

Heat Treatment of Steels

Software solutions for off-line computer simulation of the Heat Treatment of various steel products

QTSteel - the software for the 2D-FEM simulation of the Heat Treatment of carbon and alloy steels in terms of microstructure and mechanical properties

Input screens for setting of steel properties and cooling curves calculation

Element	Symbol	Min	Max	Value
Carbon	C	0.000	0.600	0.56
Manganese	Mn	0.300	2.000	0.31
Silicon	Si	0.000	0.800	0.31
Chromium	Cr	0.000	4.000	0
Nickel	Ni	0.000	0.000	0
Molybdenum	Mo	0.000	0.000	0
Vanadium	V	0.000	0.400	0
Aluminum	Al	0.000	0.000	0
Titanium	Ti	0.000	0.100	0
Niobium	Nb	0.000	0.100	0
Neon	Ne	0.000	0.000	0
Iron	Fe	0.000	0.000	0
Copper	Cu	0.000	0.000	0
Nitrogen	N	0.000	0.000	0
Boron	B	0.000	0.000	0
Sulfur	S	0.000	0.000	0
Phosphorus	P	0.000	0.000	0

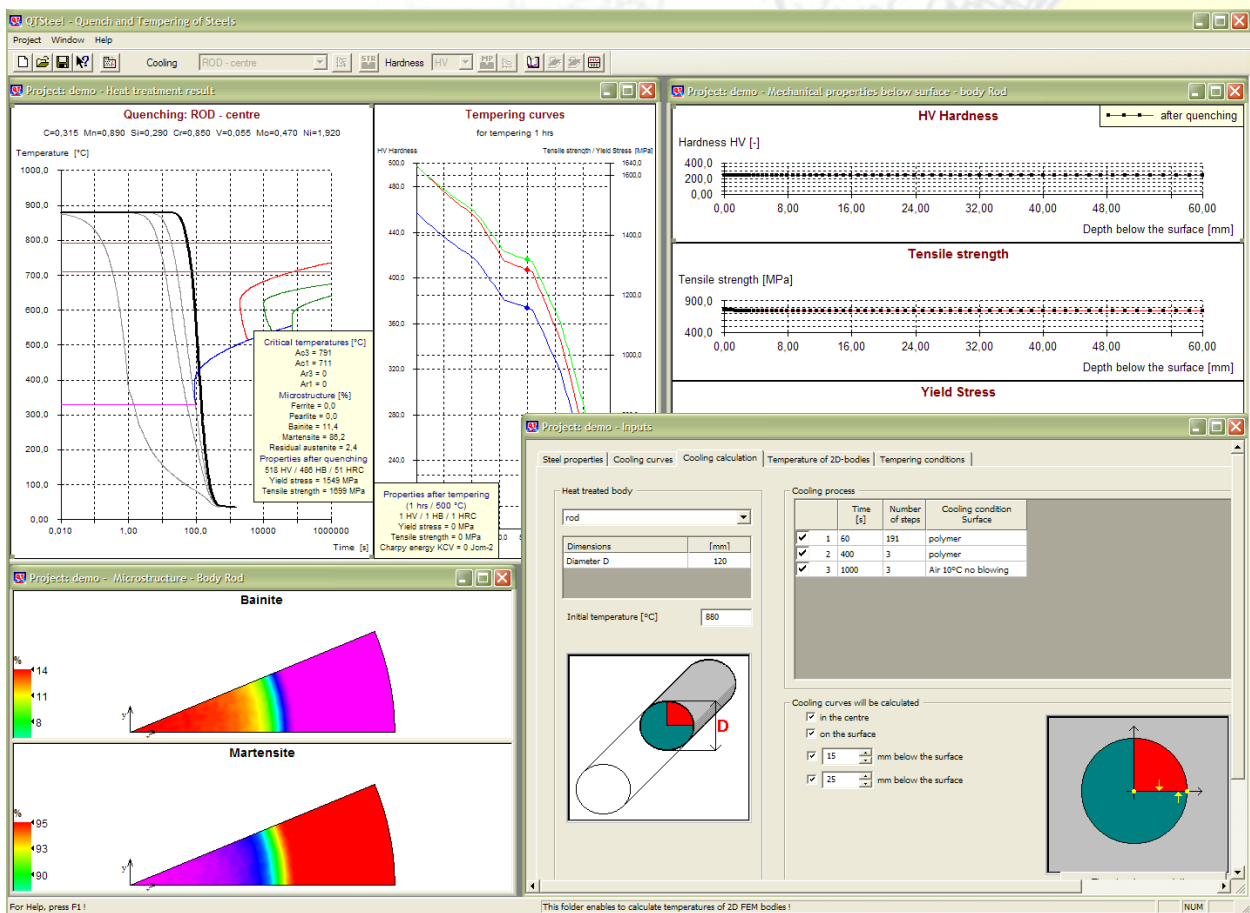
Standard scope of the software:

Carbon and structural steels with amount of C 0.1 % - 0.6 % and with the total sum of alloying additions up to 10 % (upper limits: Mn 2 %, Si 1.8 %, Cr 4.5 %, Ni 3.5 %, Mo 2.5 %, V 0.4 %, B 0.004 %)



Inputs:

- **Steel properties** (chemistry, grain size of austenite, austenitizing temperature, soak time),
- **Quench conditions** (dimensions, initial temperature and cooling conditions),
- **Tempering conditions** (tempering temperature and time, user specified tempering regime).



