Technical English
Unit 31
professional english
Force, deformation and failure

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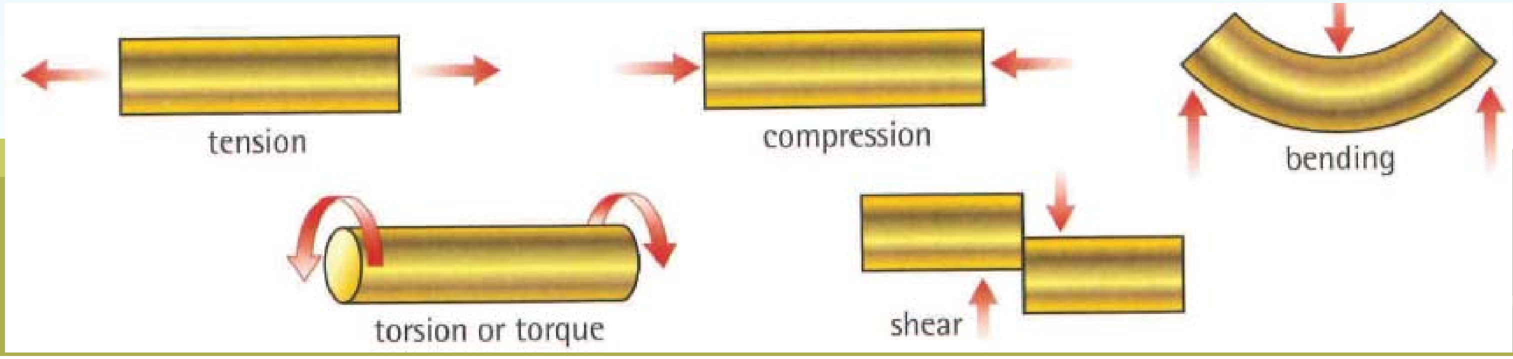
Contentes

A. Types of force and deformation

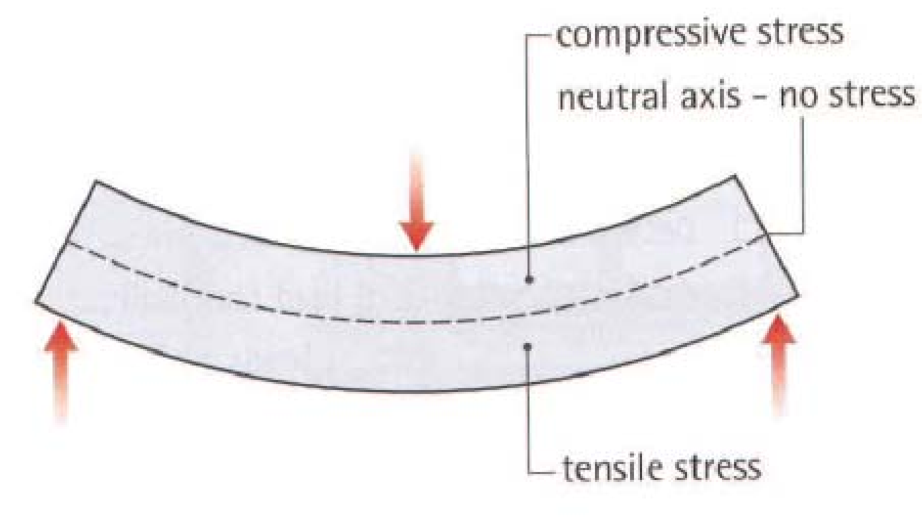
B. Types of failure

A Types of force and deformation

Non-technical word	Technical term (noun)	Adjective used with the nouns *stress*, *load* and *force*	Initial deformation of component or member
stretching	**tension**	**tensile** stress	It will **extend** (lengthen).
squashing	**compression**	**compressive** stress	It will **compress** (shorten).
bending	**bending**	**bending** stress	It will **bend** – we can also say it will **deflect** or **flex**. Beams usually **sag**, deflecting downwards. In some cases **deflection** or **flexure** is upward – the beam **hogs**.
scissoring	**shear** or **shearing**	**shear** stress	It will deform very little, failing suddenly.
twisting	**torsion** or **torque**	**torsional** stress	It will **twist**.



Bending comprises two opposite stresses: tension and compression. This is shown in the diagram of a **simply supported beam**. As a result of the bending force, the lower half of the beam is **in tension** and the upper half is in **compression**. These opposite stresses reach their maximum at the upper and lower surfaces of the beam, and progressively decrease to zero at the **neutral axis** - an imaginary line along the centre of the beam which is free from stress.



