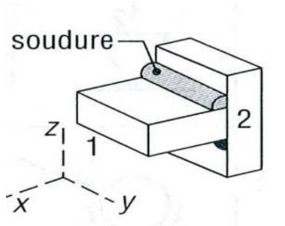
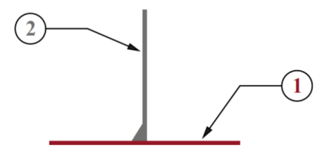
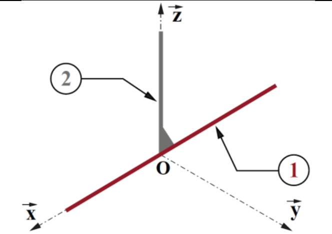
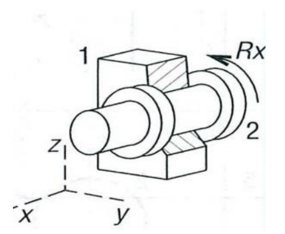
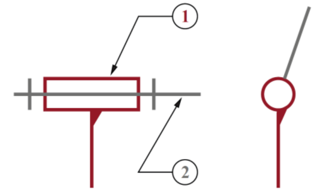
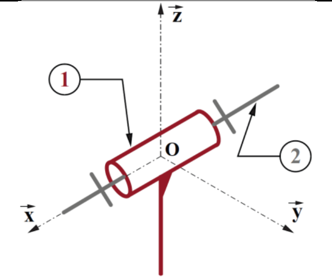
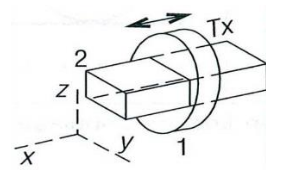
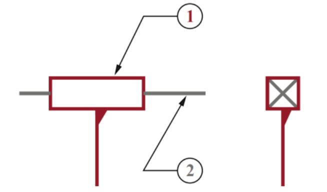
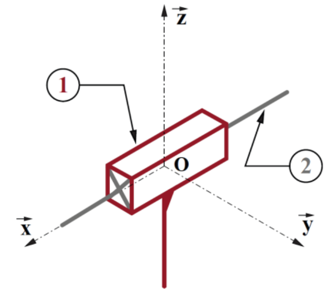
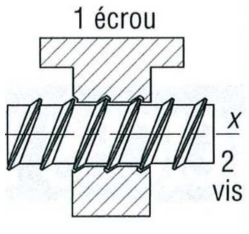
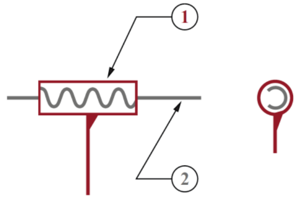
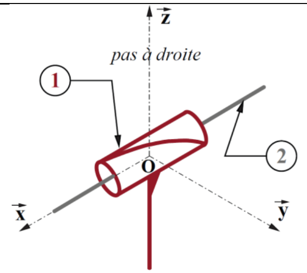
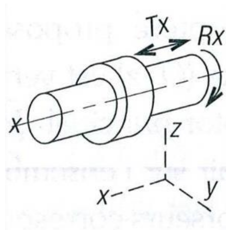
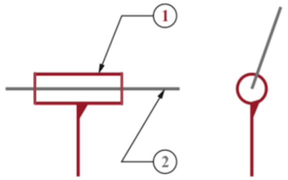
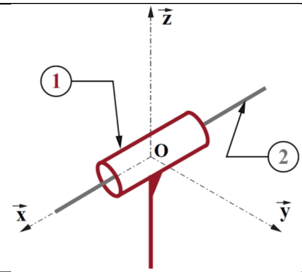
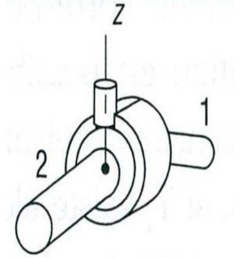
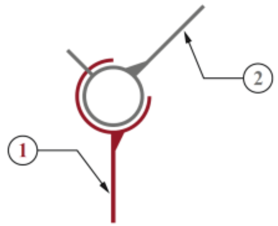
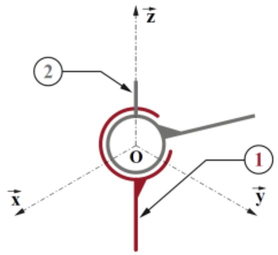
