

New Concealed Connectors Bring More Options for Timber Structures

By David Moses and Robert Malczyk

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Nails, bolts, timber rivets, shear plates and split rings make reliable timber connectors. However, they have limitations such as strength reductions for multiple connector joints, variable rigidity in the connection, and sensitivity to construction tolerances. Some recent proprietary, concealed connection systems, two from Europe and two from North America, offer new options in structural efficiency and aesthetics. Since the article appeared in 2004, the SFS and BVD connectors have been used in many new projects.

As engineers, we value connection systems that produce predictable yield modes, and that yield in the steel components where homogeneity and lower material variability lead to more accurate strength calculations. When steel yield governs, ductility can be included in the connection design – a preferable quality for structures in seismic regions.



Figure 1: The WS-T connector.

SFS Intec

SFS Intec manufactures two types of connectors for heavy timber construction – a self-tapping tight-fit dowel for steel-wood-steel connections and a long, threaded screw for wood-wood applications.

The self-tapping dowel, or WS-T connector, has a built-in drill bit at the tip of the dowel and can drill through up to three 1/8-inch steel plates in addition to the timber member. The dowel portion of the connector is smooth and is the same diameter as the drill bit, resulting in a tight-fit connection. This means no slipping of the connectors compared to standard bolts which have oversized holes.

The WS-T is approximately 1/4-inch diameter and available in lengths up to 9 inches. When massed in large groups, it produces high-strength connections for hangers, trusses, and other applications.

The screw connector, known as WT-T, has a 1/4-inch in diameter and lengths up to 12 inches. It is threaded over its full length except for about 1 inch in the middle that helps to pull the two wood members together as the screw is tightened. The result is a strong, easy to install connection.

BVD Connector

The BVD connector consists of a shaped steel shaft that is inserted into the end of the timber member leaving a flush mounted threaded connection exposed. The shaft is criss-crossed by tight-fit steel pins or dowels that form an interlock between the shaft and the timber. A non-shrink grout fills the voids between the steel and the timber.

The very solid connection forces the yield mode into the steel components so that the full tensile capacity of the timber can be reached unlike other conventional systems. BVD connectors can be designed for allowable tensile strengths as high as 65 kips. Such high tensile resistance means that true moment connections can be developed.

Multiple BVD connectors can be connected at hubs or nodes in the form of structural ball joints that also have aesthetic qualities. Multiple connections are also possible through concealed steel plates with tight fit pins within a single member of adequate cross-sectional area.

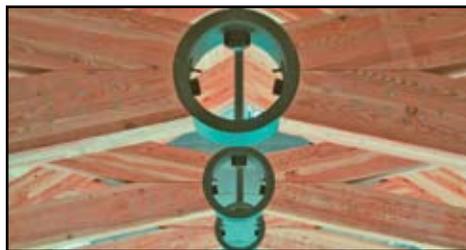


Figure 2: Truss construction with BVD connectors anchored in a steel ring housing.

Stavebolt

The Stavebolt connector is used in post and beam construction in both sawn and round log applications. Testing has shown the connector to be 4 to 5 times stronger than pinned mortise and tenon joinery, with high ductility to better resist high winds and seismic loads.

Although the Stavebolt was designed mainly to carry tensile loads parallel to its axis, most shear loads can be managed by the simple addition of split rings, shear pins or shear plates surrounding the tie bolt hole, or by shallow daps, notches or shoulders, etc.

The two basic Stavebolt models consist of sections of steel pipe (1-3/8 inch & 1-7/8 inch diameter) with receiving thread at one end for either 5/8-inch or 3/4-inch tie-bolts or threaded rods, which allow for the fastening to other members. Posts may be tied directly to threaded foundation anchors arising from the concrete.



Figure 3: Three sizes of Stavebolt are available depending on the application.

The two standard 3-pin pipe sections are drilled to receive either 1/2-inch or 5/8-inch stitch bolts, which lock the pipe in place in the end of the post or beam. The number of stitch bolts varies depending on the working loads. A stretched version of the 1.9-inch model is also available with (4) 5/8-inch stitch holes. Bolt holes in the timber may be plugged with short wood pins to simulate traditional joinery or to hide the bolt ends, as need be.

Timberlinx

Timberlinx consists of a hollow steel connection tube inserted equal distance in both members of the joint and linked by two expanding cross pins that fit through 1-1/8 inch diameter holes in the connecting tube. Installation requires only an electric drill and jig, and appears similar to a mortise and tenon joint when plugged with a wood dowel. Engineering tests have shown it to be significantly stronger than the traditional mortise and tenon. The connection can also be tightened in service by removing the dowel plugs and tightening the cross pins with an Allen key.

The hollow steel connection tube comes in three lengths: 9-1/2, 15-1/2 and 17-1/2 inches, and can be modified to handle applications such as

timber column anchorage to concrete, or as angled clusters for conical roof apices. Shear resistance can be boosted by incorporating standard split-ring connectors.

Cost

The cost of these connector types vary and should be considered with the understanding that they allow more options for using timber, often in situations where steel may have been, heretofore, the best economic choice. In this sense, the newer connectors provide competitive prices and much higher reliability at the joint. ■

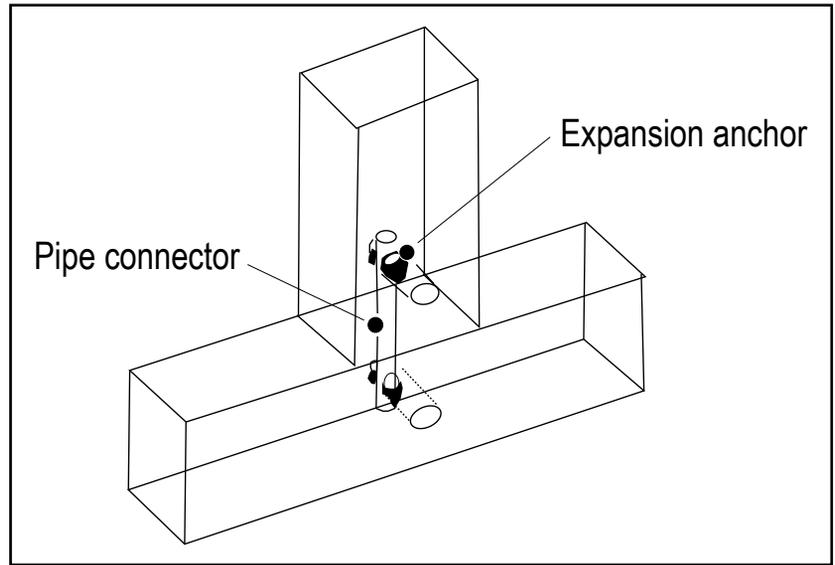


Figure 4: Timberlinx assembly.

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More information on these connectors is available from www.woodmags.com, click on Wood Design & Building. Then Mag Rack and issue #30.

For Further Information

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