

Composite construction's impact on energy efficiency of buildings

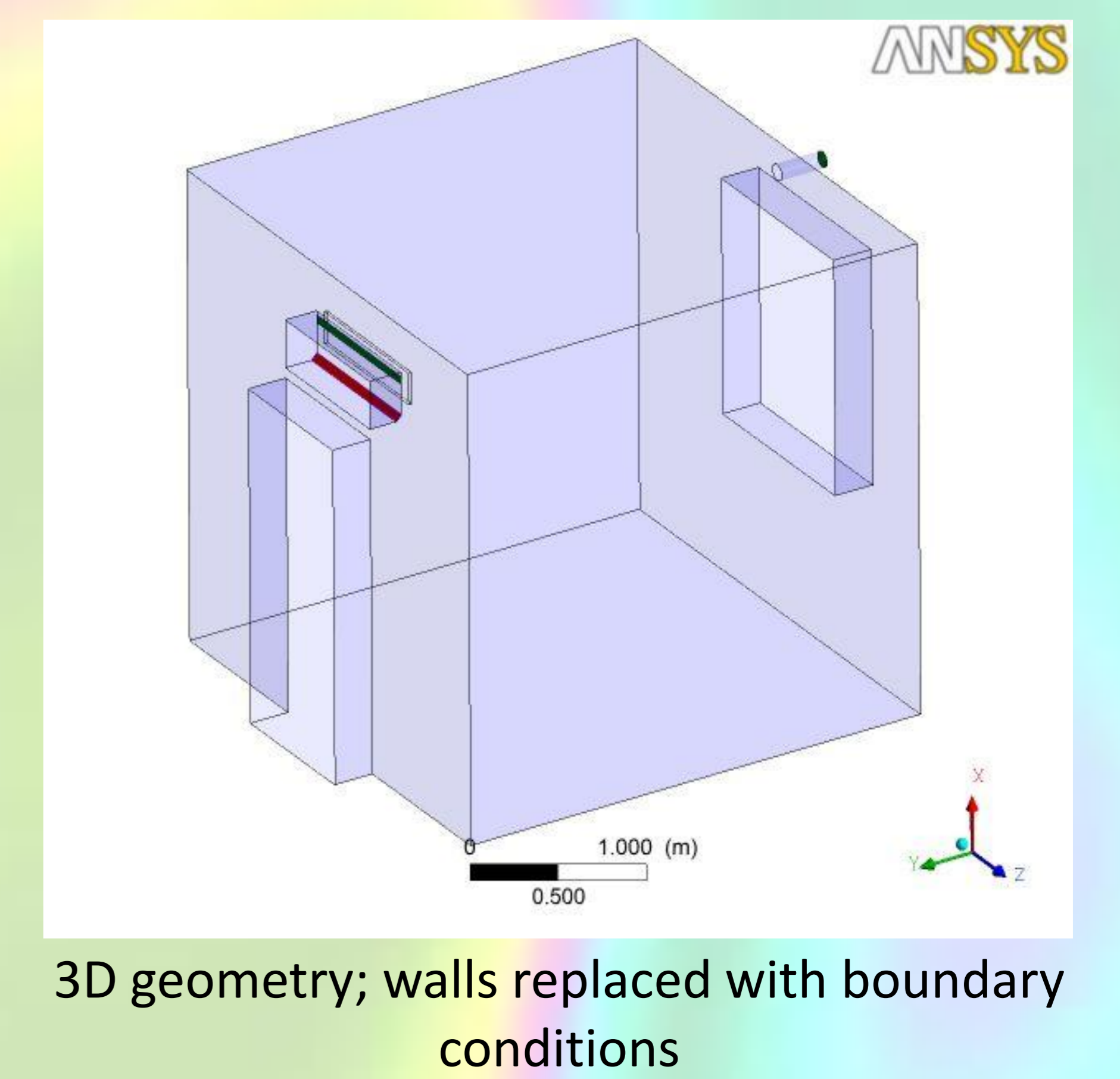
