Π - Theorem : atomic test energy

Relevant physical quantities : E, t, ρ_{air}, R $\quad n = 4$

Viscous forces can be neglected.

$[R] = L$ $\quad [E] = ML^2/T^2$ $\quad [t] = T$ $\quad [\rho_{air}] = M/L^3$ $\quad K = 3$

R: blast radius $\quad E$: test energy $\quad t$: time after blast

$$\begin{array}{c} \\ L \\ M \\ T \end{array} \begin{array}{c} \begin{array}{cccc} R & E & t & \rho_{air} \end{array} \\ \begin{pmatrix} 1 & 2 & 0 & -3 \\ 0 & 1 & 0 & 1 \\ 0 & -2 & 1 & 0 \end{pmatrix} \end{array} = A$$

$n - K = 1$ dimensionless quantity

Look for $\vec{v}$ such that $A\vec{v} = 0$ (3 equations $\Rightarrow$ one "free" unknown)

$$\vec{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \end{pmatrix}$$

A can be rewritten in the form $\begin{pmatrix} 1 & 2 & 0 & -3 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 2 \end{pmatrix}$

$v_4 = -v_2 \qquad v_4 = -\frac{v_3}{2} \qquad v_1 + 2v_2 - 3v_4 = 0$

$$\vec{v} \propto \begin{pmatrix} 1 \\ -1/5 \\ -2/5 \\ 1/5 \end{pmatrix} \qquad \Pi_1 = \frac{R \, \rho_{air}^{1/5}}{t^{2/5} E^{1/5}} = C_{ste}$$

R is known , t is known // from the film

The constant can be obtained from other (conventional) explosives.

$\rightsquigarrow$ E is determined from the image sequence