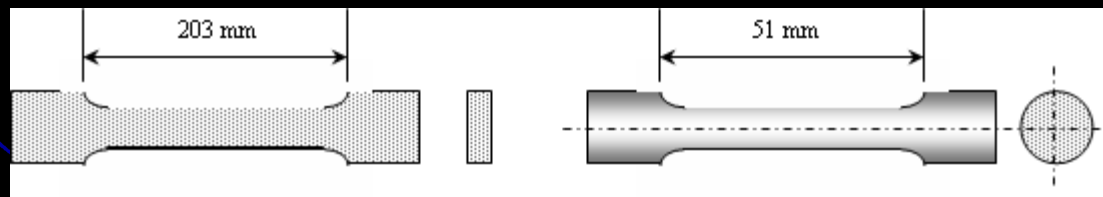


1. PENGANTAR BAHAN BANGUNAN



Ir. Sarjono Puro, MT

BAHAN BANGUNAN

Sejarah Bahan Bangunan



Pada awalnya dari bahan Alam

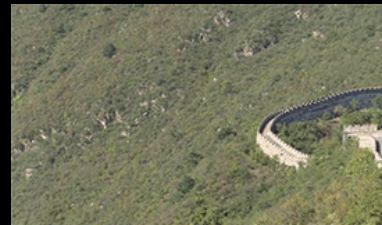


Kayu



Daun

Tanah



Perkembangan Bahan bangunan

Masa perkembangan



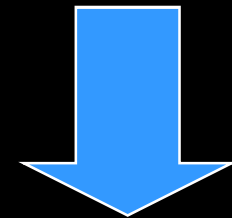
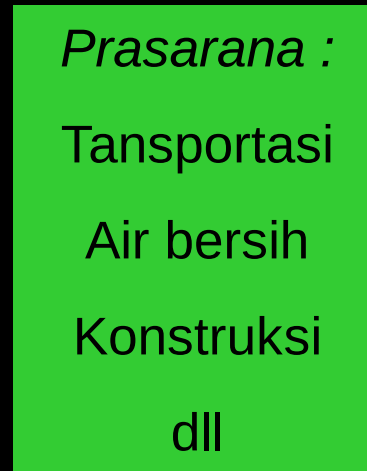
Bahan Bangunan alami



**Memanfaatkan tenaga alam
(matahari untuk pengering)**

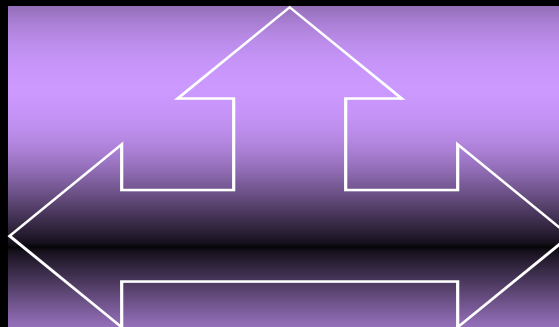


Alat modern



Cara Pengolahan Bahan bangunan

- Rangka atap kayu
- Sambungan dengan pasak
- Atap dari daun/sirap

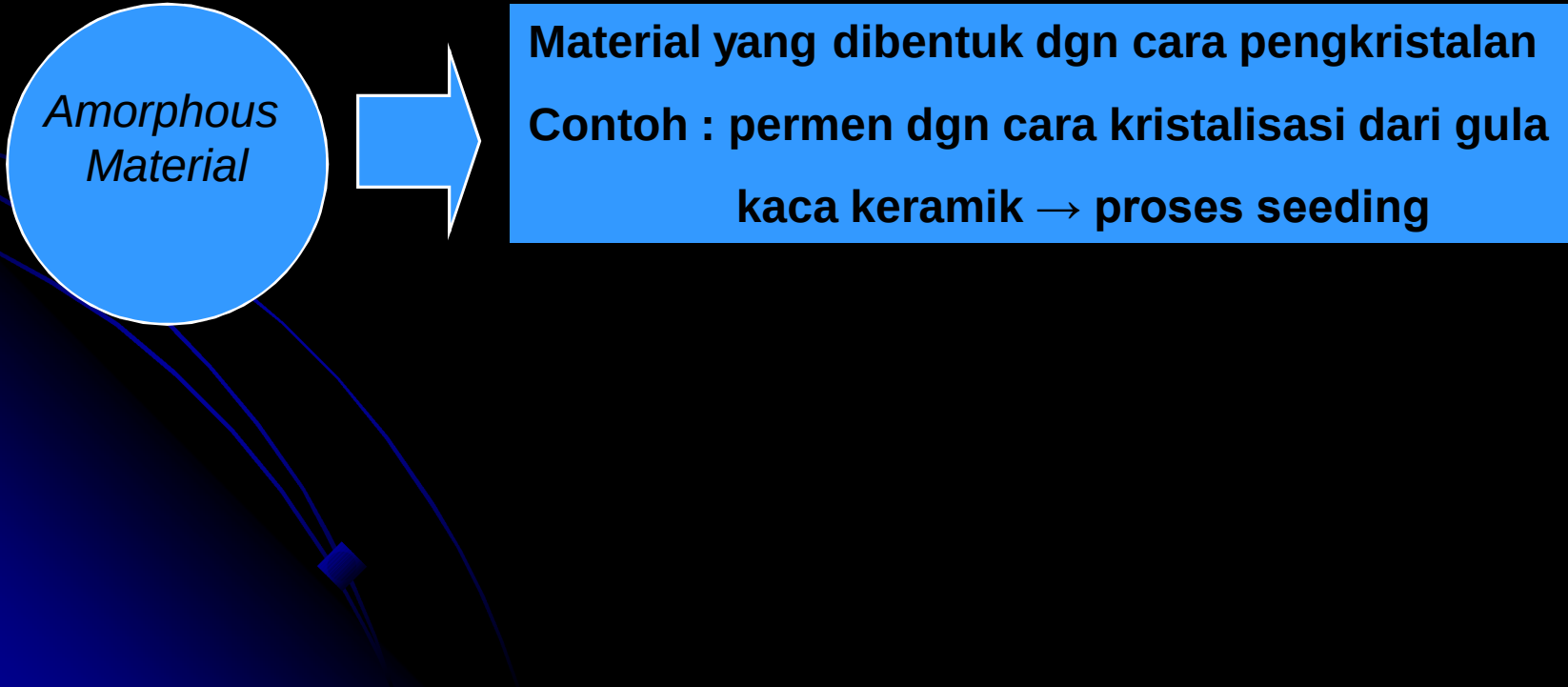


Peraturan :
Peraturan Kayu
Peraturan beton
Peraturan Baja

2. JENIS DAN TYPE MATERIAL

MATERIAL adalah sesuatu yang dibentuk dari sesuatu atau bahan yang lain

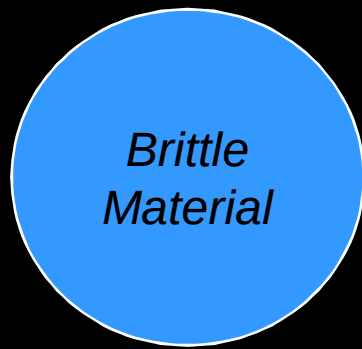
Contoh : semen, gula, aluminium, tanah dll



*Amorphous
Material*

The diagram features a blue circle on the left containing the text 'Amorphous Material'. A large blue arrow points from this circle to a blue rectangular box on the right. The box contains text describing crystallization processes and examples. In the bottom left corner, there are decorative blue curved lines with diamond-shaped markers.

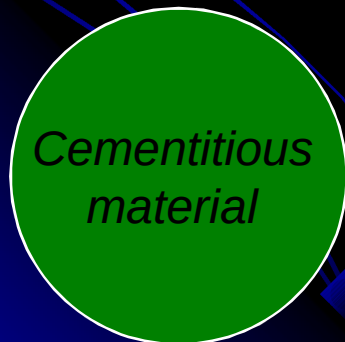
Material yang dibentuk dgn cara pengkristalan
Contoh : permen dgn cara kristalisasi dari gula
kaca keramik → proses seeding



Material yang getas (rapuh)
Contoh : beton, kaca, besi tuang



Material yang digunakan untuk pembuatan bangunan
**Contoh : smen, baja, batu bata, plastik, kayu, kaca
keramik, beton**



**Material dengan menggunakan semen (PC)
sebagai**
Pengikat utama
**Contoh : beton, grouting, roller – compacted
concrete**

*Ceramic
Material*

Material dasar dari tanah liat (clay)
Pembuatan dengan cara dibakar → keramik
Contoh : kaca, semen, batu bata

*composite
material*

Penggabungan 2 Material atau lebih
Contoh : reinforced cemen, polymer reinforced carbon
keramik, glass fibre
kayu + baja, beton + baja

*ductile
material*

Material yang akan mengalami pengurangan kekuatan bila ditarik. Biasanya diukur % pertambahan panjang atau % kehilangan luas area.

