



Residual Stresses and Fracture in Engineering Materials

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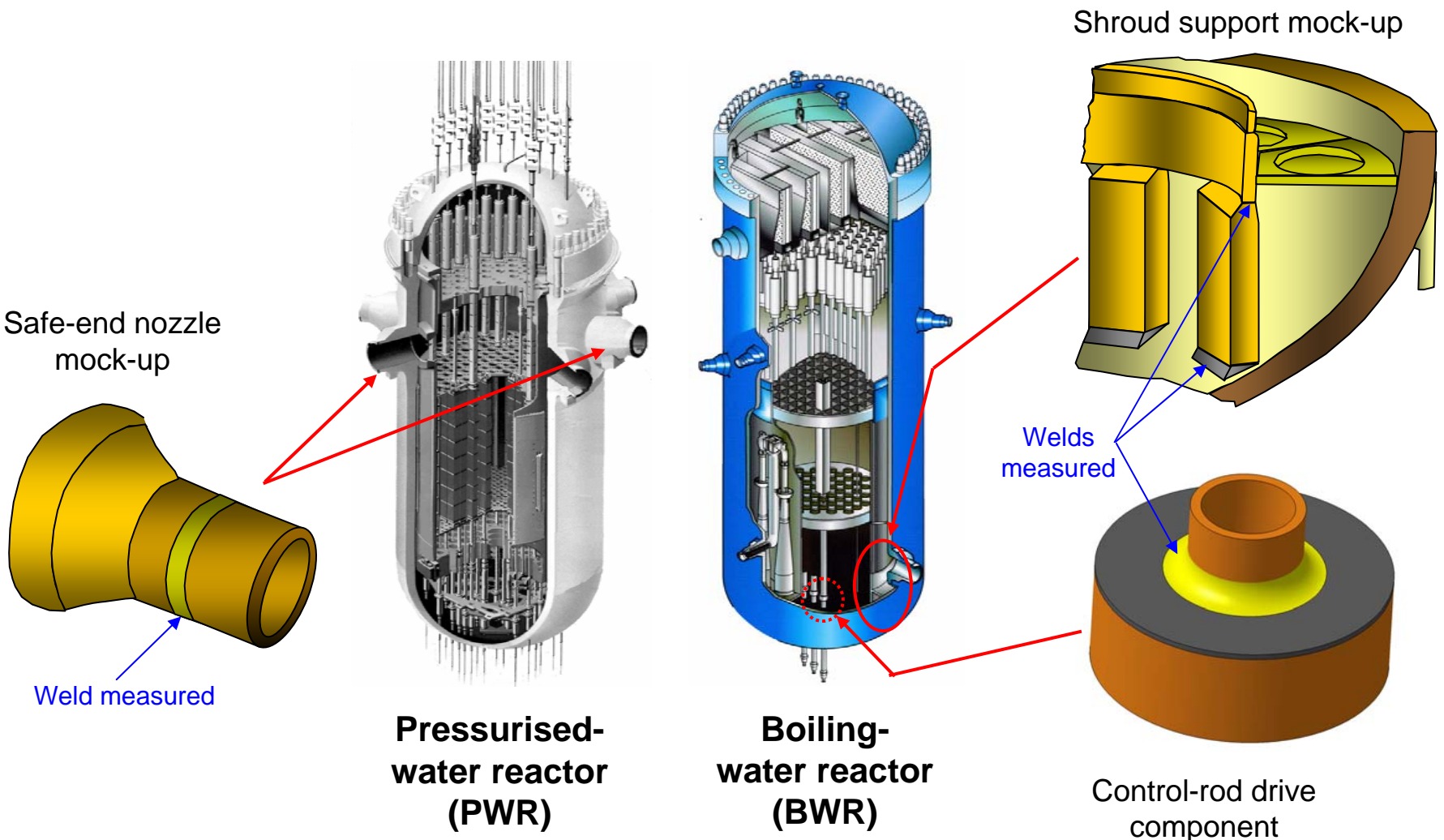


