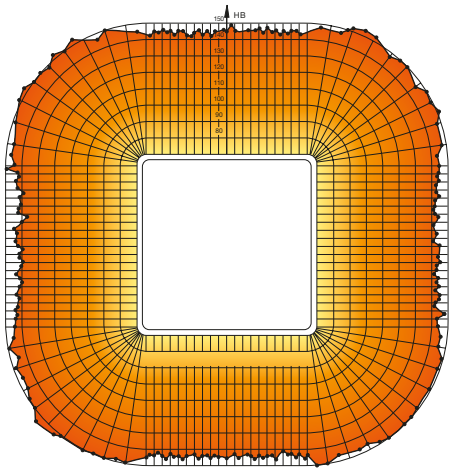
MAIN DIFFERENCES IN THE MECHANICAL PROPERTIES OF HOT FINISHED AND COLD FINISHED HOLLOW SECTIONS

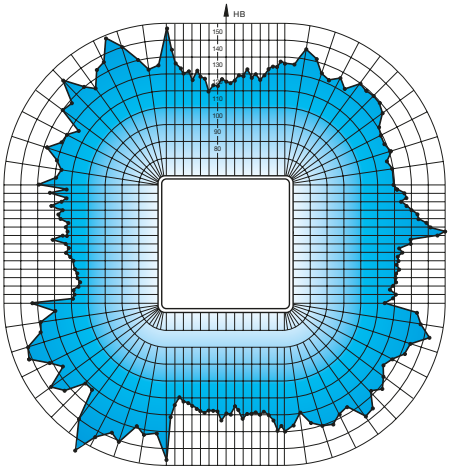
HARDNESS DISTRIBUTION

The hardness distribution over the cross section represents the most striking difference between hot finished and cold finished hollow sections. Whilst the hot finished hollow section shows a uniform hardness distribution over its entire profile, a cold formed hollow section exhibits significant hardness peaks in the areas of the cold formed corners.

This indicates that variations in the tensile properties can be expected in those areas. A further hardness peak can be found in the longitudinal weld area, therefore we can suppose lack of homogeneity in resistance properties.



HARDNESS DISTRIBUTON HOT ROLLED

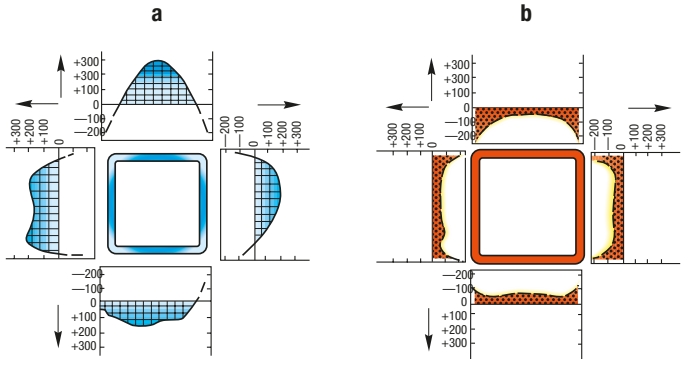


HARDNESS DISTRIBUTION COLD FORMED

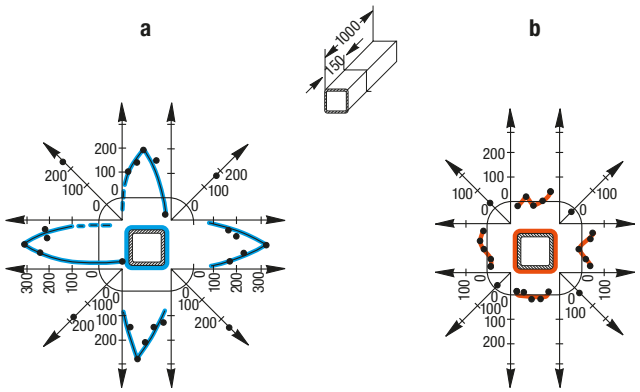
RESIDUAL STRESSES

The residual stress distribution offers a picture similar to that of the hardness distribution. As it can be seen very clearly from adjacent diagrams, hot rolled sections exhibit exceedingly uniform and low stresses over the entire cross section.

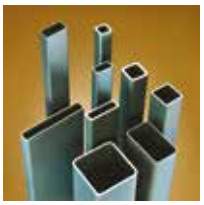
On the contrary, cold formed hollow sections are identified by high residual tensile stresses. During processing (e.g. welding, hot dip galvanizing, bending), these residual stresses may be released and may cause unexpected distortion of the hollow section or of the complete structure.



Residual tensile stress distribution in N/mm2 over the cross sections of cold formed (a) and hot formed (b) hollow sections in ST 37.



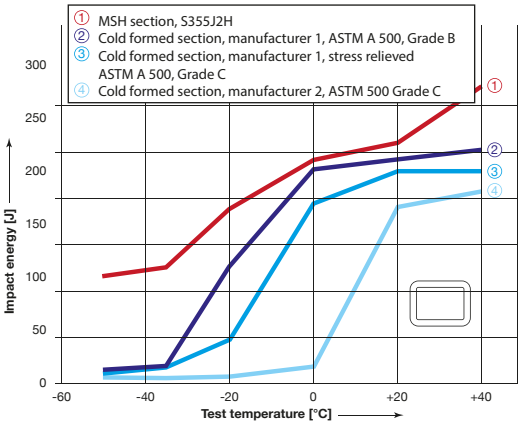
Residual transversal stress distribution in N/mm2 over the cross sections of cold formed (a) and hot formed (b) hollow sections (60 x 60 x 4 mm).



IMPACT PROPERTIES

Impact properties consist in a particular mechanical resistance that material opposes to sudden stresses, such as impacts or jerks. Steels with high impact properties are tenacious, in the opposite case they are brittle.
Carbon steel products that were subject to hot forming processes or heat treatments, such as annealing or normalizing, show a considerable mechanical resistance and high impact properties. Carbon steel products obtained by cold forming processes or subject to work hardening due to subsequent cold deformation steps, are normally characterized by high mechanical resistance against "statical" stress, but low resistance against "dynamical" stress and low impact properties, therefore this kind of materials is to be considered as "brittle". One of the most dangerous phenomena facing design engineers in both structural steel work and mechanical construction is brittle fracture.

This low ductility fracture represents a particularly severe hazard, because it occurs suddenly, without any prior indication, and sometimes under stresses far below the permissible level.
The impact properties of a material can be regarded as an important index of brittle fracture tendency, since impact properties decrease when the work hardening due to cold deformation increase.
The adjacent diagram shows the behaviour of impact properties for hot rolled and cold formed hollow sections. The American standard for cold formed hollow sections, ASTM A 500, expressly points out in a foot note that these sections may be unsuitable for dynamically stressed structures exposed to low temperature.



[1] *Extract from ASTM A500*

"Note 1 – Products manufactured to this specifications may not be suitable for those applications such as dynamically loaded elements in welded structures, etc, where low-temperature impact properties may be important"