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2005 National Design Specification® (NDS®) for Wood Construction

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The 2005 Edition of the *National Design Specification for Wood Construction* was approved as an American National Standard on January 6, 2005, with a designation *ANSI/AF&PA NDS-2005*. The *2005 NDS* was developed as a dual format specification incorporating design provisions for both allowable stress design (ASD) and load and resistance factor design (LRFD). AF&PA's Wood Design Standards Committee (WDSC) guided it through the consensus process over the course of two and a half years. The primary change in the *2005 NDS* is the introduction of LRFD methods to the Specification.

Several format changes to the *NDS* to accommodate addition of LRFD are summarized in this article and include:
- Revised terminology,
- Applicability of adjustment factors,
- Revised format of beam and column stability provisions (addition of E_{min} property), and
- Addition of *NDS* Appendix N–Load and Resistance Factor Design.

A number of other changes introduced in the 2005 Edition are not discussed here, but include:
- Removal of form factor,
- Revision of repetitive member factor for I-joists,
- Revision of full-design value terminology, and
- Clarification of built-up column provisions.

The *NDS Supplement, Design Values for Wood Construction* has also been updated to provide the latest design values for sawn lumber and glued laminated timber.

Introducing LRFD to NDS

Over the years, the WDSC identified benefits of developing a dual format specification which would include: addressing user needs for consistent design information regardless of design format (ASD or LRFD); better utilizing standards committee resources; and providing current design information for the academic community. The *2005 NDS* maintains the current *2001 NDS* format, familiar to most wood designers. As a result, *NDS 2005* is very similar to the *2001 NDS* for ASD design, with few exceptions.

Users familiar with the *NDS* ASD provisions will also find transition to LRFD straightforward. Behavioral equations, such as those for member and connection design, are the same for both ASD and LRFD. Adjustment factor tables now include applicable factors for determining an adjusted ASD design value or an adjusted LRFD design value. A new *Appendix N–Mandatory Appendix for Load and Resistance Factor Design (LRFD)* outlines requirements that are unique to LRFD and adjustment factors for LRFD (e.g., K_F, ϕ, λ).
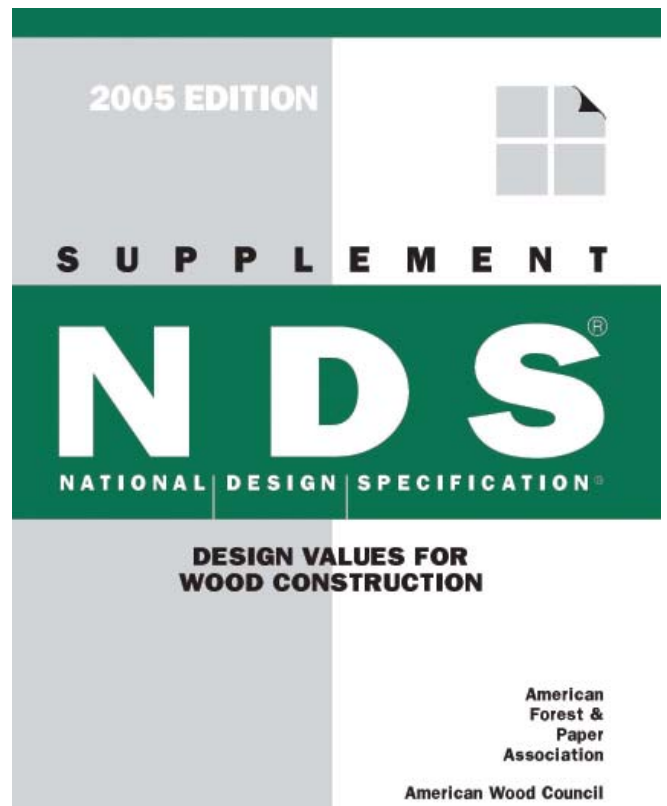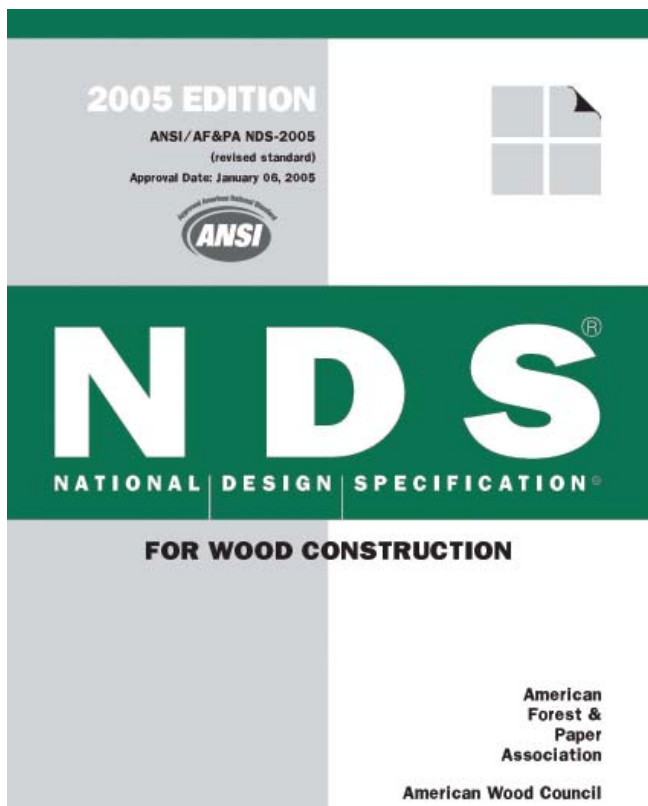
Applicability of Adjustment Factors