Contoh : aluminium, kayu, baja ringan

*Elastic
Material*

Kemampuan material mengalami deformasi akibat pembebanan, tanpa mengalami deformasi permanen
Contoh : pegas, karet

*Elastomeric
material*

Mirip dengan *Elastic Material* tetapi sdh ada bahan polimer, bila beban diangkat akan kembali kebentuk semula
Contoh : latex's (rubber) sebagai bahan elastomer

*Insulating
material*

Material yang didapat dari hasil isolasi, biasanya dibantu dengan proses panas (thermal)
metal : perak, aluminium, baja
Stone : granite, limestone, sandstone
Others: brick, concrete, asphalt

*Repair
Material*

Sebagai bahan pengisi sambungan → sealent
Contoh : waterproofing, asphalt, beton

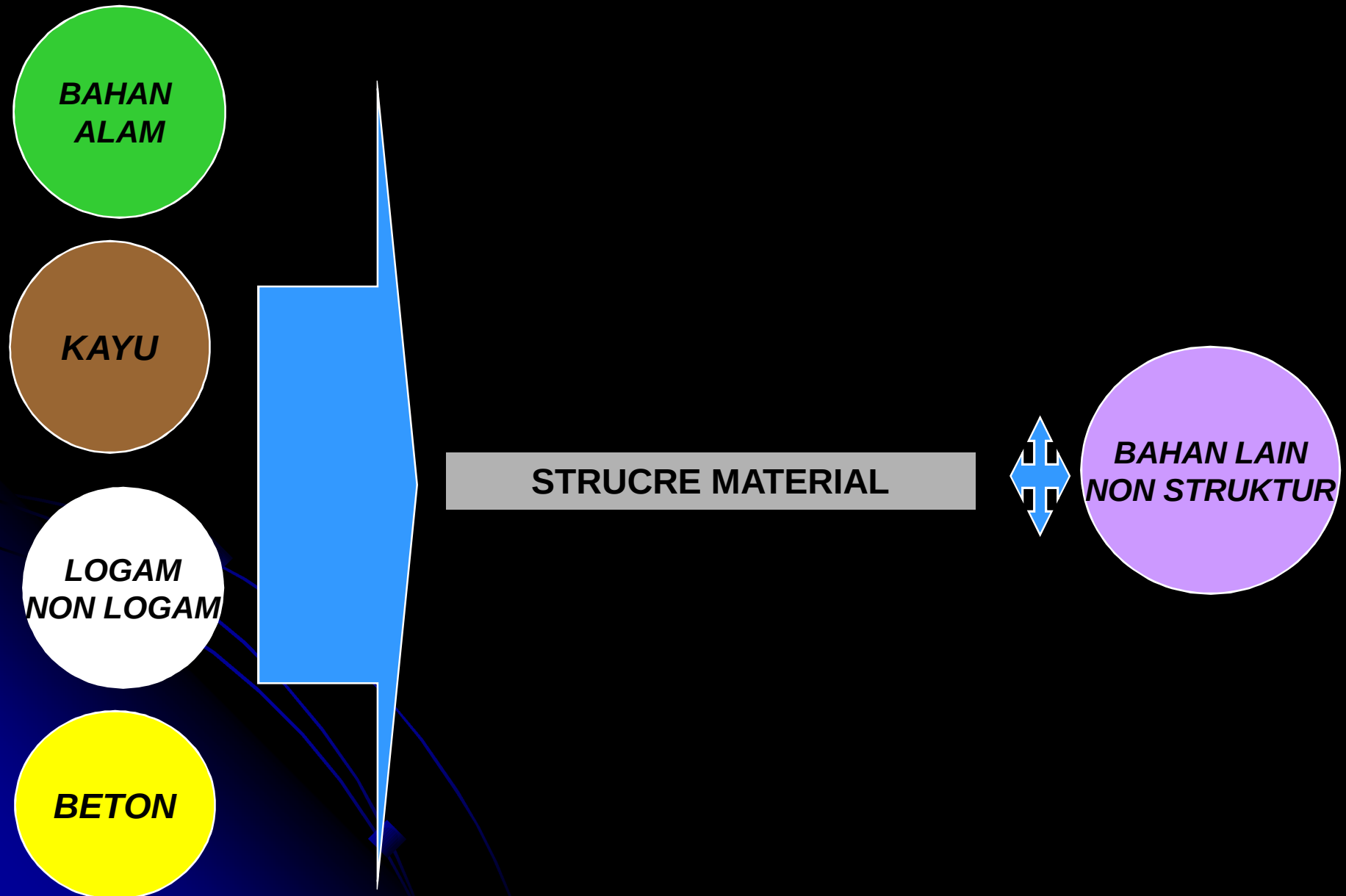
*Waste
material*

Mirip yang dihasilkan/hasil sampingan dari produksi suatu material yang terbuang
Fly ash (abu terbang → proses batu bara)
Carbondioxide (proses pemanasan tanah liat)
Sludge (lumpur)
Copersludge (proses semen)

*plastic
material*

pvc

3. MATERIAL DALAM TEKNIK SIPIL



Sifat-sifat bahan teknik pada 20 ° C

Bahan	Berat spesifik KN/m ³	Modulus Young Gpa	Tegangan maksimum kPa	Koefisien ekspansi 10e-6/ ° C	Rasio Poisson
I. Metal dalam bentuk papan, batang atau blok					
Aluminium	27	70-79	310-550	23	0.33
campuran	84	96-110	300-590	20	0.34
Kuningan	87	112-120	230-380	17	0.33
Tembaga	87	210	310-760	13	0.31
Nikel	77	195-210	550-1400	12	0.30
Baja	44	105-210	900-970	8-10	0.33
Titanium campuran					
II. Non-metal dalam bentuk papan, batang atau blok					
Beton	24	25	24-81	11	0.23
Kaca	26	48-83	70	5-11	
III. Bahan dengan filamen (diameter < 0.025 mm)					
Aluminium oksida	38	690-2410	13800-		
Barium carbide	25	450	27600		
Kaca	22	345	6900		
Grafit		980	7000-20000 20000		
IV. Bahan komposit (campuran)					
Boron epoksi	19	210	1365	4.5	
Kaca-S diperkuat epoksi	21	66.2	1900		

3. PROPERTIES OF ENGINEERING MATERIAL

UNTUK HIGWAY BRIDGE

- Cukup kuat
- Pertimbangan permukaan
- Cukup kaku

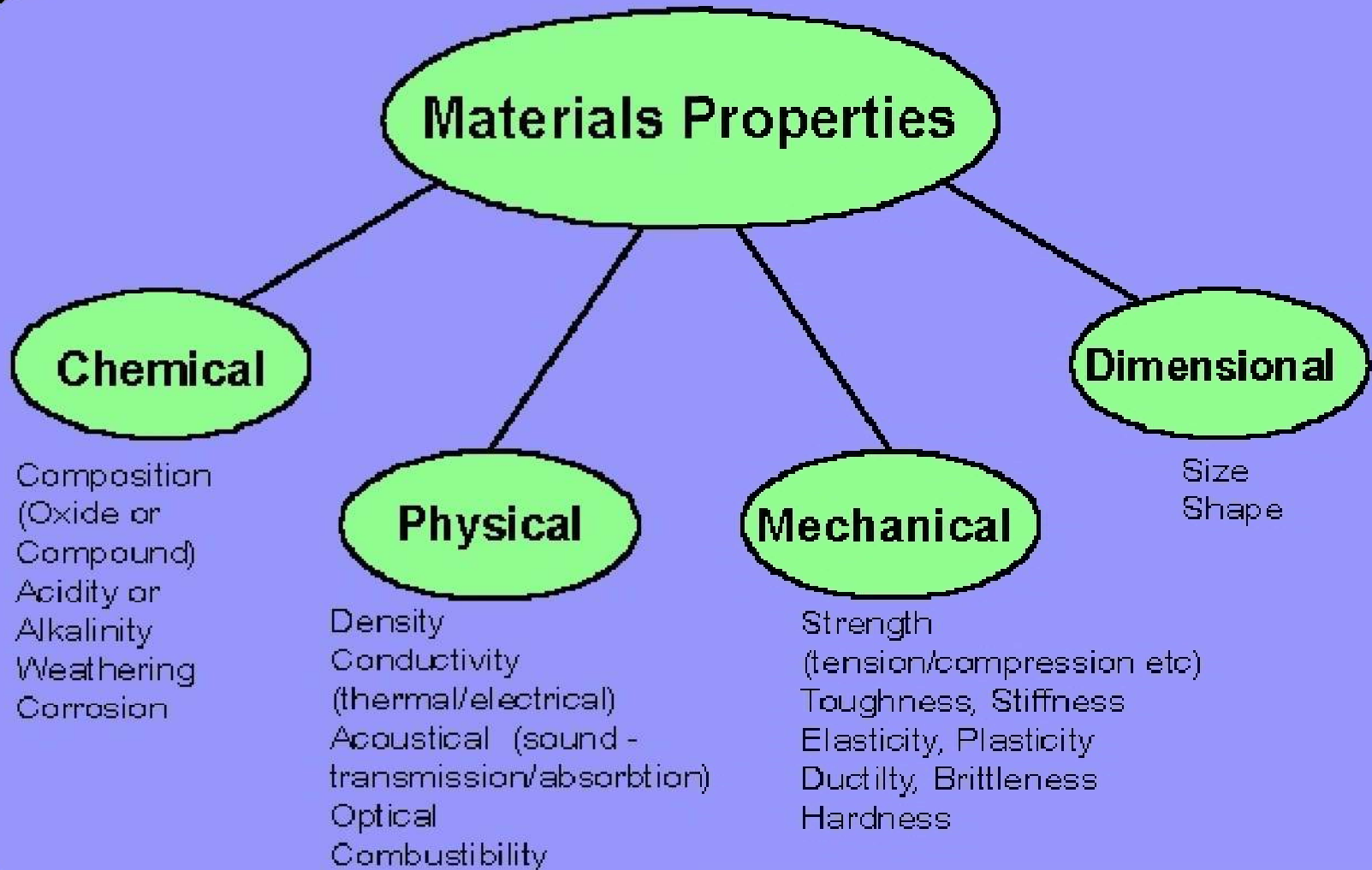
UNTUK WATER-RETAININGWALL

- Impermeable
- Crack - free
- Kuat
- Tidak bereaksi dengan air

UNTUK JALAN

- Little movement bila dibebani
- Tahan air
- Mudah diperbaiki

MATERIALS PROPERTIES :



Secara garis besar :

- **PHYSICAL PROPERTIES** (bentuk, warna ...)
- **MECHANICAL PROPERTIES** (tekanan, tarikan, geser.....)
- **CHEMICAL PROPERTIES** (kandungan bahan kimia...)

