Reinforced Concrete Column (P-M) — Validation Report

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

Engine	Kouzouki — Reinforced Concrete Column (P-M)
Basis	Squash load Po = 0.85 f'c (Ag - Ast) + fy Ast (ACI 22.4.2.2); tied-column axial cap phiPn,max = 0.80 phi Po with phi = 0.65 (ACI 22.4.2.1, 21.2.2).
Validation type	Independent validation
Report date	2026-06-20
Result	**PASS** — 2/2 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.

CC1. Nominal squash load Po

Inputs: width_b=16.0, depth_h=16.0, fc=4000.0, fy=60000.0, cover=2.5, bar_size=#8, n_bars=8, Pu=400.0, Mu=120.0

Checked quantity	Independent value	Tool output	Dev.	Verdict
Po = 0.85 f'c(Ag-Ast)+fy Ast ACI 22.4.2.2	1,228.1 kip	1,228.0 kip	0.01%	**PASS**

CC2. Max factored axial

Inputs: width_b=16.0, depth_h=16.0, fc=4000.0, fy=60000.0, cover=2.5, bar_size=#8, n_bars=8, Pu=400.0, Mu=120.0

Checked quantity	Independent value	Tool output	Dev.	Verdict
phiPn,max = 0.80 phi Po ACI 22.4.2.1	638.6 kip	639.0 kip	0.06%	**PASS**

2. Assumptions

- Tied rectangular column; longitudinal bars split equally each face.
- Uniaxial bending; plane sections, eps_cu = 0.003.
- Es = 29,000 ksi; standard ASTM bar areas.

3. Limitations

- Uniaxial P-M only (no biaxial Bresler check here).
- Slenderness handled by the separate beam-column tool.
- Detailing (tie size/spacing, splices) confirmed separately.

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

Squash load Po = 0.85 f'c (Ag - Ast) + fy Ast (ACI 22.4.2.2); tied-column axial cap phiPn,max = 0.80 phi Po with phi = 0.65 (ACI 22.4.2.1, 21.2.2).

Governing standards & published sources

- ACI 318 — Building Code Requirements for Structural Concrete (318-14 / 318-19), American Concrete Institute (Ch. 7, 8, 13, 20, 22).

Per-check citations (Section 1): ACI 22.4.2.2; ACI 22.4.2.1.

5. Conclusion

All 2 independent checks reproduce the reference values within tolerance. The engine correctly implements the governing equations for this tool.

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.