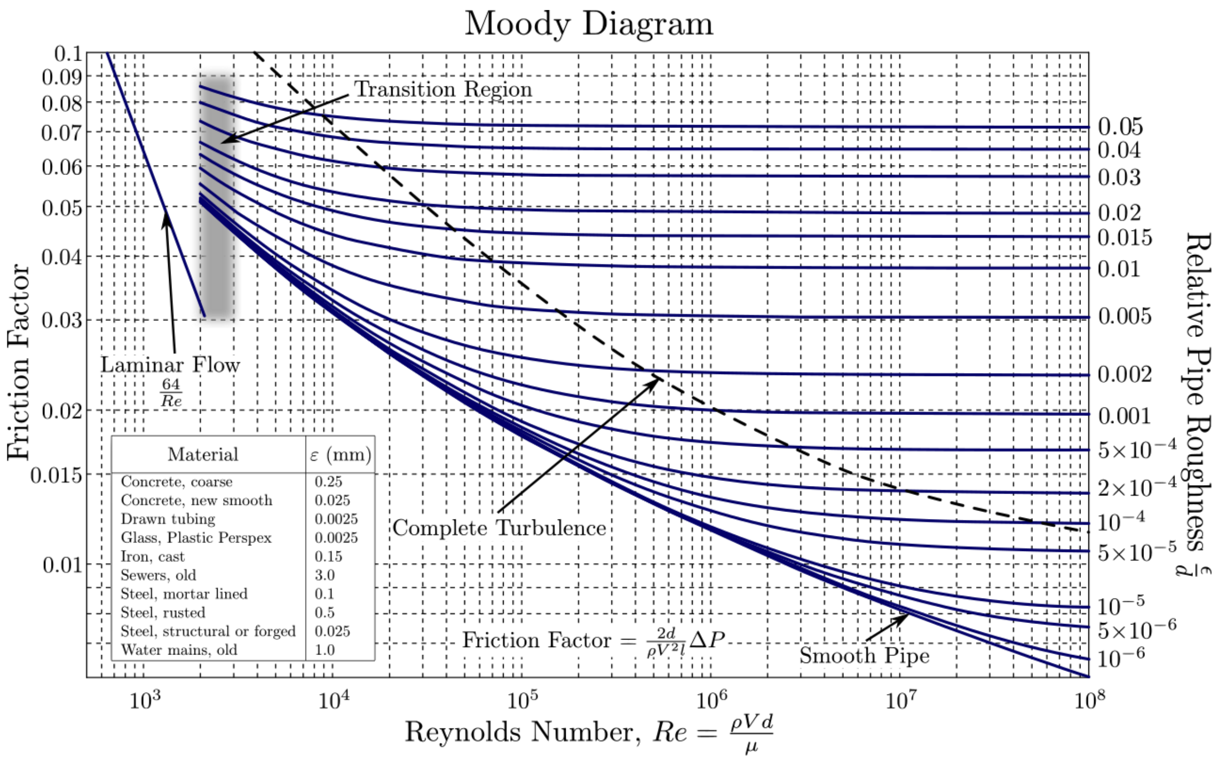
Si prega di riconsegnare al termine della prova.

Friction factor



FORMULE SEMIEMPIRICHE

Formula per flussi laminari

$$f = \frac{64}{Re}$$

Formula di Colebrook per flussi turbolenti

$$\frac{1}{f^{1/2}} = -2.0 \log\left(\frac{\varepsilon/d}{3.7} + \frac{2.51}{Re\, f^{1/2}}\right)$$

Formula di Haaland per flussi turbolenti

$$\frac{1}{f^{1/2}} = -1.8 \log\left(\left(\frac{\varepsilon/d}{3.7}\right)^{1.11} + \frac{6.9}{Re}\right)$$

