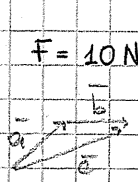
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05.03

DIREZIONE

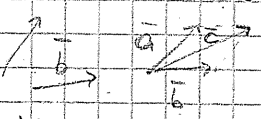
VERSO

$\bar{F}$ $F = 10\,N$

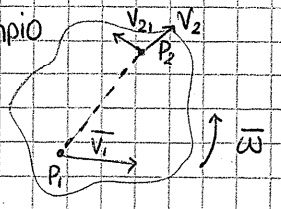


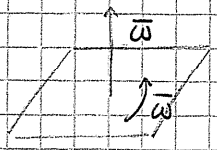
Posso anche disegnarlo così

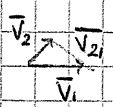
$\bar{c} = \bar{a} + \bar{b}$ vettore somma



Esempio

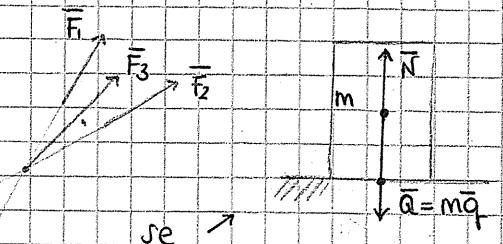




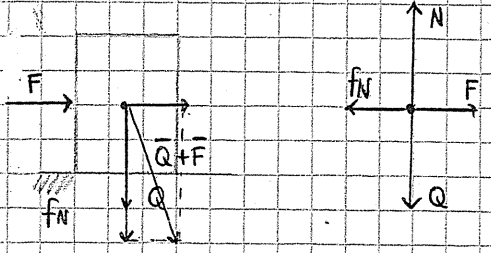


$\bar{V}_1 + \bar{V}_{21} = \bar{V}_2$

$\bar{V}_{21} = \bar{V}_2 - \bar{V}_1$

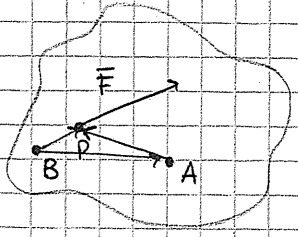


se omogeneo il baricentro è nel centro



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Si parla di momento di un vettore rispetto ad un certo punto.



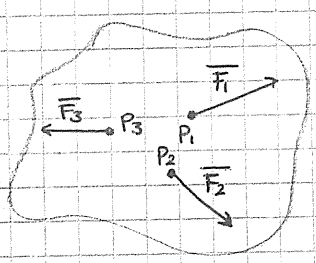
$(\bar{M}_A = \bar{AP} \wedge \bar{F})$ Il vettore momento è ortogonale al piano (direzione) verso: entrante

Regola della mano dx:
Pollice: primo vettore ($\bar{AP}$)
Indice: secondo vettore ($\bar{F}$)
Medio: entrante

Ora calcoliamo il momento rispetto al vettore B

$$\overline{M_B} = \overline{BP} \wedge \overline{F} = (\overline{BA} + \overline{AP}) \wedge \overline{F} = \underbrace{\overline{BA} \wedge \overline{F} + \overline{M_A}}$$

sfruito la conoscenza del momento A per trovare il momento B



"RISULTANTE"

$$\overline{R} = \sum_{J=1}^{n} \overline{F_J} = \overline{0}$$

$$\overline{M_A} = \sum \overline{AP_J} \wedge \overline{F_J}$$

momento risultante che agisce su questo corpo

$$\overline{M_B} = \sum \overline{BP_J} \wedge \overline{F_J} =$$

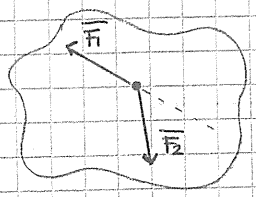
$$= \sum (\overline{BA} + \overline{AP_J}) \wedge F_J =$$

$$= \sum \overline{BA} \wedge F_J + \sum \overline{AP_J} \wedge \overline{F_J}$$

$$\overline{M_B} = \overline{BA} \wedge \sum \overline{F_J} + \sum \overline{AP_J} \wedge \overline{F_J} =$$

$$= BA \wedge R + \overline{M_A}$$

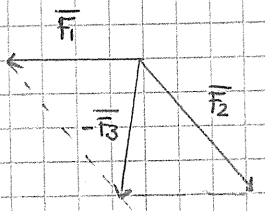
Se $\overline{R} = \overline{0} \Rightarrow \overline{M_B} = \overline{M_A}$



$$\overline{F_1} + \overline{F_2} + \overline{F_3} = \overline{0}$$

(con F_3 da trovare)

