The application of retaining walls and slabs as energy structures in underground train stations

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Abstract

Shallow geothermal technologies have proven to efficiently provide renewable energy for heating and cooling. Recently much attention has been given to utilising sub-surface structures, primarily designed for stability, to also transfer heat to and from the ground, converting them into energy geo-structures. This work investigates the potential of applying this technology to the geo-structures of underground train stations in the city of Melbourne (Australia) to fulfil some of their heating and cooling demands. The diaphragm retaining walls and slabs that form part of a case study station are designed to also incorporate geothermal pipe loops. A finite element numerical model comprising the station walls and slabs is presented and used to investigate the thermal performance of these systems, for the temperate climate and geological conditions of Melbourne, adopting an expected lifespan of at least 25 years. The technical applicability of this technology is discussed for different thermal load scenarios, showing the importance of thermal storage and the balanced distribution of the thermal load.