Formula per regione di rugosità piena

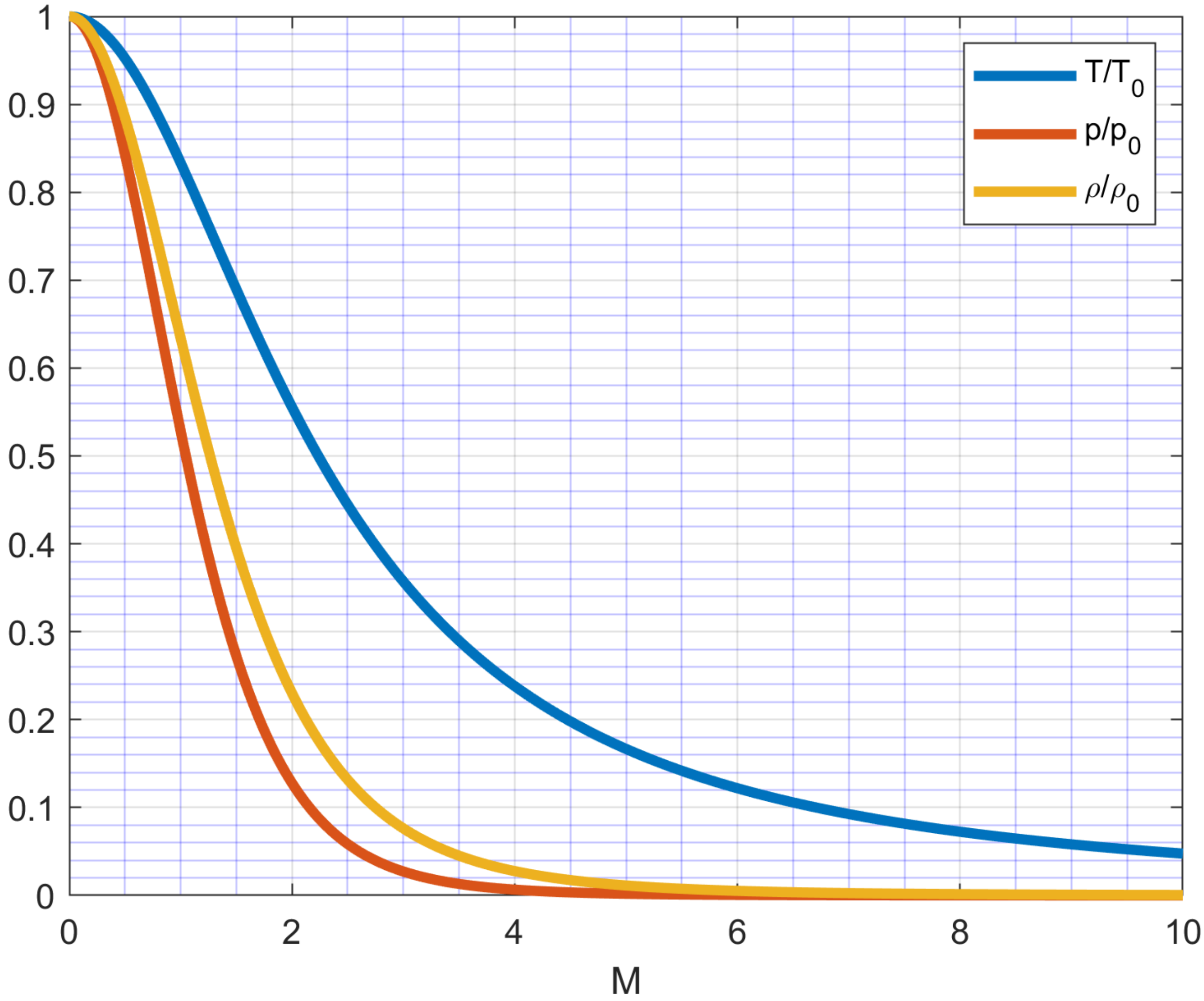
$$\frac{1}{f^{1/2}} = -2.0 \log\left(\frac{\varepsilon/d}{3.7}\right)$$