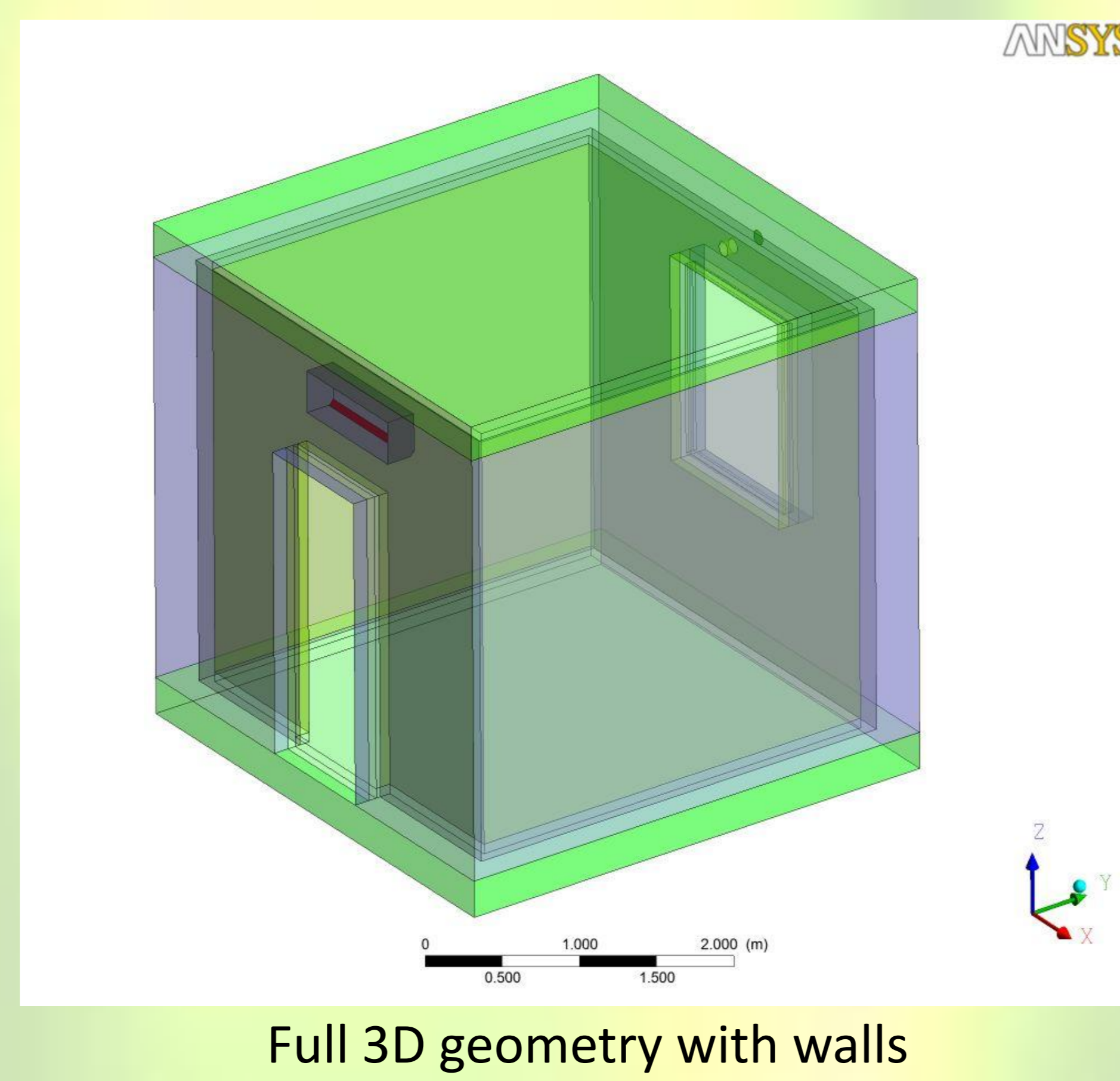
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PROBLEM FORMULATION

