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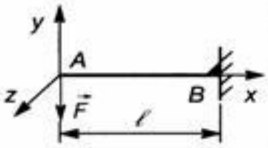
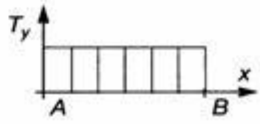
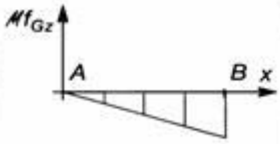
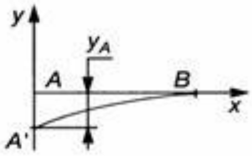
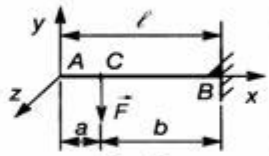
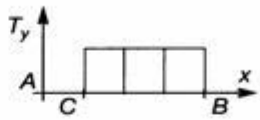
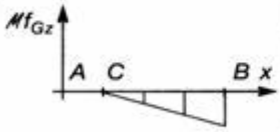
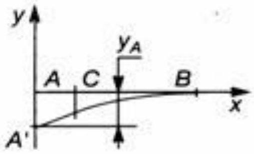
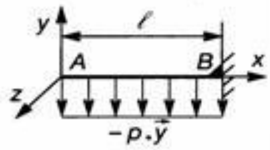
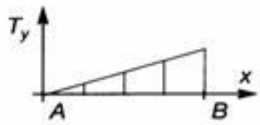
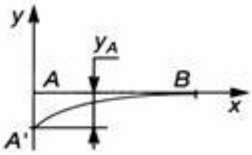
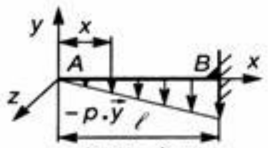
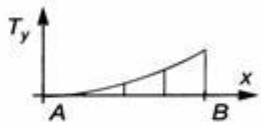
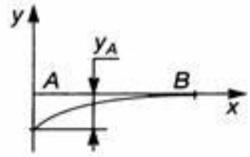
La Flexion :

POUTRES SUR UN APPUI

Charges - Appuis	Effort tranchant	Moment de flexion	Déformation
■ Concentrée en *A*  $\vec{B} = -\vec{F} = \|\vec{F}\|.\vec{y}$ (avec $F < 0$) $\vec{\mathcal{M}}_B = -\|\vec{F}\|.\ell.\vec{z}$	 avec $F < 0$ $T_y = +\|\vec{F}\|$ constant entre *A* et *B*	 avec $F < 0$ Moment de flexion en *B* : $\mathcal{M}f_{Gz} = -\|\vec{F}\|.\ell$	 Flèche en *A* : $F < 0$ $y_A = -\frac{\|\vec{F}\|.\ell^3}{3E.I_{Gz}}$
■ Concentrée en *C*  $\vec{B} = -\vec{F}$ avec $F < 0$ $\vec{B} = \|\vec{F}\|.\vec{y}$ $\vec{\mathcal{M}}_B = -\|\vec{F}\|.b.\vec{z}$	 Entre *A* et *C* : $T_y = 0$ Entre *C* et *B* : avec $F < 0$ $T_y = \|\vec{F}\|$	 Moment de flexion en *B* : avec $F < 0$ $\mathcal{M}f_{Gz} = -\|\vec{F}\|.b$	 Flèche en *A* : $y_A = -\frac{\|\vec{F}\|(\ell - a)^2(2\ell + a)}{6\,E.I_{Gz}}$
■ Uniformément répartie  *p* : coefficient de charge (N / m) $\vec{B} = p.\ell.\vec{y}$ $\vec{\mathcal{M}}_B = -\frac{p.\ell^2}{2}.\vec{z}$	 Effort tranchant max en *B* : $T_{y\,max} = p.\ell$	 Moment de flexion en *B* : $\mathcal{M}f_{Gz} = -\frac{p.\ell^2}{2}$	 Flèche en *A* : $y_A = -\frac{p.\ell^4}{8E.I_{Gz}}$
■ Linéairement répartie  avec $p = k.x$ $\vec{B} = \frac{k.\ell^2}{2}.\vec{y}$ $\vec{\mathcal{M}}_B = -\frac{k.\ell^3}{6}.\vec{z}$	 Effort tranchant max en *B* : $T_{y\,max} = \frac{k.\ell^2}{2}$	 Moment de flexion en *B* : $\mathcal{M}f_{Gz} = -\frac{k.\ell^3}{6}$	 Flèche en *A* : $y_A = -\frac{k.\ell^5}{30E.I_{Gz}}$