Flusso isoentropico adiabatico a sezione variabile

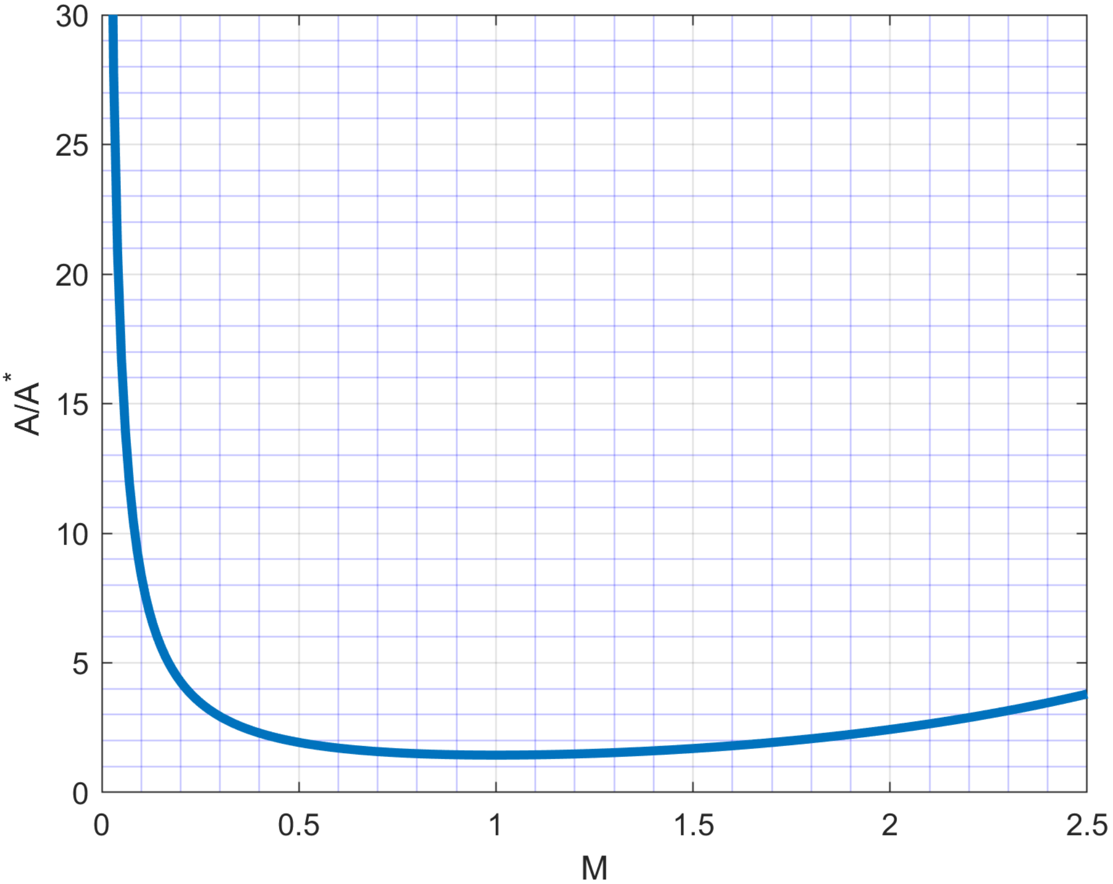
$$\frac{T_0}{T} = 1 + \frac{\gamma - 1}{2} M^2$$

$$\frac{p_0}{p} = \left(1 + \frac{\gamma - 1}{2} M^2\right)^{\frac{\gamma}{\gamma - 1}}$$

$$\frac{\rho_0}{\rho} = \left(1 + \frac{\gamma - 1}{2} M^2\right)^{\frac{1}{\gamma - 1}}$$



$$\frac{A}{A^*} = \frac{1}{M}\left[\left(\frac{2}{\gamma + 1}\right)\left(1 + \frac{\gamma - 1}{2} M^2\right)^{\frac{\gamma + 1}{2(\gamma - 1)}}\right]$$