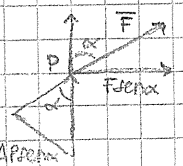
$$\overline{F_3} = -(\overline{F_1} + \overline{F_2})$$

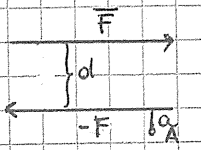


$$\overline{M_A} = \overline{AP} \wedge \overline{F}$$

$$M_A = AP \cdot F \cdot \text{sen}\alpha$$

$$(AP \text{sen}\alpha)\, F$$





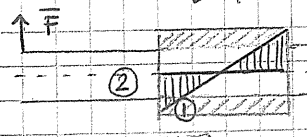
$M = F \cdot d$

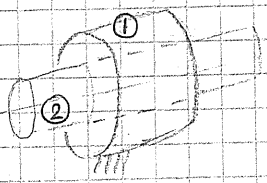
$M = -F \cdot a + F(a+d)$

(vale per qualsiasi punto io vada a considerare)

(momento puro) M_{12} (esercitato dal corpo 1 sul corpo 2)

coppia rotoidale





$$\frac{F}{A} = p$$

Coppia di forze a risultante nulla che producono un momento

- $\sum \overline{F_e} = \overline{0}$ — 1ª eq. cardinale della statica
- $\sum_{\text{rispetto ad un polo O}} \overline{M_O} = \sum_{K=1}^{m} \overline{M_K} + \sum_{J=1}^{n} \overline{OP_J} \wedge \overline{F_J} = \overline{0}$ — 2ª eq. cardinale della statica

m = numero dei momenti puri.

n = numero dei momenti generati dalla forza F.

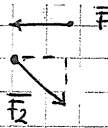
$$\overline{F_1} + \underbrace{\overline{F_2} + \overline{F_3}}_{\text{dir. nota}} = \overline{0}$$

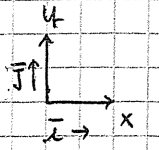
noto

$$\underbrace{\overline{F_1} + \overline{F_2}}_{\text{noti}} + \underbrace{\overline{F_3}}_{\text{incognito}} = \overline{0}$$

$\bar{F}_1 = (F_{1x}, F_{1y}) = F_{1x}\bar{\imath} + F_{2y}\bar{\jmath}$ (<0, <0)

$\bar{F}_2 = (F_{2x}, F_{2y}) = F_{2x}\bar{\imath} + F_{2y}\bar{\jmath}$ (>0, <0)





$$\begin{cases} F_{1x} + F_{2x} + (F_{3x}) = 0 \\ F_{1J} + F_{2J} + (F_{3J}) = 0 \end{cases}$$

incognite $\Rightarrow$ problema risolubile

$$\begin{cases} -F_1 + F_2\cos\alpha + (F_{3x}) = 0 \\ -F_2 J\,\text{en}\alpha + (F_3 J\,\text{en}\beta) = 0 \\ \qquad\qquad (F_{3y}) \end{cases}$$