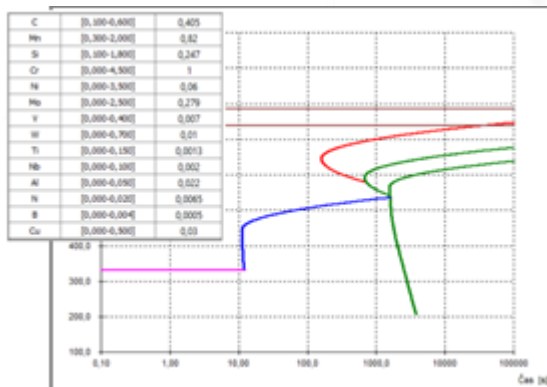
QTSteel provides the following information:

- **CCT-diagram of steel** based on chemical composition with the possibility to modify particular CCT-curves,
- **Cooling curves of standard 2D-bodies** (rounded and rectangular bars, cylinders, tubes, rings) for specified cooling conditions and depths below the surface (The Database of Quenchants is available),
- **Microstructure of the steel** (shares of Ferrite, Pearlite, Bainite and Martensite)
- **Mechanical properties of the steel** (Hardness, Yield Stress, Ultimate Tensile Strength) after quenching and subsequent tempering.

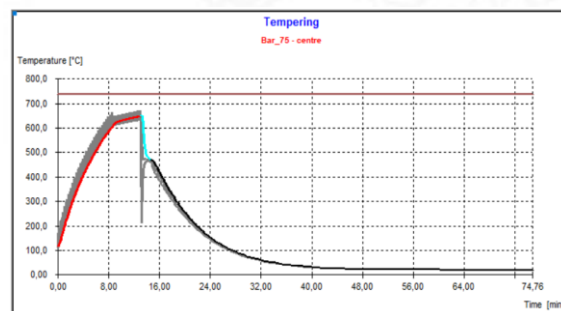
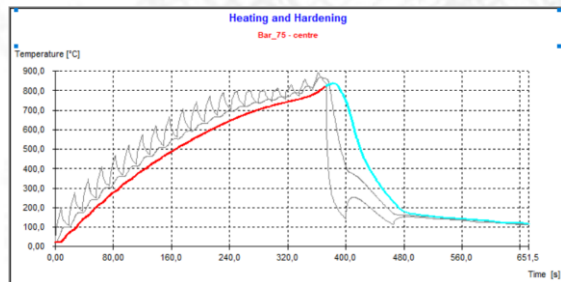


IHT_BAR – the software for the 1D-FEM calculation of microstructure and final mechanical properties of steel round bars processed in the in-line heat treatment equipment

The IHT_BAR is a “tailor-made” software adapted to the hardware configuration of the customer's technological equipment and for the adaptation of the calculation of temperatures and metallurgical properties it communicates with the process database of the equipment and the results of laboratory measurements of mechanical properties of heat-treated bars.

