SIMPLIFIED APPROACHES FOR THE PREDICTION OF THE CYCLIC BEHAVIOR OF MECHANICAL STRUCTURES

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The presentation will be devoted to the behavior of the (metallic) mechanical structures under cyclic thermomechanical loadings where the structure may exhibit (elastic or plastic) shakedown or ratcheting at the steady state.

The prediction of such behavior is generally performed using one of the two following approaches: simplified (or direct) methods and step by step analysis.

The objective of the direct methods is to evaluate quantitatively (amount of the plastic strain?) or qualitatively (elastic/plastic shakedown or ratcheting?) the steady state. For certain methods, the evaluation is based on FE structural calculation where the behavior of the material is assumed purely elastic! To apply these methods, it is necessary to split the "total" stress in primary and secondary parts which is sometimes a difficult task!

The step by step analysis uses the classical FE calculation where the behavior is followed continuously for each time step. This approach uses constitutive equations where the good representation of the isotropic and kinematic strain hardenings is essential.

The talk will start by the presentation of some experimental observations related to the cyclic behavior at the material and mechanical structure scales. The main assumptions related to the modeling of the strain hardening will be briefly described. Finally, the prediction of the cyclic behavior using either elastic or elastoplastic FE structural calculation will be discussed.