Berufskolleg Duisburg – largest project of shallow geothermal use in Germany

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ABSTRACT

With 21.600 meters of installed BHE the Berufskolleg in Duisburg (fig. 1) is currently the largest operating example of shallow geothermal use in Germany. A total of 180 double-U BHE with a depth between 110 and 130 meters provide in total 1.9 MW heating and 1.0 MW cooling.



Figure 1: Model of the Berufskolleg Duisburg [GOLDBECK PPP GmbH]

1. DESIGN

1.1 Heating-Cooling-Ratio

Developing the optimal heating-cooling-ratio for the geothermal system by integrated planning was one of the main ecological and economic targets. Therefore a thermal balance in the underground is necessary. Different cases between 10.000 and 24.000 meters of borehole-length where evaluated.

1.2 Underground Temperature

The importance of the initial underground temperature is the same as high as the temperatures during operation. The design of the thermal storage was done according to a maximum direct cooling amount.

1.3 Simulation

A thermo-hydrodynamic simulation was necessary to define the influence to the neighbourhood during operation. Therefore a complex model was calculated with FEFLOW (figure 2) and evaluated with the authorities.

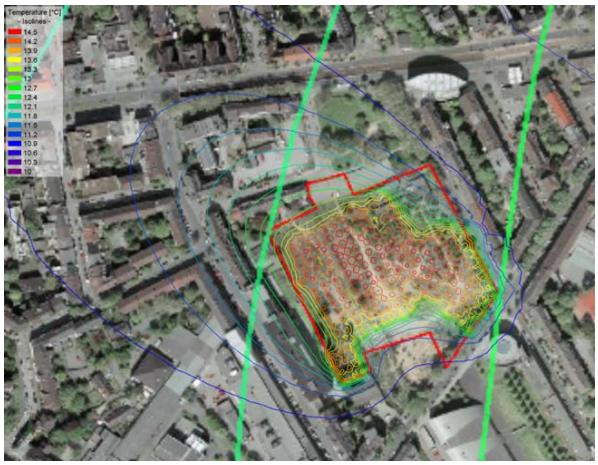

Figure 2: FEFLOW-Model of thermal influence to the neighbourhood

2. CONSTRUCTION & OPERATION

2.1 Drilling Process

Challenges during the drilling process where conflicts with the progress of construction under a exited schedule and the deviation of the boreholes (in some cases 35 meters of horizontal deviation, see figure 3).

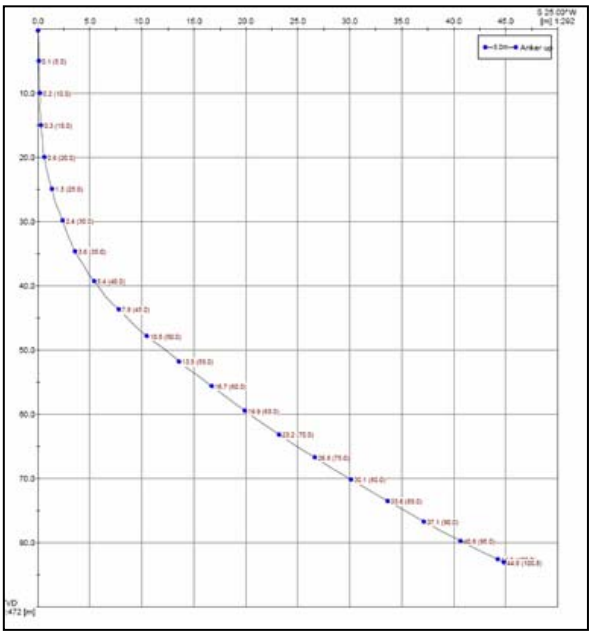

Figure 3: Deviation measurement [DMT]

2.2 Heat Pump Concept

For the heating process 3 heat pumps 529 kW each (see figure 4) and 1 heat pump with 311 kW by KWT (Viessmann Group) are operated in cascade. Two of the heat pumps are able to operate for active cooling with a total power of 1.038 MW.



Figure 4: Heat pump 529 kW [KWT]

2.3 BHE-field

The 180 probes are divided in 15 subfields of 12 BHE each to enable parallel heating and cooling. The length of the BHE is varied according to the pressure-loss.

2.4 Green Concept

The college was built in 2010/2011 during a period of 17 month. It is owned by the City of Duisburg and operated for the next 25 years through a Public Private Partnership Model by GOLDBECK PPP GmbH.

The building is DGNB-certified, which is the German standard for “green buildings”.

A detailed monitoring-system during operation allows a continuous optimization of the energy costs.

4. CONCLUSIONS

For the design and operation of large-scale buildings with geothermal heating and cooling the integrated planning is essencial. PPP-Projects are still rare but can be operated successful by intensive monitoring.

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