Then use nonshrink grout to fill the void under the baseplate. (*Practical Engineering*, 2/97)

More Column Connections

In most cases, workers on site can use ordinary wrenches to bolt columns to overhead beams and foundation anchor bolts. An alternative is to weld column plates to beam flanges, and weld the column bases to steel plates cast into the slab or footings (inset). ("Steelwork in Wood Frames," 4/92)





Securing an I-Beam to Wood Framing

Attach wood nailers to the top and bottom flanges of a steel beam with small-diameter bolts or powder-actuated fasteners, spaced 24 to 36 inches on-center and staggered side-to-side. The overhanging nailer on top splices into the top plate of the adjacent stud wall. Lag bolt the bottom flange down into the jack studs, and toenail through the king stud into vertical wood blocking bolted to the web. ("Steelwork in Wood Frames," 4/92)