

The coffer in the wall: reconstructing Khufu's coffer from the Queen's Chamber niche

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Supporting Information

This file is part of the self-contained submission package. All schedules and executable audit files cited below accompany it.

Appendix S1. Complete computational ledger

Channel	Niche value (in)	Coffer comparison	Error / role
Ideal P_e/H_e	$12.5c / 2c$	Coffer 258.20/41.31	6.25 vs 6.250303; rank 1/15
Generated S^*	$(25/8) \times 41.31 = 129.09375$	Coffer S_e 129.10; QN 128.11	Joint generator rank 1/180
Implied original L^*	$129.09375 - 38.50 = 90.59375$	Envelope 90.60; damaged 89.62	State discrimination; dependent on S^*
Generated wall fraction	$129.09375 / (129.09375 + 78.06)$	0.623178 vs 0.622861	+0.0318 percentage points; dependent
M&R premise fit	$c = 20.4915$ from five widths + T	Fixed coefficients 3, 2.5, 2, 1.5, 1, 9	1.556% RMS; max 2.865%; descriptive
Successive width drops	9.00; 10.91; 11.40; 10.13	Ideal $0.5c = 10.2458$	Total widths only; side setbacks unresolved
$T/2$	91.90	External L 90.60	+1.435%
$(5/4)\Sigma w$	258.80	External perimeter 258.20	+0.232%
Σw	207.04	Internal perimeter 209.74	-1.287%
$w_1 - w_5$	41.44	External H 41.31	+0.315%
$w_2/2$	26.37	Internal W 26.81	-1.641%
$B_2 - T/2$	7.03	Bottom thickness 6.89	+2.032%; paired with depth subtraction
$(w_1 + w_5)$	82.04	Internal diagonal 82.5357	-0.601%
B_2	98.93	External diagonal 98.4409	+0.497%
Physical depth	41.00	External H 41.31	-0.750%; withheld; two-cubit-compatible
External volume	142,812.6 in ³	Petrie $\approx 142,530$ in ³	+0.20%; dependent
Khafre control	same six predictions	103.68 $\times$ 41.96 $\times$ 38.12 / 84.73 $\times$ 26.69 $\times$ 29.59	10.526% RMS
Surviving-body sensitivity	External L target 89.62	Six-axis RMS	1.701%; primary envelope unchanged
North-wall position QN	128.11	External semiperimeter 129.10	-0.767%; independent positional input
South-wall position QS	77.57	Internal length 78.06	-0.628%; second positional output
Partition components	128.11; 77.57	129.10; 78.06	0.701% descriptive component RMS
Partition total	205.68	Target-pair total 207.16	-0.714%; first dependency-aware coordinate
Normalized cut fraction	0.622861	Target fraction 0.623190	-0.0329 percentage points
Frontal-decoder pair	129.40; 77.15	QN 128.11; QS 77.57	0.803% descriptive component RMS; same roles
Positional extrema sensitivity	127.94–128.59	External semiperimeter 129.10	-0.90% to -0.40%; not a CI
Positional preservation sensitivity	128.11	Body semiperimeter 128.12	-0.008%; not original-design evidence
Target-side P/H corpus	Nine Dynasty IV–V entries; four Dynasty VI extensions; lid and fragmentary ambiguities flagged	Khufu rank 1 under reconstructed (0.0048%) and surviving-body (0.754%) states; nearest non-Khufu 1.689%	Executed bounded specificity test; not a population p-value
Smyth wall assignment	QN/QS = 127.80/77.20	$S_e/L_i = 128.36/78.05$	Rank 1/132; dependency-aware RMS 0.514%

