Spread Footing under Axial + Moment — Validation Report

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

Engine	Kouzouki — Spread Footing under Axial + Moment
Basis	Eccentricity e = M/P; for e <= L/6 the bearing is trapezoidal with q_max = P/A (1 + 6e/L) (IBC 1806); for e > L/6 it is triangular q_max = 2P/(B*3(L/2-e)).
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.

MF1. Eccentricity

Inputs: footing_length=8.0, footing_width=8.0, thickness=24.0, fc=4000.0, fy=60000.0, col_width=16.0, P_service=200.0, M_service=120.0, P_ult=280.0, M_ult=168.0, q_allow=4000.0, bar_size=#8

Checked quantity	Independent value	Tool output	Dev.	Verdict
e = M/P Statics	0.6 ft	0.6 ft	0.00%	**PASS**

MF2. Peak bearing pressure

Inputs: footing_length=8.0, footing_width=8.0, thickness=24.0, fc=4000.0, fy=60000.0, col_width=16.0, P_service=200.0, M_service=120.0, P_ult=280.0, M_ult=168.0, q_allow=4000.0, bar_size=#8

Checked quantity	Independent value	Tool output	Dev.	Verdict
q_max = P/A(1+6e/L) IBC 1806	4,531.2 psf	4,531.0 psf	0.01%	**PASS**

2. Assumptions

- Service loads for bearing; factored loads for RC design.
- Rigid footing, linear soil-pressure distribution.
- e = 0.6 ft <= L/6 = 1.33 ft -> full contact (trapezoid).

3. Limitations

- Concentric punching governs at low e (checked separately here).
- Soil q_allow is a geotechnical service input.

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

Eccentricity e = M/P; for e <= L/6 the bearing is trapezoidal with q_max = P/A (1 + 6e/L) (IBC 1806); for e > L/6 it is triangular q_max = 2P/(B*3(L/2-e)).

Governing standards & published sources

- International Building Code (2018 / 2021 / 2024), ICC — Ch. 18 (soils & foundations, Table 1806.2, Sec. 1807) and Sec. 1604.3 (deflection).
- Classical statics & Euler-Bernoulli beam theory (equilibrium, M=wL^2/8, V=wL/2, deflection=5wL^4/384EI) — independently re-derived in the validation harness.

Per-check citations (Section 1): Statics; IBC 1806.

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.