Water suply in roman period/Hydraulic study of roman aqueduct

Field of Study : Information Science and Engineering

Mandatory training needed to apply for this research topic : Master degree in Civil Engineering or Water Engineering

SUPERVISORS

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KEYWORDS

Roman Hydraulic infrastructures; Water management; Water supply, Aqueducts, Qanat

ABSTRACT

The main objective of this proposal is to develop strong research and analytical skills of a PhD student, including the ability to formulate research questions, design experiments, gather and analyze data, and draw meaningful conclusions. Through this project, we will provide to young scientists the opportunity to develop research skills in a stimulating interdisciplinary environment. PhD candidates will acquire specialized technical skills relevant to ancient hydrology and hydraulics by a specific literature review guided by experts also on the technical themes and through modern techniques.

The development of civilization is closely related to water. Hydraulic systems existed in many cultures; let's not forget the greek and roman water supply systems or Shushtar Historical Hydraulic System, built in the Persian Empire in the 3rd century CE which served for different purposes: irrigation, water supply, transportation and even defense. The study of an ancient hydraulic system requires an interdisciplinary way, combining archaeological discoveries with the quantitative skills of hydraulic engineering. We propose to the potential PhD candidates a study of water supply in Scytia Minor in the roman period, in which we propose an analysis related to technical aspects of roman aqueduct construction including hydraulic analysis in comparison with other roman aqeducts searched in the historical and technical literature on this topic.

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Research aims and methodology

Roman Hydraulic infrastructure refers to: water outlet, aqueduct system, cisterns and distribution. Without doubt, for today's builders and even scientist, the Roman hydraulic system represents a fascination. The first analyzes referred to elements related to "hydraulic geometry" (e.g. channel length, slope, etc.), elements that were not presented in the archaeologists' reports. Later, component hydraulic structures such as: “castellum divisiorum”, siphons, inverted siphons, chutes and cascades captured the interest of scientists, including their physical and mathematical modeling. Finally, study of the flow in aqueducts, canals and pipes in order to determine the flow rates used, is of current interest. In this context the principal aim of this study is **History of water supply in Roman empire, especially in Scythia Minor. As specific objective we propose a discussion related to technical aspects of Roman aqueduct construction incuding hydraulic analysis, in order to establish the flow rates of aqueducts.**

Methodology is focused on a mixed methods: analytical approach – related to hydraulic study of water suply and technical aspects of roman aqueduct, and quantitative approach related to computational hydraulic dynamics used in order to evaluate flow rates of aqueduct.

Relevance and added-value of the proposed research in relation to the current state of knowledge

The principal questions posed are (i) What do you know? And (ii) Why should you learn?
Two primary sources provide information about the water supply of ancient Roman cities, namely those provided by Frontinus and Vitruvius. But the romans were not the ones who invented the first aqueducts. Among the achievements that preceded the Roman constructions, we list the Jerwan aqueduct built by King Sennacherib and the qanats that were built in the Middle East sometime at the beginning of the first millennium BC. Although when we talk about aqueducts we immediately think of the "Pont du Gard", most Roman water supply systems are underground, in the form of canals whose dimensions did not depend on the flow they could carry but above all on the possibility access of the people who maintained the system. In this context, the study of Roman water systems requires information about the geometry of the hydraulic system, but especially about its components, their hydraulic operation and especially about the determination of rate flows. The recovery of ancient information about the aqueducts rate flow represents much more than the understanding of the "hardware" of the Romanian water infrastructure, but can provide information regarding urbanization, societal changes and climate changes and the response of past civilizations to them. It is useful to reflect to some lessons: (i) the meaning of sustainability in modern times should be reevaluated; (ii) security of water is an important aspect of population sustainability and (iii) in the arid area the water management program is essential.

Interdisciplinary nature of the research together with the alignment with the CHORAL programme and complementarity expertise of the teams

Cultural Heritage types refer to Built and Natural Environment and also to Artefacts. In line with this, cultural heritage is not only in the sphere of humanities and social sciences, but also in the more recent environment and built sciences. The constructions made during the Roman period in the area of Scythia Minor and especially those for the water supply of the Roman cities impress not only by the construction itself but also by the technical and technological methods of realization. Cultural significance must be seen under a completely new perspective, going beyond the mere act of preserving, maintaining or protecting the physical heritage. From this perspective, we believe that an analysis of the Roman water supply constructions, using modern methods, will lead not only to a clear understanding of the principles used and of the Roman water engineering design practice, but especially to an understanding of how the ancient water systems actually worked: amount of water that flowed, its variation over time, and the types of problems its designers and operators might have faced.

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Output plan including publication and dissemination activities

According to UniTBv methodologies the training programme of a PhD student is based on (i) Advanced Academic Studies (AAS) which takes place over two semesters (1 year) and (ii) Scientific Research Program (SRP), which lasts for 3 years. In the first year, doctoral students follow common courses for engineering fields, accumulating 30 credits, and will accumulate an additional 30 credits in specialized courses established by their research supervisors for each doctoral student. SRP refers to the planning of the elaboration and defense of the Research Reports during the doctoral studies (2^{nd} and 3^{th} year). The name, number (2-3) and duration of each research report is established by the doctoral student together with the coordinators in line with the topics and specific rules. SRP include also the period necessary to public defense of the doctoral thesis which is organized ordinary in the 4th year (with the possibility of extension, according to the law, for 1-2 years). Minimum four research articles are necessary to be accepted to public defence of PhD thesis from which one is published in WOS Journal and the others can be published in different BDI (International Base Data) Journal (e.g. Scopus, EBSCO, Proquest, etc) or national/international scientific conferences.

Estimated schedule

1st year: October 2025 – September 2026 dedicated to AAS program
2nd year: October 2026- September 2028 dedicated to research reports 3rd year:

- October 2028 – mars 2028 thesis writing
- Mars-August 2028 administrative issues related to preparing and conducting the public defense of the doctoral thesis
- September -October 2028 public defenses of PhD thesis

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