PHYSICAL PROPERTIES :

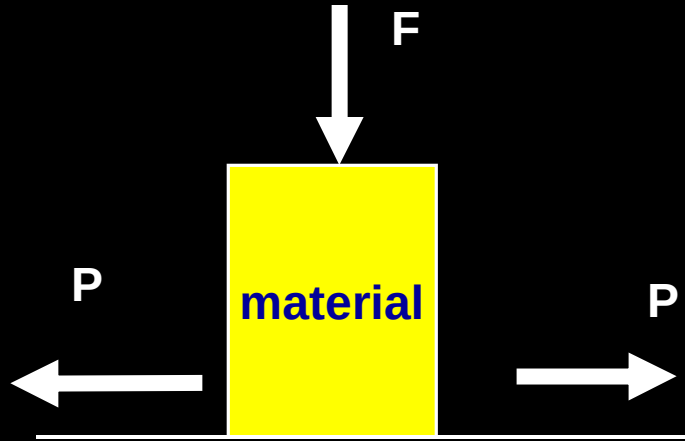
- Density, porositas, void content, specific gravity,
- Permeability, bentuk, warna, berat

MECHANICAL PROPERTIES :

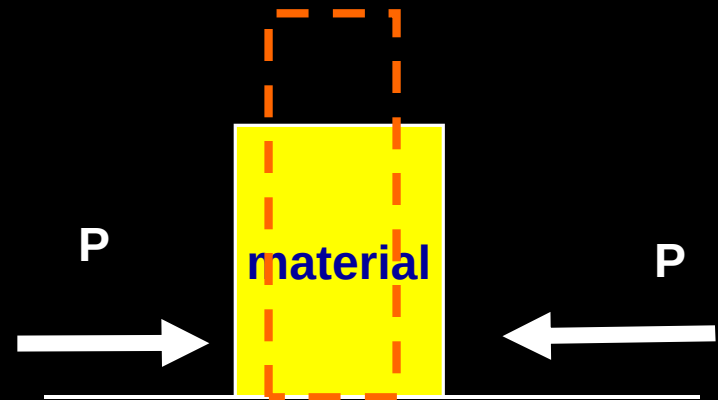
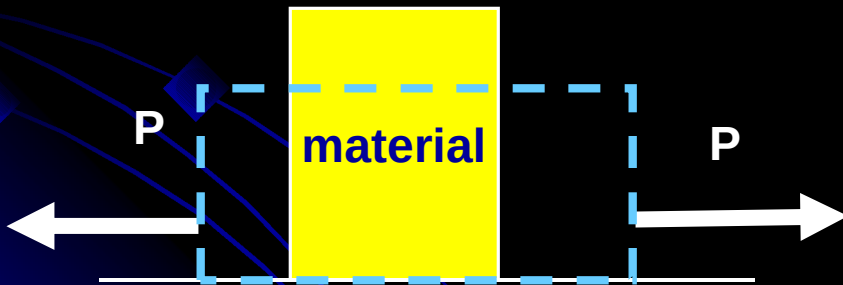
- Load, force, strength of material
- Deformation, kekakuan (EI)

MECHANICAL PROPERTIES :

Beban max → tarik, tekan, geser, torsi, tumbukan (impact)

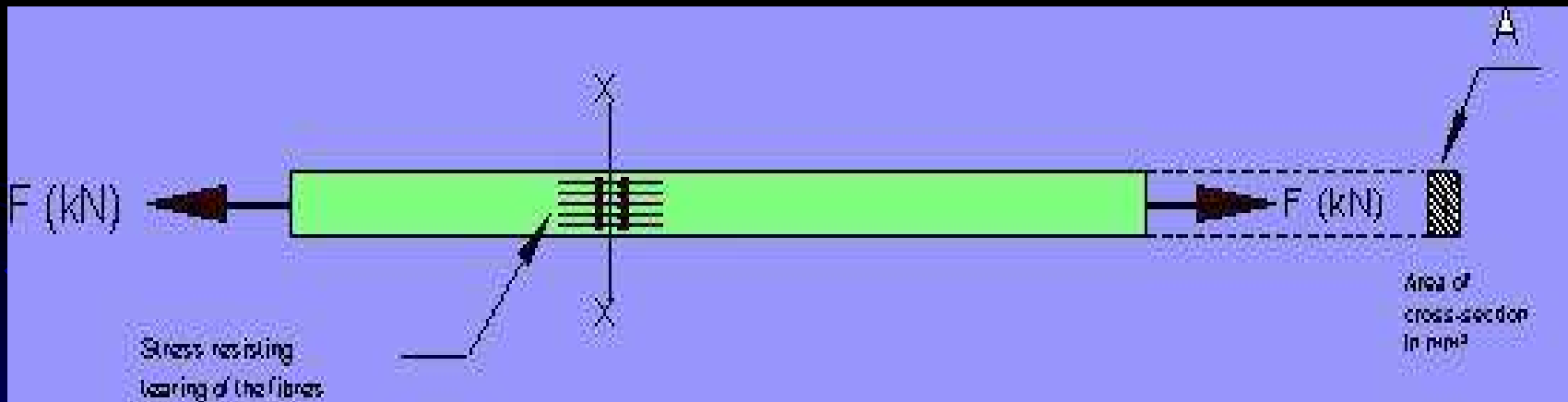


MECHANICAL PROPERTIES :



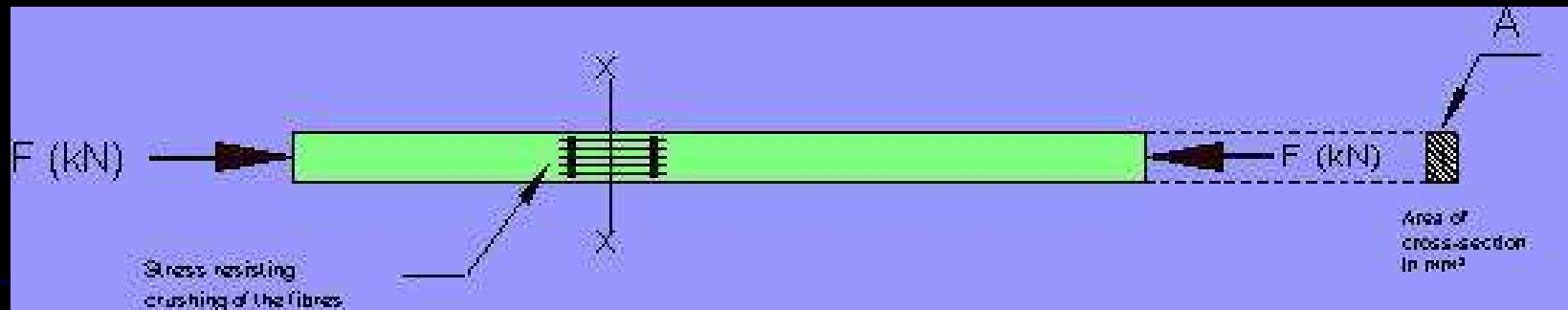
Tensile stress

The steel bar shown below has a cross section area A (mm^2) and is pulled out at each end by forces F . (Note that the total force in the member is F kN not $2F$ kN. At the plane $x-x$ there exists a state of stress between the fibres on one side of plane $x-x$ and those on the other.



Compressive stress

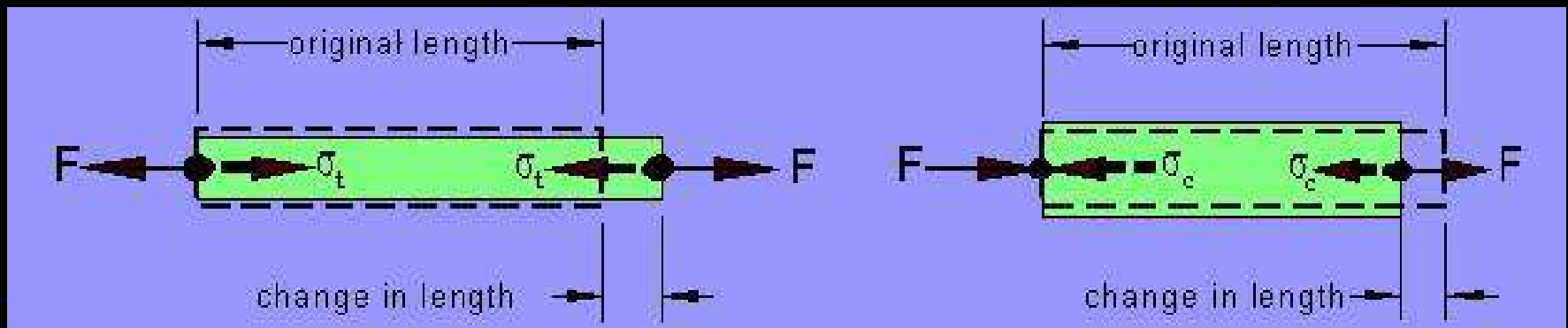
Compressive stress is similar to the tension stress but the forces acting towards each other putting the bar in compression. Here the cross section is resisting the tendency of the fibres to be crushed



Strain: deformation or change in shape of a material caused by an external loading. Strain is the ratio of the change in length (Δl) per unit length (or original length (l_o)).

