Appendix J. Reverse-Engineered Hydraulic Design of the Khafre–Sphinx Complex

If the Khafre and Sphinx Valley Temples were conceived as harbor facilities, their design must have adhered to fundamental hydraulic and structural principles that remain valid in modern quay construction. The engineering logic underlying the Khafre–Sphinx complex can therefore be reconstructed as a sequential design framework consistent with contemporary hydraulic-quay practice. Table J1 summarises the inferred construction stages, associated functional requirements, and corresponding archaeological evidence preserved within the KVT and Sphinx Temple. The following sequence outlines the likely procedural steps undertaken by ancient engineers and compares them with stratigraphic and architectural data reported in prior excavations (Ricke 1970; Lehner 1991; AERA 2017; refs. 1, 2).

J1. Stepwise Functional Sequence and Archaeological Correlates

Table J1. Reverse-engineered hydraulic-design sequence for the Khafre–Sphinx complex, with corresponding structural and archaeological correlates.

Stage	**Requirement**	**Evidence (KVT / ST)**	**Interpretation**
1. Establish High Nile Datum	Define operational flood level (~22 m a.s.l.)	Identical floor elevation (KVT & ST)	Mean high water datum for docking
2. Prepare Impermeable Base	Prevent infiltration & erosion	Silty limestone bed smoothing	Dock foundation layer
3. Excavate U-shaped Slipway	Enable barge entry and unloading	Recessed U-plan floor	Functional quay basin
4. Build Retaining Walls	Resist hydrostatic pressure	2.6 m thick N/S walls	Levee or quay walls
5. Install Drainage Channel	Evacuate residual water	Central groove in KVT	Controlled outflow trench
6. Reinforce with Megalithic Blocks	Counteract buoyancy and distribute load	50 t blocks in lower course	Hydraulic counterweight

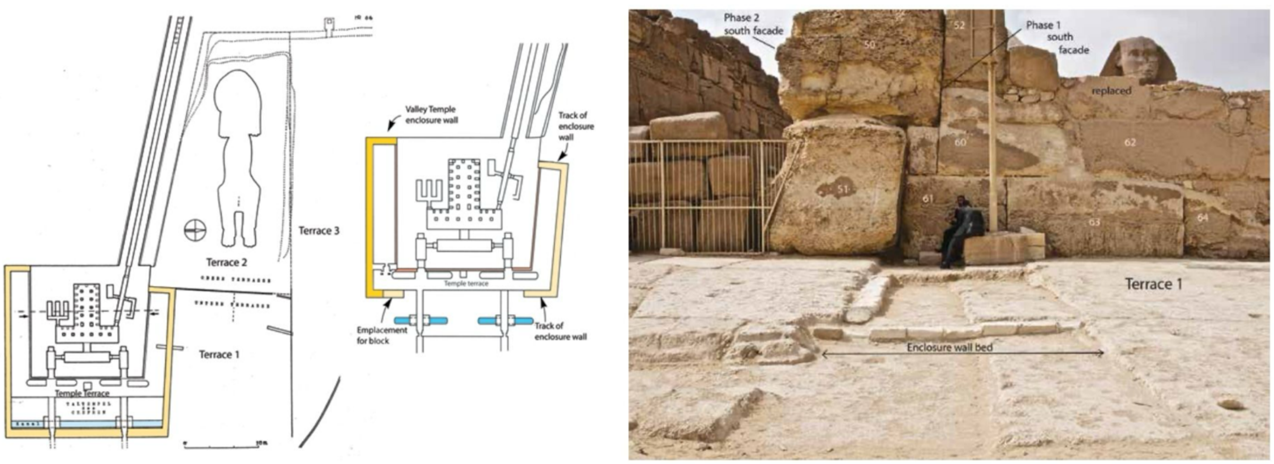
Stage	Requirement	Evidence (KVT / ST)	Interpretation
7. Add Granite Veneer	Protect against scouring	Granite casing (Lehner 1993)	Erosion shield / later ritual facade
8. Ritual Repurposing	Functional obsolescence	ST colonnade, casing unfinished	Adaptive ritual reuse following hydraulic obsolescence.

J2. Stratigraphic Convergence

Excavation records from the 2017 AERA season demonstrate that the northern enclosure wall of the KVT was dismantled prior to the construction of the Sphinx Temple, whose foundation trench directly reuses its earlier wall bed. Both temples occupy the same elevation (~22 m a.s.l.), exhibit comparable wall thickness (~2.6 m; ≈5 cubits), and employ similar limestone typologies, indicating a continuous sequence of architectural adaptation rather than two independent foundations.

This evidence supports a stepwise functional sequence beginning with (1) the levelling of Terrace 1 to create a stable docking platform during a mid-Holocene highstand; (2) the quarrying of core blocks from adjacent limestone members; (3) the emplacement of the KVT's U-shaped retaining

Figure JI. Stratigraphic and architectural correlation between the Khafre and Sphinx Valley Temples



Note: Left: schematic plan adapted from Ricke (1970) and AERA (2017), indicating the preserved enclosure-wall tracks (highlighted in yellow) surrounding the Khafre Valley Temple and their continuation toward the Sphinx Temple across Terrace 1. Right: field photograph of the same terrace showing the bed of the removed northern enclosure wall (Blocks 61-63), later incorporated into the southern core of the Sphinx Temple. Together, these complementary views reveal the stratigraphic convergence and architectural continuity linking both valley temples, consistent with a unified constructional phase and shared engineering framework.

walls functioning as quay revetments; and (4) the later ritual refacing and reuse of these structural beds within the Sphinx Temple. Fig. J1 illustrates the U-shaped basin geometry reconstructed from KVT survey data, supporting this interpretation. In engineering terms, this represents a unified hydrological–architectural system that evolved from a functional harbour facility into a ceremonial complex.

J3. Alignment with Modern Port-Engineering Practice (PIANC/CIRIA checks)

This stepwise progression parallels modern port-engineering practice, in which quay formation, slipway access, and basin drainage are treated as interdependent processes (cf. PIANC 2015; CIRIA *Rock Manual*). Comparable staging and design checks are discussed in contemporary engineering guidance, while full parameter sweeps and verification routines are provided in Supplementary Appendix A.

J4. Integrated Conclusion — Harbor-Capable Phase under Mid-Holocene Conditions

When viewed through an integrated engineering and hydrological framework, the Khafre and Sphinx Valley Temples form an interconnected hydraulic system rather than isolated ritual monuments. Stratigraphic and architectural correlations indicate a functional harbor-capable phase that was later adapted for ceremonial use. Quantitative evaluations of hydrostatic loading, structural stability, and drainage performance support the feasibility of such an installation under mid-Holocene hydrological conditions (see Supplementary Appendix A for technical parameters; Appendix H for geomorphic context; and Appendix I for paleoenvironmental evidence). These findings reconcile architectural and hydrological data under a unified engineering framework, providing empirical grounds for reinterpreting the Khafre–Sphinx complex as a functional hydraulic installation of the mid-Holocene.

References

1. Ricke H. 1970. *Der Harmachis-Tempel des Chefren in Giseh.* Schweizerisches Institut für Ägyptische Bauforschung und Altertumskunde, Zürich.

2. Lehner M. 2017. *Giza Plateau Mapping Project: Season Report — "The Old and the New."* Ancient Egypt Research Associates (AERA), Cairo.