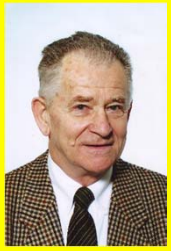
# MECHANICAL PROPERTIES OF REINFORCING BARS HEATED UP UNDER STEADY STRESS CONDITIONS

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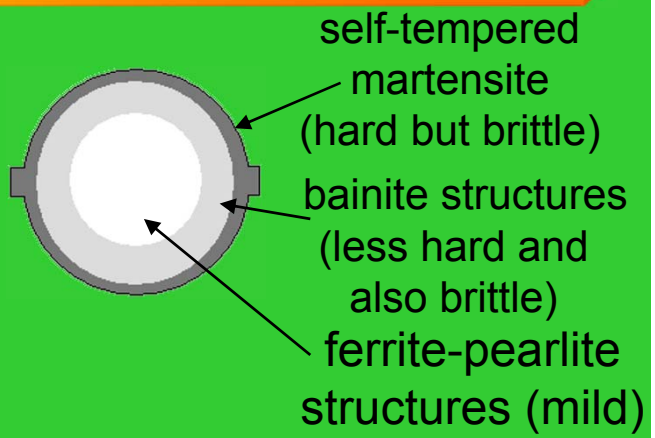
# THE REASON OF RESEARCH

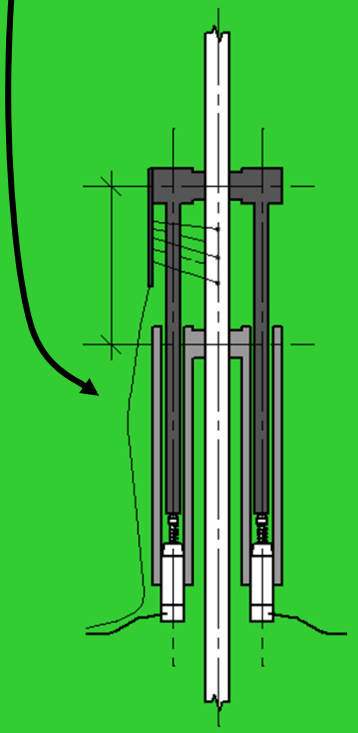
**The bars, which are nowadays most frequently used for reinforced concrete structures, are produced in a process of quenching and self-tempering; such method results in diversified mechanical properties in several zones of bar cross-section.**



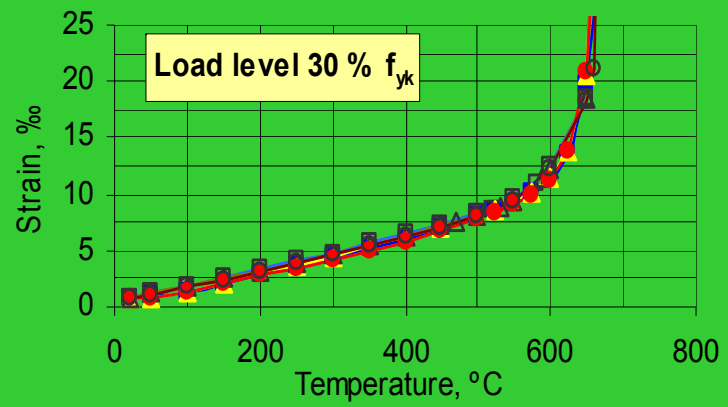

- **Is it proper to test mechanical properties of reinforcing steel on specimens turned from bars of bigger diameter, as recommended in EN 10002-5:1998 code?**
- **Would the decrease of mechanical properties in high temperature for bars with various diameters be the same?**