✦ Why worried about Residual Stresses in Engineering Materials and Structures

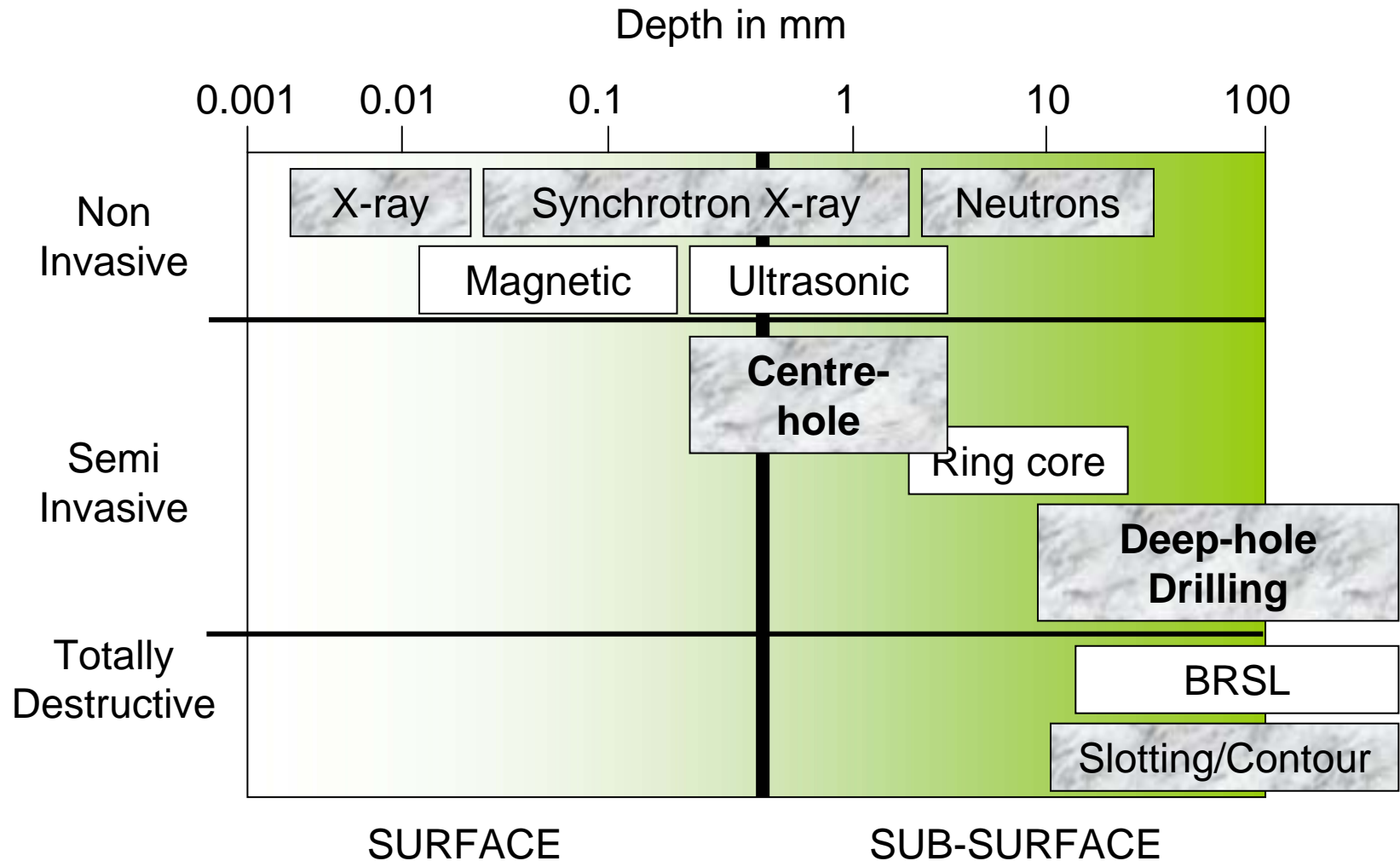
- Residual and applied stresses contribute to driving force for fracture
- Provides direct input into a Structural Integrity assessment -i.e. understand how safe it is to operate the structure
- Two routes; model the creation of residual stress and/or measure them directly