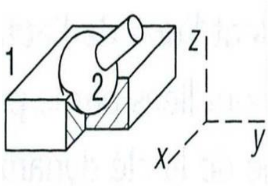
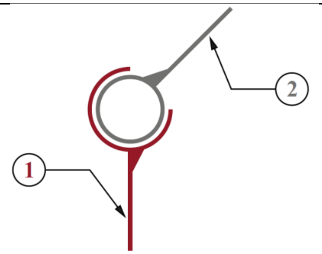
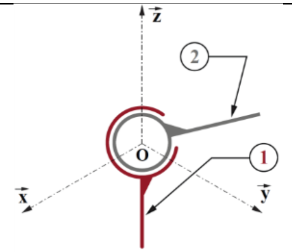
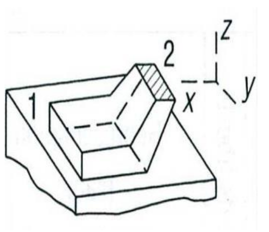
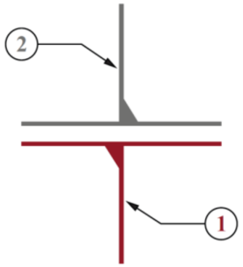
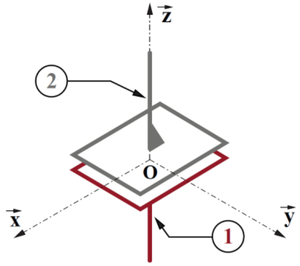
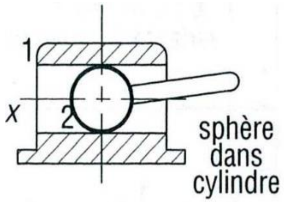
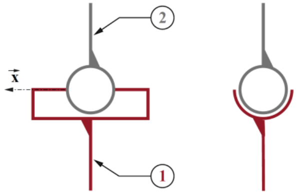
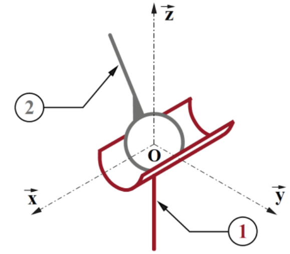
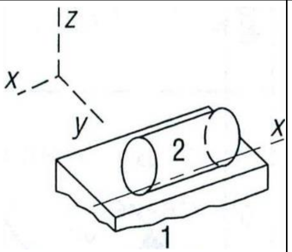
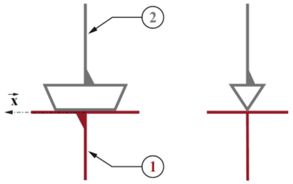
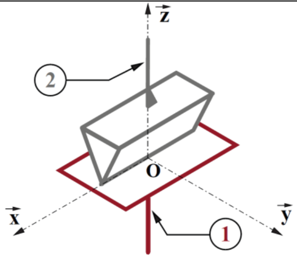
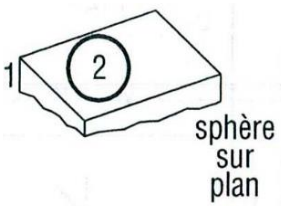
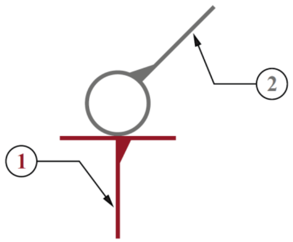
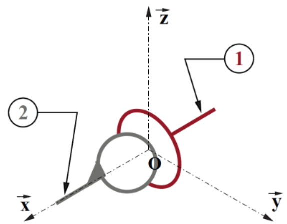
Dernière mise à jour	Fiche Torseurs	Denis DEFAUCHY
28/11/2016	Cinématique - Statique	Les indispensables