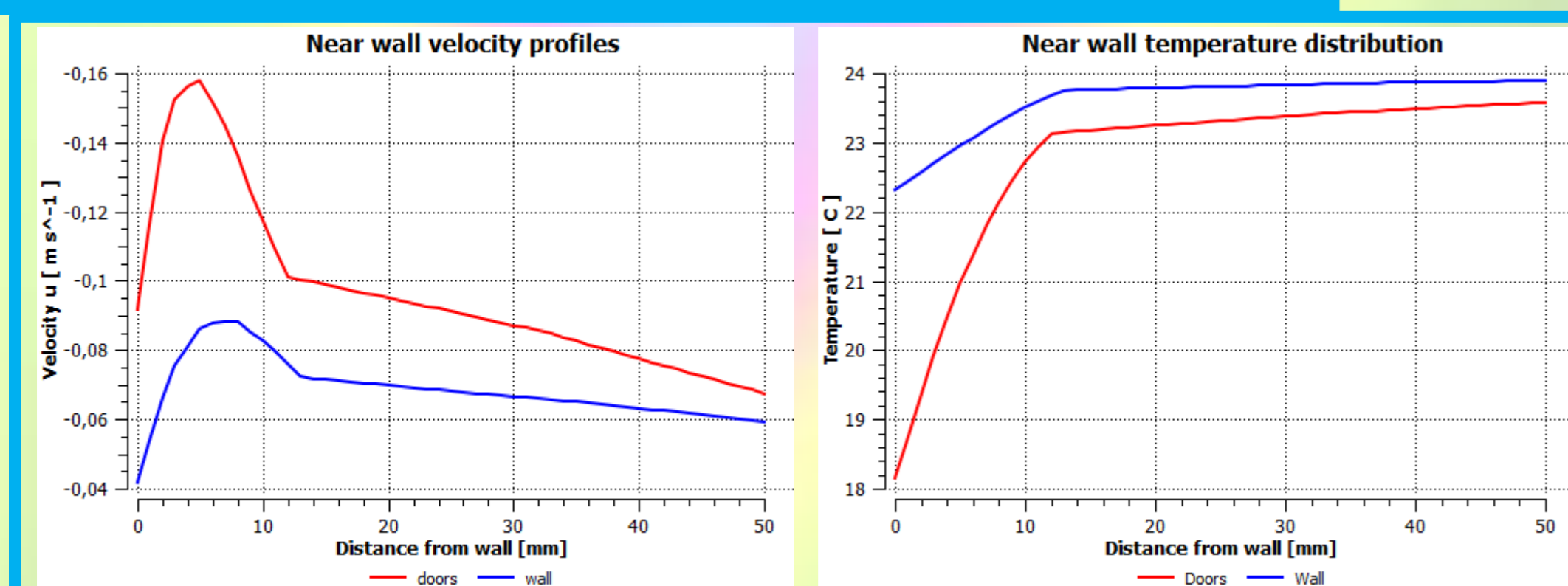
Composite construction vary widely from light constructions made of wooden frame and insulating material to heavy brick constructions. For each construction type thermal properties vary significantly as well as the price range and resulting thermal comfort inside buildings. The purpose of this study is to find the best solution to a complex problem where the thermal comfort and energy efficiency is taken into account. An important factor is humidity inside the construction that increase the thermal conductivity as the low conducting air enclosures are filled with water condensate. To achieve the goal a total energy needed to maintain A class thermal comfort is calculated and penalty function introduced for the period where these conditions are not met.