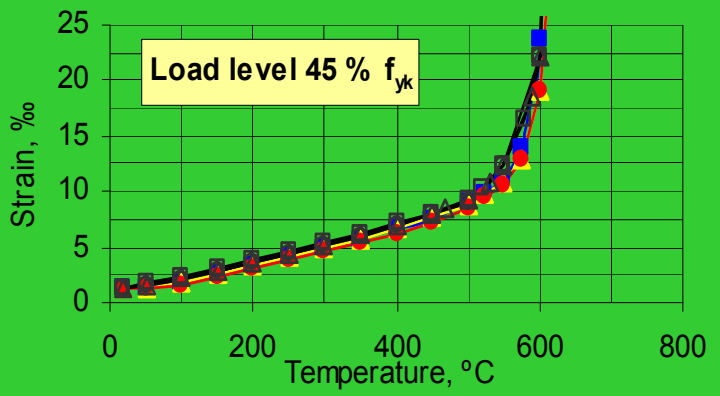
# TEST METHOD

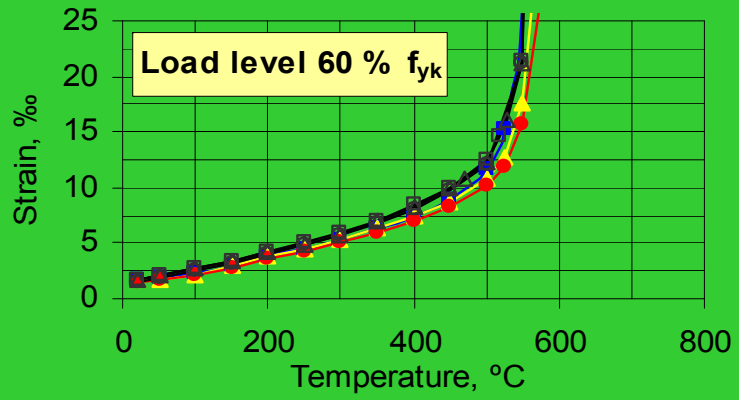
- Tests performed at variable (increasing) temperature;
- 10 ºC/min heating rate,
- Hydraulic testing machine, onto which an electrically heated furnace was mounted,
- 10, 12 and 16 mm diameter bars, made of B500SP thermal strengthened steel, commonly used in Poland,
- Yield strength claimed by the manufacturer: 500 MPa, tensile strength: 575 ÷ 675 MPa (verified in room temperature tensile tests),
- 80 mm gauge length,
- Load levels: 0, 30, 45, 60 and 75% of average yield strength determined experimentally at room temperature,
- total: 75 tests.