$$\frac{T^*}{T_0} = \frac{2}{\gamma + 1}$$

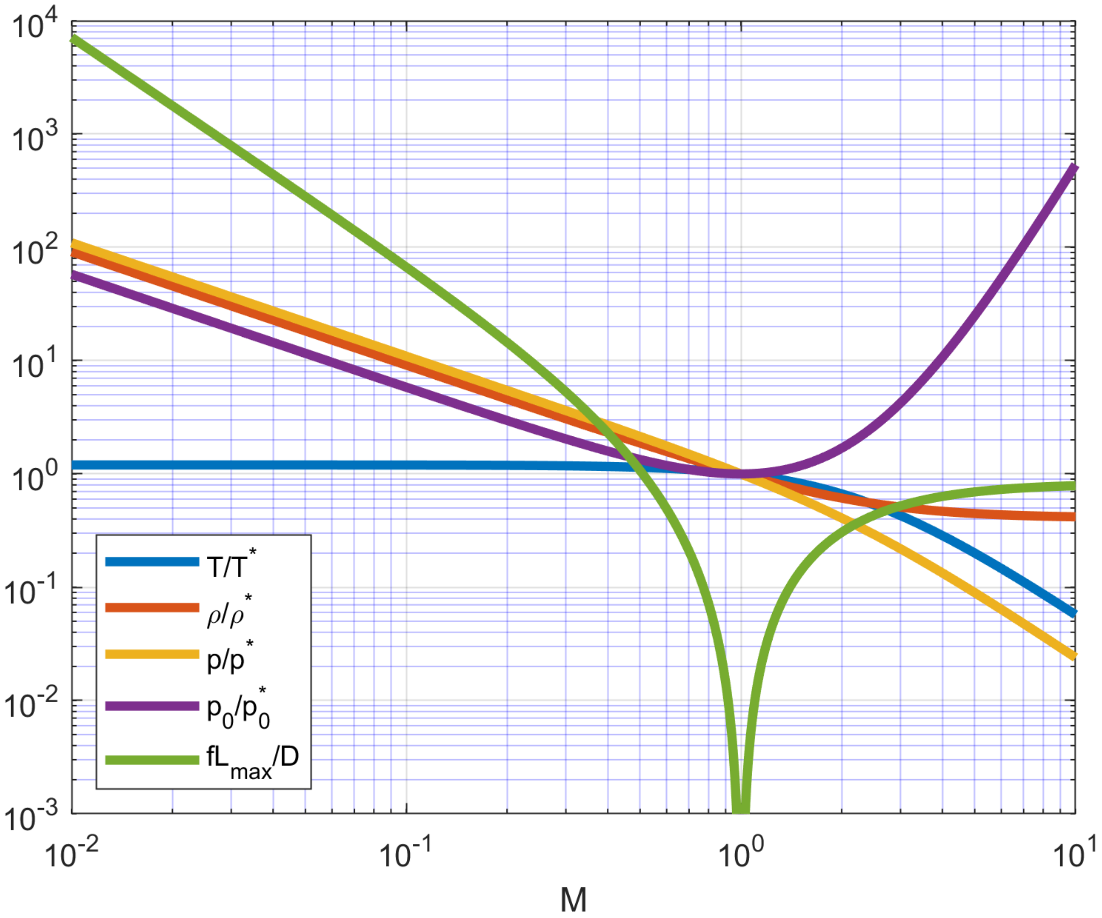
$$\frac{p^*}{p_0} = \left(\frac{2}{\gamma + 1}\right)^{\frac{\gamma}{\gamma - 1}}$$

$$\frac{\rho^*}{\rho_0} = \left(\frac{2}{\gamma + 1}\right)^{\frac{1}{\gamma - 1}}$$

$$\frac{\dot{m}}{A} = \sqrt{\frac{\gamma}{R}} \frac{p_0}{\sqrt{T_0}} \frac{M}{\left(1 + \frac{\gamma - 1}{2} M^2\right)^{\frac{\gamma + 1}{2(\gamma - 1)}}}$$

$$\left(\frac{\dot{m}}{A}\right)_{max} = \sqrt{\frac{\gamma}{R} \left(\frac{2}{\gamma + 1}\right)^{\frac{\gamma + 1}{\gamma - 1}}} \frac{p_0}{\sqrt{T_0}}$$

