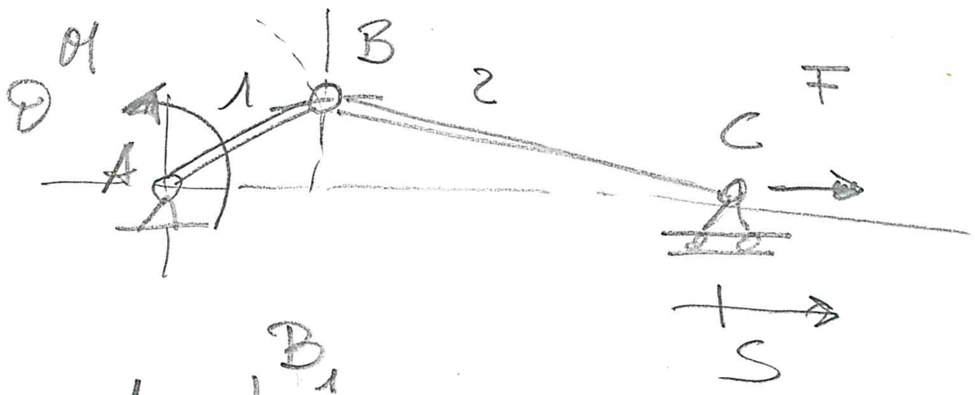
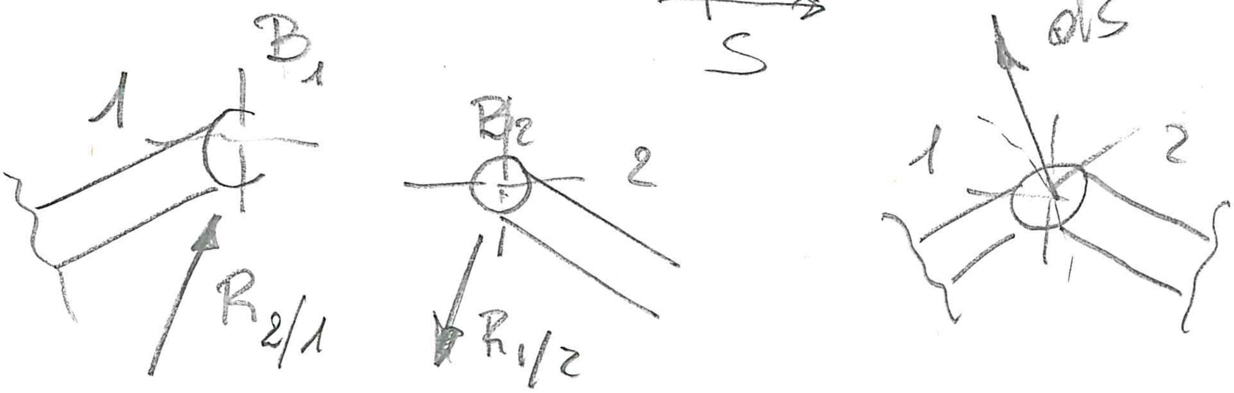
$$\underbrace{dL_e + dL_i} = \underbrace{dE_c + dE_g + dE_{el} + \ldots}$$





$$R_{2/1}\, ds + R_{1/2}\, ds = 0 \qquad R_{2/1} = R$$

$$R_{1/2} = -R$$

- POTENZA

$$P = \frac{dL}{dt} \qquad \frac{N \cdot m}{s} \qquad kg\frac{m^2}{s^2} \qquad W$$

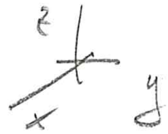
- RENDIMENTO

$$\eta = \frac{L_{utile}}{L_{speso}} = \frac{Pot_u}{Pot_s} \lesssim 1$$

$$\vec{a} = \frac{\vec{F}}{m} \qquad \vec{a} = \frac{\sum \bar{F}_e}{m}$$

$$\sum \bar{F}_e = m\bar{a} = m\frac{d\bar{v}}{dt} = \frac{d(m\bar{v})}{dt} \qquad \bar{Q} = m\bar{v}$$

$$\sum \bar{F}_e = \frac{d\bar{Q}}{dt}$$



$$\sum F_{ex} = \frac{dQ_x}{dt}$$

$$\sum F_{ey} = \dots$$

$$\sum F_{ez} = \dots$$

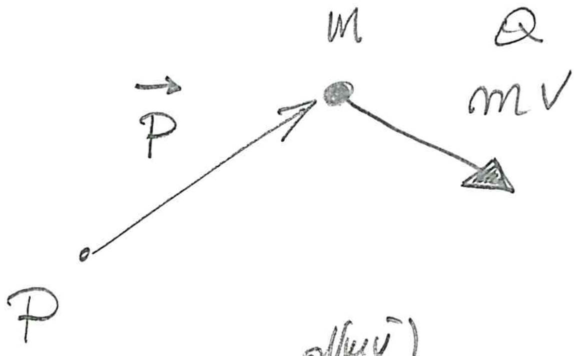
$$\int_{t_1}^{t_2} \sum \bar{F}_e \, dt = \int_1^2 d\bar{Q} = \bar{Q}_2 - \bar{Q}_1 \, ; \quad \sum F_e \, dt$$ IMPULSO LINEARE