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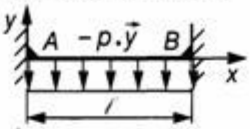
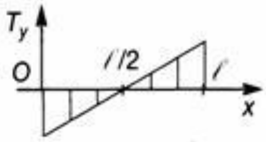
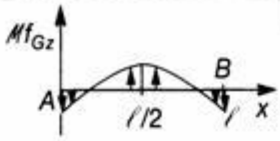
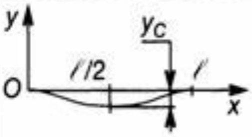
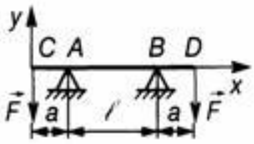
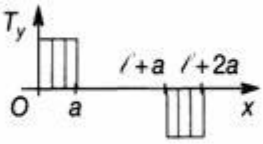
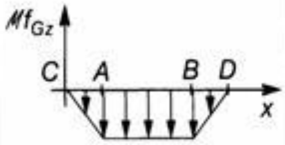
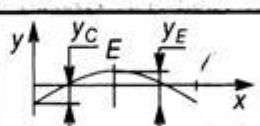
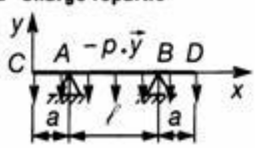
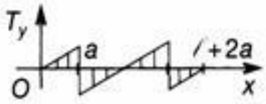
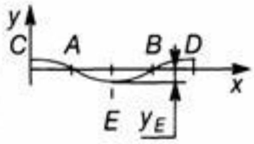
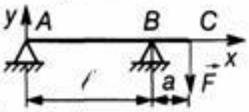
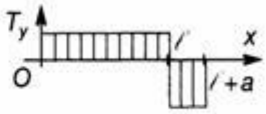
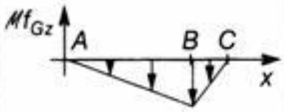
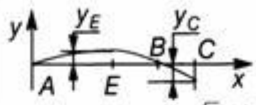
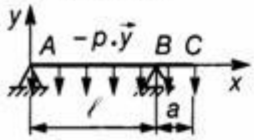
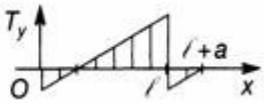
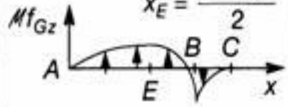
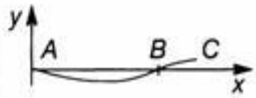
Charges - Appuis	Effort tranchant	Moment de flexion	Déformation
■ Uniformément réparti  $\vec{A}=\vec{B}=\frac{p.\ell}{2}.\vec{y}$; $\vec{\mathcal{M}}_A=-\vec{\mathcal{M}}_B=\frac{p.\ell^2}{12}.\vec{z}$	 $T_y=px-\frac{p.\ell}{2}$; en A : $T_y=-\frac{p.\ell}{2}$; en B : $T_y=\frac{p.\ell}{2}$	 Mf_{Gz} est max pour : $x=\frac{\ell}{2}$; $Mf_{Gz}=\frac{p.\ell^2}{24}$	 Flèche en C : $x_C=\frac{\ell}{2}$; $y_C=-\frac{p.\ell^4}{384\,E.I_{Gz}}$

POUTRE SUR DEUX APPUIS AVEC PORTE-À-FAUX SYMÉTRIQUE

Charges - Appuis	Effort tranchant	Moment de flexion	Déformation
■ Deux charges concentrées  $\vec{A}=\vec{B}=\|\vec{F}\|.\vec{y}$; $\vec{\mathcal{M}}_A=\vec{\mathcal{M}}_B=\vec{0}$	 Entre C et A : $T_y=\|\vec{F}\|$; Entre B et D : $T_y=-\|\vec{F}\|$	 Mf_{Gz} entre A et B : $Mf_{Gz}=-\|\vec{F}\|.a$	 ■ Flèche en E : $x_E=\frac{\ell+2a}{2}$; $y_E=\frac{\|\vec{F}\|.a.\ell^2}{8\,E.I_{Gz}}$ ■ En C : $y_C=-\frac{\|\vec{F}\|.a^2}{6\,E.I_{Gz}}(3\ell+2a)$
■ Charge répartie  $\vec{A}=\vec{B}=\frac{p}{2}(\ell+2a).\vec{y}$; $\vec{\mathcal{M}}_A=\vec{\mathcal{M}}_B=\vec{0}$	 Entre C et A : $T_y=px$; De A à B : $T_y=px-\frac{p(\ell+2a)}{2}$	 ■ Mf_{Gz} en E : $x=\frac{\ell+2a}{2}$; $Mf_{Gz}=\frac{p}{8}(\ell^2-4a^2)$ ■ En A : $Mf_{Gz}=-\frac{p.a^2}{2}$	 ■ Flèche en E : $x_E=\frac{\ell+2a}{2}$; $y_E=-\frac{p.\ell^4}{16\,E.I_{Gz}}\left(\frac{5}{24}-\frac{a^2}{\ell^2}\right)$