A simply supported beam

B. Types of failure

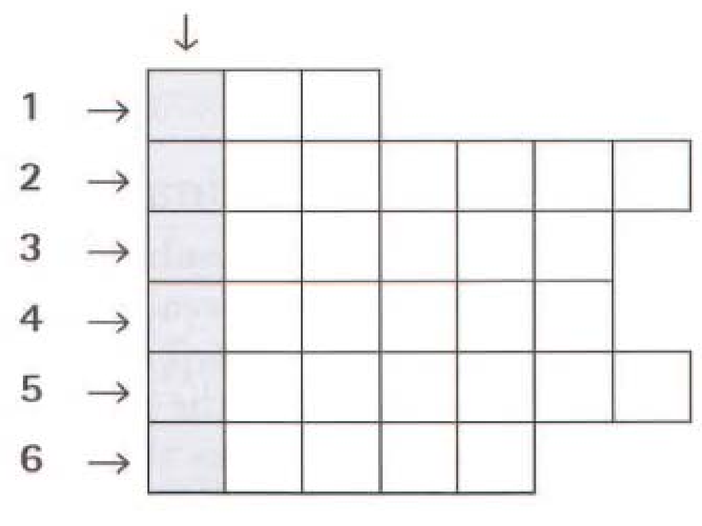
The ultimate failure of a component or **structural member** depends on the type of force:

- in tension - it will **fracture**
- in compression- if it is thick, it will **crush (squash**). If it is **slender** (long and thin), it will **buckle**, bending out of shape
- **in bending** - it will fracture on the side of the component which is in tension, or crush on the side which is in compression- or fail due to a combination of both
- **in shear**- it will **shear** (break due to shear force)
- **in torsion** - it will fracture or shear.

When vertical members can no longer **resist** a load they either crush or buckle.

31.1 Complete the word puzzle and find the word going down the page.

1. bend downwards
2. a twisting force
3. take a force without breaking
4. increase in length, due to tension
5. long and thin, likely to buckle rather than crush
6. a scissoring force



31.1

	↓						
1 →	S	A	G				
2 →	T	O	R	S	I	O	N
3 →	R	E	S	I	S	T	
4 →	E	X	T	E	N	D	
5 →	S	L	E	N	D	E	R
6 →	S	H	E	A	R		

31.2 The question below, which was posted on a forum on a construction website, contains a mistake about a technical fact. Can you find the mistake? Look at A opposite to help you.

Post 1:

I was under the impression that concrete and steel bars were used together in reinforced concrete (RC) because concrete is good at resisting compression and poor at resisting tension, whereas steel is strong in tension. I also thought the steel always went at the bottom of an RC beam because that's the part that's in tension, whereas the top of the beam is free from stress. But if that's the case, when you see reinforcement being fixed in big RC beams, why are there bars both at the bottom and at the top?

31.2 Mistake = '... the top of the beam is free from stress'. The top of the beam is in compression. The part of the beam which is free from stress is the neutral axis along the centreline of the beam.

31.2 Now complete a structural engineer's answer to the question in 31.2 using the words in the box.

bending	compressive	deflect	fracturing	neutral	tensile
compression	crushing	deflection	hog	sag	tension

Replies to post 1:

Let me start by clarifying something. When a beam is subjected to (1) .... stress, the bottom part is generally in tension, as you rightly say. But the top part is not 'free from stress', as you suggest. It's in (2) .... Only the horizontal centreline of the beam – a zone called the (3) .... axis – is not stressed. It's also important to be clear about the strengths of concrete and steel. You're right that concrete is poor at resisting (4) .... stress as it's prone to failure by (5) .... suddenly. It's also true that concrete is good at resisting (6) .... stress. But steel is much stronger than concrete, not just in (7) .... as you point out, but also when it's compressed. So steel is often put in the tops of beams in cases where the beam is subjected to high levels of compression, meaning that the concrete requires reinforcing to prevent it from (8) ... and failing.

Another possible reason for
you get tension in the top of
downwards because gravity
of the beam in tension. But i
want to (11) ....

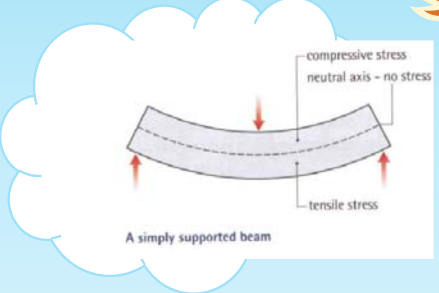
31.3

1 bending
2 compression
3 neutral axis
4 tensile
5 fracturing
6 compressive
7 tension
8 crushing
9 deflect
10 sag
11 hog
12 deflection

Think about.

the different forces acting on a machine or structure you're familiar with.
How would the different components or members deform or fail if they were not adequately designed, or if they were overstressed?

I know it



Any Questions