Flusso di Fanno



$$\frac{\bar{f}}{D}L_{max} = \frac{1}{\gamma}\left(\frac{1-M^2}{M^2} + \frac{\gamma+1}{2}\ln\frac{\frac{\gamma+1}{2}M^2}{1+\frac{\gamma-1}{2}M^2}\right)$$

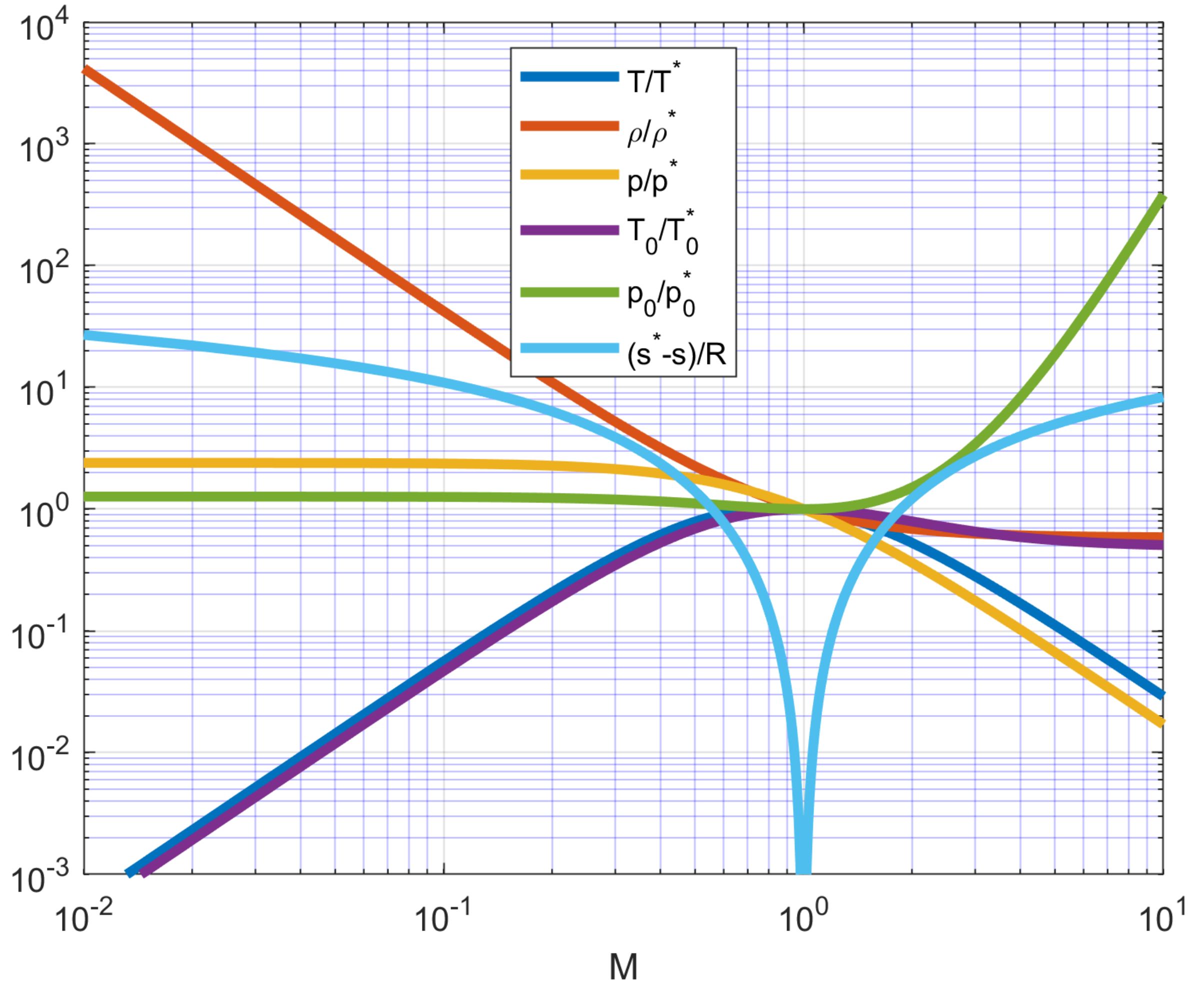
$$\frac{T}{T^*} = \frac{\frac{\gamma+1}{2}}{1+\frac{\gamma-1}{2}M^2}$$

