LATVIJAS UNIVERSITATE
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VTPMML

Composite construction's impact on energy efficiency of buildings

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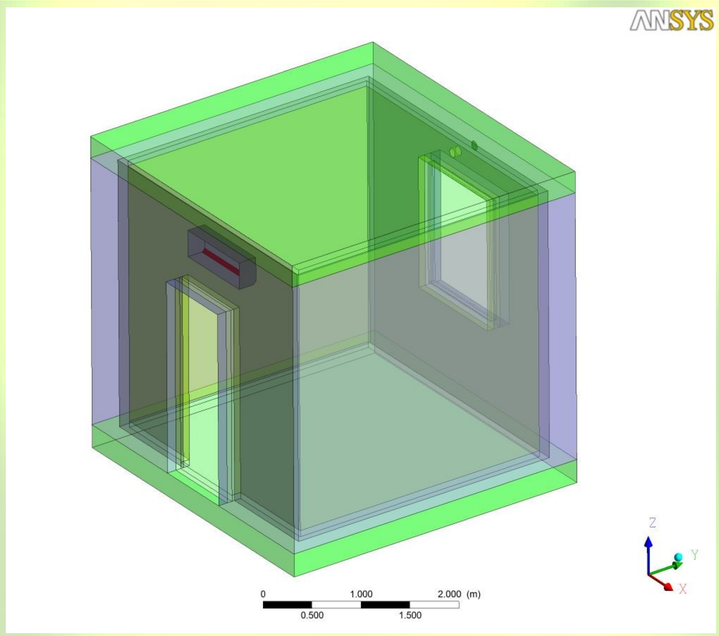
PROBLEM FORMULATION

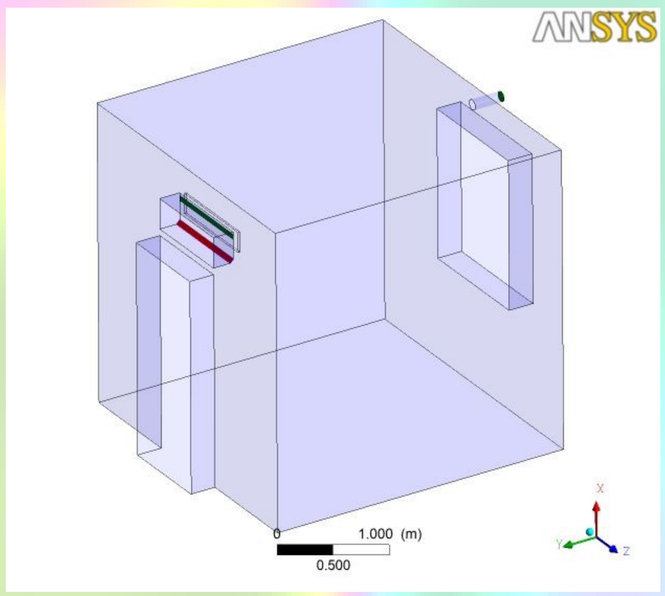
Building constructions vary widely from light constructions made of wooden frame and insulating material to heavy brick and ceramic constructions.
Thermal properties and the price range significantly varies for different constructions. Different types of them can be modelled using numerical calculations.
Mathematical modelling can be used to predict changes in energy comsumption and distribution of physical fields for buildings with composite wall constructions.

MATHEMATICAL MODEL

- ANSYS/CFX software is used for simulations
- 3D steady state model for built test buildings
- Reynolds Averaged Navier-Stokes (RANS) equations
- Shear stress transport (SST) turbulence model
- The heat transfer equation for heat conduction
- Radiation is not included in this model
- Boundary conditions for the problem are as follows:
  - Convection for the outer boundaries
  - Air velocities for the openings.
  - Different AC inflow angles
  - Continuity at the solid/solid interfaces
  - Wall functions for fluid/solid boundaries
- Airflow is modelled as incompressible using Boussinesq approximation for buoyancy

