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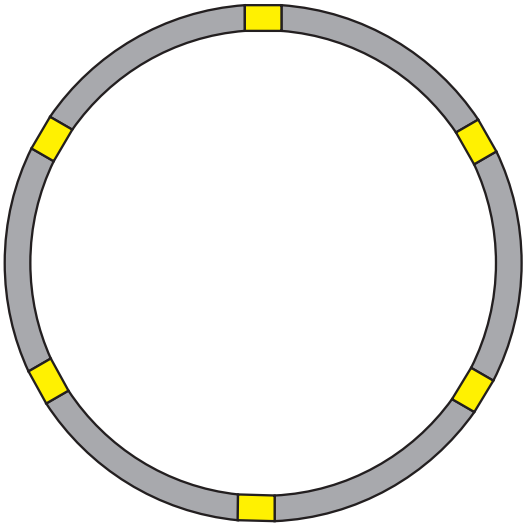
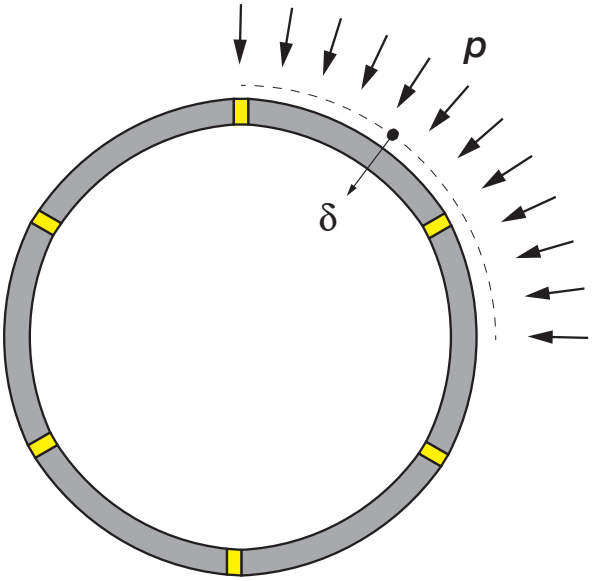
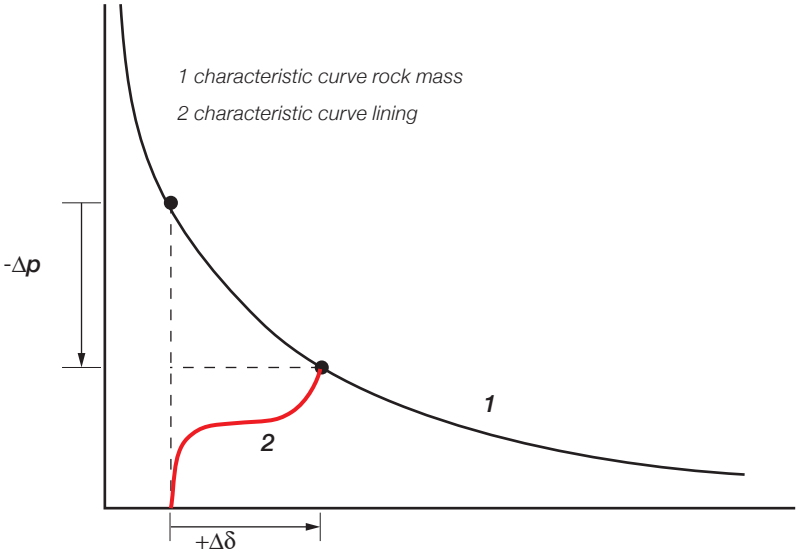
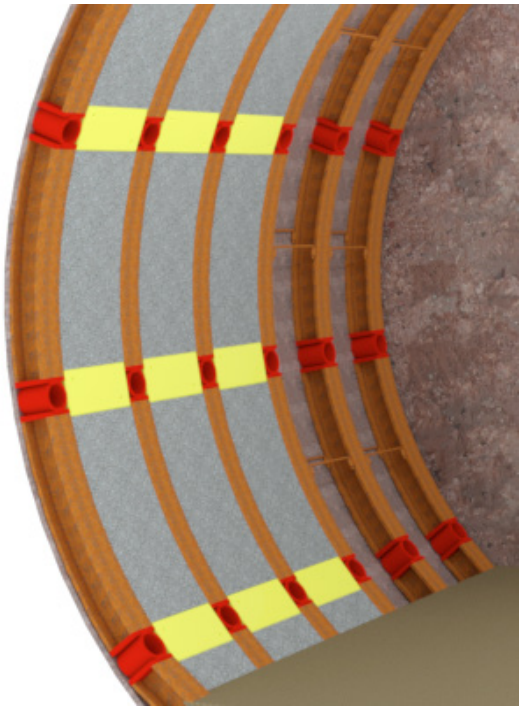
hiDSte® – high Deformable Steel elements