$$\frac{\rho}{\rho^*} = \frac{1}{M}\left(\frac{1+\frac{\gamma-1}{2}M^2}{\frac{\gamma+1}{2}}\right)^{\frac{1}{2}}$$

$$\frac{p}{p^*} = \frac{1}{M}\left(\frac{\frac{\gamma+1}{2}}{1+\frac{\gamma-1}{2}M^2}\right)^{\frac{1}{2}}$$

$$\frac{p_0}{p_0^*} = \frac{1}{M}\left(\frac{\frac{\gamma+1}{2}}{1+\frac{\gamma-1}{2}M^2}\right)^{\frac{\gamma+1}{2(\gamma-1)}}$$

Flusso di Rayleigh



$$\frac{T}{T^*} = M^2 \left(\frac{1+\gamma}{1+\gamma M^2}\right)^2$$

$$\frac{\rho}{\rho^*} = \frac{1+\gamma M^2}{(1+\gamma)M^2}$$

$$\frac{p}{p^*} = \frac{1+\gamma}{1+\gamma M^2}$$

$$\frac{T_0}{T_0^*} = \frac{2(1+\gamma)M^2\left(1+\frac{\gamma-1}{2}M^2\right)}{(1+\gamma M^2)^2}$$

$$\frac{p_0}{p_0^*} = \frac{1+\gamma}{1+\gamma M^2}\left(\frac{1+\frac{\gamma-1}{2}M^2}{1+\frac{\gamma-1}{2}}\right)^{\frac{\gamma}{\gamma-1}}$$

$$\frac{s-s^*}{R} = \ln\left(M^{\frac{2\gamma}{\gamma-1}}\left(\frac{1+\gamma}{1+\gamma M^2}\right)^{\frac{\gamma+1}{\gamma-1}}\right)$$

