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THERMAL BEHAVIOR OF PIGGYBACK LAID DISTRICT HEATING AND DISTRICT COOLING PIPES

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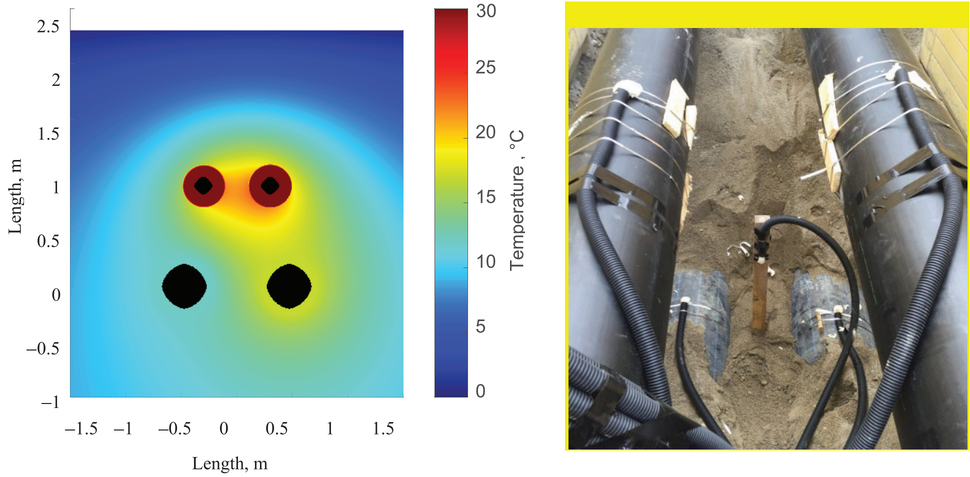
Abstract – The expansion of district heating networks is a key component of Europe's strategy to reduce CO2 emissions and achieve climate targets. Simultaneously, district cooling networks are being developed in major metropolitan areas, with cities like Hamburg, Paris, Vienna, Berlin, and Munich. A key challenge in the implementation of both heating and cooling systems is their economic viability, which is strongly influenced by the design and construction of the distribution infrastructure. Efficient network design requires a high demand density and the adoption of intelligent pipe-laying strategies. In this context, the piggyback installation of district heating and cooling pipes – where both systems are laid above one another in the same trench – has gained attention to optimize space usage and reduce construction efforts. However, this installation method can lead to significant thermal interactions between the two systems, particularly in cases where the temperature differences between the heating and cooling pipes create mutual effects that impact the performance of each system. This paper investigates the thermal behavior of piggyback-laid district heating and cooling pipes through a case study in Munich, where over 400 meters of district heating and cooling pipelines are installed in this configuration. The study provides detailed insights into the execution and experimental measurement setup of the pipeline section and evaluates the thermal interactions using long-term simulations of transient heat transfer. Experimentally obtained Temperature-Data is used to validate the Model and allows a detailed analysis of the actual heat transfer within the cross-section. The results of the simulation highlight the extent to which pipe placement influences the thermal performance of the systems. Furthermore, a parametric study is presented to explore how modifications to the pipe geometry can optimize the arrangement, potentially improving the efficiency, sustainability, and cost effectiveness of both district heating and cooling networks. This research aims to inform the design and operation of urban energy systems, providing valuable guidance for enhancing energy efficiency in metropolitan regions striving to meet stringent climate goals under cramped underground conditions.

Keywords – District heating; district cooling; heat losses; finite element analysis; transient heat transfer; pipeline construction; piggyback



FEM-Simulation and Measurement setup (Copyright SWM)

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