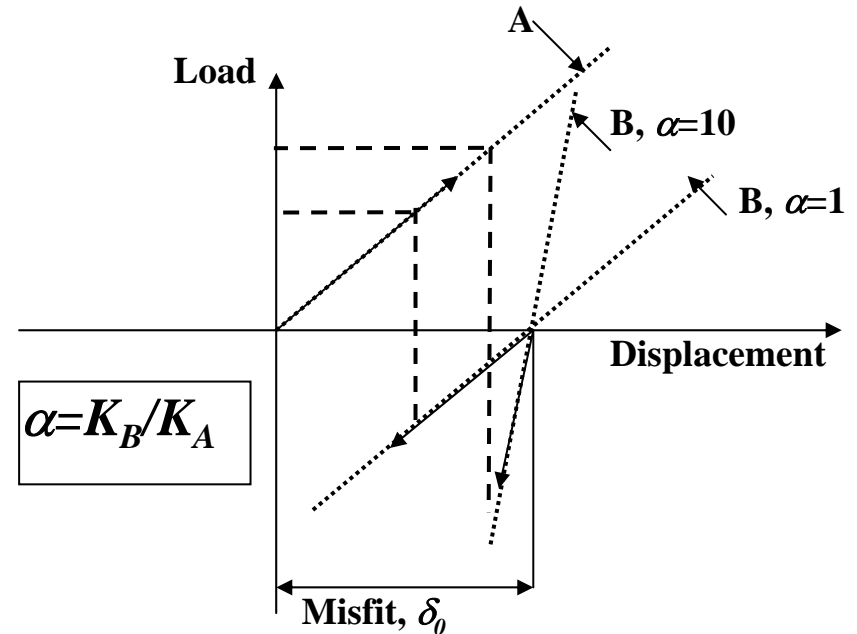
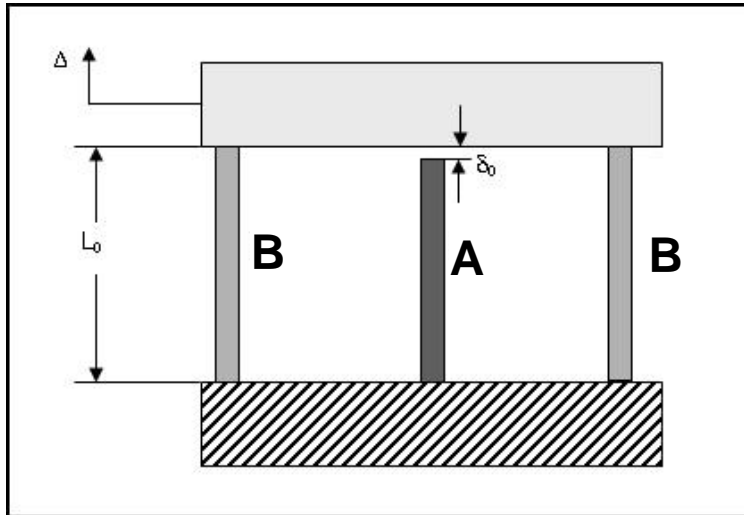
Nuclear Welded PWR/BWR Components