ONDA D'URTO NORMALE

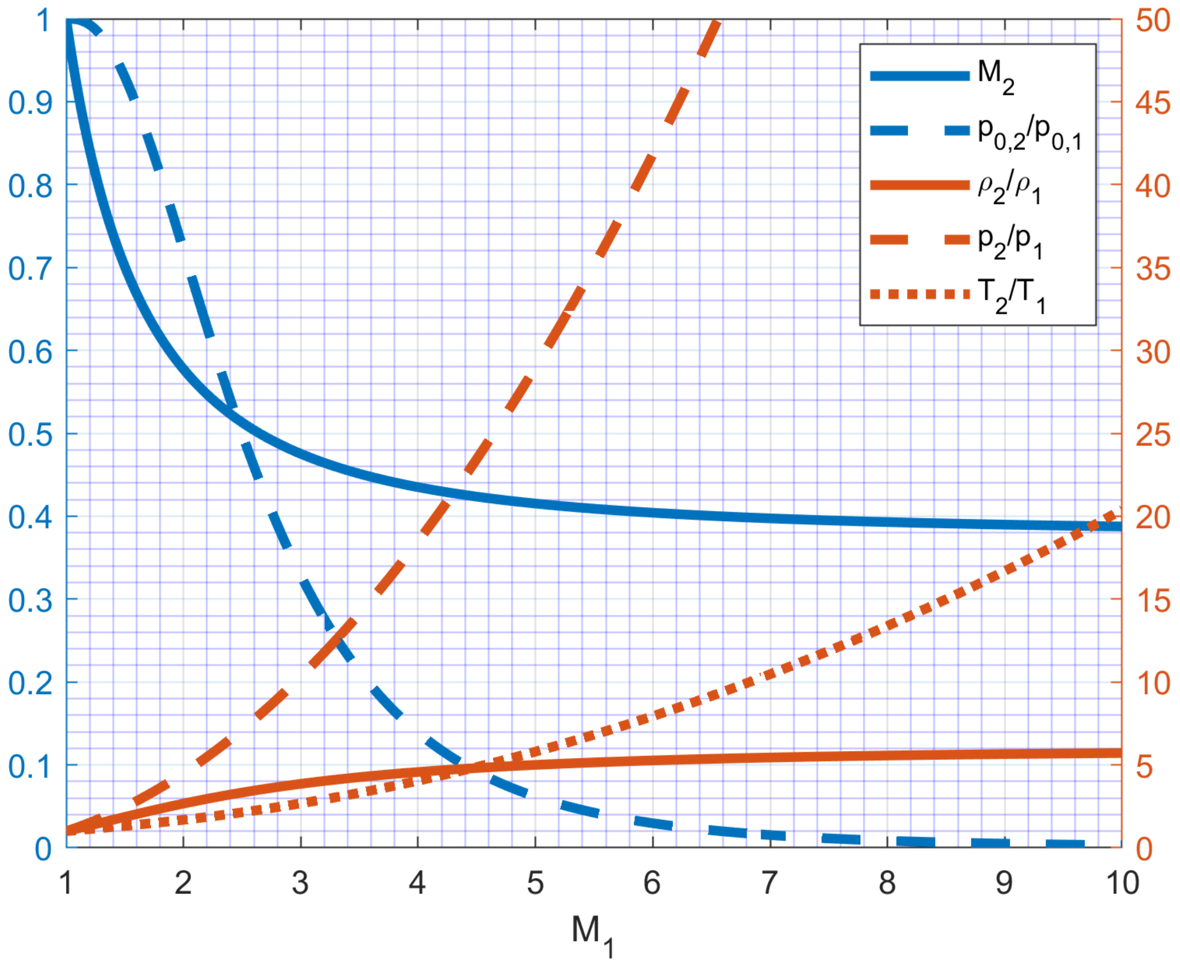
$$M_2 = \sqrt{\frac{2+(\gamma-1)M_1^2}{2\gamma M_1^2-(\gamma-1)}}$$

$$\frac{\rho_2}{\rho_1} = \frac{u_1}{u_2} = \frac{(\gamma+1)M_1^2}{2+(\gamma-1)M_1^2}$$