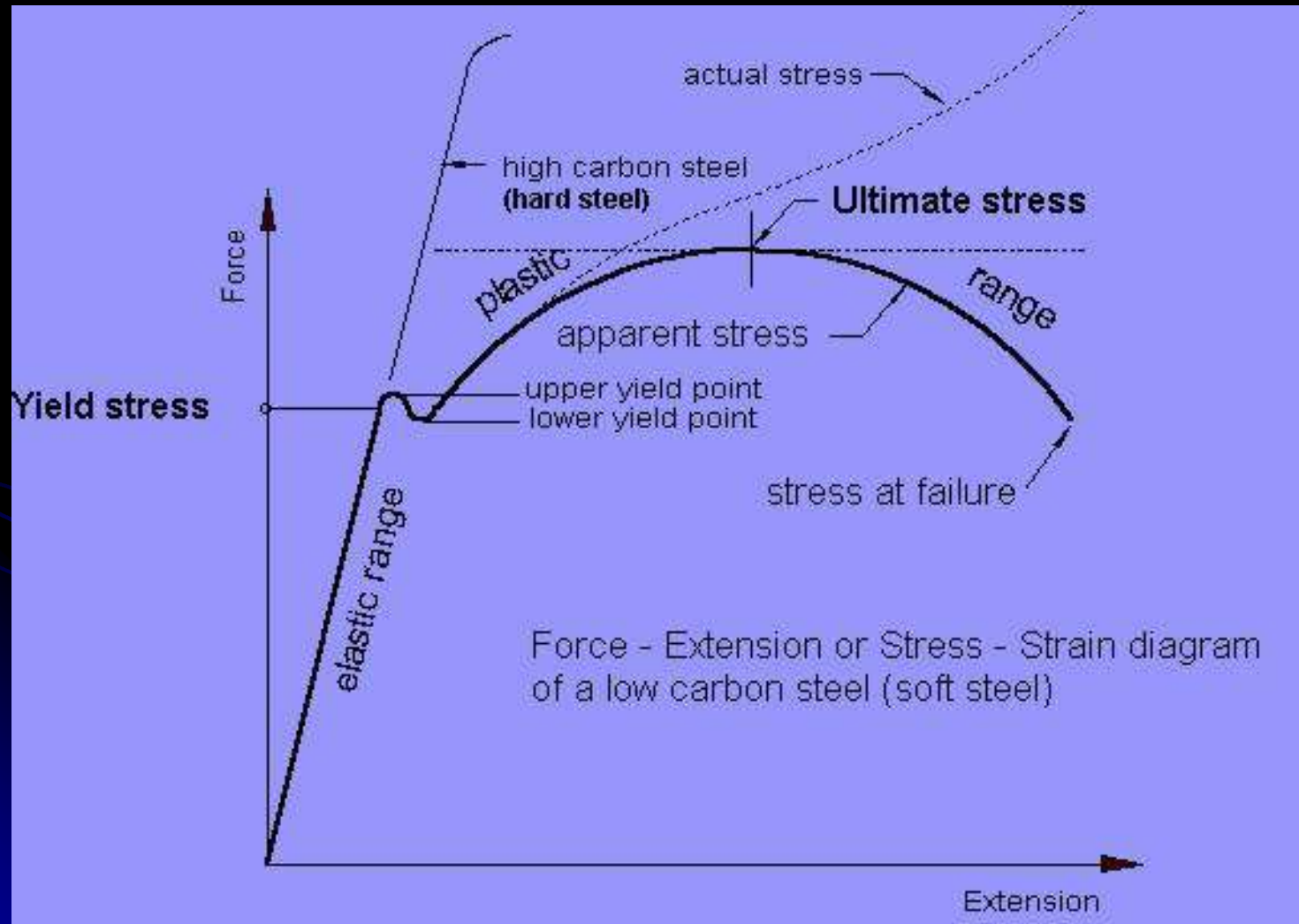
Elasticity

All material bodies will deform. As the stress increased the deformation also increases and if the load on the material is removed at any stage up to the elastic limit it will return to its original shape and dimension (original length).



Modulus of elasticity

In a tensile test a graph is produced of stress against strain as the load is gradually applied. The first portion of the graph will be a straight line



The slope of this straight line is the constant of proportionality known as the **MODULUS OF ELASTICITY**

$$\text{modulus of elasticity} = \frac{\text{stress}}{\text{strain}}$$

where

$$E = \frac{\sigma}{\varepsilon} = \frac{\frac{F}{A}}{\frac{\Delta l}{l_o}} = \frac{F \times l_o}{A \times \Delta l}$$

F = applied axial force

l_o = original length

A = area of cross-section

Δl = change in length

E = modulus of elasticity

Example 1

With the right equipment in a laboratory a technician can test a metal bar to find the modulus of elasticity. Assume a low carbon (mild) steel bar of 10mm diameter, original length 50 mm (standard test length) was tested and the following data were obtained:

The extensometer reading was $\Delta l = 62.1 \mu\text{m}$ (0.0621 mm) when the load was exactly 20 kN

Solution

By using the above formula we are now able to calculate the modulus of elasticity (E).

First we have to find the cross-sectional area of the 10 mm diameter steel bar. Using the formula shown in the above example, the area is 78.54 mm².

Now we have all figures to calculate the modulus of elasticity

$$A = \pi \times R^2$$

or

$$= \frac{\pi \times D^2}{4}$$

$$(D = 2R)$$

$$E = \frac{F \times l_o}{A \times \Delta l}$$

$$= \frac{20 \times 10^3 \times 50}{78.54 \times 0.0621}$$

$$= 205,030 \text{ MPa}$$

$$\text{or } = \underline{\underline{205 \text{ GPa}}}$$

Example 2

Determine the increase in length of a steel rod four (4) metre long and 20 mm diameter when subjected to a tensile force of 85 kN. (modulus of elasticity = 200 Gpa)

Solution

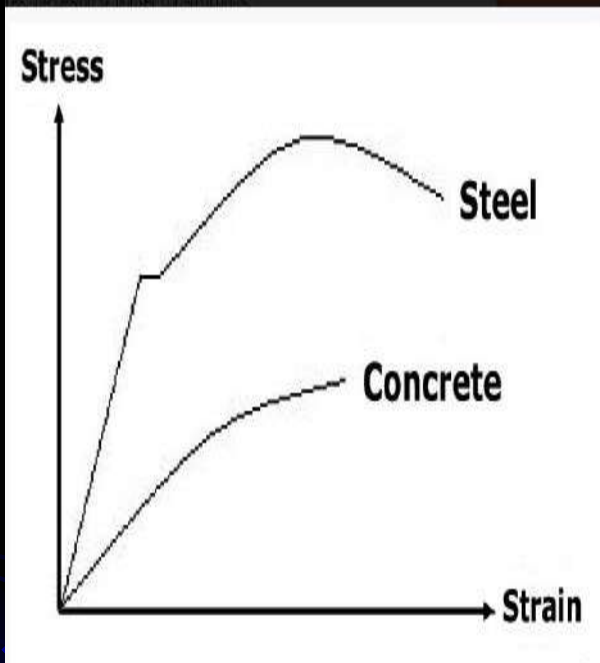
Area of cross

$$\begin{aligned} A &= \frac{D^2}{4} \times \pi \\ &= \frac{20^2}{4} \times \pi \\ &= 314 \text{ mm}^2 \end{aligned}$$

$$\begin{aligned} E &= \frac{\sigma}{\epsilon} = \frac{\frac{F}{A}}{\frac{\Delta l}{l_o}} \\ &= \frac{F \times l_o}{A \times \Delta l} \end{aligned}$$

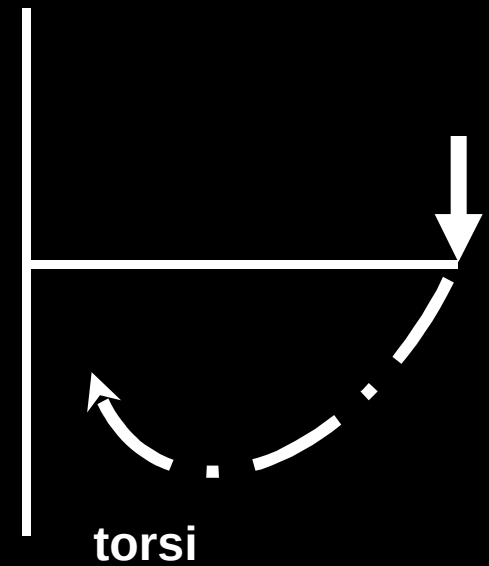
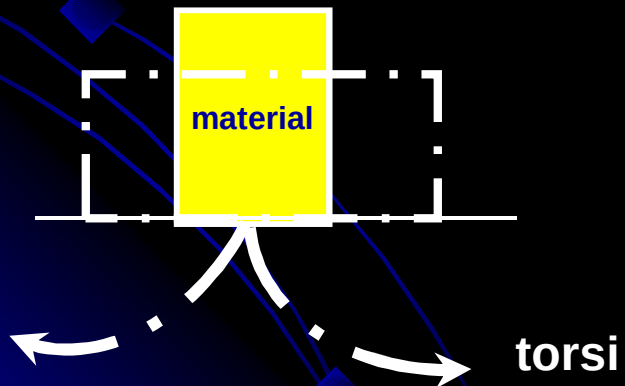
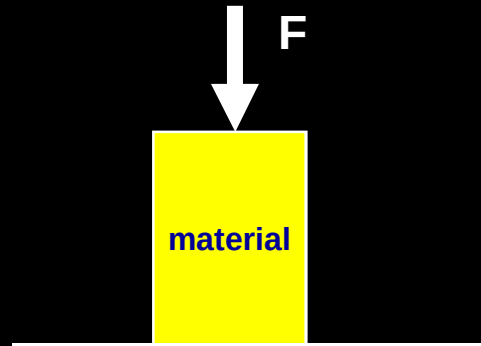
Re-arranging the equation from above and making Δl to the subject of the formula:

$$\begin{aligned} \Delta l &= \frac{F \times l_o}{A \times E} \\ &= \frac{85 \times 10^3 \times 4000}{314 \times 200 \times 10^3} \\ &= 5.4 \text{ mm} \end{aligned}$$

