The adjustment factors and their applicability to wood connection design are briefly described as follows:

- *C_D–Load Duration Factor* (NDS•2.3.2 and Chapter 5, Table 5.3)–applies to W and Z values for all fasteners based on design load duration but shall not exceed 1.6 (i.e., wind and earthquake load duration factor).
- *C_M–Wet Service Factor* (NDS•7.3.3)–applies to W and Z values for all connections based on moisture conditions at the time of fabrication and during service; not applicable to residential framing.
- *C_t–Temperature Factor* (NDS•7.3.4)–applies to the W and Z values for all connections exposed to sustained temperatures of greater than 100^oF; not typically used in residential framing.
- *C_g–Group Action Factor* (NDS•7.3.6)–applies to Z values of two or more bolts or lag screws loaded in single or multiple shear and aligned in the direction of the load (i.e., rows).
- *C_Δ–Geometry Factor* (NDS•8.5.2, 9.4.)–applies to the Z values for bolts and lag screws when the end distance or spacing of the bolts is less than assumed in the unadjusted design values.
- *C_d–Penetration Depth Factor* (NDS•9.3.3, 12.3.4)–applies to the Z values of lag screws and nails when the penetration into the main member is less than 8D for lag screws or 12D for nails (where D = shank diameter); sometimes applicable to residential nailed connections.
- *C_{eg}–End Grain Factor* (NDS•9.2.2, 9.3.4, 12.3.5)–applies to W and Z values for lag screws and to Z values for nails to account for reduced capacity when the fastener is inserted into the end grain (C_{eg}=0.67).
- *C_{di}–Diaphragm Factor* (NDS•12.3.6)–applies to the Z values of nails only to account for system effects from multiple nails used in sheathed diaphragm construction (C_{di} = 1.1).
- *C_{tn}–Toenail Factor* (NDS•12.3.7)–applies to the W and Z values of toenailed connections (C_{tn} = 0.67 for withdrawal and = 0.83 for shear). It does not apply to slant nailing in withdrawal or shear; refer to Section 7.3.6.

The total allowable design value for a connection (as adjusted by the appropriate factors above) must meet or exceed the design load determined for the connection (refer to Chapter 3 for design loads). The values for W and Z are based on single fastener connections. In instances of connections involving multiple fasteners, the values for the individual or single fastener can be summed to determine the total connection design value only when C_g is applied (to bolts and lag screws only) and fasteners are the same type and similar size. However, this approach may overlook certain system effects that can improve the actual performance of the joint in a constructed system or assembly (see Section 7.3.6). Conditions that may decrease estimated performance, such as prying action induced by the joint configuration and/or eccentric loads and other factors should also be considered.

In addition, the NDS does not provide values for nail withdrawal or shear when wood structural panel members (i.e., plywood or oriented strand board) are used as a part of the joint. This type of joint–wood member to structural wood panel–occurs frequently in residential construction. Z values can be estimated by using the yield equations for nails in NDS 12.3.1 and assuming a reasonable specific gravity (density) value for the wood structural panels, such as G = 0.5. W values for nails in wood structural panels can be estimated in a similar fashion by using the withdrawal equation presented in the next section. The tabulated W and Z values in NDS•12 may also be used, but with some caution as to the selected table parameters.

7.3.3 Nailed Connections

The procedures in NDS•12 provide for the design of nailed connections to resist shear and withdrawal loads in wood-to-wood and metal-to-wood connections. As mentioned, many specialty "nail-type" fasteners are available for wood-to-concrete and even wood-to-steel connections. The designer should consult manufacturer data for connection designs that use proprietary fastening systems.

The withdrawal strength of a smooth nail (driven into the side grain of lumber) is determined in accordance with either the empirical design equation below or NDS•Table 12.2A.

[NDS•12.2.1]

$$W = 1380(G)^{\frac{5}{2}} D L_p$$ unadjusted withdrawal design value (lb) for a smooth shank nail

where,

G = specific gravity of the lumber member receiving the nail tip
D = the diameter of the nail shank (in)
L_p = the depth of penetration (in) of the nail into the member receiving the nail tip

The design strength of nails is greater when a nail is driven into the side rather than the end grain of a member. Withdrawal information is available for nails driven into the side grain; however, the withdrawal capacity of a nail driven into the end grain is assumed to be zero because of its unreliability. Furthermore, the NDS does not provide a method for determining withdrawal values for deformed shank nails. These nails significantly enhance withdrawal capacity and are frequently used to attach roof sheathing in high-wind areas. They are also used to attach floor sheathing and some siding materials to prevent nail "back-out." The use of deformed shank nails is usually based on experience or preference.

The design shear value, Z, for a nail is typically determined by using the following tables from NDS•12: