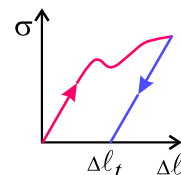


8. Basic properties of elastic-plastic material

If plastic (irreversible) deformations (Δl_t) occur in the body after a loading cycle (loading up to a certain value of stresses and strain and then unloading to zero stress), the material of the body is said to be in **elastic-plastic state** under the load in question. The stress-strain curve is different during loading and unloading.



In general, the constitutive relations of elastic-plastic materials are very complex, therefore the stress-strain analysis of a body in elastic-plastic state is much more difficult in comparison with the elastic state. These problems are solved by the **theory of plasticity**.

Elastic-plastic behaviour is dominant for judging of limit states of strength and bearing capacity of steel structures. Therefore it should be taken into account in stress analyses and in evaluation of their results. In this course, however, only the simplest cases will be analysed.

General properties of materials and bodies in the elastic-plastic state can be expressed by the following statements:

- The dependencies among loads, deformations and stresses are always **non-linear** \Rightarrow the principle of superposition is not more valid.
- Stress and strain states in the defined instant are dependent on all the **history** of elastic-plastic loading.
- The elastic-plastic state of material occurs in a body as soon as the **yield stress was exceeded**.
- The simplest **computational models** of elastic-plastic behaviour replace the curve $\sigma - \varepsilon$ above the yield stress by a straight line. According to its slope we distinguish between the following models of elastic-plastic constitutive behaviour:
 - a) **perfectly elastic-plastic** material - the zero slope of the straight line
 - b) material with **linear hardening** - non-zero slope of the straight line.
- If the body is completely unloaded from the loaded state in which plastic deformations occurred, **residual stresses** come into existence in the body (provided that the stress state in the body was not homogeneous).

