Finite Difference Transient Heat Eq'n

$$\nabla^2 T + \frac{\dot{q}}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$$

$$\frac{1}{\alpha}\frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \qquad t = p\Delta t \qquad F_o = \frac{\alpha \Delta t}{\Delta x^2}$$

$$\left.\frac{\partial T}{\partial t}\right|_{m,n} \simeq \frac{T_{m,n}^{p+1} - T_{m,n}^{p}}{\Delta t}$$

$$T_{m,n}^{p+1} = F_o\left(T_{m+1,n}^{p} + T_{m-1,n}^{p} + T_{m,n+1}^{p} + T_{m,n-1}^{p}\right) + \left(1 - F_o\right) T_{m,n}^{p}$$

Table 5.3

$16 \times 16 = 256$

$160 \times 160 = 25{,}600$

$20 \times 20 \times 100 = 40000$

Two large blocks of different materials, such as aluminum and glass, have been sitting in a room (20°C) for a very long time. Which of the two blocks, if either, will feel warmer to the touch? Assume the blocks to be semi-infinite solids and your hand to be at a temperature of 37°C.

$T_{ai} = 37°C$

$T_{bi} = 20°C$

$$T_s = \frac{\sqrt{k_a \rho_a c_a}\, T_{ai} + \sqrt{k_b \rho_b c_b}\, T_{bi}}{\sqrt{k_a \rho_a c_a} + \sqrt{k_b \rho_b c_b}}$$

$$.03 \frac{g}{cm^3} \left(\frac{1\,kg}{1000\,g}\right)\left(\frac{100\,cm}{1\,m}\right)^3 = 30 \frac{kg}{m^3}$$

$$1.8 \frac{J}{g°C} \left(\frac{1000\,g}{1\,kg}\right) = 1800 \frac{J}{kg\,K}$$

	k	ρ	c	$\sqrt{k\rho c}$
Glass	1.4	2500	750	1620
Aluminum	237	2702	903	24047
Aerogel	0.014	30	1800	45