

Moving normal Shock.

We know that

$$V_2 = W_s \left(1 - \frac{u_2}{u_1} \right) \\ = W_s \left(1 - \frac{s_1}{s_2} \right)$$

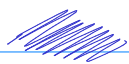
$$= a_1 M_1 \left(1 - \frac{1}{s_2/s_1} \right)$$

$$= a_1 \left(\frac{r+1}{2r} \frac{p_2}{p_1} + \frac{r-1}{2r} \right)^{1/2} \left(1 - \frac{\left(\frac{r+1}{r-1} \right) + \frac{p_2}{p_1}}{\left(\frac{r+1}{r-1} \right) \left(\frac{p_2}{p_1} \right) + 1} \right)$$

$$\text{Now, } M_2 = \frac{V_2}{a_2} = \left(\frac{V_2}{a_1} \right) \left(\frac{a_1}{a_2} \right)$$

$$\therefore M_2 = \left(\frac{r+1}{2r} \frac{p_2}{p_1} + \frac{r-1}{2r} \right)^{1/2} \left[1 - \frac{\frac{r+1}{r-1} + \frac{p_2}{p_1}}{\left(\frac{r+1}{r-1} \right) \left(\frac{p_2}{p_1} \right) + 1} \right] \left[\frac{\frac{r+1}{r-1} + p_1/p_2}{\frac{r+1}{r-1} + \frac{p_2}{p_1}} \right]^{1/2}$$

This comes from
 $\frac{a_1}{a_2} = \sqrt{\frac{T_1}{T_2}}$



For weak shock, as $\frac{p_2}{p_1} \rightarrow 1$,

$$W_s \rightarrow a_1 \quad \& \quad V_2 \rightarrow 0 \quad \& \quad M_2 \rightarrow 0$$

For strong shock, as $\frac{p_2}{p_1} \rightarrow \infty$,

$$W_s \rightarrow \infty \quad \& \quad V_2 \rightarrow \infty \quad \& \quad M_2 = \sqrt{\frac{2}{r(r-1)}}$$

Now, let's see what happens to P_{02}/P_{01} ?
(In earth ref. frame)

$$\frac{P_{02}}{P_{01}} = \frac{P_{02}}{P_1} = \frac{P_{02}}{P_2} \cdot \frac{P_2}{P_1}$$

$$\therefore \frac{P_{02}}{P_{01}} = \left(1 + \frac{r-1}{2} M_2^2\right)^{r/(r-1)} \cdot \frac{P_2}{P_1}$$

This means that $\frac{P_{02}}{P_{01}} \gg 1$ (Always!!)

$$\frac{T_{02}}{T_{01}} = \frac{T_{02}}{T_1} = \frac{T_2 + \frac{V_2^2}{2C_p}}{T_1} = \frac{T_2}{T_1} + \frac{V_2^2}{2\gamma R T_1}$$

$$= \frac{T_2}{T_1} + \left(\frac{V_2}{a_1}\right)^2 \cdot \frac{r-1}{2}$$

$$\therefore \frac{T_{02}}{T_{01}} = \frac{\frac{r+1}{r-1} + \frac{P_2}{P_1}}{\frac{r+1}{r-1} + \frac{P_1}{P_2}} + \left(\frac{r-1}{2}\right) \left[\left(\frac{r+1}{2r} \frac{P_2}{P_1} + \frac{r-1}{2r} \right) \left(1 - \frac{\frac{r+1}{r-1} + \frac{P_2}{P_1}}{\left(\frac{r+1}{r-1}\right)\left(\frac{P_2}{P_1}\right) + 1} \right)^2 \right]$$

This is not equal to 1, because we are in earth fixed ref. In the shock ref. frame, this will be 1.