POUTRES SUR DEUX APPUIS AVEC PORTE-À-FAUX UNILATÉRAL

Charges - Appuis	Effort tranchant	Moment de flexion	Déformation
■ Charge concentrée en C  $\vec{A}=-\frac{\|\vec{F}\|.a}{\ell}.\vec{y}$; $\vec{\mathcal{M}}_A=\vec{0}$; $\vec{B}=\frac{\|\vec{F}\|}{\ell}(\ell+a).\vec{y}$; $\vec{\mathcal{M}}_B=\vec{0}$	 Entre A et B : $T_y=\frac{\|\vec{F}\|.a}{\ell}$; Entre B et C : $T_y=-\|\vec{F}\|$	 Mf_{Gz} en B : $Mf_{Gz}=-\|\vec{F}\|.a$	 ■ Flèche en E : $x=\ell\sqrt{3}/3$; $y_E=\frac{\|\vec{F}\|.a.\ell^2\sqrt{3}}{27\,E.I_{Gz}}$ ■ en C : $y_C=-\frac{\|\vec{F}\|.a^2(a+\ell)}{3\,E.I_{Gz}}$
■ Charge répartie  $\vec{A}=\frac{p}{2\ell}(\ell^2-a^2).\vec{y}$; $\vec{B}=\frac{p}{2\ell}(\ell+a)^2.\vec{y}$	 De A à B : $T_y=px-\frac{p}{2\ell}(\ell^2-a^2)$; De B à C : $T_y=-p(\ell+a)+px$	$x_E=\frac{\ell^2-a^2}{2}$  ■ Mf_{Gz} max pour $x=x_E$; $Mf_{Gz}=\frac{p}{8\ell^2}(\ell^2-a^2)$ ■ En B : $Mf_{Gz}=-\frac{p.a^2}{2}$	

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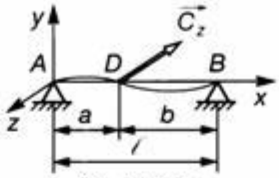
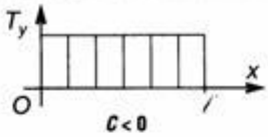
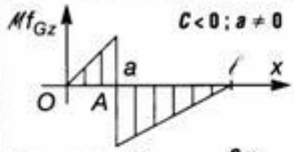
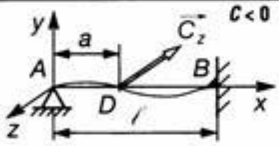
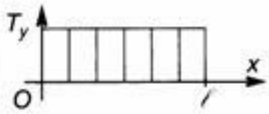
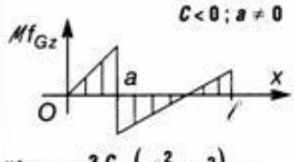
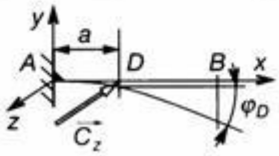
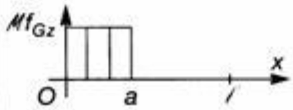
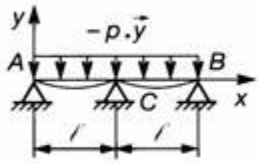
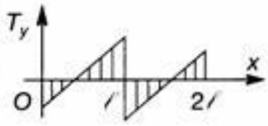
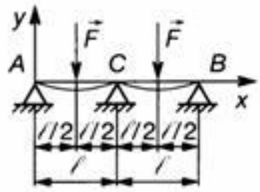
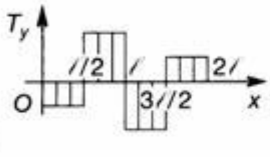
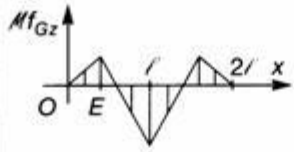
POUTRES SUPPORTANT UN COUPLE