$(F_3\cos\beta)$

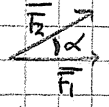
direzione orizzontale

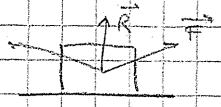
direzione verticale

sistema con 2 eq. con 2 incognite

06.03

$\bar{F}_1 \cdot \bar{F}_2 = F_1 F_2 \cos\alpha$

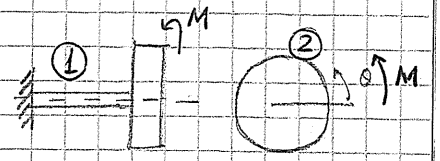




$L = \bar{F}\cdot\bar{s} = F\cdot s\cos\alpha$

$L_r = \bar{R}\cdot\bar{s} = R\cdot s\cdot\cos\alpha = -R s \sin\beta$

$F = \sqrt{\bar{F}\cdot\bar{F}}$



L lavoro

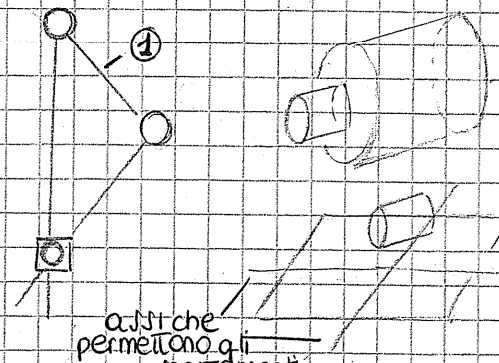
W potenza $= \frac{dL}{dt} = \frac{d(\bar{F}\cdot\bar{s})}{dt} = \bar{F}\frac{d\bar{s}}{dt} = \bar{F}\cdot\bar{v}$

$dt \to d\theta$ $\quad dL_M = M d\theta$

$dL_r = -M_r d\theta$

θ ed M sono vettori che sono sul piano (1)

Coppie cinematiche : zone di contatto tra i corpi

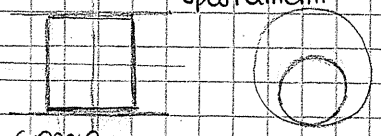


- conformi o combacianti
- non conformi o non combacianti

(dove la superficie è ampia)

→ rullo appoggiato su un piano

assi che permettono gli spostamenti



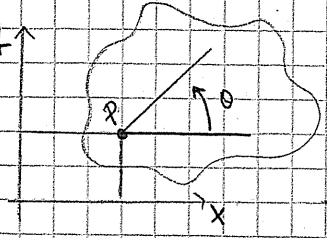
coppia prismatica

coppia rotoidale

- rigide
- non rigide (deformabili)

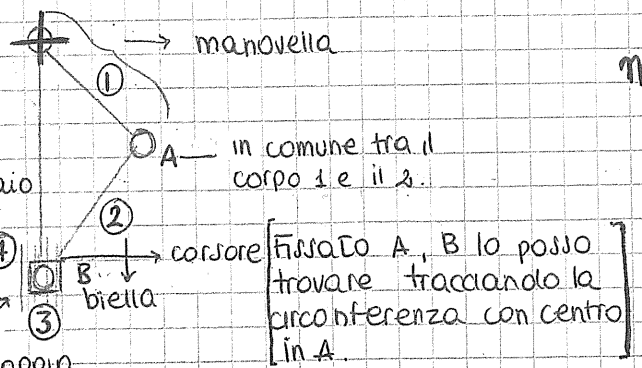
Quando almeno uno dei due elementi della coppia è deformabile → la coppia si dice "non rigida"

- ELEMENTARI → rigide e combacianti
- SUPERIORI → o non rigide o non combacianti



P(x,y)
θ

- 3 gradi di libertà' (rotazionale) del corpo rigido nel piano
- 6 gradi di libertà' del corpo rigido nello spazio



Fissato A, B lo posso trovare tracciando la circonferenza con centro in A.

m = numero di elementi del meccanismo

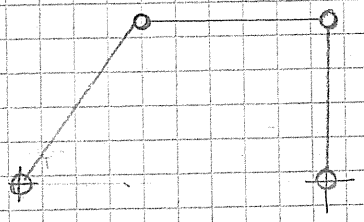
$3\cdot(m-1)$ → sarebbe il num. dei gradi di libertà senza vincoli

n_1 = numero di coppie che tolgono 1 GDL.

