C9. Materials

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Part 1 Chapter 4 is dedicated to civil engineering materials and their specificities.

Defining materials is a rather simple task when modeling because most software have predefined material laws that follow one or more codes.

These laws correspond to a simplified "curve" of the material’s stress-strain behavior, which is considered linear elastic and incorporates safety reduction coefficients (on the modulus and the limit strength). Some very specific problems may require introducing a more complex curve (Sargin's law for example), which is allowed by most software.

When using the predefined laws for concrete, one should be aware that the Young modulus is generally by default the short-term modulus. For long-term effects, for some thermal and seismic calculations, it will be necessary to correct the modulus. This is also the case for phased calculations where the modulus varies according to the age of the concrete.

Similarly, the software considers a default value of Poisson's ratio. Generally $\upsilon=0.2$ for concrete and $\upsilon=0.3$ for steel. Some codes require that a coefficient of $\upsilon=0$ is taken for concrete at ULS. In particular, see BAEL and §3.1.3 (4) of Eurocode 2.

For all Strength of Material calculations that require considering the concrete cracking (seismic, second-order, mixed bridge slabs ...), the moment-curvature law of the cracked section must be considered. It represents the weakening of the section and the actual stiffness of the structure. Sometimes, the code provides simple rules for the adaptation of inertias. This may require iterative calculations, first in uncracked inertia to determine the cracking zones, and then taking into account the cracked inertia.

It should be noted that some software allows to directly consider cracked inertia.

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