Charges - Déformées	Effort tranchant	Moment de flexion	Déformation
 $C_z = C ; C < 0$ $\vec{A} = \frac{C}{\ell}.\vec{y}$; $\vec{B} = -\frac{C}{\ell}.\vec{y}$	 $C < 0$ $0 < x < a \quad T_y = -\frac{C}{\ell}$ $a < x < \ell \quad T_y = -\frac{C}{\ell}$	$C < 0 ; a \neq 0$  $0 < x < a \quad Mf_{Gz} = -\frac{Cx}{\ell}$ $a < x < \ell \quad Mf_{Gz} = \frac{C(\ell - x)}{\ell}$	Flèche en D : $y_D = \frac{1}{E.I_{Gz}} . \frac{C.a.b\,(b-a)}{3\ell}$ $\varphi_A = -\frac{C}{6E.I_{Gz}.\ell}.(\ell^2 - 3b^2)$ $\varphi_B = -\frac{C}{6E.I_{Gz}.\ell}.(\ell^2 - 3a^2)$
$C < 0$  $\vec{A} = -\vec{B} = \frac{3C}{2\ell^3}(\ell^2 - a^2).\vec{y}$ $\vec{\mathcal{M}_B} = \left\lvert \frac{C}{2\ell^2}(\ell^2 - 3a^2) \right\rvert .\vec{z}$	 $0 < x < a \quad T_y = -A$ $a < x < \ell \quad T_y = -A$	$C < 0 ; a \neq 0$  $Mf_{Gz} = -\frac{3C}{2\ell^3}(\ell^2 - a^2).x$ $Mf_{Gz} = +\frac{C}{2\ell^3}\left[2\ell^3 - 3(\ell^2 - a^2).x\right]$	$0 < x < a$ $y = -\frac{C(\ell - a)x}{4E.I_{Gz}.\ell^3} \ldots$ $\ldots \left[\ell^2(3a - \ell) - (\ell + a)x^2\right]$ $\varphi_A = -\frac{C}{4E.I_{Gz}.\ell}(\ell - a)(\ell - 3a)$
 $C < 0$ $\vec{R_A} = \vec{0}$ $\vec{\mathcal{M}_A} = -C.\vec{z}$	 $x < a \quad T_y = 0$ $x > a \quad T_y = 0$	 $C < 0$ $x < a$; $Mf_{Gz} = -C$ $x > a$; $Mf_{Gz} = 0$	$f_D = \frac{C\,a^2}{2E.I_{Gz}}$ $f_B = \frac{C\,a}{E.I_{Gz}}\left(\ell - \frac{a}{2}\right)$ $\varphi_D = \frac{C\,a}{E.I_{Gz}} = \varphi_B$
POUTRES SUR TROIS APPUIS DE NIVEAU			
 $\vec{A} = \vec{B} = 0{,}375\ p.\ell.\vec{y}$ $\vec{C} = 1{,}250\ p.\ell.\vec{y}$ $\vec{\mathcal{M}_A} = \vec{\mathcal{M}_B} = \vec{\mathcal{M}_C} = \vec{0}$	 $0 < x < \ell$ $T_y = p\,x - 0{,}375\ p.\ell$ $\ell < x < 2\ell$ $T_y = p\,x - 1{,}625\ p.\ell$	 $0 < x < \ell$; $Mf_{Gz} = 0{,}07\ p.\ell^2$ $Mf_{Gz\ell} = -0{,}125\ p.\ell^2$ $\ell < x < 2\ell$; $Mf_{Gz} = 0{,}07\ p.\ell^2$	Flèche pour $x_E = 0{,}42\ \ell$ $f_E = -0{,}043\ \frac{p.\ell^4}{E.I_{Gz}}$
 $\vec{A} = \vec{B} = \frac{5F}{16}.\vec{y}$ $\vec{C} = \frac{11F}{8}.\vec{y}$	 $0 < x < \ell/2 \quad T_y = -\ 5F/16$ $\ell/2 < x < \ell \quad T_y = \ 11F/16$ $\ell < x < 3\ell/2 \quad T_y = -11F/16$ $3\ell/2 < x < 2\ell \quad T_y = -\ 5F/16$	 $x = \frac{\ell}{2}$; $Mf_{Gz} = \frac{5F.\ell}{32}$ $x = \ell$; $Mf_{Gz} = -\frac{3F.\ell}{16}$	pour $x_E = \frac{\ell\sqrt{5}}{5}$ $f_E = -\frac{F.\ell^3}{240\ E.I_{Gz}}$