$$\int_{t_1}^{t_2} \sum F_{ex} = Q_{2x} - Q_{1x}$$

$$\int \qquad y$$

$$\int \qquad z$$

$$\bar a = \frac{\sum F_e}{m}$$



$$\bar K_P = \bar P \wedge \bar Q$$

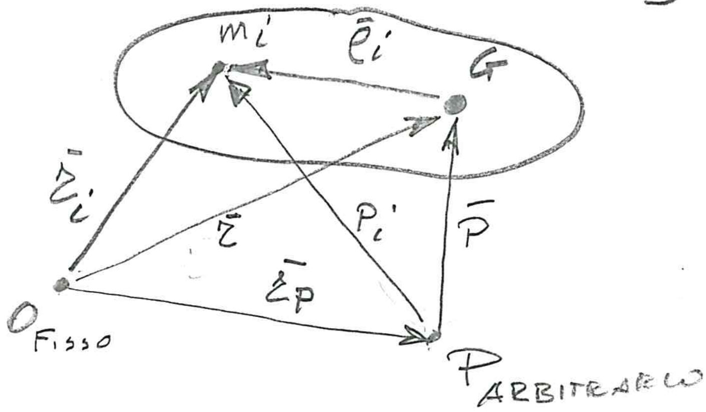
P ≡ O FISSO

$$\frac{d\bar K_0}{dt} = \frac{d\bar P}{dt}\wedge(m\bar v) + P\wedge\frac{d(m\bar v)}{dt} = \bar v\wedge(m\bar v) + P\wedge\frac{d(m\bar v)}{dt} =$$

$$= \bar P\wedge m\frac{d\bar v}{dt} = \bar P\wedge m\bar a = \bar P\wedge\sum \bar F_e = \bar M_0$$

$$\frac{d\bar K_0}{dt} = \bar M_0$$

$$\int_{t_1}^{t_2} M_0\,dt = \int_{K_1}^{K_2} d\bar K_0 = \bar K_{0_2} - \bar K_{0_1}\,;$$ $M_0\,dt$ IMPULSO ANGOLARE



$$\bar K_P = \sum \bar\rho_i \wedge m \bar v_i$$

$$= \sum \bar\rho_i \wedge m \dot{\vec r}_i$$

$$\bar v_i = \dot{\bar r}_i$$

$$\bar r_i = \bar r + \bar\varrho_i$$

$$\bar r_i = \bar r_P + \bar\rho_i$$

$$\sum \bar M_O = \frac{d\bar K_O}{dt}$$

$$\bar K_G = \sum \bar\varrho_i \wedge m_i \dot{\bar r}_i$$

$$\frac{d\bar K_G}{dt} = \sum_i \dot{\bar\varrho}_i \wedge m_i(\dot{\bar r} + \dot{\bar\varrho}_i) + \sum \bar\varrho_i \wedge m_i \ddot{\vec r}_i = \sum \bar\varrho_i \wedge m_i \ddot{\bar r}_i$$

$$\sum_i \dot{\bar\varrho}_i \wedge m_i \dot{\bar r} \quad + \sum \dot{\bar\varrho}_i \wedge m_i \dot{\bar\varrho}_i \; +$$

$$-\sum_i \dot{\bar r} \wedge m_i \dot{\bar\varrho}_i \quad + \quad 0 \qquad +$$

$$-\dot{\bar r} \wedge \sum \frac{d}{dt}(m_i \bar\varrho_i) + 0 \qquad +$$

$$-\dot{\bar r} \wedge \frac{d}{dt} \sum (m_i \bar\varrho_i) + 0 \qquad +$$

$$0 \qquad + 0 \qquad + \sum \bar\varrho_i \wedge m_i \ddot{\bar r}_i$$

$$\sum \bar M_G = \frac{d\bar K_G}{dt} = \sum \bar\varrho_i \wedge m_i \ddot{\bar r}_i$$

$$\dot{r}_{P_i} + \dot{p}_i = \dot{r}_i$$

$$\left(\bar{K}_G\right)_{relP} = \sum \bar{\rho}_i \wedge m_i \dot{\bar{p}}_i = \sum \bar{\rho}_i \wedge m_i \left(\dot{\bar{r}}_i - \dot{\bar{r}}_{P_i}\right) =$$