Appendix S2. Dependency and non-independence

The six measured axes share niche inputs and coupled coffer targets and are not six independent experiments. The internal-depth residual is cancellation-sensitive; depth, diagonals and volume are retained for complete-shape coherence, not multiplied evidence. The ideal layer is not independent of the measured relief: M&R's modules are a design idealization of the same architecture. It is also internally dependent: $N=5H$ in the modular scheme, so ideal perimeter and height reduce to one invariant family. S^* , the implied original length and the north-wall coordinate are consequences of the same generated scalar. QN and QS additionally sum to a fixed wall width. Equations 1–3 contain neither the M&R sequence 3, 2.5, 2, 1.5, 1, nor the 9c height or 25/4 invariant. The measured closure is therefore logically independent of the modular premise, although it is not an independent replication because both layers concern the same architectural relief. We report separate roles—design-level discriminative invariant, modular-premise-independent measured closure and constrained wall realization—without multiplying ranks or residuals. No combined p-value or formal residual degrees of freedom is claimed. The two Khufu corpus rows are alternate states of one object and are never counted as independent cases; each is ranked separately against the same comparator set. Smyth's 1865 result is a second within-campaign test of the positional schedule only: each campaign is internally closed, while their shared monument and historical relationship preclude treating them as statistically independent experiments.

Appendix S3. Frozen model, ratio and generator schedules

The measured-stone schedule enumerates 31 non-empty width subsets, 55 reduced factors, five band choices, six boundaries and three height sources, leaving 21,519 valid boxes; the frozen six-axis chain ranks first. The ideal ratio audit contains 15 external and 55 complete role-preserving ratios, plus 3,025 unrestricted cross-role comparisons. The 25/4 family ranks 1st, 1st and 2nd, respectively. The scalar-generator audit applies every ideal external ratio by multiplication and division to each of six coffer external metrics, yielding 180 routes. Against QN alone the focal route ranks second. Requiring one scalar to fit both coffer semiperimeter and QN gives rank 1/180 at 0.5409% joint RMS; the next route scores 0.9968%. These are conditional descriptive ranks, not p-values.

The workbook additionally retains the deliberately overinclusive maximum-universe tabs Broad_Cross (25,116 comparisons; 25,120 worksheet rows including headings) and Broad_Unique (9,078 numerically distinct ratios; 9,082 rows including headings). In that adversarial universe the focal relation ranks 39th before collapsing exact numerical duplicates and 3rd afterward. The two distinct ratio families ahead of it are a definitional 2:1 identity and an arbitrary cross-role match. Because this maximum universe discards archaeological role preservation and contains exact identities, algebraic dependencies and duplicated ratios, it is retained as a sensitivity bound, not as the inferential schedule; the role-preserving schedules are the archaeologically admissible tests reported above.

Appendix S4. Control and robustness ledger

Control	Universe / perturbation	Result	Meaning
Ideal ratio schedule	15 external / 55 complete	Rank 1 / rank 1	Role-preserving; no p-value
Cross-role ratio schedule	3,025 pairings	Focal rank 2	Sole superior match changes roles
Single-scalar generator	180 routes	Joint rank 1; 0.541%	Object + position required together
Khufu role scramble	720 six-axis permutations	Correct order 1st; next 4.991%	Role coherence
Khafre matched coffer	Fixed roles	10.526% RMS	Same-period control fails
Khafre role scramble	720 six-axis permutations	Best 8.945% RMS	Relabelling cannot rescue control
Input stress	± 0.25 in; 200,000 draws	median 1.525%; P95 1.941%	97.0% remain below 2%
Input stress	± 0.50 in; 200,000 draws	median 1.678%; P95 2.494%	Band 2 retained throughout
Input stress	± 1.00 in; 200,000 draws	median 2.212%; P95 3.768%	Robustness envelope only
Target-state sensitivity	External $L=89.62$ in	1.701% RMS	Preservation choice does not create closure
Positional target schedule	132 ordered distinct-target assignments	Rank 1; 0.507% vs 2.486% next	Total + cut score; not a p-value
Target-side P/H corpus	Nine Dynasty IV–V entries plus four Dynasty VI extensions	Khufu rank 1 in both preservation states; nearest non-Khufu 1.689%	Executed bounded specificity test; not population frequency
Smyth positional replication	Same 132 typed assignments; Smyth-only ledger	Focal pair rank 1; 0.514%; next 2.601%	Historical within-campaign replication; no Petrie values imported