$$\frac{p_2}{p_1} = 1 + \frac{2\gamma}{\gamma+1}(M_1^2-1)$$

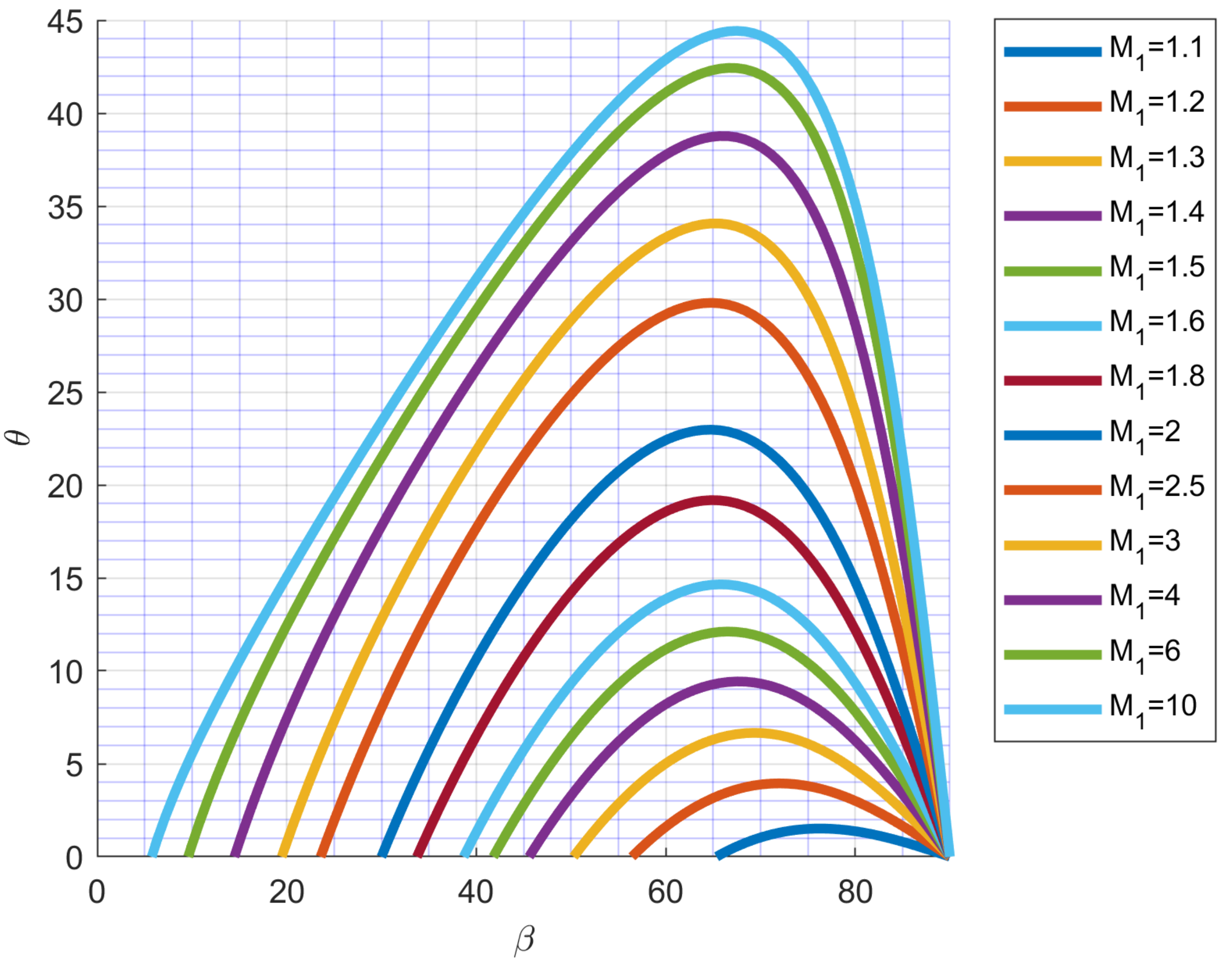
$$\frac{T_2}{T_1} = \left(1+\frac{2\gamma}{\gamma+1}(M_1^2-1)\right)\left(\frac{2+(\gamma-1)M_1^2}{(\gamma+1)M_1^2}\right)$$

$$\frac{p_{0,2}}{p_{0,1}} = \frac{\left(\frac{(\gamma+1)M_1^2}{2+(\gamma-1)M_1^2}\right)^{\frac{\gamma}{\gamma-1}}}{\left(\frac{2\gamma M_1^2-(\gamma-1)}{\gamma+1}\right)^{\frac{1}{\gamma-1}}}$$



ONDE D'URTO OBLIQUE

$$tan\theta = 2cot\beta \frac{M_1^2 sen^2\beta - 1}{M_1^2\left(\gamma + cos(2\beta)\right) + 2}$$



FLUSSI ALLA PRANDTL-MEYER

$$\nu = \sqrt{\frac{\gamma+1}{\gamma-1}}\, atan\left(\sqrt{\frac{\gamma-1}{\gamma+1}(M^2-1)}\right) - atan\left(\sqrt{M^2-1}\right)$$