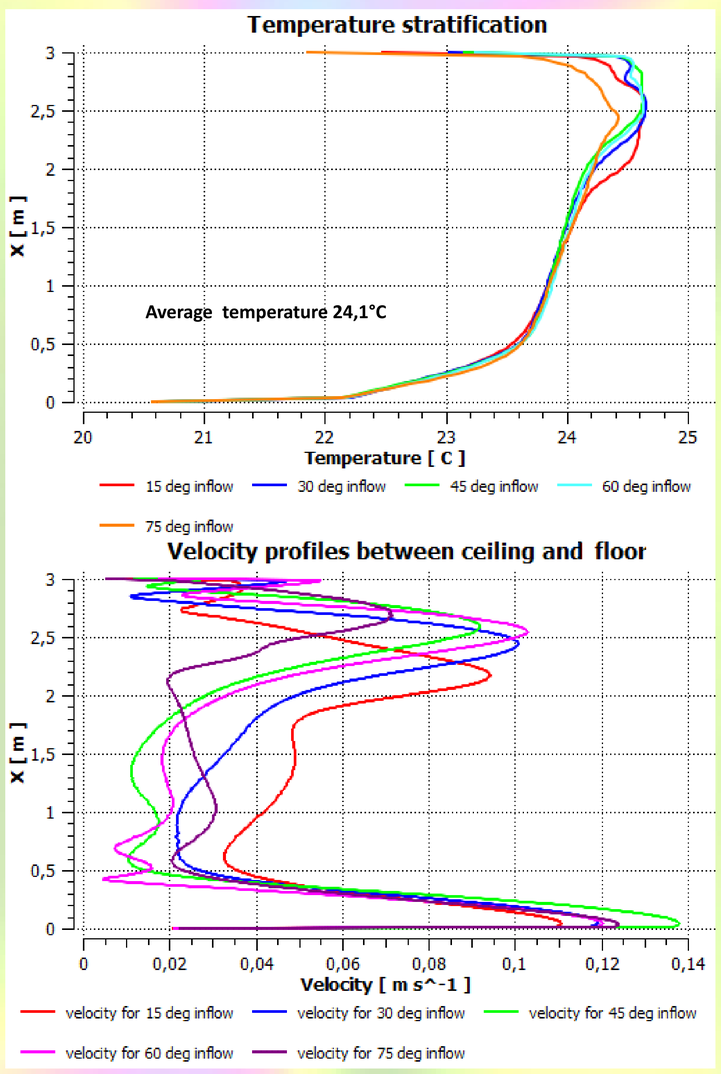


Full 3D geometry with walls

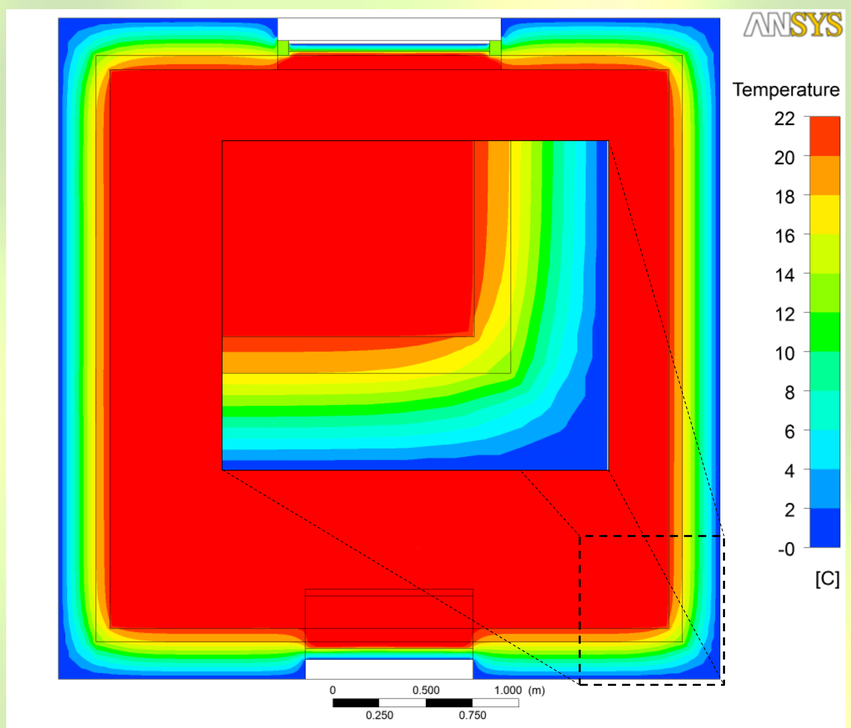


Simplyfied 3D geometry; walls replaced with boundary conditions including thermal resistance

