Ventilation Test Case

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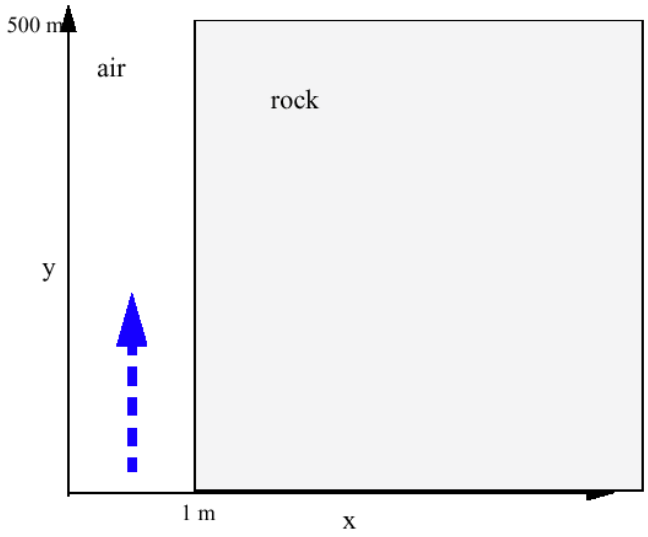
Description:

This is a quasi two dimensional heat transfer problem with no moisture involved. Air is flowing in the positive y direction along a drift that is 500 meters long. The air enters the drift at 21 degrees C and flows at a rate of 0.1 kg/s per meter in the z (not modeled) direction. The center of the drift (no flux boundary) is 1 meter from the rock wall. The rock is assumed to be anisotropic with zero thermal conductivity in the y direction. The initial temperature of the rock is 20 degrees Celsius. The heat transfer coefficient is 2 $W/m^2/K$. The thermal diffusivity in the rock is 0.85×10^{-6} m^2/s. The specific heat of the air is 1000 J/kg/K. The simulation time is 0-3 years. The rock is infinite in the x direction, however, for the assumed parameters the rock will appear infinitely thick as long as the thickness is > 40 m. The z direction is not modeled. For numerical modeling purposes it could be 1 m thick with adiabatic boundary conditions. Adiabatic boundary conditions are present at y=0 and y=500 m.



Reporting:

Results will be submitted as flat ASCII files that can easily be imported into plotting software such as MS Excel.
File 1: Air temperatures. Provide a time history of drift air temperatures in the drift at distances of 250 and 500 m along the drift. Times are every 0.25 year.
250 m distance
t1 (seconds), T1 (C)
t2, T2
t3, T3
. . .

500 m distance
t1 (seconds), T1 (C)

t2, T2
t3, T3
. . .

File 2: Rock Temperatures. Provide a temperature history of the rock at distances from the drift wall of 0, 0.25, 0.5, 0.75, 1.0, 1.25, 1.5, 1.75, and 2.0 meters at y distances of 0, 250 and 500 meters. Time intervals are 0.25 year.

0 m
t1, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
t2, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
. . .
250 m
t1, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
t2, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
. . .

500 m
t1, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
t2, T_0, $T_{0.25}$, $T_{0.50}$, $T_{0.75}$ . . . $T_{2.0}$
. . .