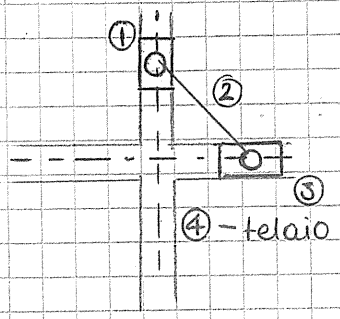
n_2 = numero di coppie che tolgono 2 GDL.

$m = 4 \quad n_2 = 4 \quad n_1 = 0$

$$GDL \geq 3(m-1) - 2n_2 - 1n_1$$
$$GDL \geq 3(4-1) - 2\cdot 4 - 1\cdot 0$$

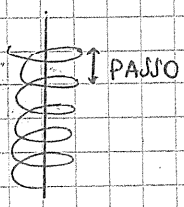


QUADRILATERO ARTICOLATO

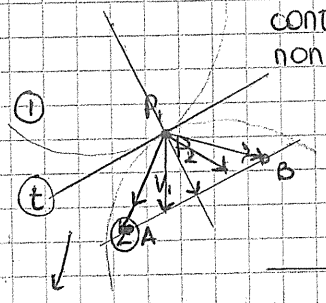


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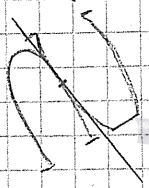
COPPIE ELEMENTARI 1 GDL
1) COPPIA ROTOIDALE
2) COPPIA PRISMATICA
3) COPPIA ELICOIDALE



Vite che entra dentro un foro: apparentemente sembrerebbero 2 gradi di libertà (rotazione e avanzamento) ma questi due movimenti sono legati ⇒ 1 GDL



ex. contatto tra denti di ruote dentate



devono avere la stessa componente normale di velocità

PROFILO CONIUGATO
Nel punto P ho 2 corpi fisici sovrapposti.
Possono avere componenti di velocità diverse.
La velocità può essere una di quelle disegnate in figura.
Se avessi una velocità più lunga si staccherebbero i due corpi, altrimenti se fosse più corta si compenetrerebbero.

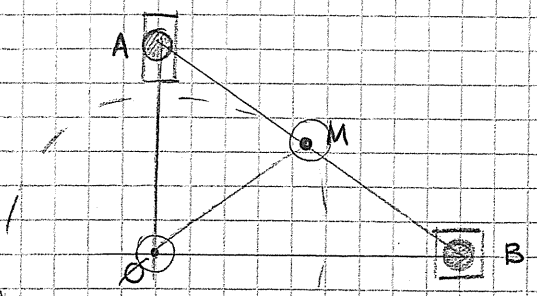
$\overline{V_{1n}} = \overline{V_{2n}}$ VELOCITÀ RELATIVA → tutta lungo la tangente

$\overline{V_{12}} = -\overline{V_{21}}$ ⇒ COMPONENTE TANGENZIALE (lungo t)

$\overline{V_{12}}$ = velocità relativa è la differenza delle velocità.

SOMMO I VETTORI SULLA FIGURA → $\overline{V_1} = \overline{V_2} + \overline{V_{12}}$

$GDL \geq 3(m-1) - 2n_2 - 1n_1$

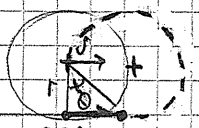


Considero un rullo che rotola e striscia su un piano.



$GDL \geq 3(2-1) - 1 \cdot 1 = 2$

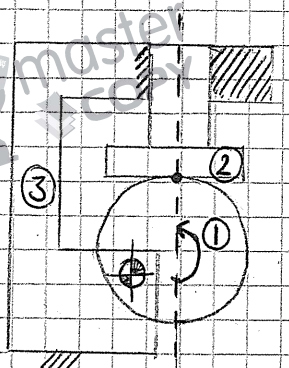
↳ vincolo che toglie un solo grado di libertà



$r\theta = s$

RSS

GDL = 1



CAMMA-PIATTELLO

(ci sono coppie rotoidali)

$GDL \geq 6(m-1) - 5n_5 - 4n_4 - 3n_3 - 2n_2 - 1n_1$

$n_5 = 4$

$\Rightarrow 6 \cdot 3 - 5 \cdot 4 = -2 \Rightarrow$ IPERVINCOLATO

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