In the present article the jet impingement cooling of a heated solid rectangular block immersed in a fluid saturated porous media is considered for investigation numerically. The jet direction is considered to be perpendicular from the top to the solid rectangular block which is heated from below as shown in Figure 1. Therefore, the jet flow and the buoyancy driven flow are in opposite directions. For a fixed jet width, the governing parameters in the present Darcy flow problem are: Rayleigh number (Ra), Péclet number (Pe), solid to porous thermal conductivity ratio ($K_r$) and the dimensionless thickness (or height) of the solid wall ($H$). The results are presented in the mixed convection regime with wide ranges of the governing parameters with fixed jet width of 20% of the solid wall length.

At low values of Pe (natural convection cases), it is found that the effect of Pe is negligible and the average Nusselt number ($Nu$) is increasing with the increase of either Rayleigh number or the thermal conductivity ratio or decreasing the thickness of the solid wall. At high values of Pe (forced convection cases), it is found that the effect of Ra is negligible and the Nu is increasing with increasing either Pe or the thermal conductivity ratio or decreasing the thickness of the solid wall. At moderated values of Pe (opposing mixed convection cases), it is observed that the values of average Nusselt number show minimum values for some values of Pe number around 30. The value of Pe at which minimum Nu occurs depends on Ra, thermal conductivity ratio and the thickness of the solid wall. At low values of either Ra or thermal conductivity ratio this case where Nu shows minimum value is not obvious.

It is found that the thinner solid walls have higher values of the average Nusselt number with fixed other parameters. This due to the fact that thicker walls have higher thermal resistances to the heat dissipation from the isothermal surface with fixed other parameters. In special cases of the natural convection cases, for the high conductive walls (solid to porous thermal conductivity ratio = 10), the values of $Nu$ are increasing with the increase of the solid wall thickness.

![Figure 1 - Schematic diagram of the physical model and coordinate system](image-url)