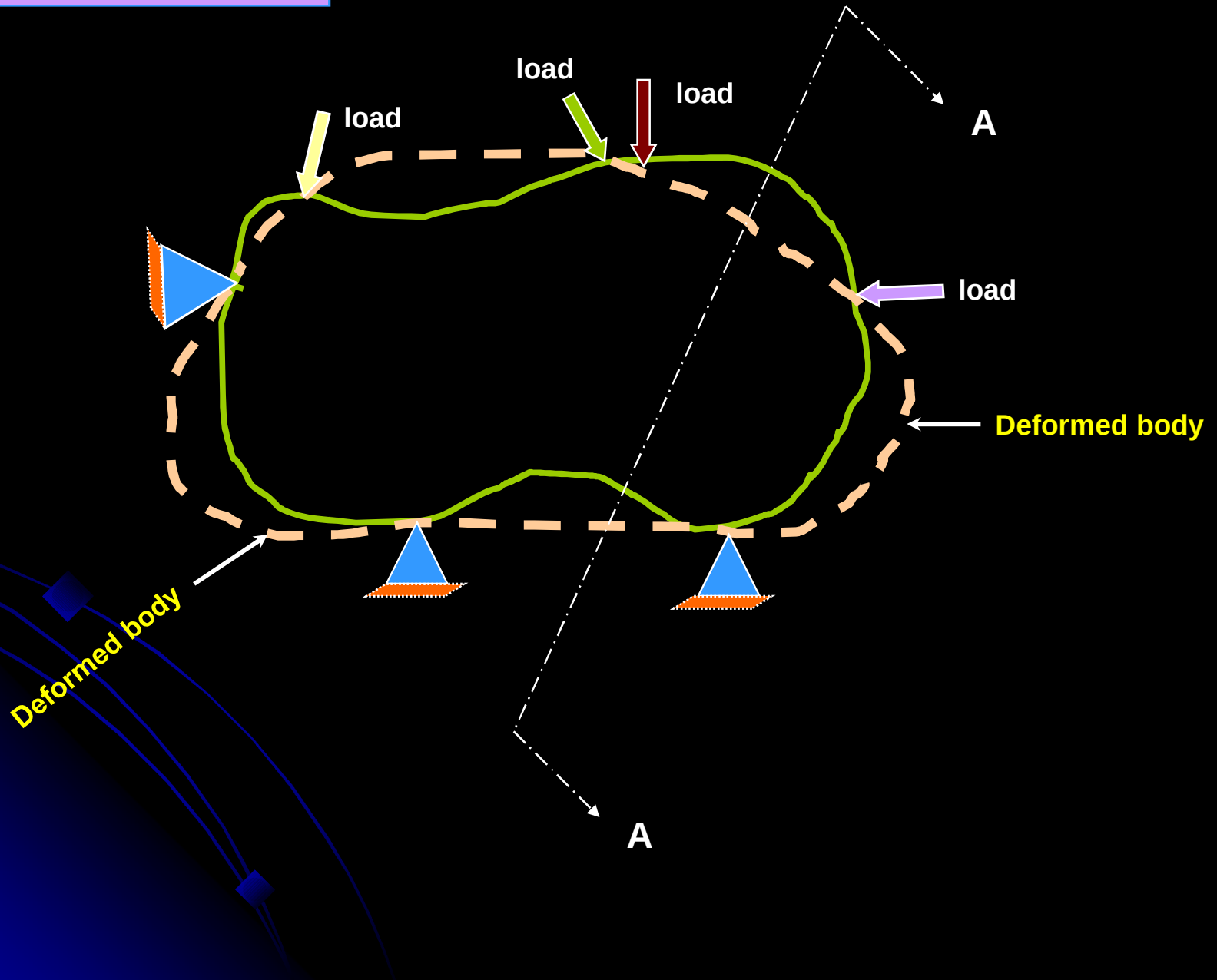


Material	Concrete	Steel
Specific gravity(kn/m ³)	2.00	7.66
Tensile strength 	10	509
Compressive strength 	100	445
Flexural Strength 	7	182

MECHANICAL PROPERTIES :



Pembebanan material

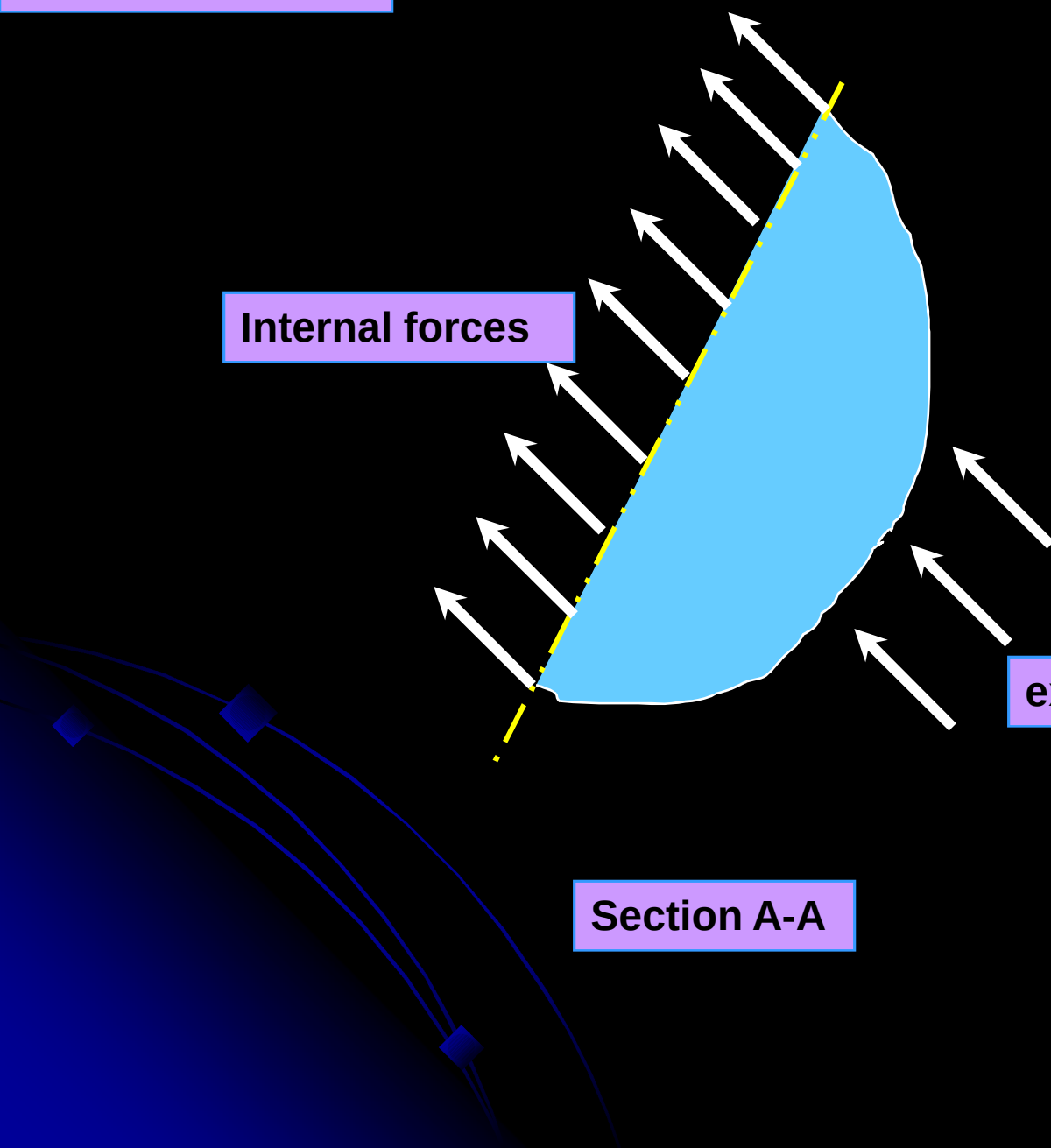


pembebanan

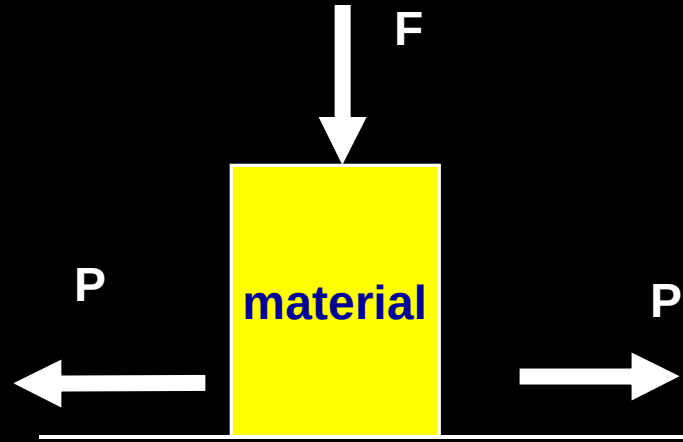
Internal forces

external forces

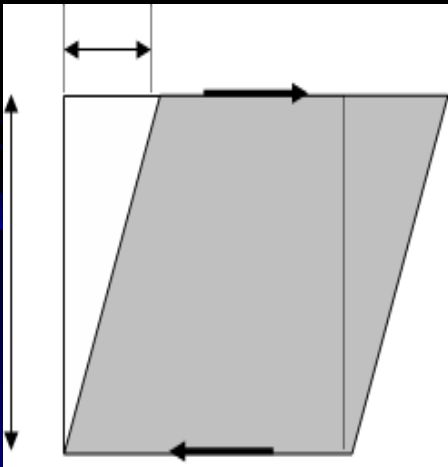
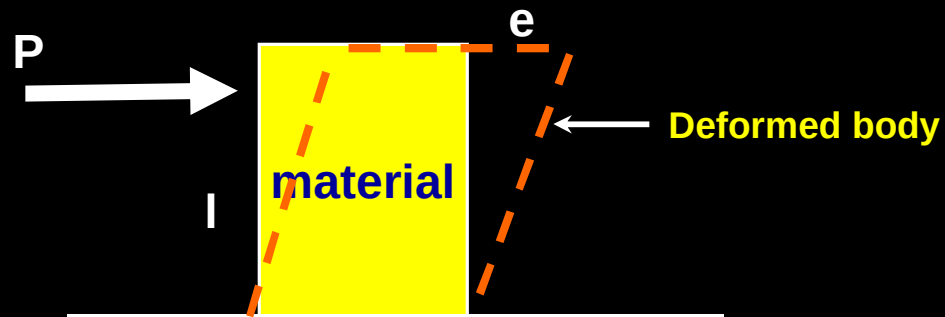
Section A-A



