# Wood Column Design — Validation Report

Independent verification of the Kouzouki calculation engine against closed-form statics, published design-standard values and worked examples

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| **Engine** | Kouzouki — Wood Column Design |
| **Basis** | Axial stress fc=P/A and NDS 3.7 column stability: Fc*=Fc·CD·CF, FcE=0.822·Emin'/(le/d)^2, CP and Fc'=Fc*·CP re-derived by hand. |
| **Validation type** | Independent validation |
| **Report date** | 2026-07-11 |
| **Result** | **PASS** — 10/10 checks within tolerance |

## 1. Validation cases

Each case feeds the tool a defined input set and compares its output against a value derived independently of the engine (cited per row). Tolerance is 1% unless noted.

### C1. 6x6 DF-L No.2, 10 ft, P=10 kip

Inputs: material_type=Sawn Lumber, species=Douglas Fir-Larch, grade=No.2, b=5.5, d=5.5, height=10.0, Ke_b=1.0, Ke_d=1.0, P_dead=4000.0, P_live=6000.0, M_dead=0.0, M_live=0.0, load_duration=Ten years / Floor Live (1.0), moisture=Dry (CM=1.0), temperature=T <= 100F (Ct=1.0), incised=False

| Checked quantity | Independent value | Tool output | Dev. | Verdict |
|---|---|---|---|---|
| Axial stress fc = P/A<br>fc=P/A, A=30.25 in^2 | 330.6 psi | 330.6 psi | 0.00% | **PASS** |
| FcE = 0.822 Emin'/(le/d)^2<br>NDS 3.7.1.5 | 1,001.5 psi | 1,001.5 psi | 0.00% | **PASS** |
| Fc* = Fc·CD·CF(6)<br>NDS 3.7.1; Fc=1350, CF=1.1 | 1,485.0 psi | 1,485.0 psi | 0.00% | **PASS** |
| CP (re-derived closed form)<br>NDS Eq. 3.7-1 | 0.544 | 0.544 | 0.00% | **PASS** |

### C2. 6x6 DF-L No.2, 10 ft — Fc' = Fc*·CP

Inputs: material_type=Sawn Lumber, species=Douglas Fir-Larch, grade=No.2, b=5.5, d=5.5, height=10.0, Ke_b=1.0, Ke_d=1.0, P_dead=4000.0, P_live=6000.0, M_dead=0.0, M_live=0.0, load_duration=Ten years / Floor Live (1.0), moisture=Dry (CM=1.0), temperature=T <= 100F (Ct=1.0), incised=False

| Checked quantity | Independent value | Tool output | Dev. | Verdict |
|---|---|---|---|---|
| Fc' = Fc*·CP<br>NDS 3.7.1 | 808.4 psi | 808.4 psi | 0.00% | **PASS** |
| Slenderness le/d<br>Ke·h/d | 21.818 | 21.8 | 0.08% | **PASS** |

### C3. 6x6 SS DF-L, 12 ft, P=13 kip

Inputs: material_type=Sawn Lumber, species=Douglas Fir-Larch, grade=Select Structural, b=5.5, d=5.5, height=12.0, Ke_b=1.0, Ke_d=1.0, P_dead=5000.0, P_live=8000.0, M_dead=0.0, M_live=0.0, load_duration=Ten years / Floor Live (1.0), moisture=Dry (CM=1.0), temperature=T <= 100F (Ct=1.0), incised=False

| Checked quantity | Independent value | Tool output | Dev. | Verdict |
|---|---|---|---|---|
| Axial stress fc = P/A<br>P/A | 429.8 psi | 429.8 psi | 0.00% | **PASS** |
| Slenderness le/d = 12·12/5.5<br>Ke·h/d | 26.182 | 26.2 | 0.07% | **PASS** |

### C4. Stocky 8x8-like, low slenderness

Inputs: material_type=Sawn Lumber, species=Douglas Fir-Larch, grade=No.1, b=7.5, d=7.5, height=8.0, Ke_b=1.0, Ke_d=1.0, P_dead=8000.0, P_live=12000.0, M_dead=0.0, M_live=0.0, load_duration=Ten years / Floor Live (1.0), moisture=Dry (CM=1.0), temperature=T <= 100F (Ct=1.0), incised=False

| Checked quantity | Independent value | Tool output | Dev. | Verdict |
|---|---|---|---|---|

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|---|---|---|---|---|
| Axial stress fc = P/A<br>P/A | 355.6 psi | 355.6 psi | 0.00% | **PASS** |
| Slenderness le/d = 96/7.5<br>Ke·h/d | 12.8 | 12.8 | 0.00% | **PASS** |

## 2. Assumptions

- Concentric axial load, pinned-pinned (Ke=1.0), c=0.8 (sawn).
- Square 6x6 (5.5x5.5); reference values NDS Supplement Table 4A.
- Dry/normal service; no applied moment (pure column).

## 3. Limitations

- Combined axial+bending (NDS 3.9-3) is covered by the Stud Wall tool.
- Buckling about the weak axis only when unbraced; biaxial not separated here.

## 4. Sources of the independent values

**How the independent values are obtained.** Every value in the Independent-value column of Section 1 is computed in a validation harness (validation/cases.py) written and run separately from the calculation engine. Each is an independent re-derivation of the governing closed-form equation, or a value read from a cited published worked example or design-standard table - never copied from the engine's own output. The match therefore confirms the engine reproduces the cited source within tolerance. The source beside each value (Section 1) and the references below identify the governing standard section, equation, or publication.

**Basis of the independent values**

Axial stress fc=P/A and NDS 3.7 column stability: Fc*=Fc·CD·CF, FcE=0.822·Emin'/(le/d)^2, CP and Fc'=Fc*·CP re-derived by hand.

**Governing standards & published sources**

- AWC NDS — National Design Specification for Wood Construction (2018 / 2024) and the NDS Supplement (reference design values).

**Per-check citations (Section 1):** fc=P/A, A=30.25 in^2; NDS 3.7.1.5; NDS 3.7.1; Fc=1350, CF=1.1; NDS Eq. 3.7-1; NDS 3.7.1; Ke·h/d; P/A.

## 5. Conclusion

All 10 independent checks reproduce the reference values within tolerance. The engine correctly implements the governing equations for this tool.

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Reproduce: **python scripts/run_tool_validation.py** → **python scripts/make_tool_validation_pdfs.py**. This report is for verification/demonstration; results are for preliminary design and must be confirmed by a licensed engineer against the current adopted code and project-specific conditions.