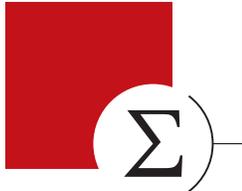


Engineering Notes



**WELLS &
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Plywood and Lumber Beams

by Jeffrey David Wells, PE

Field-expedient solutions to framing problems are common--especially in wood-framed construction. Today's fashionable roof geometries for upscale residential and light office construction are complex. Not every beam, joist, and header can be easily detailed in the plans.

Framing carpenters are used to solving problems like this without delay. Invariably, I see a common solution on the jobsite. When a header or transfer beam is needed, (3) 2x12's with two layers of 1/2" plywood sandwiched between the plies is used. Construction adhesive is applied between the layers, and nailguns are used like Uzis.

Later, when I repeat, "three 2x12's," I am always reminded: "and two layers of plywood, and we glued 'em, and we nailed the s*** out of it." The assumption is that plywood adds a great deal to the beam's capacity.

This default solution has a long history. Carpenters have built these types of girders since plywood became available. The advent of engineered-lumber has reduced this tendency. But sometimes gang-lams are not immediately available. So the idea remains that this is a good way to built a strong, stiff beam that can support virtually anything.

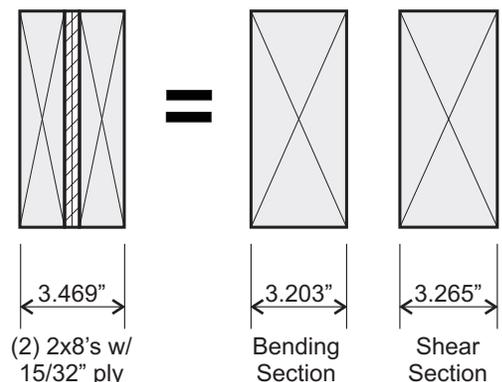
Flitch Plate Effectiveness

Quick, practical fixes using the materials on-hand is imperative. Architects and engineers can learn much from a carpenter's experience. However, there are two important issues with multi-member lumber beams using plywood flitch plates:

"That beam's not going anywhere: we used three 2x12's with two layers of 1/2" plywood - glued and nailed together."

- If the beam span is greater than 8', then there will be a vertical joint in the plywood plates. The plywood cannot carry any stresses across this joint.
- Construction plywood is cross-laminated. Wood has almost no bending strength perpendicular to the grain. The amount of wood effective in resisting bending is about 50% of the thickness.

The American Plywood Association publishes a design example¹ of (2) 2x8's with a 15/32" plywood layer in between. Skipping the calculations, the equivalent effective beam is shown below:



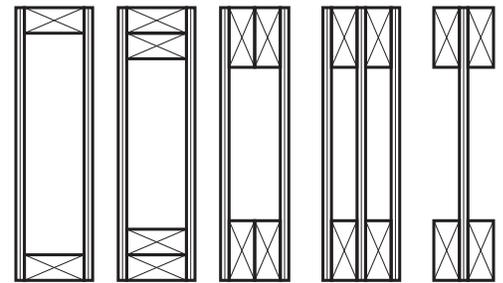
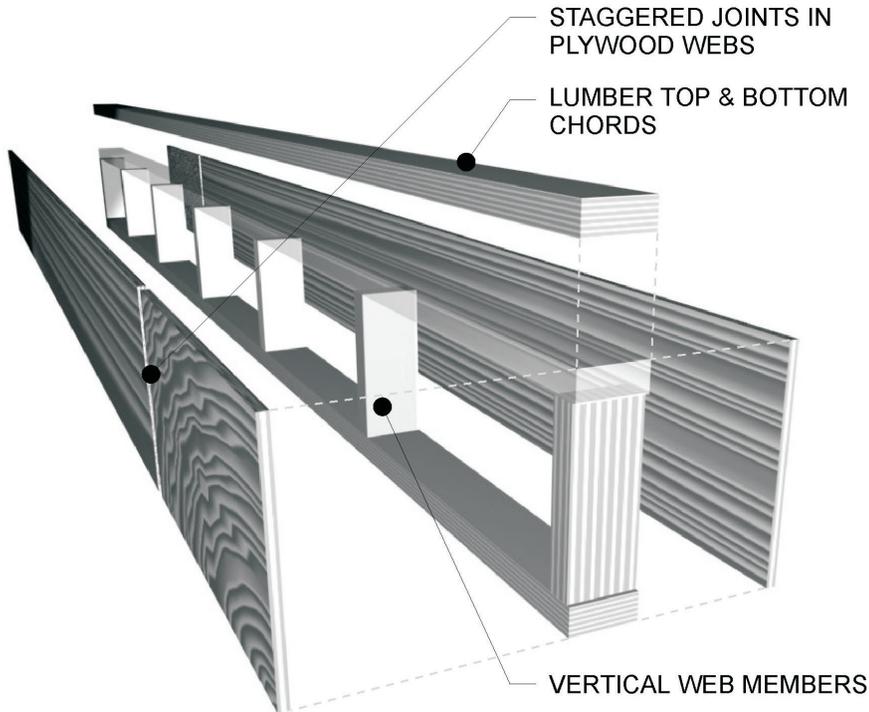
The plywood only adds approximately 6% to the bending, shear, and deflection characteristics of the beam.

¹"Technical Topics", Form No. TT-030, Technical Services Division, APA - The Engineered Wood Association, Tacoma, WA, July 1996.

Plywood and Lumber Box Beams

There is another way. Plywood and 2x's can be fabricated into a box beam. The depth and span of these composite members have few limits. Additionally, 2x4's and 2x6's can be used for the chords, eliminating the need for more expensive 2x12's.

to be staggered at least 24". Extra lumber chords can be added to allow for splices in these members. Thus, the spans aren't limited to stock lumber lengths. Lateral bracing may be necessary for deep box beams. A depth to span ratio of 1:10 is a good starting point.



Typical Lumber and Plywood Beam Configurations

Again, this is a common construction method familiar to both architects and carpenters. However, the load-carrying capacity can be much higher than with plywood flitch plates. Since plywood is often used for exterior sheathing anyway, it can be very economical to build this type of header.

Like an I-beam, the lumber flanges carry the bending stresses. The plywood web(s) resist shear stresses.

The actual calculations for this type of composite beam are complex. However, the APA has compiled tables for beam depths of 12" to 48". This simplifies the process. Visit www.apawood.org for these publications.

Deflection calculations need to account for shear deformation (traditional calculations only account for flexural deflection). Camber can be easily introduced into members. Values of 1.5 times the dead load deflection are recommended.

Sources:

"Nailed Structural-use Panel and Lumber Beams," Form No. Z416S, APA - The Engineered Wood Association, Tacoma, WA, May 1999. Available at www.apawood.org.

"Plywood Design Specification Supplement #2: Design and Fabrication of Glued Plywood-Lumber Beams," APA - The Engineered Wood Association, Tacoma, WA, July 1992. Available at www.apawood.org.

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Vertical butt-joints in the plywood webs need