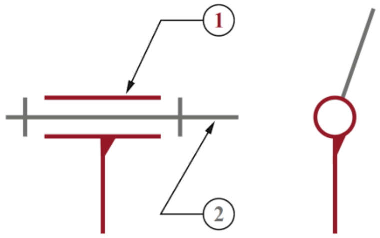
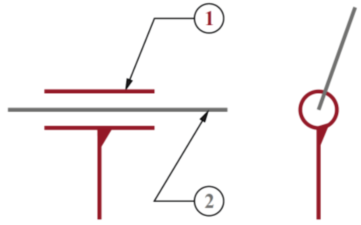
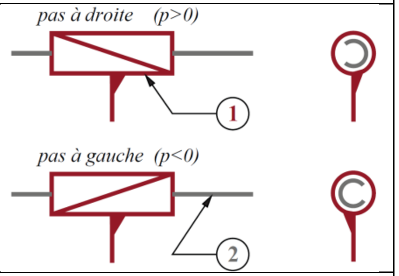
Torseurs cinématiques et statiques des liaisons usuelles parfaites

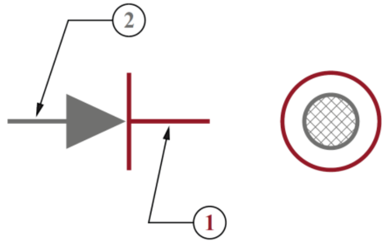
Schéma	Liaison	Eléments Géom	2D	3D	$\{\mathcal{V}_{2/1}\}$	$\{\mathcal{T}_{2/1}\}$	Validité P	$\mathfrak{B}$	I_c	I_s
	Encastrement E	RAS			$\begin{Bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} X_{2/1} & \boldsymbol{L_{2/1}} \\ Y_{2/1} & \boldsymbol{M_{2/1}} \\ Z_{2/1} & \boldsymbol{N_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$	$\forall P$	— — —	0	6
	Pivot P	$(O,\vec{x})$			$\begin{Bmatrix} P_{2/1} & 0 \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} X_{2/1} & 0 \\ Y_{2/1} & \boldsymbol{M_{2/1}} \\ Z_{2/1} & \boldsymbol{N_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$	$(O,\vec{x})$	$\vec{x}$ — —	1	5
	Glissière Gl	$\vec{x}$			$\begin{Bmatrix} 0 & U_{2/1} \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} 0 & \boldsymbol{L_{2/1}} \\ Y_{2/1} & \boldsymbol{M_{2/1}} \\ Z_{2/1} & \boldsymbol{N_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$	$\forall P$	$\vec{x}$ — —	1	5

	Hélicoïdale *He*	$(O,\vec{x})$			$\begin{Bmatrix} P_{2/1} & U_{2/1} \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $U_{2/1} = \frac{pas}{2\pi} P_{2/1}$	$\begin{Bmatrix} X_{2/1} & \boldsymbol{L_{2/1}} \\ Y_{2/1} & \boldsymbol{M_{2/1}} \\ Z_{2/1} & \boldsymbol{N_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$ $L_{2/1} = -\frac{pas}{2\pi} X_{2/1}$	$(O,\vec{x})$	$\vec{x}$ — —	1	5
	Pivot Glissant *PG*	$(O,\vec{x})$			$\begin{Bmatrix} P_{2/1} & U_{2/1} \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} 0 & 0 \\ Y_{2/1} & \boldsymbol{M_{2/1}} \\ Z_{2/1} & \boldsymbol{N_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$	$(O,\vec{x})$	$\vec{x}$ — —	2	4
	Rotule à doigt Sphérique à doigt	O Rainure $(O,\vec{x},\vec{z})$ Doigt $\vec{z}$			$\begin{Bmatrix} 0 & 0 \\ Q_{2/1} & 0 \\ R_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} X_{2/1} & L_{2/1} \\ Y_{2/1} & 0 \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1\ \&\ \mathfrak{B}_2$	O	$\vec{x}$ $\vec{y}$ $\vec{z}$	2	4
	Rotule *R* Sphérique *S*	O			$\begin{Bmatrix} P_{2/1} & 0 \\ Q_{2/1} & 0 \\ R_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} X_{2/1} & 0 \\ Y_{2/1} & 0 \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	O	— — —	3	3

	Appui plan *AP*	$\vec{z}$			$\begin{Bmatrix} 0 & \mathbf{U_{2/1}} \\ 0 & \mathbf{V_{2/1}} \\ R_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} 0 & \mathbf{L_{2/1}} \\ 0 & \mathbf{M_{2/1}} \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	$\forall P$	— — $\vec{z}$	3	3
	Linéaire annulaire *LA* Sphère cylindre *SC*	$(O,\vec{x})$			$\begin{Bmatrix} P_{2/1} & U_{2/1} \\ Q_{2/1} & 0 \\ R_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1$	$\begin{Bmatrix} 0 & 0 \\ Y_{2/1} & 0 \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1$	O	$\vec{x}$ — —	4	2
	Linéaire rectiligne *LR* Cylindre Plan *CP*	$\{(O,\vec{x}),\vec{z}\}$			$\begin{Bmatrix} P_{2/1} & \mathbf{U_{2/1}} \\ 0 & \mathbf{V_{2/1}} \\ R_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1\ \&\ \mathfrak{B}_2$	$\begin{Bmatrix} 0 & 0 \\ 0 & \mathbf{M_{2/1}} \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1\ \&\ \mathfrak{B}_2$	$(O,\vec{x},\vec{z})$	$\vec{x}$ $\vec{y}$ $\vec{z}$	4	2
	Ponctuelle *Pct* Sphère plan *SP*	$(O,\vec{x})$			$\begin{Bmatrix} P_{2/1} & 0 \\ Q_{2/1} & \mathbf{V_{2/1}} \\ R_{2/1} & \mathbf{W_{2/1}} \end{Bmatrix}_P^{\mathfrak{B}}$	$\begin{Bmatrix} X_{2/1} & 0 \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_P^{\mathfrak{B}}$ $Ref\ \mathfrak{B}_1$	$(O,\vec{x})$	$\vec{x}$ — —	5	1