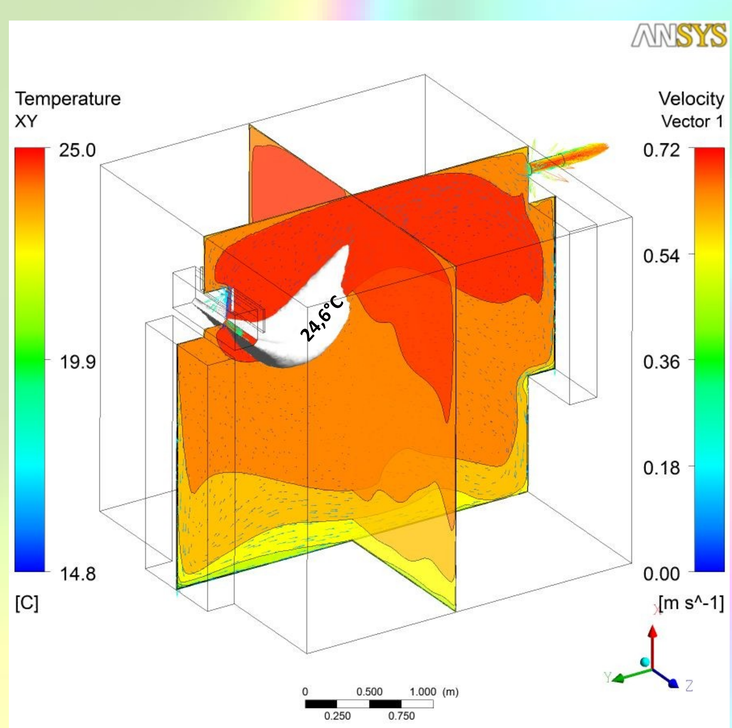
NUMERICAL RESULTS



Vertical temperature and velocity profiles between ceiling and floor for different AC inflow angles



Horizontal temperature distribution with corner effects

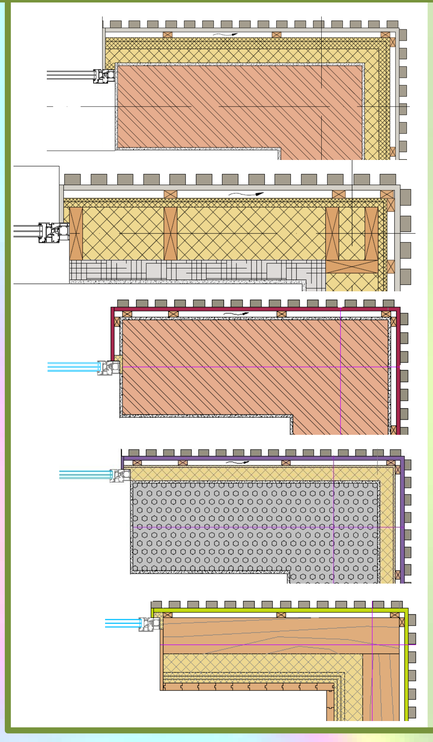


Temperature and airflow distribution for 45° inflow angle in middle cross-section

ENERGY CONSUMPTION

	Walls	Floor	Doors	Ceiling	Window	Ventilation	Recirculation	Total
Heat losses, W	-125	-30	-31	-32	-29	-129	-11	**-387**
Heat gain, W	From the heat pump							**392**

EXPERIMENTAL SET-UP



Clay brick wall with a layer of mineral wool

Mineral wool with plywood

Clay brick wall with cavities filled with insulating material

Aerated concrete with a layer of mineral wool

Wooden construction with a layer of mineral wool

Construction stage of 5 different test buildings in Riga (www.eem.lv)

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