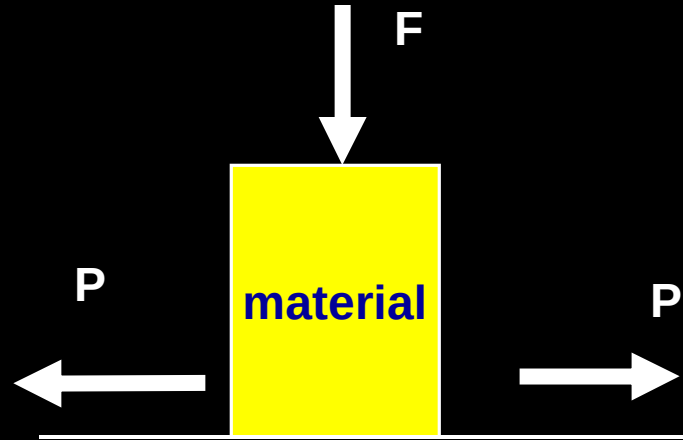
DEFORMASI



Shear force



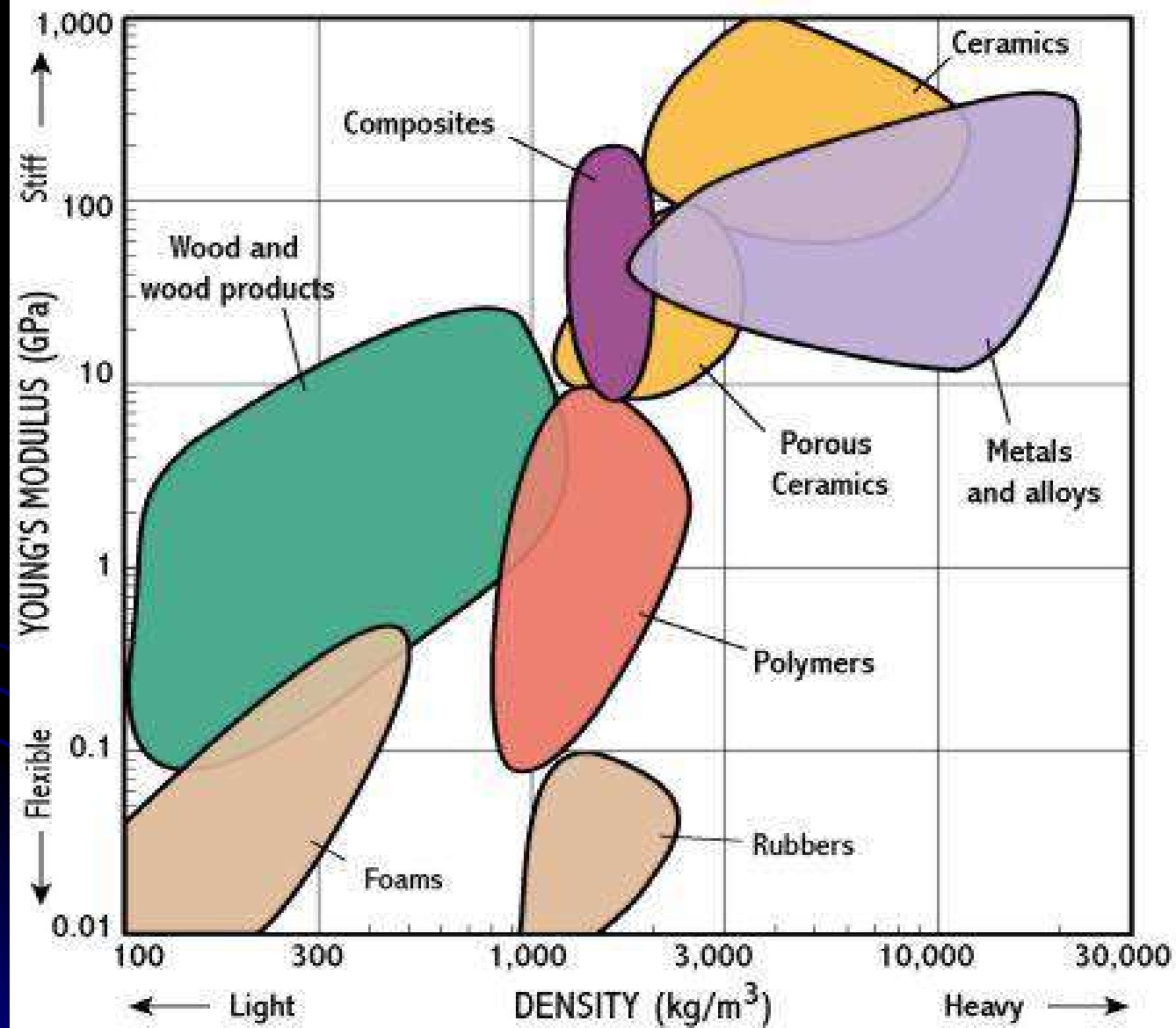
DEFORMASI

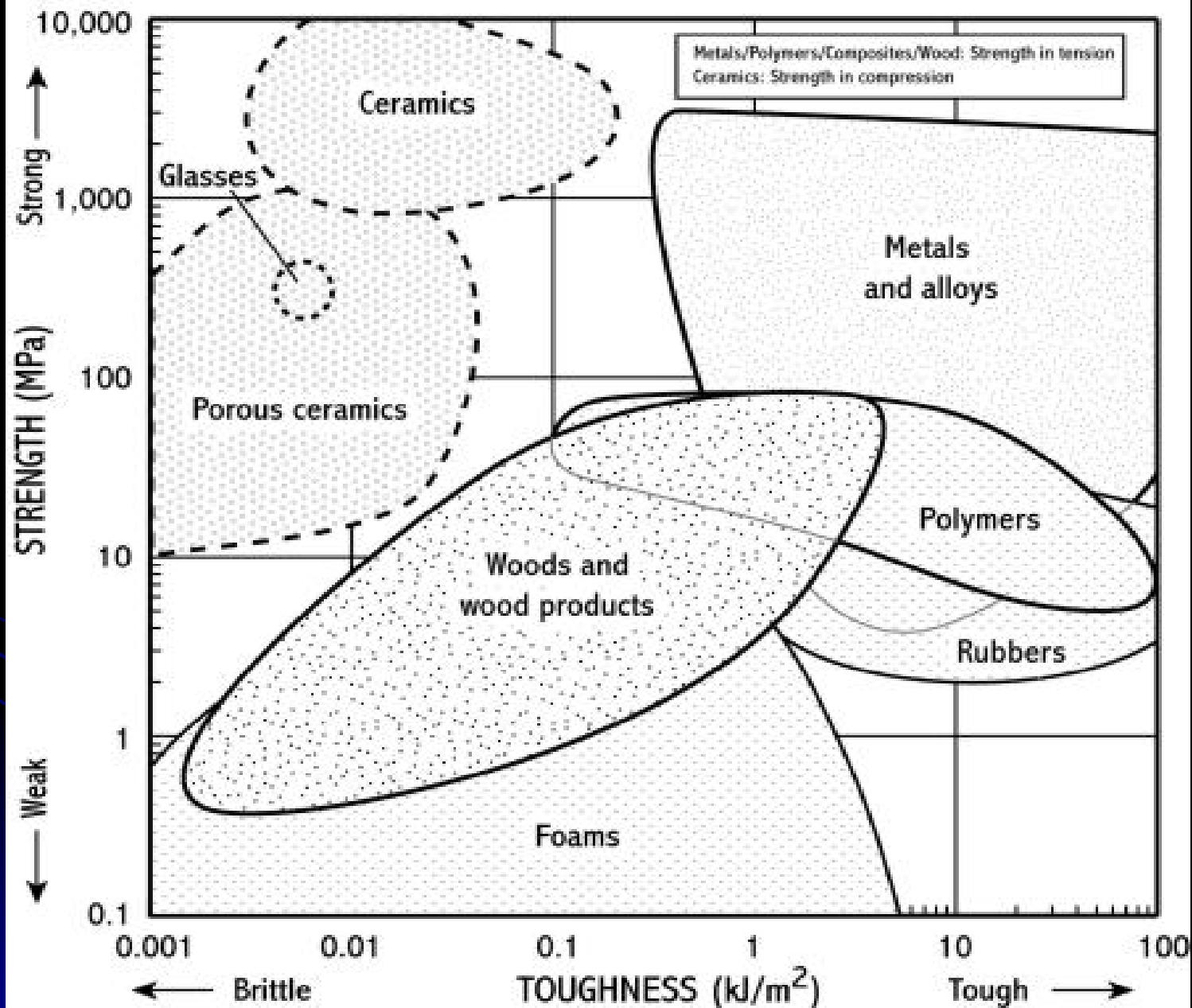


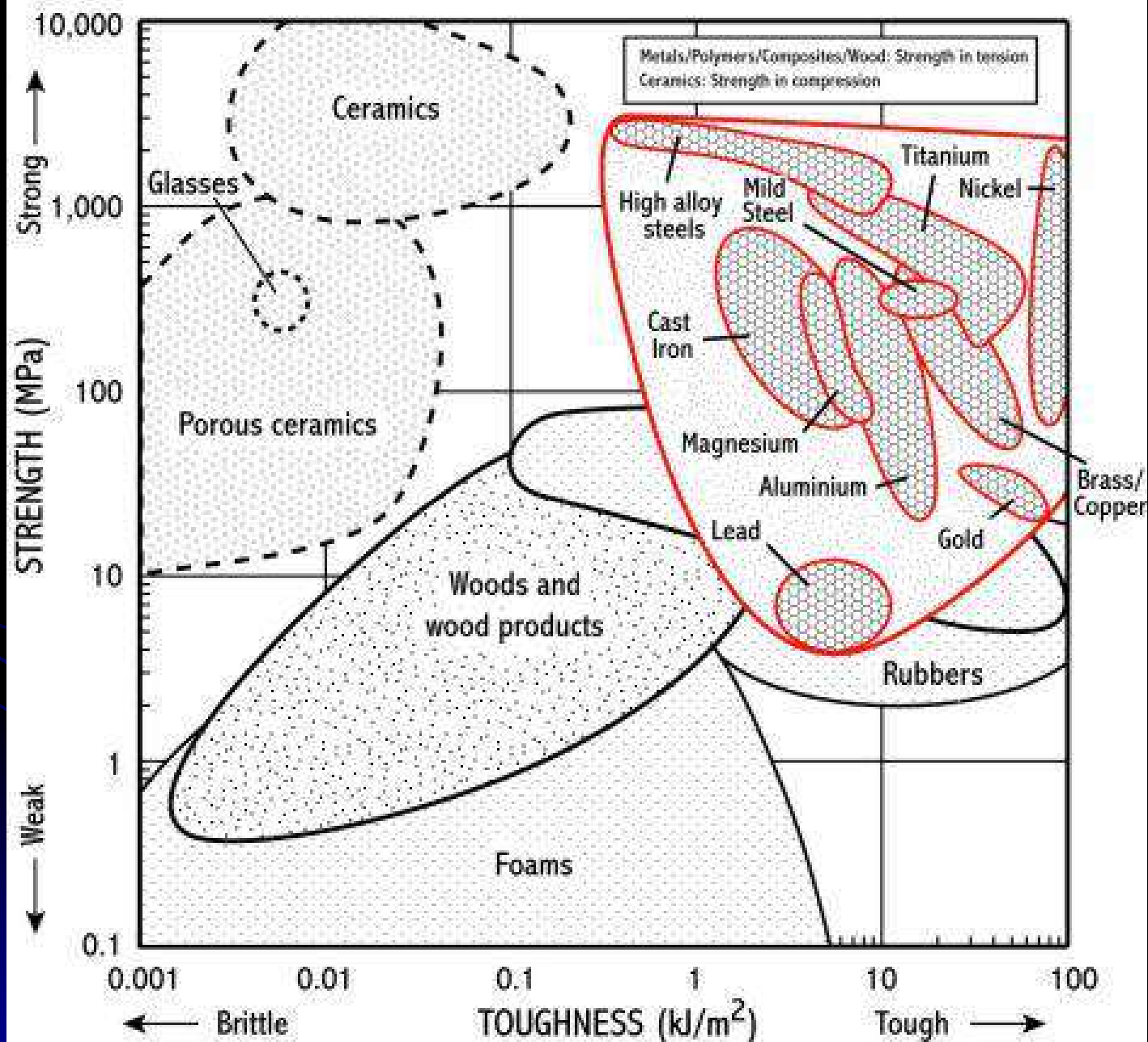
Axial force