$$= \sum \bar{\rho}_i \wedge m_i \dot{r}_i + \dot{r}_P \wedge \underbrace{\sum m_i \vec{\rho}_i}_{=0} = K_G$$

$$\left(K_G\right)_{relG} = \sum \bar{\rho}_i \wedge m_i \dot{\vec{\rho}}_i = \sum \bar{\rho}_i \wedge m_i \left(\dot{\bar{r}}_i - \dot{\bar{r}}\right) =$$

$$= \sum \bar{\rho}_i \wedge m_i \dot{r}_i + \dot{r} \wedge \underbrace{\frac{d}{dt} \sum m_i \bar{\rho}_i}_{0} = K_G$$

$$\left.\bar{K}_G\right)_P = \left.\bar{K}_G\right)_G = \bar{K}_G$$

$$\bar{K}_P = \sum \bar{p}_i \wedge m_i \dot{\bar{r}}_i = \sum \left(\bar{p} + \bar{\rho}_i\right) \wedge m_i \dot{r}_i =$$

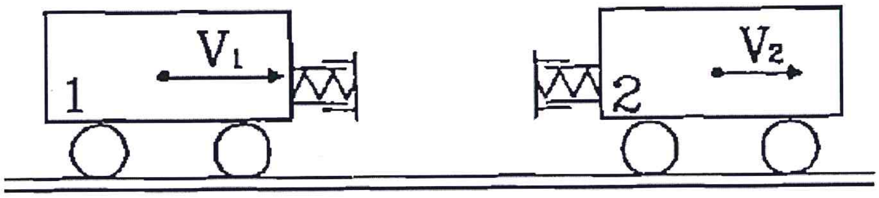
$$= \sum \rho_i \wedge m_i \dot{r}_i + \sum \bar{P} \wedge m_i \dot{r}_i$$

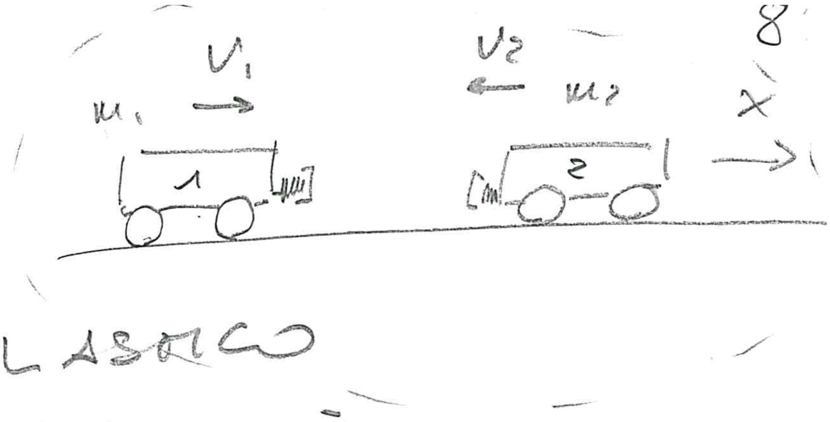
$$= \bar{K}_G + \sum \bar{P} \wedge m_i \dot{r}_i$$

$$= \bar{K}_G + \bar{P} \wedge M_t \bar{V}_G$$

Un esempio classico è costituito dall'urto di carrelli ferroviari che compiono una manovra su un tratto di linea pianeggiante (figura 2.33).

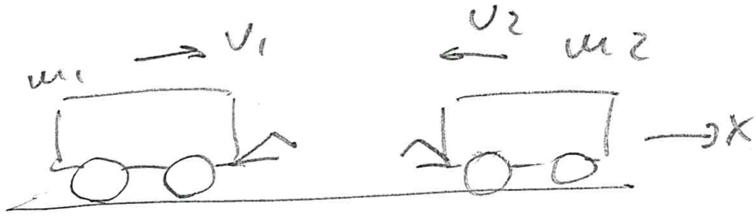
Il carrello 1, di massa m_1, avente una velocità $\vec{V}_1$, urta il carrello 2, di massa m_2, avente velocità $\vec{V}_2 < \vec{V}_1$. Si vogliono determinare le velocità dei due carrelli dopo l'urto nei due casi di urto elastico e urto anelastico.





