Tunnel Geothermics – International experiences on regenerative energy concepts in tunnel projects

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Tunnels can make a respectable contribution to renewable energy concepts, as previously completed projects and studies show impressively. With little technical effort the static and structural function of the tunnel lining can be extended by a thermal-energy function.
This lecture gives an overview of the technologies used in tunnel constructions and shows technical developments for the use of geothermal energy. In addition to the hydro-geothermal use, which is currently limited in its application to Switzerland, absorber technology from Austria and Germany are known in which heat exchanger tubes are integrated into the tunnel structure (see figure 1 and figure 2).

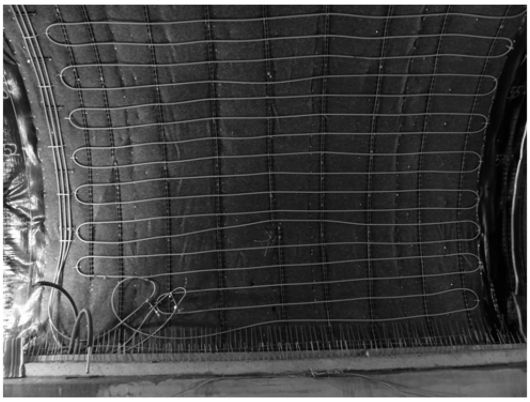

Figure 1: Absorber tubes fixed in the outer shell of the tunnel lining (Stuttgart Fasanenhof)

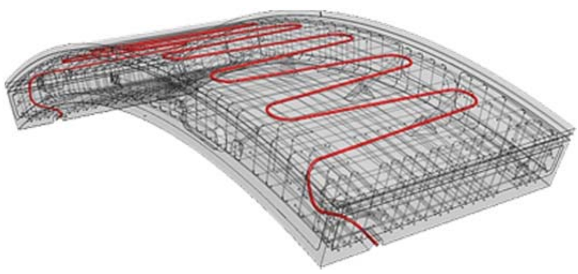

Figure 2: Absorber tubes inside a tubbing (Ed. Züblin AG)

The tunnel Fasanenhof in Stuttgart and the tunnel Jenbach in Austria two pilot projects will be presented in this lecture. The characteristics of these two pilot projects ideally give a wide range of possible boundary conditions for tunnel projects: The tunnel Fasanenhof made of shotcrete to be relatively short, shallow-lying passes hard rock strata with low groundwater flow. The tunnel Jenbach realized as a tunnel drive with tubbing with a length of 3.5 km and a cover of approximately 16 m is situated in sand and gravel layers with a relevant groundwater flow. Both plants are extensively equipped with measuring devices to determine the temperature field in the construction, the tunnel air and the encircling soil (see figure 3). For the first time these pilot projects will compared holistically. This lecture reports about the results of the complex interactions between the subsoil, the tunnel air and the environment and assesses the long-term

energy efficiency (productivity) in terms of investments taking into account the different boundary conditions.

For both geothermal tunnel plants numerical simulations were carried out. Based on the calculation results the influences of different boundary conditions have been analysed.

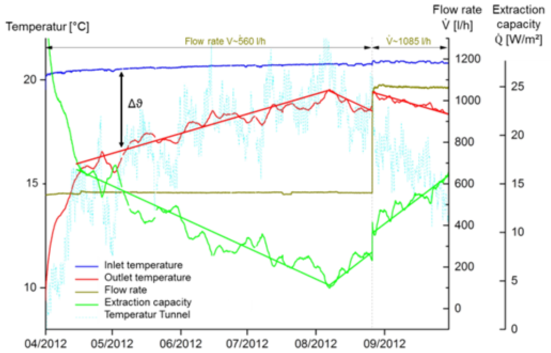

Figure 3: Measured tunnel air temperature against calculated extraction rate (Stuttgart Fasanenhof)

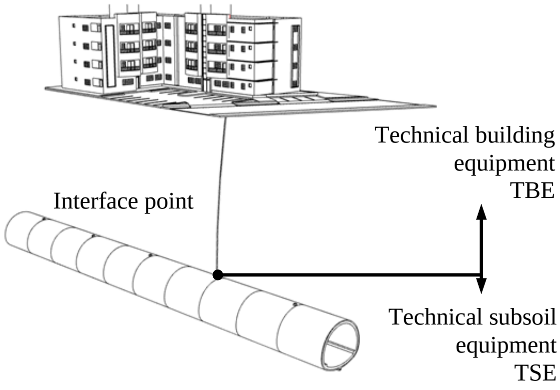

Figure 4: Interface point between TBE and TSE

Furthermore recommendations have been developed allowing an orientation, under what conditions geothermal tunnel projects are technically, economically and ecologically applicable. With regard to the future increased use of this technology optimizations in both planning and technical aspects are required to form the interface between the technical building equipment (TBE) and the technical subsoil equipment (TSE) (see figure 4). The concepts presented in this lecture for the constructive implementation of this interface allow a clear separation between TBE and TSE and thus reduce planning constraints.