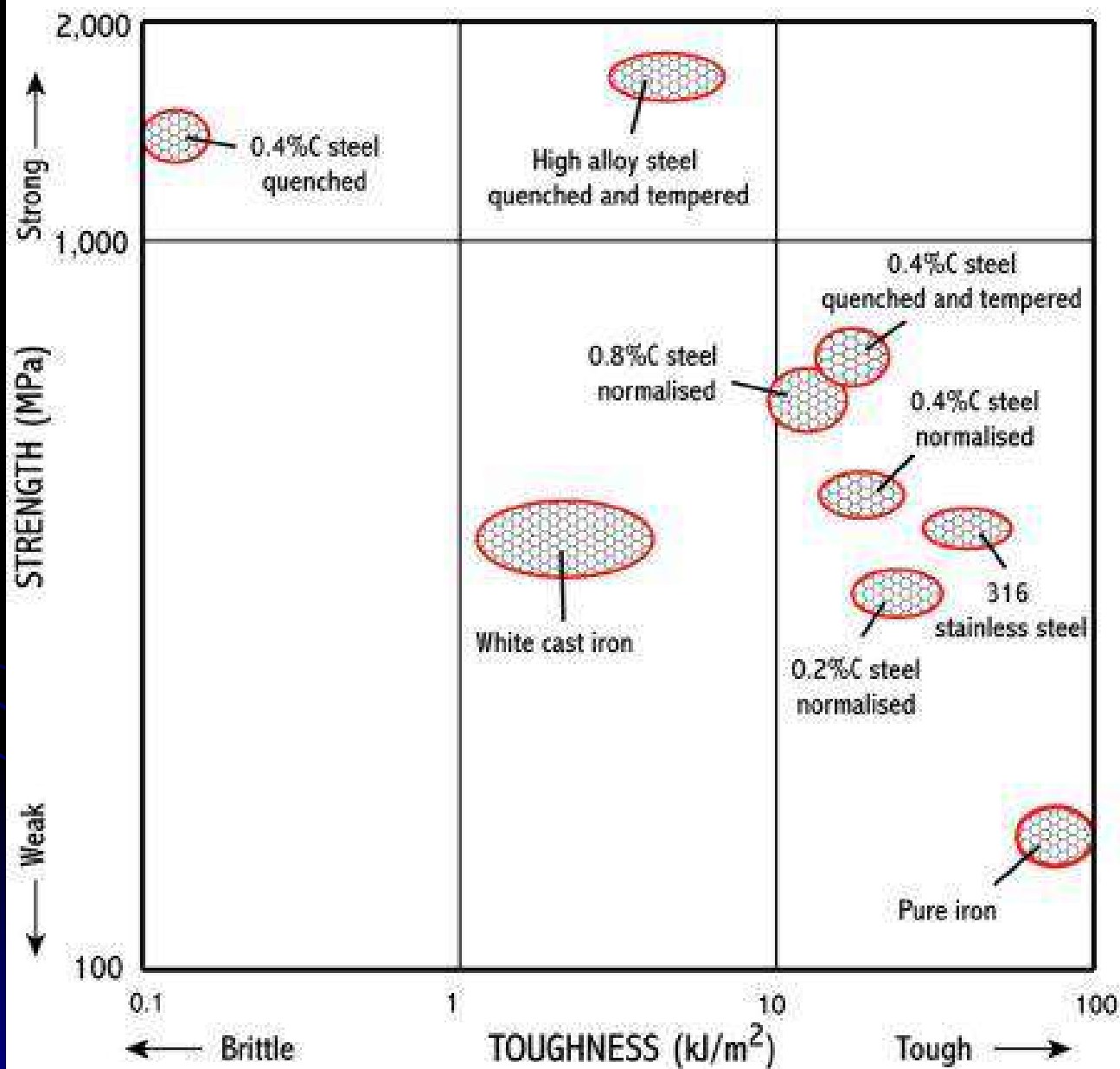


Deformed body

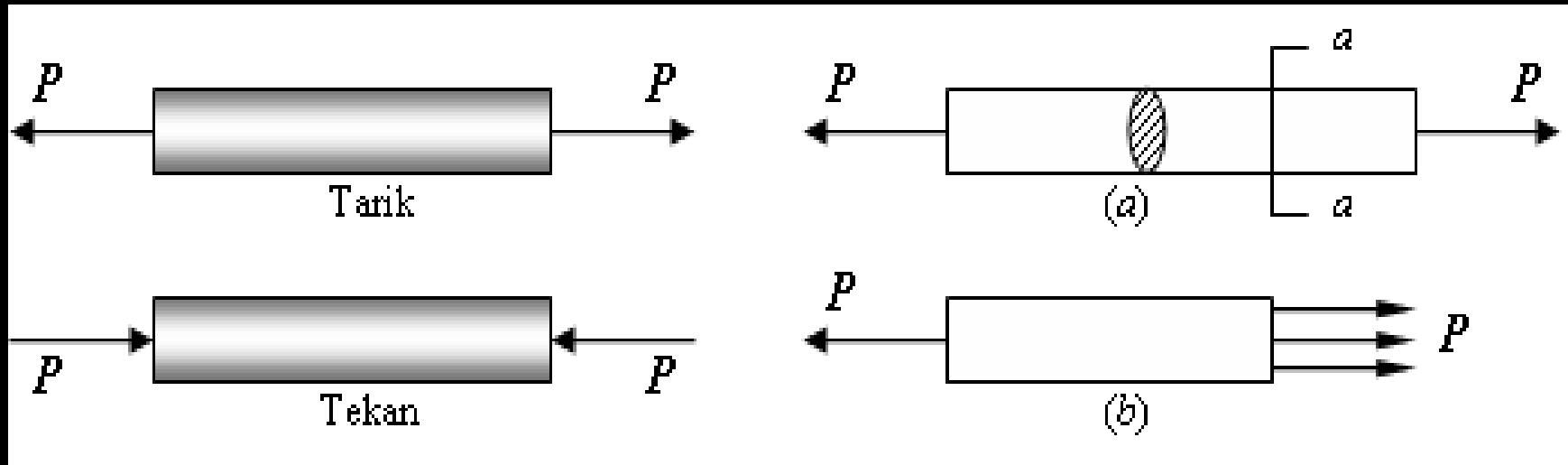




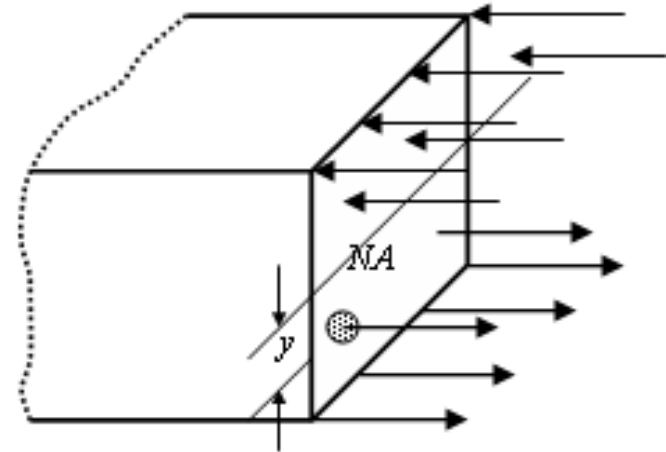
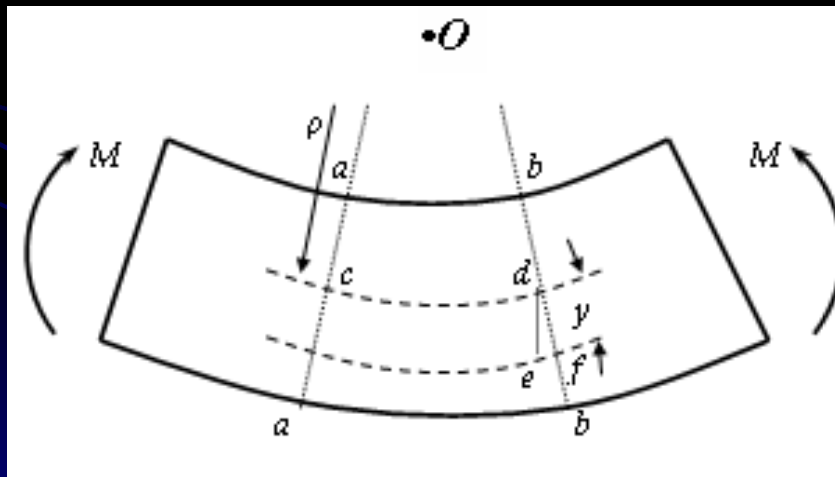
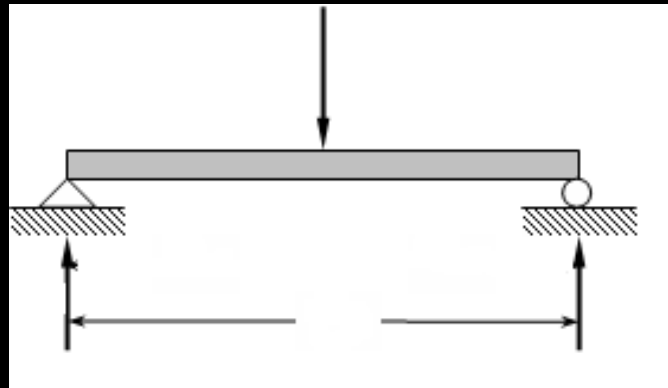