Appendix S5. Claim-boundary checklist

Statement	Status	Permitted conclusion
The ideal invariant identifies the coffer boundary relation	Rank 1/15 external and 1/55 complete role-preserving ratios	First-ranked scale-free design evidence
The M&R ideal is an independent replication	No; it idealizes the same architectural relief	Design-compression premise; modern covariance-aware resurvey required
The niche depth matches coffer height	Direct cross-object measurement; shared two-cubit scale	Three-dimensional compatibility, not independent discrimination
The diagonal channels identify rectangles	Computed, shared inputs	Corroborative engineering check
The mapping favours Khufu over Khafre	One matched coffer plus 720 role permutations	Supported for the tested six-axis pair; full-grammar niche-corpus specificity pending
The mapping was intentional	Convergent form, position and control evidence	Supported conclusion: deliberate coordination
The niche had no other function	Not tested	Not claimed
The relation proves symbolism or chamber gender	No evidence	Not claimed
The niche axis realizes the generated coffer scalar	Shares S* with envelope reconstruction; 132-pair and 180-generator schedules	Strong dependent bridge; requires resurvey
The 25/4 invariant selects Khufu across preservation states	Rank 1 in the bounded target-side corpus under reconstructed and surviving-body states	Supported comparative specificity within the audited corpus; not population frequency

Appendix S6. Literature map and novelty boundary

This is a targeted novelty review rather than a systematic review of all pyramid literature. Searches through 5 September 2026 combined 'Queen's Chamber niche' or 'stepped niche' with coffer, sarcophagus, dimensions, projection, negative, serdab, statue, hidden chamber, corridor and construction. Historical surveys, standard architectural syntheses, recent peer-reviewed proposals and their backward citations were checked. The negative finding is bounded to this retrieved scholarly corpus.

Novelty boundary. Within this bounded corpus, we found no earlier study that proposes and quantitatively tests the Queen's Chamber niche as a wall-integrated negative projection of Khufu's coffer using complete external and internal axes, a frozen geometric grammar, an enumerated alternative universe and a dependency-aware wall-partition test. This statement does not extend to isolated dimensional coincidences or to a general relationship between the chambers.

Appendix S7. Historical within-campaign positional replication

The identical frozen 132-pair schedule was rerun using only Smyth's 1865 wall, niche-offset and coffer measurements. The external-semiperimeter plus internal-length pair again ranks first, with direct two-arm RMS 0.830% and dependency-aware scale/partition RMS 0.514%; the next mapping scores 2.601%. The corresponding Petrie dependency-aware score is 0.507%. No value is transferred between campaigns. Smyth's three upper niche widths were explicitly estimated without a ladder; consequently his 8.320%-RMS full-decoder result is retained as a negative result and not promoted as six-axis replication. Files SMYTH_POSITIONAL_REPLICATION_CHECKPOINT_v0_1.md, SMYTH_POSITIONAL_SCHEDULE_FULL_v0_1.csv and RUN_SMYTH_AUDIT.py provide the source boundary, all 132 assignments and an executable reproduction.

Literature family	Principal reading / evidence	Unresolved relative to this study
Survey and metrology	Petrie [2]: five-stage geometry, original depth and eccentric distance marker	No identified target object or complete reconstruction
Comparative architecture	Maragioglio and Rinaldi [3]: corbelled form within the internal building sequence	No six-axis coffer mapping or positional partition
Funerary / cultic	Lehner and Hawass [16]: serdab and ka-statue locus	Explains possible use, not the measured dimensional programme
Construction history	Lehner [15], summarizing and questioning Lauer: successive burial-chamber plans and later plan change	Addresses sequence, not why the niche has these dimensions
Mechanical	Scheuring [17]: niche/extension as oversight for a proposed lifting shaft	Functional mechanism without coffer attribution
Rear cavity / conservation	Sessa et al. [12]: altered Thieves' Corridor and original surface condition	Separates later excavation but does not interpret the original relief