Technical Bulletin No. 4

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Subject: Angle to grain loading of Timberlinx connectors	

The design values for Timberlinx connectors contained in Technical Bulletin No. 1 are defined for four individual loading configurations.

- *Tension parallel to grain*: The Timberlinx tube is installed parallel to grain of both members in the connection. Tension load is applied parallel to the axis of the tube.
- *Tension perpendicular to grain*: The Timberlinx tube is installed perpendicular to grain of at least one member in the connection. Tension load is applied parallel to the axis of the tube.
- *Shear parallel to grain*: The Timberlinx tube is installed perpendicular to grain of both members in the connection. Load is applied transversely to the axis of the tube.
- *Shear perpendicular to grain*: The Timberlinx tube is installed parallel to grain of at least one member in the connection. Load is applied transversely to the axis of the tube.

In some applications, the Timberlinx connector may be installed at an angle to the grain. In other applications, loading of the Timberlinx connector in combined tension and shear may be applied. For these cases, combinations of the individual loading configurations are needed to determine appropriate design values. One approach to determine the appropriate design values is to use the Hankinson formula.

Angle to Grain Installation of Timberlinx Connector

When the Timberlinx connector is installed at an angle to the grain and subjected to direct tension loading, such as in Figure 1, the dowel bearing capacity of the expansion pin varies from that under parallel or perpendicular to grain loading. For this case the design value Z_θ can be determined as

$$Z_\theta = \frac{Z_\parallel Z_\perp}{Z_\parallel \sin^2\theta + Z_\perp \cos^2\theta} \qquad \text{Eq. (1)}$$

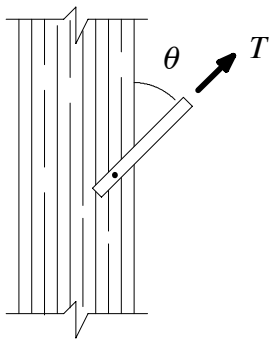


Figure 1 — Angle to grain installation of connector with tension loading

In Eq. (1), the following definitions apply.

Z_θ = the tension capacity of the connector when installed at an angle to grain

$Z_\parallel$ = the tension capacity of the connector when installed parallel to grain

$Z_\perp$ = the tension capacity of the connector when installed perpendicular to grain

θ = the inclination angle of the connector relative to the grain direction

Values of $Z_\parallel$ and $Z_\perp$ are taken from the capacities given in Technical Bulletin No. 1.

Combined Tension and Shear Loading

The capacity of the Timberlinx connector loaded in combined tension and shear, such as in Figure 2, has not been tested in the laboratory. However, it is reasonable to assume that the interaction between tension and shear capacity is similar to that for combined loading of other fastener types. Again, the Hankinson equation is used to determine the capacity of the connector. The design value Z_ϕ can be determined as

$$Z_\phi = \frac{TV}{T\sin^2\phi + V\cos^2\phi} \qquad \text{Eq. (2)}$$

In Eq. (2), the following definitions apply:

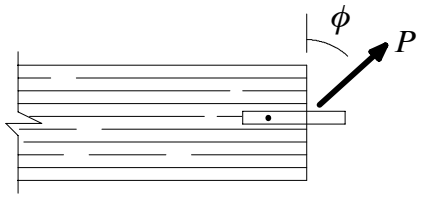
Z_ϕ = the capacity of the connector under combined tension and shear loading

T = the tension capacity of the connector (installed parallel or perpendicular to grain)

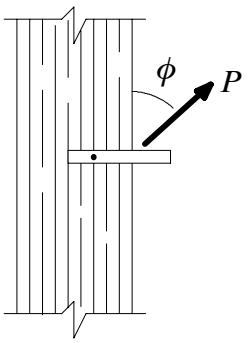
V = the shear capacity of the connector (installed parallel or perpendicular to grain)

ϕ = the inclination angle between the wood surface and the direction of applied load

Values of T and V are taken from the capacities given in Technical Bulletin No. 1.



a) Connector installed parallel to grain



b) Connector installed perpendicular to grain

Figure 2 — Combined tension and shear loading of connector