In this paper, we present a two dimensional Computational Fluid Dynamic (CFD) simulation of an energy efficient smart wall configuration for thermal building insulation. The simulated multilayered configuration is composed from the outdoor to the indoor respectively of a tungsten (W) doped Vanadium dioxide (VO2) thin film deposited on a glass substrate, an air gap, an Aluminium nitride (AlN) coating, a cement plaster, brick and cement plaster. Several studies were conducted on smart roofs and walls in the aim of reducing both heating and cooling loads, nevertheless, high heating penalties values still noticed. The objective of this innovative smart wall configuration is to optimize the energy consumption during cold and hot seasons. To investigate the impact of this configuration on energy consumption and indoor comfort, CFD simulations based on a surface to surface (S2S) radiative model were carried out with four different air gap thicknesses (10, 25, 50 and 75mm). Outdoor boundary condition was the solar-air temperature $T_{sa}$ of south orientation assigned using a user defined function (UDF).

Results have shown that the optimal air gap thickness was 25 mm. This choice was based on Nusselt values and radiative heat flux assessed in the fabry-pérot cavity (glass-air) and (air-AlN coating). Moreover, a comparison between the configuration with optimal air gap and an uninsulated wall composed of cement plaster and brick has shown that the optimal innovative configuration can reduce significantly both heating and cooling loads. In addition, the integration of W doped VO2 as a thermochromic material leads to a regulation of the radiative heat produced by solar radiations on the outdoor surface. In fact, during summer, near infrared (NIR) reflectance of W doped VO2 increase to 70%. While it decreases during winter to around 30%.

**Keywords**

CFD simulations; S2S radiation model; Smart wall; Multilayered configuration; Heating and cooling loads; Thermal optimization.