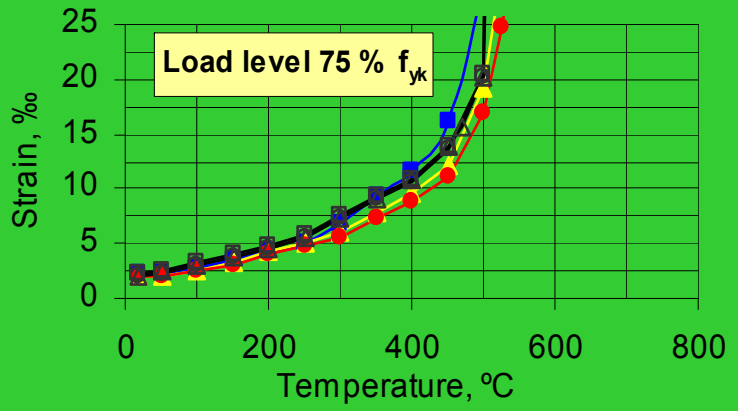



# RESULTS



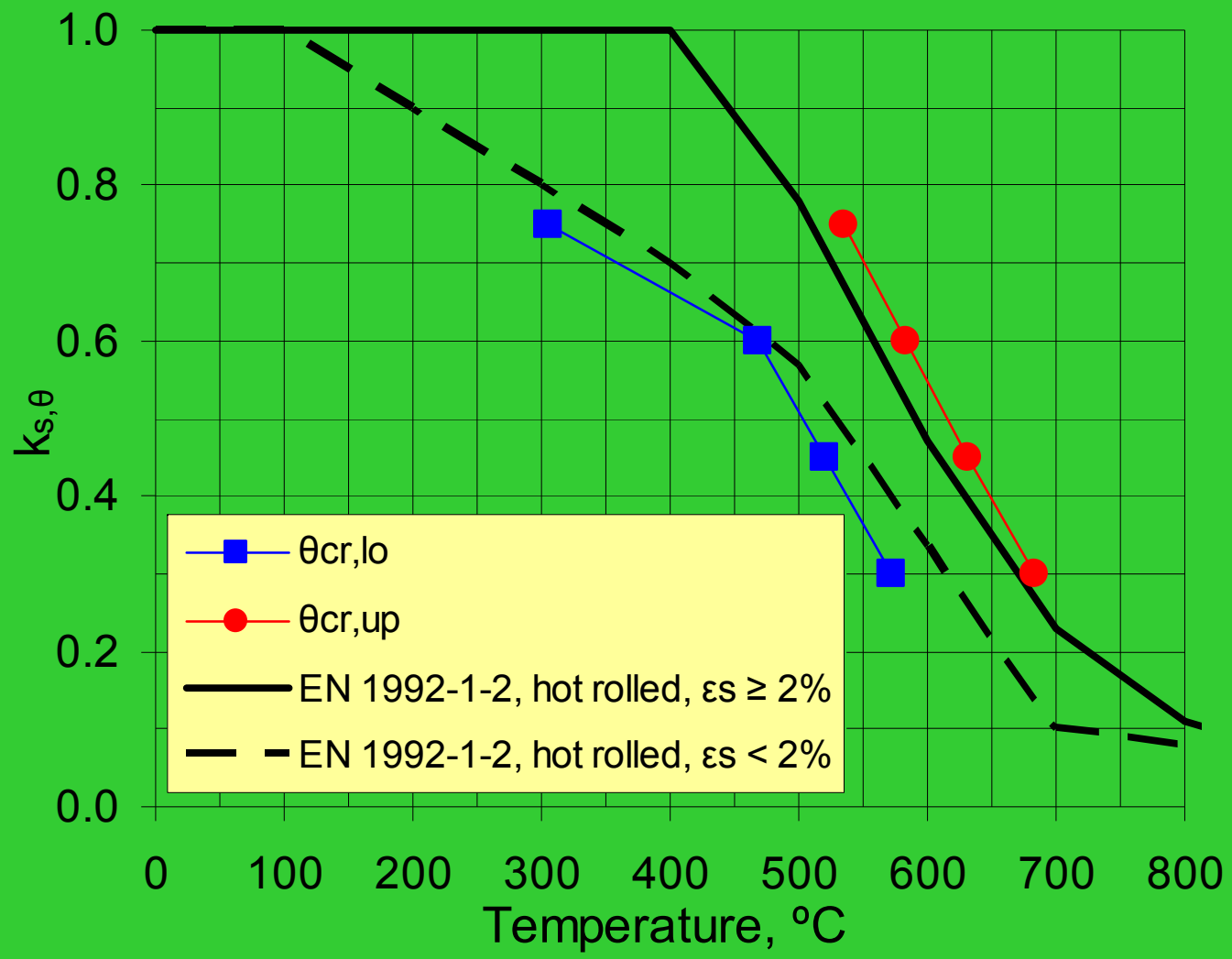





**Experimentally determined strain-temperature relationships**

# RESULTS




**Steel strength reduction factor ($k_{s,\theta} = f_{y,\theta}/f_{yk}$)**

# CONCLUSIONS

- The obtained strain-temperature relationships that range from the beginning of heating process to reaching a critical value of temperature, are close to linear. Afterwords, one may observe an impetuous increase of strain, leading to the breaking of tested bar.
- The obtained strain-temperature relationships are accordant to the relationships found in the EN 1992-1-2 recommendations; despite the fact, that EN 1992-1-2 model assumptions are based on tests carried out in steady (constant) temperature.
- Experimentally evaluated temperature-strain relationships and values of the steel strength reduction factor deems not to be diameter-dependent.
- While predicting a behaviour of thermal strengthened reinforcement in bent RC elements in fire, it seems justified enough, to take into consideration the sum of free thermal strain and the strain caused by stress.

**Thank you for your attention**