$\Delta Q_x = 0$ ELASTICO

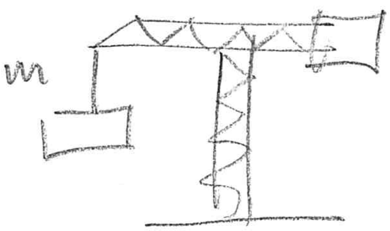
$$\begin{cases} m_1 \bar{v}_1 + m_2 \bar{v}_2 = m_1 \bar{v}_{1d} + m_2 \bar{v}_{2d} \\ \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_{1d}^2 + \frac{1}{2} m_2 v_{2d}^2 \end{cases}$$



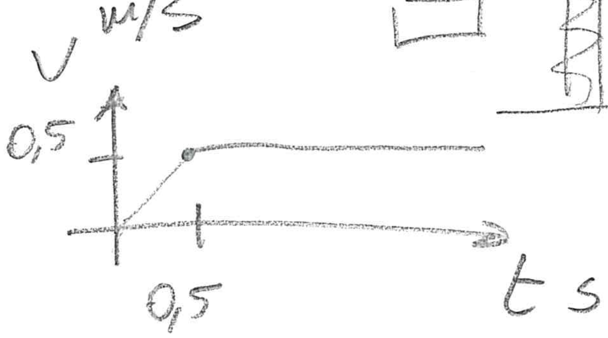
$\Delta Q_x = 0$ ANELASTICO

$$\begin{cases} m_1 \bar{v}_1 + m_2 \bar{v}_2 = (m_1 + m_2) \bar{v}_d \\ \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} (m_1 + m_2) v_d^2 + L_w \end{cases}$$

Un carico di 4 tonnellate viene sollevato da una gru alla velocità costante $v=0,5m/s$; tale velocità viene raggiunta in 0,5s. Trovare la forza a cui è sottoposto il cavo durante la fase di moto a velocità costante e durante la fase iniziale di moto accelerato.



$P = 4000\ kg_F = 39240\,N$



$m = 4000\ kg$

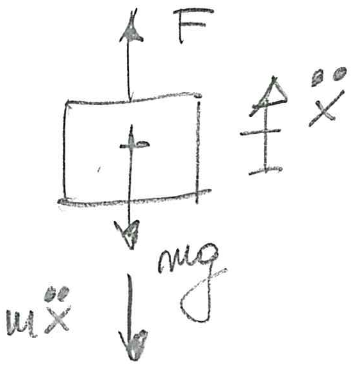
$V = 0{,}5\ m/s \qquad \Delta t = 0{,}5\ s$

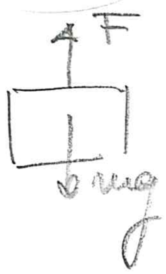
$\ddot{x} = \frac{V}{t} = 1\ m/s^2$

$x)\quad F - mg - m\ddot{x} = 0$

$F = m(g + \ddot{x}) = 43240\,N$

$F = m(g + 0) = 39240\,N$

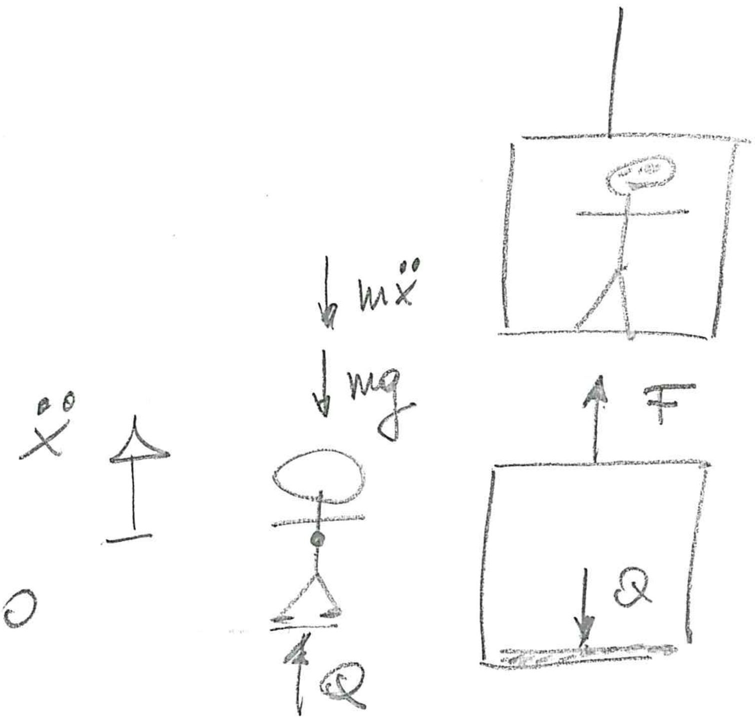




Calcolare la forza esercitata da un uomo di massa m=80kg su un ascensore in quiete e la stessa forza nel caso l'ascensore si muova in salita e in discesa con accelerazione di 0,2m/s2

$m = 80\,kg$

$\ddot{x} = 0{,}2\, m/s^2$



$$\begin{cases} Q - mg - m\ddot{x} = 0 \\ F - Q = 0 \end{cases}$$

$Q = m(g + \ddot{x}) = 800{,}8\,N$