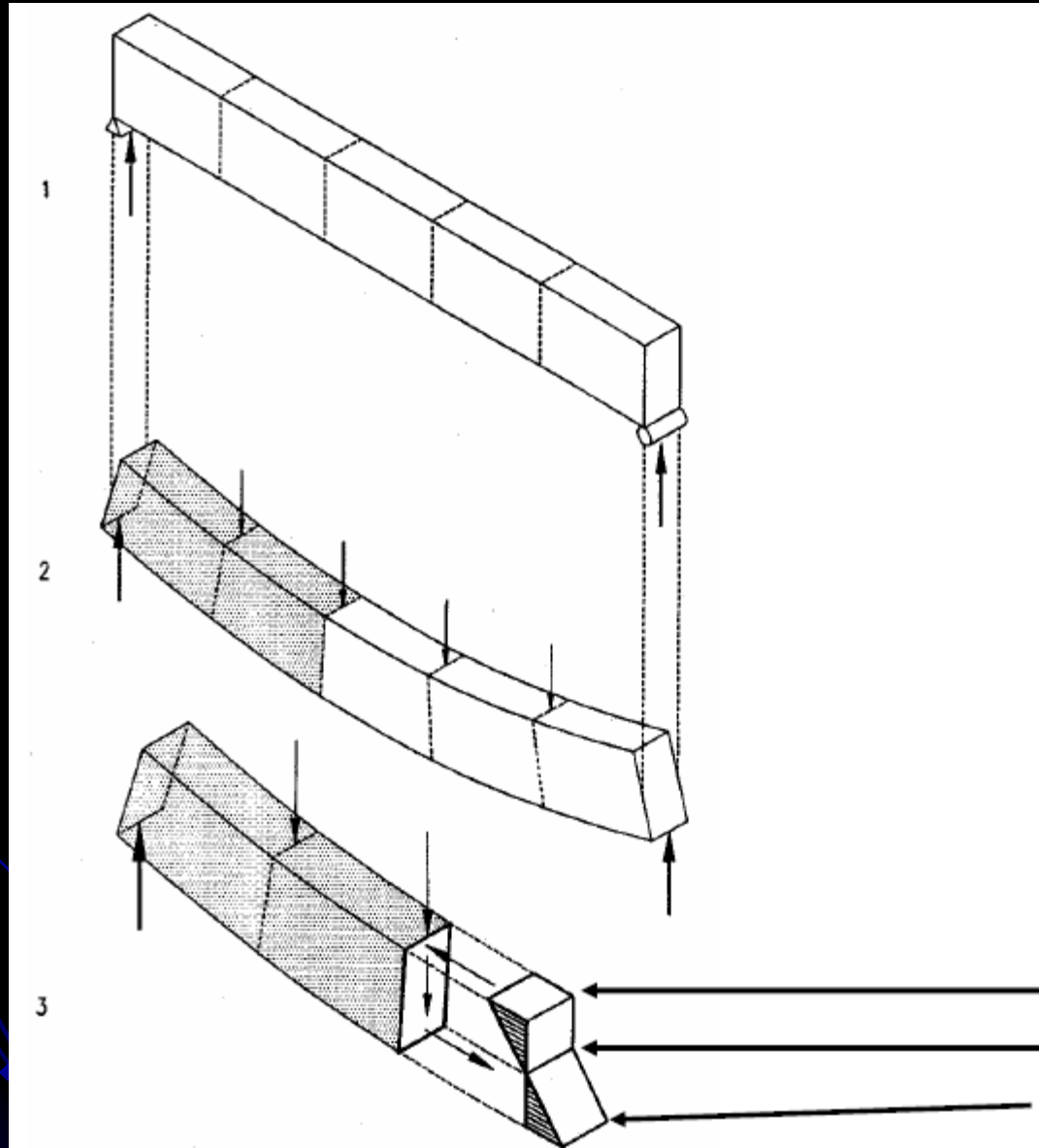
AXIAL



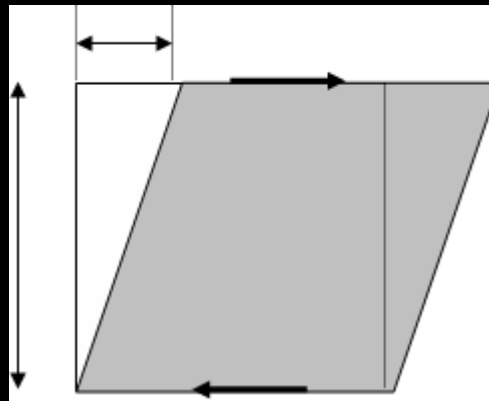
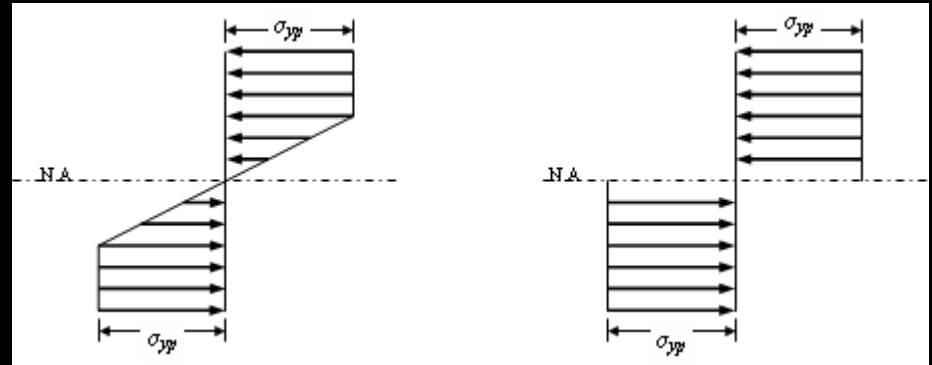
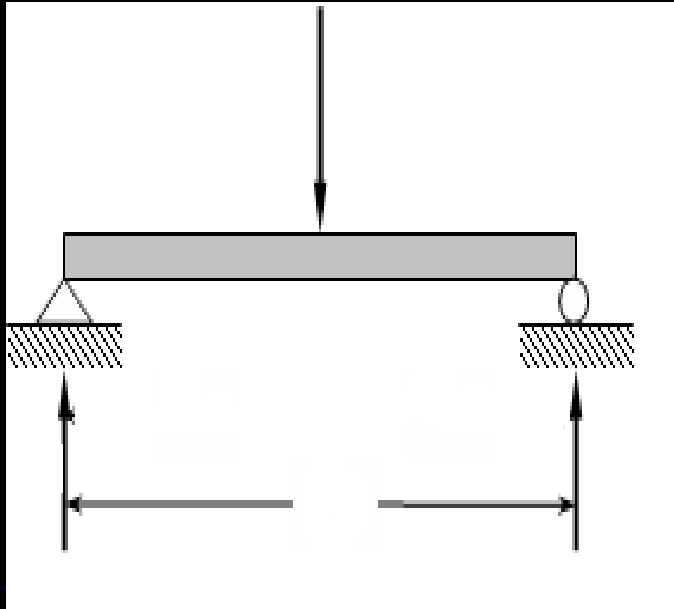
BENDING STRESSES



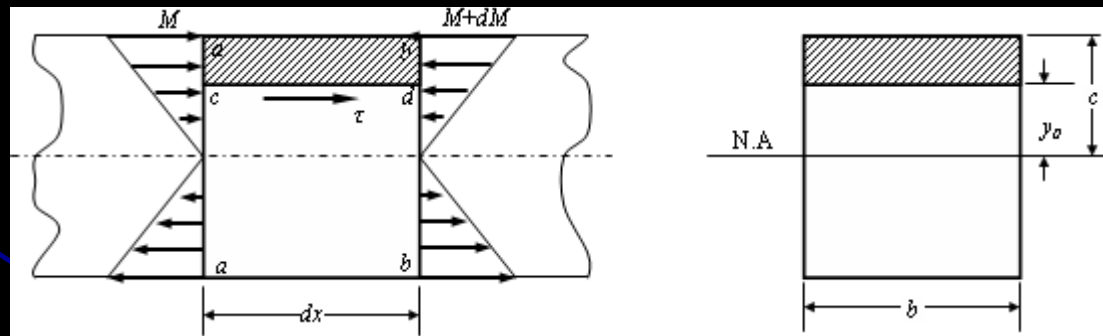
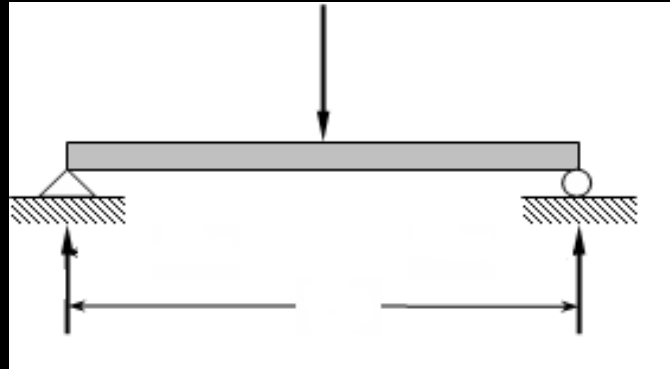
BENDING STRESSES

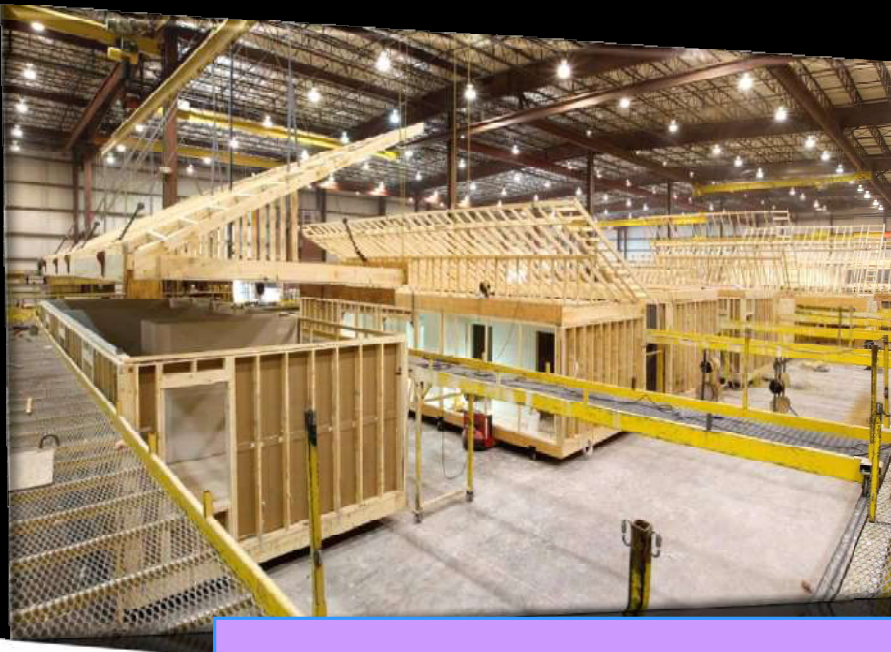


BENDING STRESSES



BENDING STRESSES





NEXT.....

Bahan Alam

