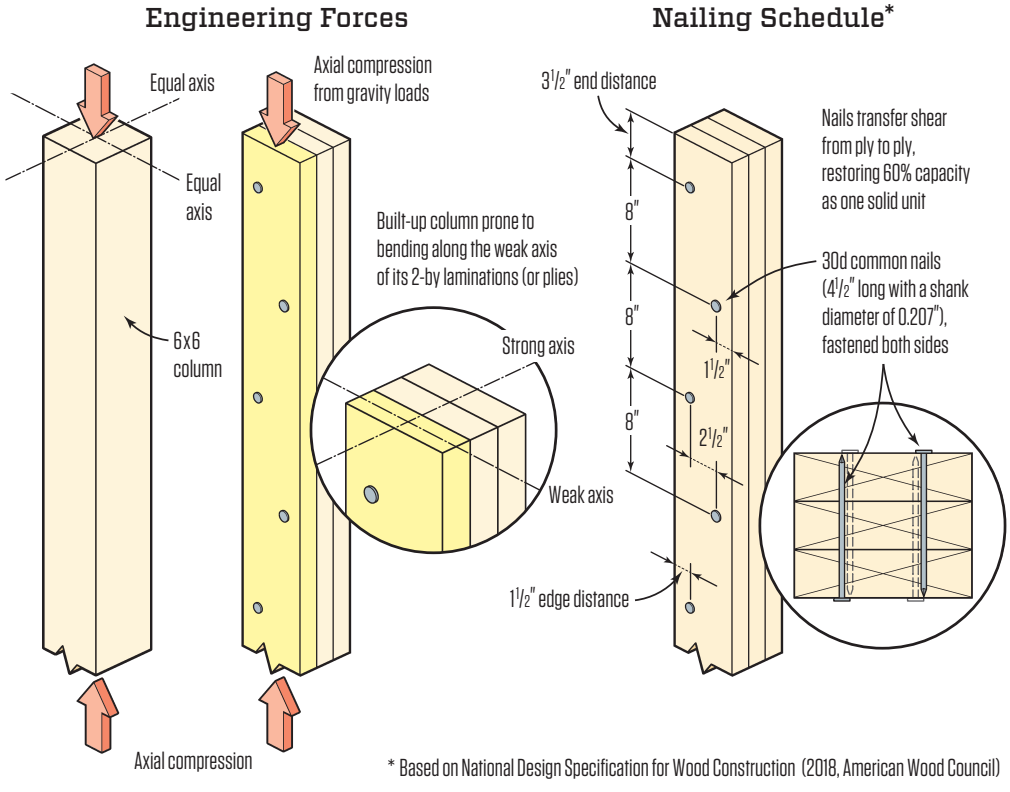
Q Is a site-built column made with three pressure-treated No. 2 southern pine 2x6s and 1/2-inch plywood spacers added to produce a 5 1/2-by-5 1/2-inch cross-section the structural equivalent of a solid-sawn 6x6 post made of the same material? If not, will laminating the layers together with construction adhesive make the column stronger?

A *Frank Woeste, P.E., professor emeritus at Virginia Tech, responds:* The short answer to the first question is no; a solid-sawn column will always be stronger than a free-standing, built-up column made with graded dimensional stock of the same lumber species. But it's possible that the column can be built so that it is strong enough to function as a structural alternative. Don't rely on glue, though; while it might help and certainly can't hurt, there's no way to determine the structural benefit and assign any meaningful values for a field-glued assembly.

Columns are subject to axial compression from gravity loads (and tension from wind uplift). To find the compressive strength of a built-up column made up of three 2x6s, you can't just look up the compressive strength of one of the 2x6s and multiply it by three. Instead, there's a formula in the NDS (National Design Specification for Wood Construction) that can be used to find the column's allowable compression stress. If the 2x6s are nailed together per the rules (see illustration, below), the reduction factor is 0.6, or a 40% reduction in allowable axial stress. It matters what material you use to build the columns. Fortunately, compared with some species, the design properties of 2x6 southern pine are very good.



Axial loads on a built-up column tend to act on the weak axis of each member, rather than on the whole assembly as they would with a solid-sawn column (far left). Even when the plies are fastened together per NDS specifications (left), the bending strength of a post assembled from three 2x6s is about 60% that of a solid-sawn 6x6 post.

Illustrations by Tim Healey

In addition to proper placement, the size and quality of the nails are important. The NDS specifies quality 30d common nails, which have a shank diameter of 0.207 inch and are 4 1/2 inches long, and so will penetrate through all three laminations. As tested, there are no gaps between the 2x6 members of the columns, so any plywood or OSB spacers should be added to the outside of the assembly after the plies are nailed together. It may be possible to fasten the plies together with structural screws, though you would need to determine (likely from their manufacturer) the size and number of screws needed to equal the NDS-required nailing schedule.