MATHEMATICAL MODEL

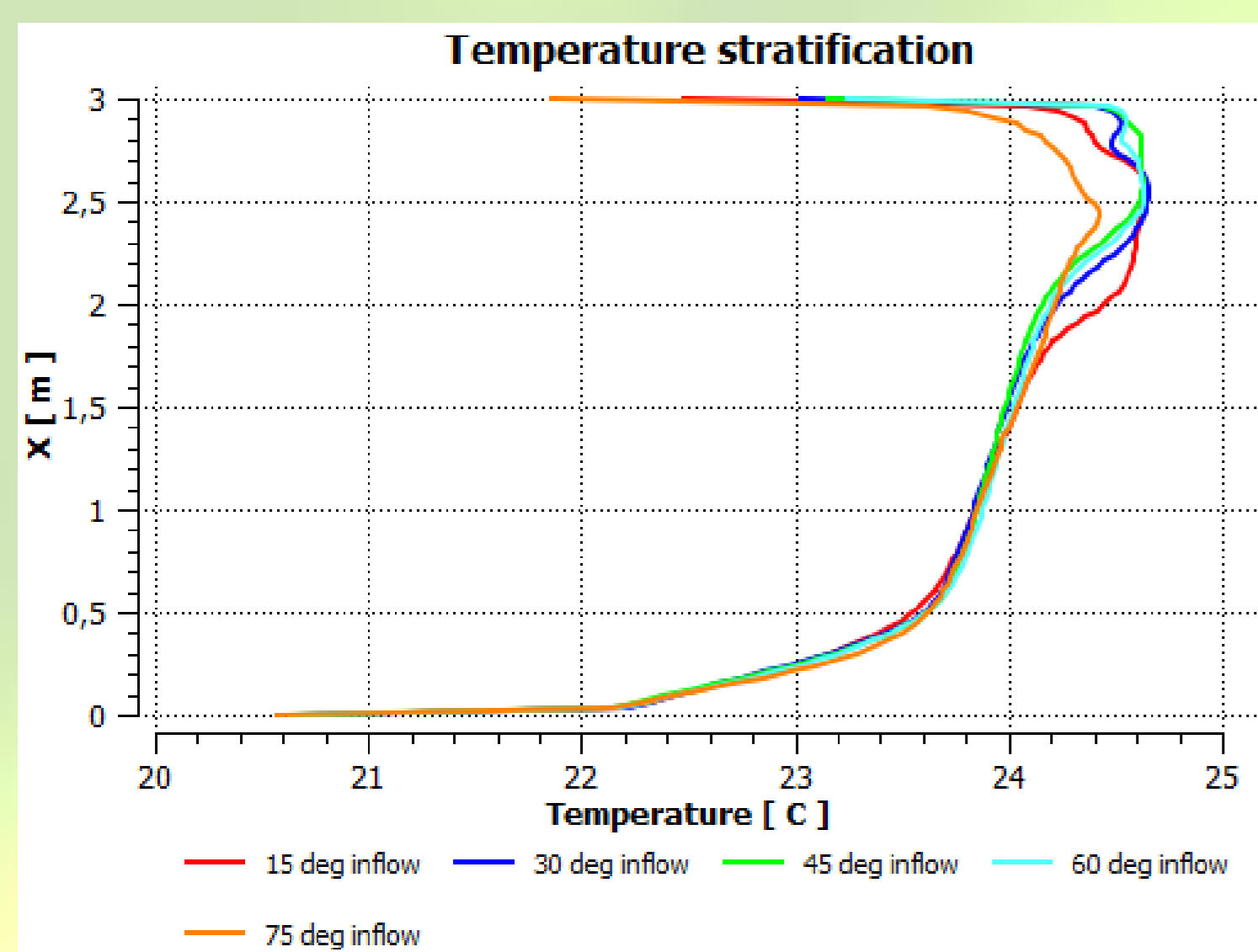
- 3D stationary model is used
- ANSYS/CFX software is used for simulations
- Reynolds Averaged Navier Stokes equation is solved along with energy and continuity equations for airflow
- Shear stress transport turbulence model is used, because the flow velocities are high
- The heat transfer equation is used for heat conduction. Radiation is not included in this model
- The boundary conditions for the problem are:
 - Convection for the outer boundaries
 - Continuity at the solid/solid interfaces
 - Wall functions for fluid/solid boundaries
- The flow is modeled as incompressible and Boussinesq approximation is used for buoyancy



