REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

REHVA COURSE at CLIMA 2019

How to design hybridGEOTABS buildings' components

Teachers

Héctor CANO ESTEBAN	
M.Sc., Project Manager in "R&D and Projects Department", Geoter	
	MSc Civil Engineer by ETSICCP of the Polytechnic University of Madrid. Specialising in Hydraulics and Energy. Manager of Audits and R+D for Geothermal Energy Company SL., responsible for planning and implementing projects and engineering studies of HVAC through geothermal and other renewable energies in residential, commercial, industrial and public buildings. Project Manager and participation in different Spanish R+D projects (GREENMAR, REACT, ENERGYSIS and REHABILITA-GEOSOL). Expert in coordination and planning energy audits. Professor in ERMA Master Programme at Polytechnic University of Madrid and in RERU Master Programme at Polytechnic University of Valencia. National and international experience (Spain, Chile, Bolivia and Argentina).

Jan HOOGMARTENS	
Ing. Project Engineer, Viessmann Belgium	
	Jan Hoogmartens is an industrial engineer in electro-mechanics (MSc 2008) from Campus Denayer. After four years of project work about heat pump applications in dwellings and offices (WP-DIRECT and GEOTABS), he started as product manager for heat pump at Viessmann Belgium sprl-bvba. As member of WPP he follows the Flemish heat pump sector.

Qian WANG
Ph.D., Research and Innovation Specialist, Uponor AB / Division of Fluid and Climate Technology, KTH Royal Institute of Technology

	Qian Wang graduated as a HVAC engineer, PhD in Building Science in KTH Royal Institute of Technology, Sweden. He has long research and development experiences in the area of sustainable HVAC and energy technology in the built environment. His main R&D focus on low-temperature heating/high temperature cooling system, indoor climate, building energy performance and retrofitting technology. Qian Wang is a main project developer and leader of several Swedish and EU research projects currently and in the past years. Areas of expertise also involve ventilation and thermal comfort, numerical and analytical modeling, business development for building/community energy and water supply.

Lieve HELSEN	
Prof. PhD Head of the Thermal Systems Simulation research group, KU Leuven/EnergyVille	
	Lieve Helsen graduated as Chemical Engineer (Leuven, 1993), PhD in Mechanical Engineering (Leuven, 2000), she was awarded a Postdoctoral Fellowship from the Research Foundation Flanders (FWO), and currently she is Full Professor in Mechanical Engineering at the University of Leuven (KU Leuven) in Belgium. She is head of the Thermal Systems Simulation (The SySi) Research Group. Her expertise can be mainly situated in the field of optimal design, dynamic system behaviour, global system integration and (optimal) control of thermal systems (both experimentally and theoretically). Model Predictive Control (MPC) is now being demonstrated in multiple hybridGEOTABS buildings, and steps are taken to move from building to district level. Lieve Helsen is affiliated member of OPTEC, WP Leader within IBPSA Project 1, member of the management committee of the KU Leuven Energy Institute, core-member of EnergyVille, Chair of the BS2021 Conference, member of the International Scientific Committee of the ZEN Centre at NTNU and of UCEEB connected to TUPrague, member of AcademiaNet, EHPA, IBPSA-NVL, ATIC, ODE.

Introduction to the training

hybridGEOTABS refers to the efficient integration of the combination of GEOTABS (GEOthermal heat pumps in combination with Thermally Activated Building Systems (TABS)) and secondary heating and cooling systems in a building.
This course deals with some specific components of hybridGEOTABS installations, presenting them in the context of the necessary holistic design:

- **OPTIMIZED DESIGN OF BOREHOLE FIELDS.** Geothermal energy, a low temperature, efficient and reliable source, is used to cover heating and cooling base load of hybridGEOTABS buildings. For this reason, optimized design and increased security of thermal supply of the borehole field are important and necessary. Selecting proper elements to monitor the boreholes during design and operation allows size optimization of the borefield and provides extra data that can be used by the controller to assist efficient thermal building management.
- **OPTIMIZED DESIGN OF GEOTHERMAL HEAT PUMPS.** The heat pumps are a major component in the hybridGEOTABS concept, serving the upgrade from low temperature geothermal energy to high(er) temperature TABS heating energy**.** The course will offer different heat pump technical features and explain how these relate with hybridGEOTABS primary and secondary systems.
- **OPTIMIZED DESIGN OF TABS**. Thermally Active Building Systems (TABS) have proven to be one of the innovative radiant heating and cooling systems for future sustainable buildings. This course is introducing the basic concept of TABS, their design principle, performance and key technical features. Additionally, TABS as a mature product, have gone through optimizations based on the requirements of building structure, slab conditions as well as construction methods. In this context, different types of TABS and their applications are presented. Special applications of TABS, such as in residential buildings and retrofitting practice, will also briefly be discussed.

Optimal energy management in these hybrid installations is provided by a **Model Predictive Control** (MPC) strategy which decides between different production sources and distribution systems, thereby anticipating on future disturbances (weather, user behavior …). The course will also provide an overview of what MPC is and why it is crucial in hybridGEOTABS buildings.

Target audience of the training

The target groups of the course are: HVAC designers and manufacturers, architects, drillers, researchers, engineering students.

After this training you will:

- Understand the design and optimization of the borefield from an economical and security of thermal supply point of view. Thermal balance and operation in hybrid installations.
- Understand the design, construction and system integration of TABS. The advantages of TABS and its suitable application in the respective building type and energy systems.
- Understand how an MPC approach works, which benefits it can create and why it has especially advantages when applied in hybridGEOTABS buildings.

Contents

- ABOUT THE BOREHOLE FIELD:
  - Borefield: design phase
  - Geothermal Response Test and borehole optimization.
  - Real cases on field and simulations
  - Borefield: operation phase
  - Hybrid operation and thermal balance

- ABOUT GEOTHERMAL HEAT PUMPS:
  - primary and secondary temperature boundaries of heat pumps.
  - bèta curves (heat pump power as a function of building heat loss and consequent energy delivery by heat pump) and the relation to bore hole sizing
  - different ways to couple an energy storage tank with their advantages and disadvantages
  - bivalent coupling of e.g. gas boiler with its advantages and disadvantages
  - different refrigerants used in heat pumps with their advantages and disadvantages (relation to F-gas)
  - one compressor versus 2 compressors versus invertor
  - hydraulic coupling of Natural Cooling, the use of a cooling buffer

- ABOUT TABS:
  - TABS introduction and its working principle
  - Optimal Design of TABS
  - Construction of TABS
  - Hydraulic Integration of TABS …
  - Cost perspectives of TABS…
  - Special applications of TABS in practice…

- ABOUT MPC:
  - Model Predictive Control (MPC) strategy and role as system integrator
  - Advantages of MPC
  - Application of MPC to hybridGEOTABS buildings