# Résistance des matériaux by William VOIROL, Switzerland

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| --- | --- | --- | --- |
| **Diagramme de traction** (acier)  limite de rupture  limite d'élasticité  limite de proportionnalité  allongement relatif ε  traction σ  0 | **Grandeurs utilisées** | **Formule** | **Unité** |
| *l* | longueur (initiale) |  | m |
| *l* | allongement absolu |  | m |
| ** | allongement relatif | * = l / l* |  |
| *A* | aire (de section) |  | m2 |
| *F* | force |  | N |
| *M* | moment de force | *M = F****⋅****l* | N**⋅**m |
| ** | traction, compression | * = F* ***/*** *A* | Pa |
| *τ* | glissement, cisaillement | *τ = F / A* | Pa |
| *s* | coefficient de sécurité | *s = élast /admiss.* |  |
| *E* | module d’élasticité | *E = / * | Pa |
| *G* | module de glissement | *G* | Pa |
| *I* | moment d’inertie axial | *Ix , Iy* | m4 |
| *Io* | moment d'inertie polaire | *Io=Ix+Iy* | m4 |
| *W* | moment de résistance | *W = I / emax* | m3 |
| *Wo* | moment de résistance polaire |  | m3 |

## Unités de contrainte (pression)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 **Pa** = | 1 **MPa** = | 1 **N/mm2** = | 1 **kp/cm2** = | 1 **kp/mm2** = |  |
| 1 | 106 | 106 | 9.81⋅104 | 9.81⋅106 | **Pa** |
| 10-6 | 1 | 1 | 0.0981 | 9.81 | **MPa** |
| 10-6 | 1 | 1 | 0.0981 | 9.81 | **N/mm2** |
| 1.02⋅10-5 | 10.2 | 10.2 | 1 | 100 | **kp/cm2** |
| 1.02⋅10-7 | 0.102 | 0.102 | 0.01 | 1 | **kp/mm2** |

## Elasticité

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Module d’élasticité** | |  | **Module de** |  | **Limites d’élasticité *élast* [MPa]** | | | | |  | |  | ***τélast*[MPa]** | |  |
|  | ***E* [MPa]** | |  | **glissement** | **traction** | | |  | **compression** | |  | **cisaillement** | | | |  |
| **Matière** | **min** | **max** | | ***G* [MPa]** | **min** | | **max** | | **min** | **max** | **min** | | | | **max** | |
| acier | 200’000 | 220’000 | | 80'000 | 250 | | 1500 | | 250 | 1500 |  | | | |  | |
| acier fondu | 215’000 | |  | 80'000 | 180 | | 600 | | 200 | 600 |  | | | |  | |
| aluminium | 67’500 | |  |  | 80 | | 270 | | 80 | 270 |  | | | |  | |
| béton | 20’000 | 50’000 | |  | 2 | | |  | 20 | 80 |  | | | |  | |
| chêne ≡≡ | 10’500 | |  |  | 50 | | |  | 16 | 22 |  | | | |  | |
| cuivre | 120’000 | |  | 42'000 | 200 | | 315 | | 200 | 315 |  | | | |  | |
| fer | 210’000 | |  | 80'000 | 130 | | 170 | | 130 | 170 |  | | | |  | |
| fonte | 60’000 | 160’000 | | 25'000 | 20 | | 70 | | 60 | 200 |  | | | |  | |
| granit | 20’000 | 60’000 | |  | 5 | | 8 | | 80 | 200 |  | | | |  | |
| sapin ≡≡ | 10’000 | |  |  | 47 | | |  | 15 | 2 |  | | | |  | |

## 

## Moments d’inertie et de résistance

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Section** | ***emax*** | **Moment d’inertie**  ***I*** | **Moment de résistance**  ***W = I / emax*** | **Moment d’inertie**  **polaire *Io*** | **Moment de résistance**  **polaire *Wo*** |  | ***h/b*** | ***kmip*** | ***kmrp*** |
| *b*  *h*  *emax* |  |  |  |  |  |  | 1  1.1  1.2  1.3  1.4  1.5  1.6 | 7.11353  6.49419  6.01978  5.64783  5.35034  5.10828  4.90832 | 4.80387  4.67437  4.56759  4.47715  4.39879  4.32958  4.26751 |
| *D*  *emax* |  |  |  |  |  |  | 2  2.5  3  4  5 | 4.37289  4.01018  3.79770  3.56109  3.43269 | 4.06705  3.88214  3.74240  3.55031  3.43053 |
| *D*  *d* |  |  |  |  |  |  | 7  10  20  100  ∞ | 3.29683  3.20179  3.09761  3.01903  3 | 3.29674  3.20179  3.09761  3.01903  3 |

## Traction et compression



*l*

*Δl*

*F*

*A*



## Flexion



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *l*  *l* | **Contrainte max.**  ***σflex*** | | **Flèche maximale**  ***f*** | |
| *F*  *f*  *G* |  |  |  |  |
| *F*  *G*  *f* |  |  |  |  |
| *F*  *f*  *G* |  |  |  |  |

## Cisaillement

A faire

## Torsion

*l*

*Mt*

*ϕ*



## 

## Flambage

*h* = 2**⋅***H* *h* = *H* *h* = 0.699**⋅***H* *h* = 0.5**⋅***H*

F

F

F

F

H