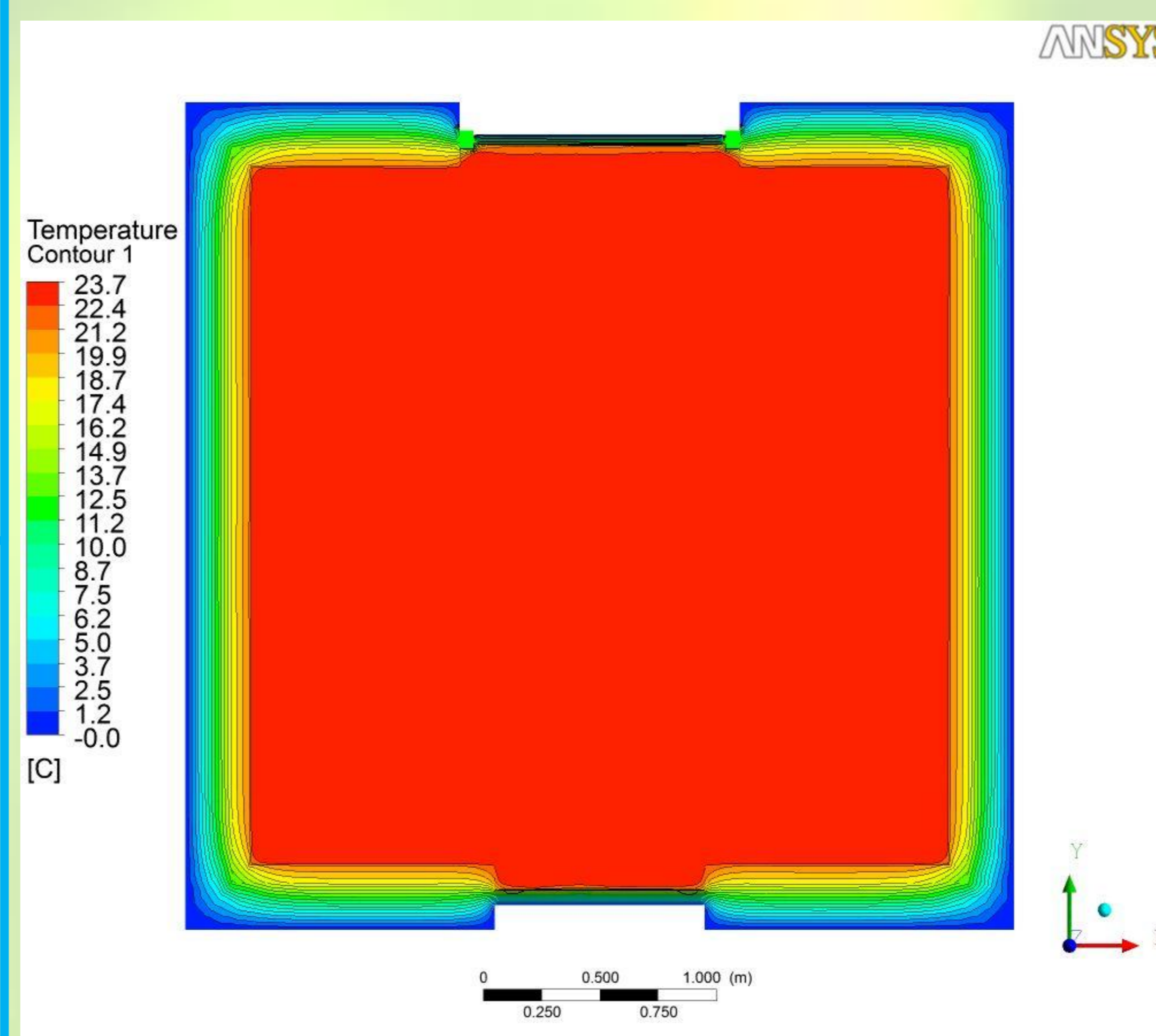
NUMERICAL RESULTS



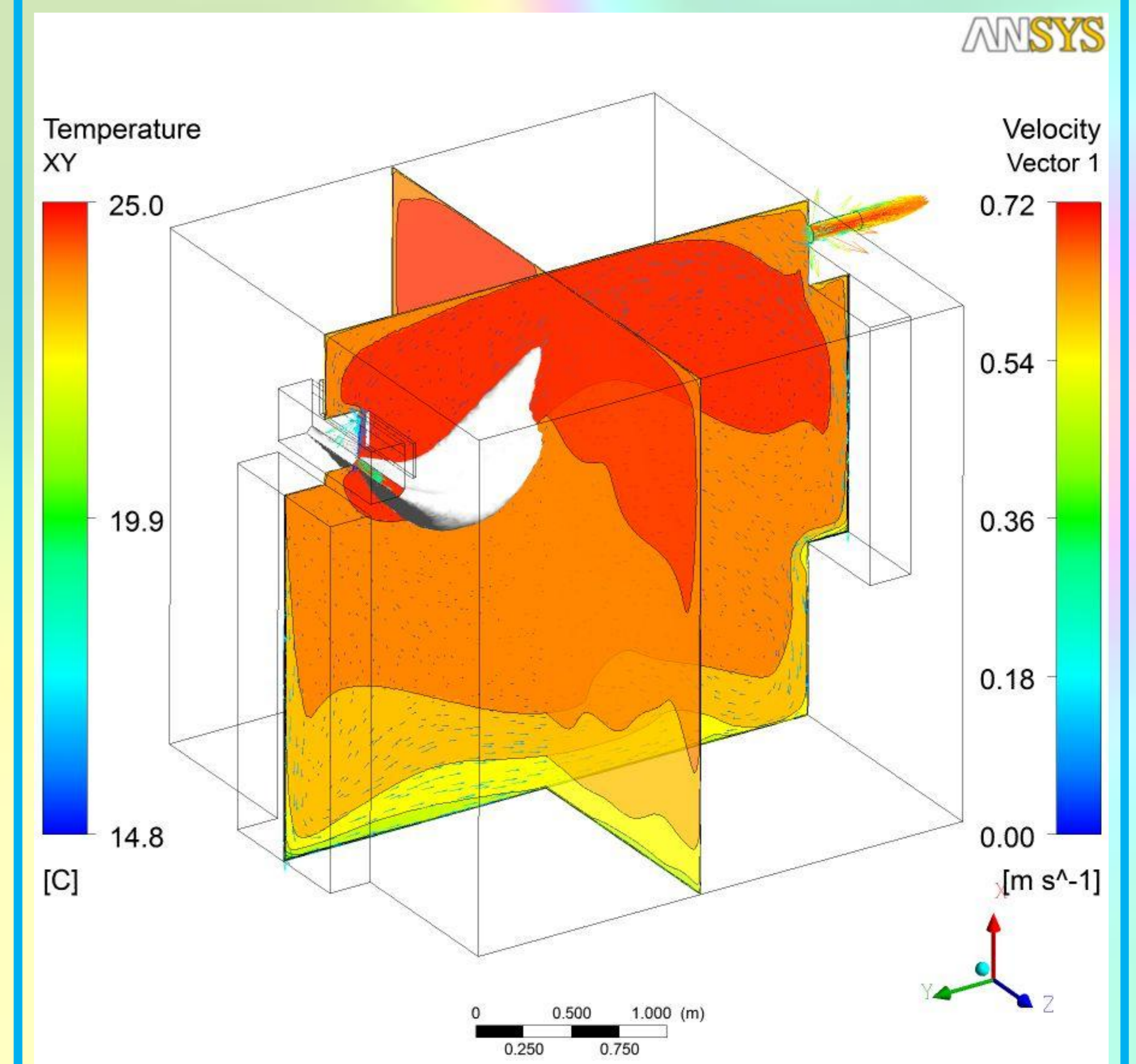
Velocity and temperature profiles for near wall region for doors and wall



