Designing for
Damp Conditions

A truss designer who recognizes conditions that require a reduction in lumber or plate design properties can help ensure trusses perform as the building designer intends.

ANSI/TPI 1-2014 requires building designers to identify in construction documents any conditions that are expected to result in high wood moisture content, sustained high temperatures or environments that have the potential to cause truss plate corrosion (section 2.3.2.4(g)(6)). Each of these conditions requires a reduction in lumber or connector plate design values. In addition, these environments might require chemical treatment of the lumber or corrosion protection of the plates. Truss technicians who recognize the situations that create these conditions can implement appropriate design practices to mitigate potential serviceability issues and to ensure the trusses are designed to perform as intended by the building designer.

Design values for stress-graded dimensional lumber, published in the National Design Specification® for Wood Construction (NDS), apply only to wood with a maximum moisture content of 19 percent that is used in dry service conditions. Typical applications include enclosed buildings, properly ventilated roofs and covered structures where members are protected from the weather. However, when the moisture content of wood is expected to exceed 19 percent for an extended period of time while in service, allowable design values must be reduced by the appropriate wet service factors.

<table>
<thead>
<tr>
<th>$F_b$</th>
<th>$F_t$</th>
<th>$F_v$</th>
<th>$F_{c_u}$</th>
<th>$F_c$</th>
<th>$E$ &amp; $E_{min}$</th>
<th>$V_{LR}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85</td>
<td>1.0</td>
<td>0.97</td>
<td>0.67</td>
<td>0.8</td>
<td>0.9</td>
<td>0.8</td>
</tr>
</tbody>
</table>

*ANSI/TPI 1-2014 Table 6.4-4 Wet Service Factor ($F_{c_u}$)*

The wet service factors for truss design vary by property. For example, there is no reduction for tension parallel-to-grain ($F_t$), but a 33 percent reduction is required for compression perpendicular-to-grain ($F_{c_u}$). Additionally, the lateral resistance (or grip) value ($V_{LR}$) for metal connector plates is reduced by 20 percent.

The same 20 percent reduction of plate grip applies to trusses that are fabricated with green or wet lumber, where the moisture content is greater than 19 percent. However, no reduction is required when those green or unseasoned...
Truss designers are in the right spot to mitigate potential serviceability issues.

2.3.2.4 Required Information in the Construction Documents.

The Building Designer, through the Construction Documents, shall provide information sufficiently accurate and reliable to be used for facilitating the supply of the Structural Elements and other information for developing the design of the Trusses for the Building, and shall provide the following:
(a) All Truss and Structural Element orientations and locations.
(b) Information to fully determine all Truss profiles.
(c) All Structural Element and Truss support locations and bearing conditions (including the allowable bearing stress).
(d) The location, direction, and magnitude of all dead, live, and lateral loads applicable to each Truss including, but not limited to, loads attributable to roof, floor, partition, mechanical, fire sprinkler, attic storage, rain and ponding, wind, snow (including snow drift and unbalanced snow), seismic; and any other loads on the Truss.
(e) All anchorage designs and connections to the Structural Elements and the Permanent Building Stability Bracing required to resist uplift, gravity, and lateral loads.
(f) Truss-to-Structural Element connections, but not Truss-to-Truss connections.

(g) Criteria related to serviceability issues including:
(1) Allowable vertical, horizontal or other required deflection criteria.
(2) Any dead load, live load, and in-service creep deflection criteria for roofs subject to ponding loads.
(3) Any Truss camber requirements.
(4) Any differential criteria from Truss-to-Truss or Truss-to-adjacent Structural Element.

User (non-mandatory) note: See Commentary section §2.3.2.4(h)
(4) regarding methods to address differential deflection.
(5) Any deflection and vibration criteria for floor Trusses including:
(i) Any strongback bridging requirements.
(ii) Any dead load, live load, and in-service creep deflection criteria for floor Trusses supporting stone or ceramic tile finishes.

(i) Moisture, temperature, corrosive chemicals and gases expected to result in:
(i) Wood moisture content exceeding 19 percent.
(ii) Sustained temperatures exceeding 190 degrees F, and/or
(iii) Corrosion potential from wood preservatives or other sources that can be detrimental to Trusses.
lumber trusses are used in an application that results in the wood elements drying to and remaining below a 19 percent moisture content.

ANSI/TPI 1-2014 notes two scenarios in which the design value of metal connector plates do not need to be reduced.

6.4.6.2 Exceptions.

$C_M$ shall be taken as unity for $F_B$ or $F_C$ if the following conditions are met:

- If $(F_B/C_M) \leq 1150$ psi, $C_M = 1.0$ for $F_B$
- If $(F_C) \leq 750$ psi, $C_M = 1.0$ for $F_C$

Lumber moisture content is expected to exceed 19 percent when the wood is exposed to an average air humidity of 85 percent or more for an extended period of time or when the wood has direct exposure to rain and other moisture sources. For example, wet service scenarios might include:

- Floor trusses over a crawl space and within 18 inches of exposed ground.
- Trusses supporting an outdoor balcony with a moisture-permeable floor covering like concrete or masonry and without an impervious moisture barrier.
- Trusses over an indoor swimming pool where the plenum or attic space is insufficiently ventilated and conditioned.
- Open-air sheds that experience repeated wetting and drying due to rain.
- Agricultural buildings housing livestock where slatted floors hold manure slurry.

A sustained high moisture level not only has an adverse effect on wood strength properties and plate grip, but it also makes wood more susceptible to wood-destroying fungi and decay. Accordingly, if trusses are to be placed in high moisture applications, truss designers should select a wood species that is naturally resistant to decay or preservative-treated lumber.
6.4.6.3 Moisture Content > 19% at the Time of Fabrication.

6.4.12 Other Adjustment Factors.

Wood design stresses for dry lumber shall be permitted to be used for green lumber when the following three conditions are met:

(a) Trusses shall be stored after fabrication and installed in an exposure with equilibrium moisture content conditions of 19 percent or less;

(b) Appropriate reduction factors ($C_{d}$) shall be used for design of fasteners installed prior to the drying of lumber, including Truss plates, nails, joist hangers, and similar fasteners; and

(c) Typical conditions in that geographical area permit drying of the lumber to 19% moisture content or less prior to the closing in of the structure.

Of course, preservative treatment options can also affect lumber and connector plate design properties—but that’s a topic for a future article!

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