As an example of applicability of adjustment factors for member design, the adjusted bending design value, F_b', of a sawn lumber bending member is determined as follows:

For ASD: $F_b' = F_b \, C_D \, C_M \, C_t \, C_L \, C_F \, C_{fu} \, C_i \, C_r$

For LRFD: $F_b' = F_b \, K_F \, \phi_b \, \lambda \, C_M \, C_t \, C_L \, C_F \, C_{fu} \, C_i \, C_r$

where: F_b is the reference bending design value based on normal load duration.

For ASD member and connection design, this approach is identical to that used in prior Editions of the *NDS*. For LRFD member and connection design, adjustment factors applicable to reference design values, make conversion between ASD-and LRFD-based design values transparent.

Revised Format of NDS Beam and Column Stability Provisions

The *2005 NDS* includes a revised format for column and beam behavioral equations to address both ASD and LRFD. The value F_{bE} = $1.20E_{min}′ / R_b^2$ is algebraically equivalent to and replaces $F_{bE} = K_{bE} E′ / R_b^2$ used in the *2001 NDS*. Because the design equation for K_{bE} includes a reduction for safety, two different formats of the *2001 NDS* equation would be needed to address both ASD and LRFD. Instead, the *2005 NDS* utilizes E_{min}, which is adjusted for safety, so the safety factor is not part of the basic design equation. Applicable adjustments to E_{min}, based on applicability of adjustment factor tables are used to establish the appropriate adjusted modulus of elasticity for beam and column stability, $E_{min}′$, for either ASD or LRFD. A similar approach is used for column design.

Modulus of Elasticity for Beam and Column Stability

For sawn lumber and glulam, reference modulus of elasticity for beam and column stability, E_{min} (which represents an approximate 5% lower exclusion value on pure bending modulus of elasticity, divided by a 1.66 factor of safety), is tabulated in the *NDS Supplement*.

New Appendix N–Load and Resistance Factor Design

Applicable for LRFD only, Appendix N specifies format conversion factors (K_F) and resistance factors (ϕ) consistent with those in *ASTM D5457–Standard Specification for Computing the Reference Resistance of Wood-Based Materials and Structural Connections for Load and Resistance Factor Design*. Applicable time effect factors are associated with load combinations of *ASCE 7-02–Minimum Design Loads for Buildings and Other Structures*.

Additional Design Tools

The revised *NDS* will be packaged with additional publications as follows:
- *NDS Commentary, 2005 Edition,*
- *NDS Supplement–Design Values for Wood Construction, 2005 Edition,*
- *ANSI/AF&PA SDPWS-05 AF&PA Supplement–Special Design Provisions for Wind and Seismic (SDPWS)* with Commentary, and
- *ASD/LRFD Manual for Engineered Wood Construction, 2005 Edition.*

The 2005 Wood Design Package will be available second quarter of 2005. Call 1-800-890-7732 to order, or shop online at **www.awc.org**.

A related design tool is also being developed to assist designers with the use of the *2005 NDS*. A workbook titled *LRFD Solved Example Problems for Wood Structures* has been updated and renamed *Structural Wood Design Using ASD and LRFD* to include parallel ASD solutions to the 40 LRFD example problems shown in the former.

Conclusion

The primary change in the *2005 NDS* is the introduction of LRFD methods to the Specification. Several format changes to the *NDS* to accommodate the addition of LRFD have been summarized. Users will find very minimal impact on the ASD process as a result, with the added benefit of having a transparent approach to learn and use LRFD. An integrated commentary and other design tools will be available for the new standard.▪

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