Temperature stratification for different inflow angles



Horizontal temperature distribution with corner effects

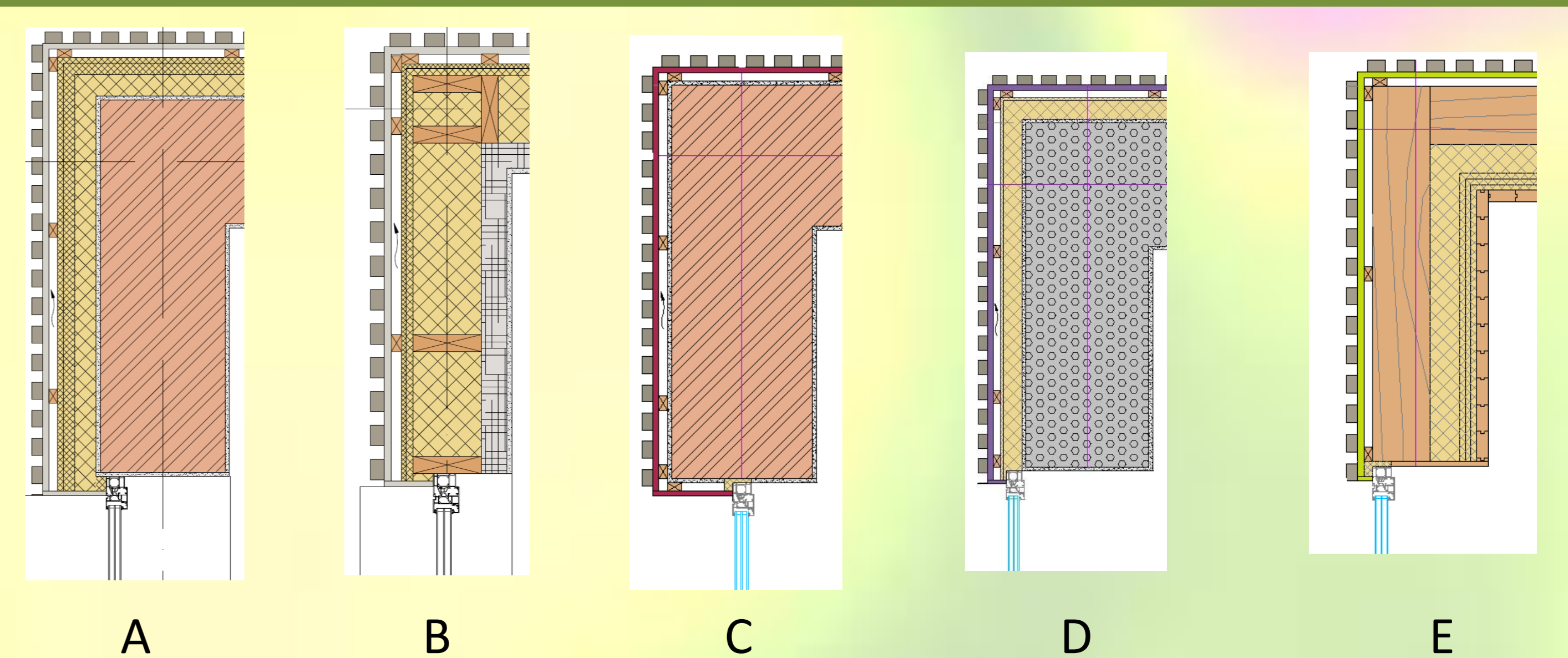


Temperature and airflow distribution for 45° inflow angle

EXPERIMENTAL SET-UP



Test polygon in Riga with 5 different test houses



Different construction solutions being tested: A) clay brick wall with a layer of rock wool B) rock wool with plywood C) clay brick wall with cavities filled with insulating material. D) aerated concrete with a layer of rock wool E) Wooden construction with a layer of rock wool