Stress Measurement Technologies

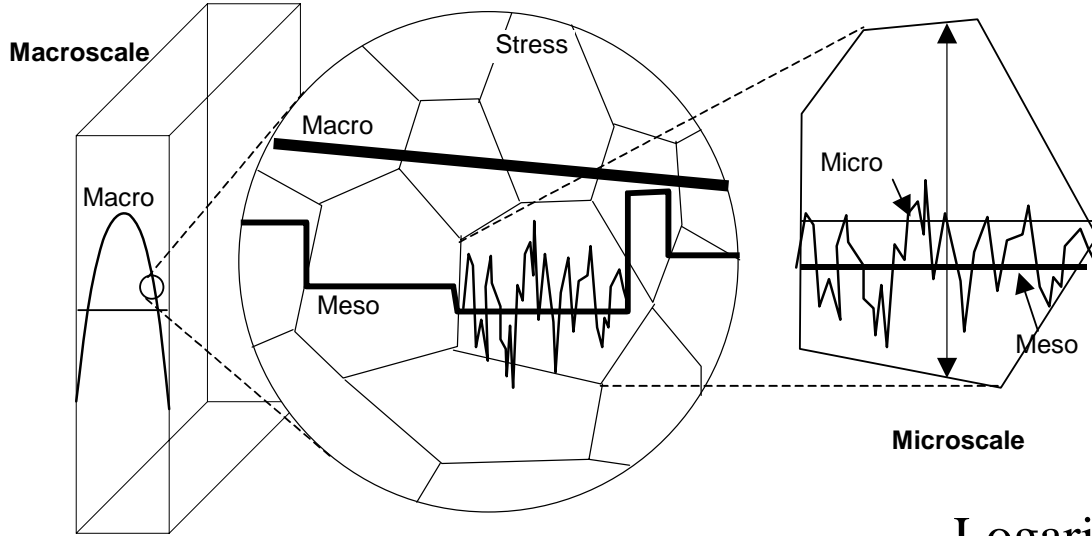


Creation of residual stress



- Residual stresses introduced by misfit
- Residual stress is a function of both stiffness and misfit
- Higher stiffness ratio results in higher RS for same misfit