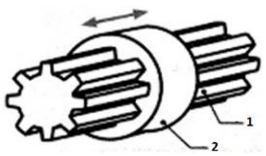
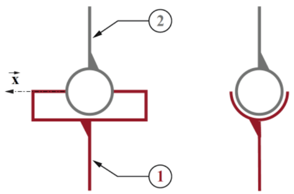
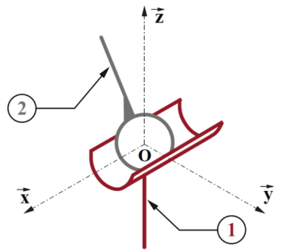
Ancienne norme

Pivot	Pivot Glissant	Hélicoïdale
		

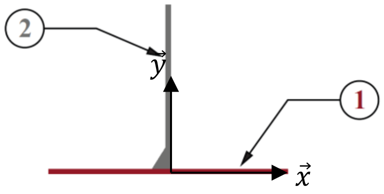
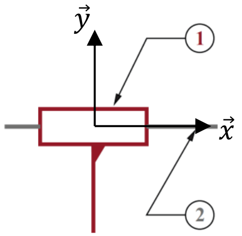
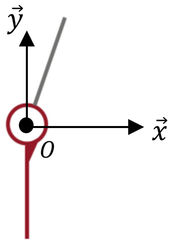
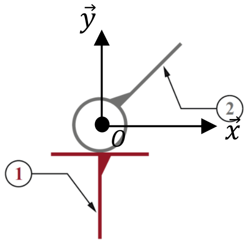
Ponctuelle


Liaison non usuelle parfois rencontrée

Ex : 2 arbres – Cannelures sur faible longueur /Disques d'embrayages ou freins

	Linéaire annulaire à doigt	$(O,\vec{x})$ Doigt non // à $\vec{x}$			$\begin{Bmatrix} 0 & U_{2/1} \\ Q_{2/1} & 0 \\ R_{2/1} & 0 \end{Bmatrix}_O^{\mathfrak{B}}$	$\begin{Bmatrix} 0 & L_{2/1} \\ Y_{2/1} & 0 \\ Z_{2/1} & 0 \end{Bmatrix}_P^{\mathfrak{B}}$	O	$\vec{x}$ $\vec{y}$ $\vec{z}$	3	3

Liaisons planes dans le plan $(O,\vec{x},\vec{y})$

Encastrement		$\left\{\begin{matrix}0&0\\0&0\\0&0\end{matrix}\right\}_{\forall P}^{\mathfrak{B}_0}$	$\left\{\begin{matrix}X_{2/1}&0\\Y_{2/1}&0\\0&\color{red}{\boldsymbol{N_{2/1}}}\end{matrix}\right\}_{P}^{\mathfrak{B}}$	$\forall P$	$I_c^{2D}=0$	$\color{red}{\boldsymbol{I_s^{2D}=3}}$
Glissière $\vec{x}$		$\left\{\begin{matrix}0&U_{2/1}\\0&0\\0&0\end{matrix}\right\}_{\forall P}^{\mathfrak{B}_0}$	$\left\{\begin{matrix}0&0\\Y_{2/1}&0\\0&\color{red}{\boldsymbol{N_{2/1}}}\end{matrix}\right\}_{P}^{\mathfrak{B}}$	$\forall P$	$I_c^{2D}=1$	$\color{red}{\boldsymbol{I_s^{2D}=2}}$
Pivot $(O,\vec{z})$		$\left\{\begin{matrix}0&0\\0&0\\R_{2/1}&0\end{matrix}\right\}_{O}^{\mathfrak{B}_0}$	$\left\{\begin{matrix}X_{2/1}&0\\Y_{2/1}&0\\0&0\end{matrix}\right\}_{P}^{\mathfrak{B}}$	$(O,\vec{z})$	$I_c^{2D}=1$	$\color{red}{\boldsymbol{I_s^{2D}=2}}$
Ponctuelle $(0,\vec{y})$		$\left\{\begin{matrix}0&U_{2/1}\\0&0\\R_{2/1}&0\end{matrix}\right\}_{O}^{\mathfrak{B}_0}$ $P\in(O,\vec{y})$	$\left\{\begin{matrix}0&0\\Y_{2/1}&0\\0&0\end{matrix}\right\}_{P}^{\mathfrak{B}}$	$(O,\vec{y})$	$\color{red}{\boldsymbol{I_c^{2D}=2}}$	$I_s^{2D}=1$