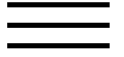


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recreating the decision process underlying
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Water engineering at Petra (Jordan): recreating the decision
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pipeline system

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Highlights

- â€¢ Petra Wadi Mataha water system investigated.
- â€¢ Several hydraulic engineering design choices analyzed.
- â€¢ Design selected demonstrates advanced engineering knowledge.

Abstract

The water supply and distribution systems of Nabataean Petra (300 BCE–300 CE) possibly incorporate traces of hydraulic engineering knowledge gathered through interaction with cities of the ancient Mediterranean and the Orient. While the degree of utilization of available knowledge is not known, the rough mountainous terrain interlaced with many deep wadis, distant spring water sources and low seasonal rainfall availability (Laureano, 2005) presented water supply problems requiring unique innovations from Nabataean engineers to maintain year-round water supply for Petra's population. From water transport solutions developed over centuries as well as technology possible borrowings from outside sources, successful hydraulic design choices were made by Nabataean engineers to optimize water transport to the city's urban core. This paper explores a number of design choices available to Nabataean engineers for the design and construction of the Wadi Mataha pipeline system prior to its construction. Given that the final design choice had sophisticated features indicative of advanced hydraulic knowledge, there is indication of a well-developed knowledge base supporting the final design choice. To explore aspects of several design options and provide insight into the Nabataean use of hydraulic design principles, computational fluid dynamics (CFD) methods are used to model several pipeline design options to visualize hydraulic phenomena occurring for different pipeline system design options. CFD refers to finite-difference, numerical solutions of the governing fluid mechanics equations applied to water flow within pipeline networks. The CFD results demonstrate fluid mechanics phenomena, presumably known to Nabataean engineers through prior observation or borrowed knowledge, supporting their final design choice. CFD results then provides insight into the civil engineering knowledge available to their engineers. Given that the Wadi Mataha pipeline design is close to a design obtained using western technology developed 2000 years later, observation of water flow patterns and flow rates under different pipeline slope conditions must have been a vital part of their engineering knowledge base given its importance to the life of the city. Given the limited survival rate of documents related to ancient water technology, the present paper provides an alternate path of discovery of the decision process behind ancient Nabataean engineering decision making and adds a chapter to the history of hydraulic science.



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