✦ Length scales

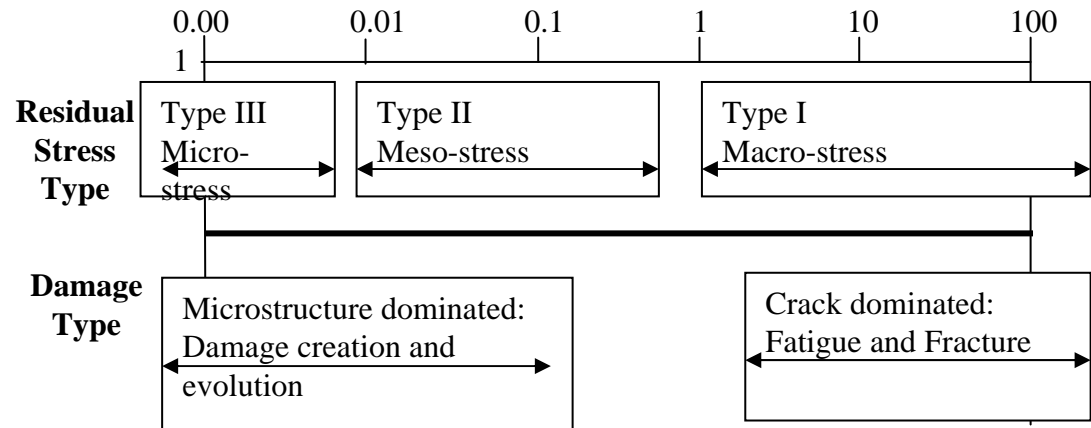


Type I = Macrostress

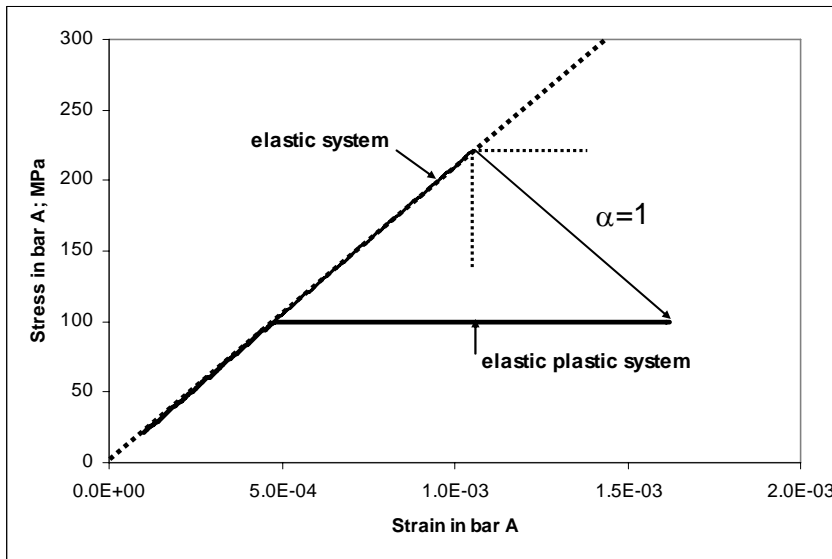
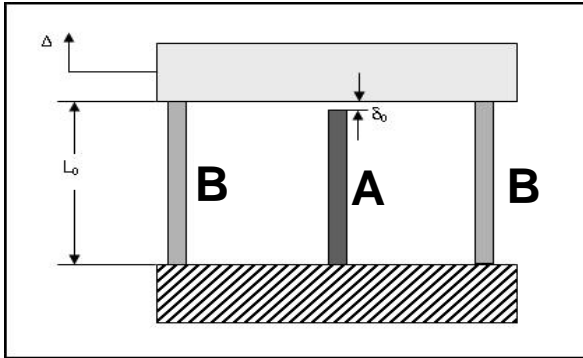
Type II = Mesostress

Type III = Microstress

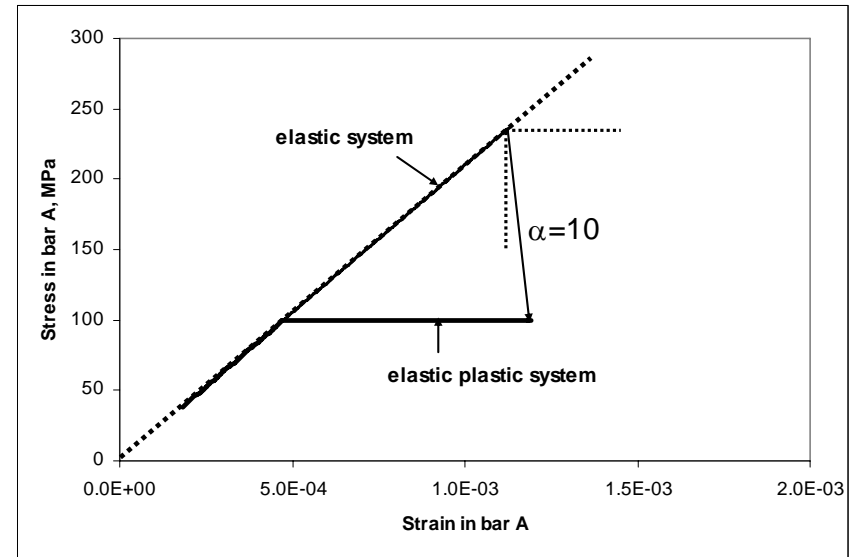
Logarithmic length, mm



Combined residual and applied stresses



$(\alpha=1)$



$(\alpha=10)$

Challenges:

- Unless in a simple system residual stresses are not usually known. **Should we always measure residual stress?**
- **What length scale is important for fracture?**
- If non-linear behaviour occurs we can accommodate the misfit but also obtain elastic follow-up. **How do we account for elastic follow-up?**
- Presence of residual stress changes local stress state can influences fracture mechanism. **Is there evidence for residual stress changing mechanisms of fracture?**