The purpose of the nails or screws is to transfer shear from ply to ply, as the column is prone to bend about the weak axis. The fastener's task is to make the plies behave as one solid unit in an attempt to restore some of the bending stiffness and strength that is lost by not using a solid-sawn column.

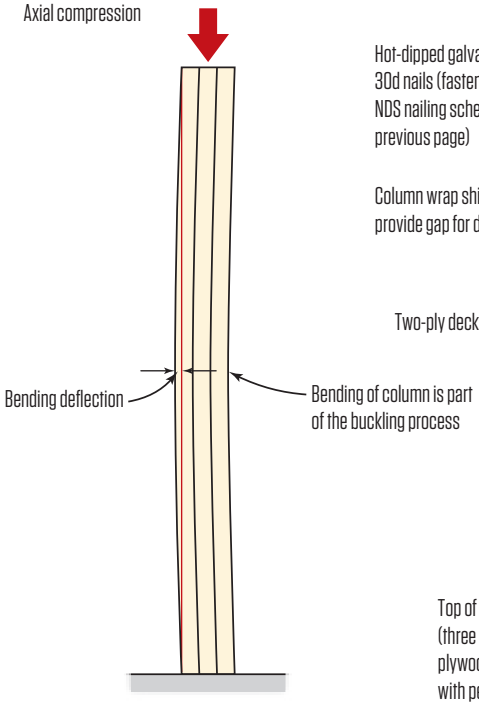
The overriding principle is "column buckling," which is the result of "column bending." "Bending deflection" is the devil. Once an unbraced column starts to bend—let's call the amount Δ—under an axial load P, a bending moment (P x Δ) is created. This in turn creates more Δ, which creates more bending moment from the same P until eventually the column fails ... it's a runaway process.

In short, there is nothing simple about substituting a three-ply column for a solid-sawn column. Some of the lumber that is now available is much weaker and has lower density, or nail strength, and less stiffness, or modulus of elasticity (E), than southern pine. Along with the design details discussed above, E and compression strength parallel-to-grain are the most important variables for column strength.

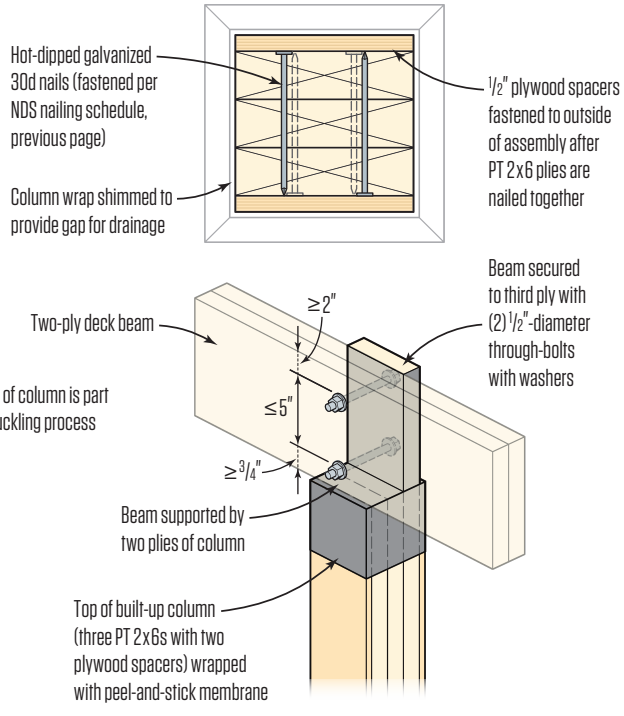
Another concern is water protection, say, if a PVC column wrap is used. Can wind blow water into the wrap, or is it a square sleeve? How can these columns be inspected in service if covered by a sleeve?

The pathway to using nail-laminated posts is for the contractor to decide on the species, the required preservative treatment (note that because the posts fall under the definition of "critical structural elements," the lumber used to build them should be "ground contact" preservative treated per AWPA Use Category 4A), the post height, the tributary loading, the snow load if applicable (more than 40 psf), and the method of connecting the plies. Then an engineer could come up with a go or no-go answer. If the answer is go, then the engineer can say using a certain species, you can replace the nails (which must be hot-dipped galvanized) with certain structural screws (which must also be hot-dipped galvanized or the equivalent) based on the manufacturer's rating and the properties of the nails as specified by the NDS.

Bending Deflection



Example: Wrapped Exterior Column



Under load, each ply in a built-up column deflects along its weak axis (far left). Proper nailing helps to transfer shear from ply to ply and strengthen the assembly, while a column wrap can help prevent water from penetrating the plies (top left). For better water protection, the author recommends wrapping the top or beam pocket, along with the rest of the column, with a flashing membrane (bottom left) and providing a drainage gap between the column wrap and the outside plywood spacers, which should be only lightly nailed to the assembly.