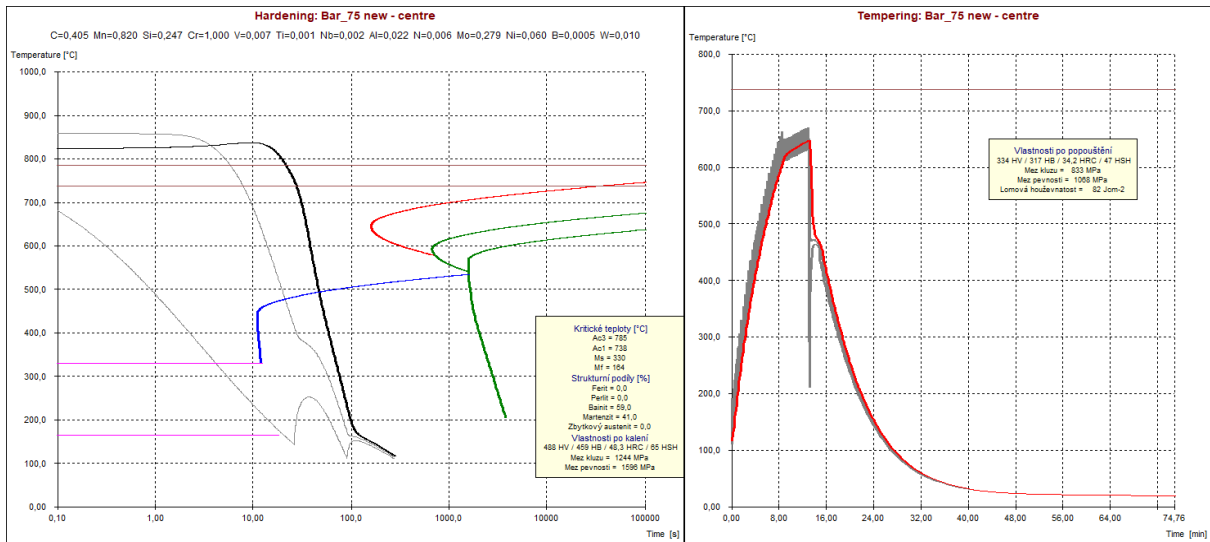


Predicted CCT diagram and calculated Heating, Quenching and Tempering curves for the bar D75 mm

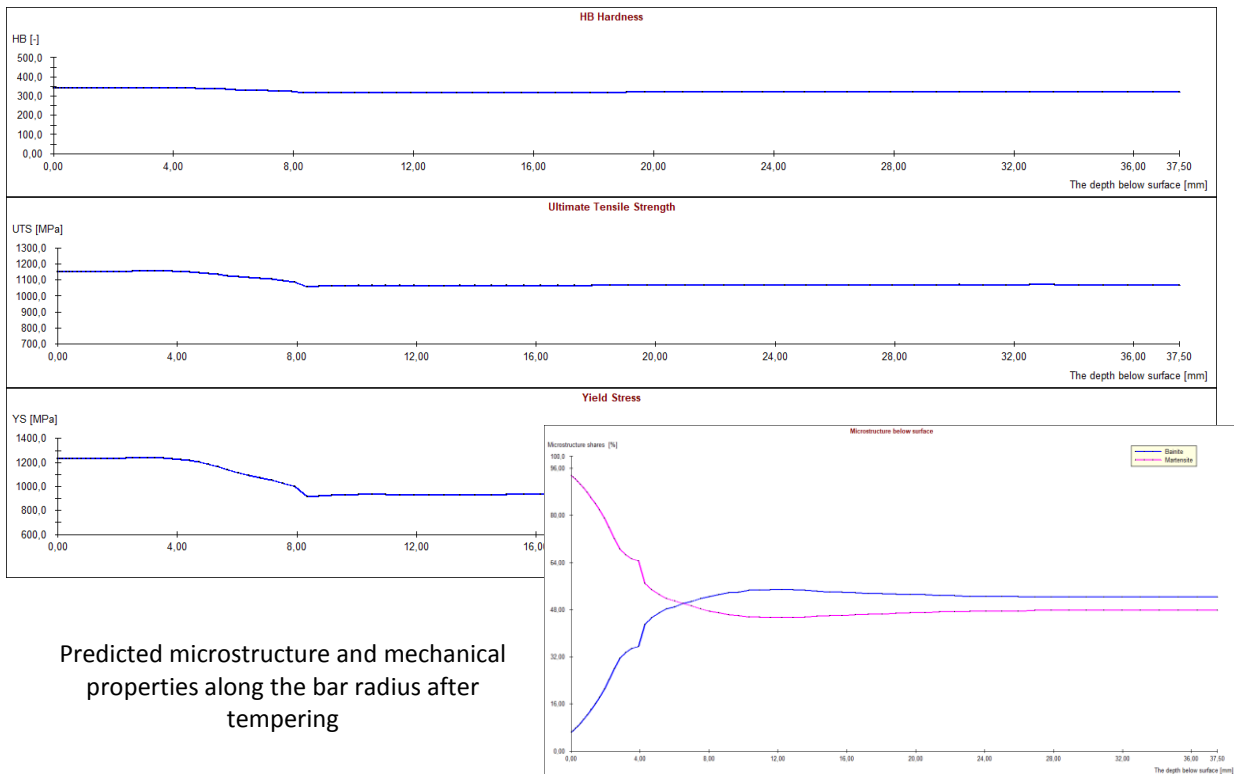


The IHT_BAR provides the following information:

- **CCT-diagram of steel** based on chemical composition with the possibility to modify particular CCT-curves,
- **Temperature predictions in places where process pyrometers are located**,
- **Microstructure of the steel** (shares of Ferrite, Pearlite, Bainite and Martensite),
- **Final mechanical properties along the bar radius** (Hardness, Yield Stress, Ultimate Tensile Strength, KCV).



Predicted microstructure and mechanical properties in the center of the bar D75 mm after quenching and tempering



Predicted microstructure and mechanical properties along the bar radius after tempering