When tunnelling in squeezing ground large deformations (convergence) or high rock pressure may arise. To overcome such zones the most economical solution consists in applying a deformable lining system avoiding re-profiling and reconstruction of the tunnel. It has the advantage of being safe and time efficient. A number of deformable elements are placed in the shotcrete lining between TH-steel profiles or lattice girders.

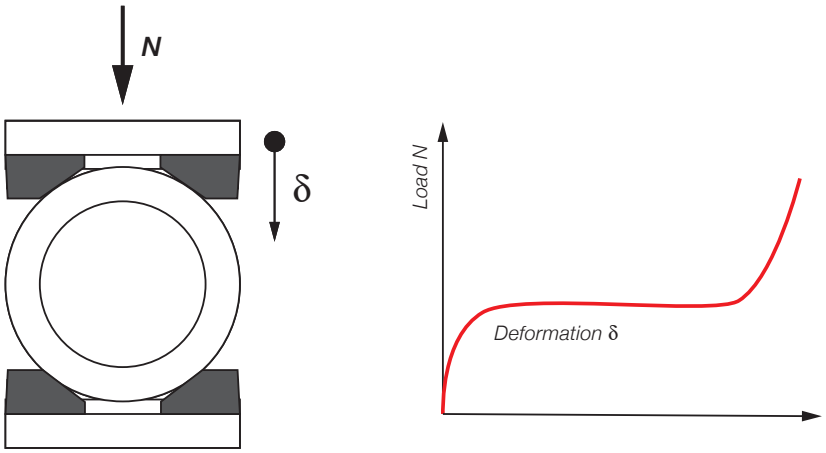




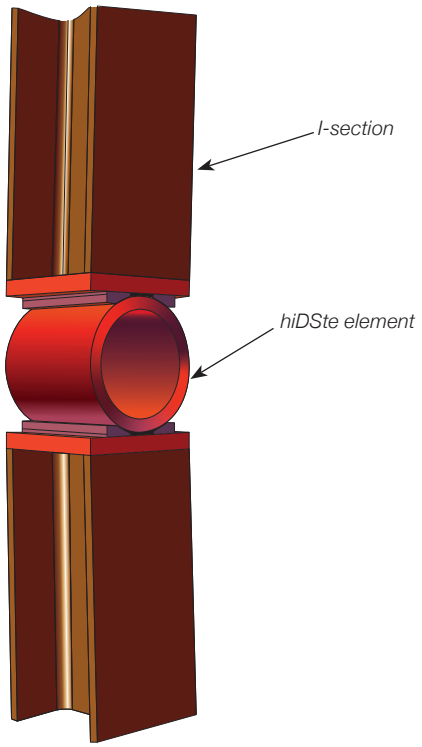
In heavily squeezing rock conditions the installation of large I-sections with a high deformation capacity is more efficient. hiDSte elements in combination with I-sections offer the desired high deformability in combination with high lining resistance. The load-deformation mechanism is illustrated by the adjacent figure. It shows the characteristic line of the rock mass and that of the deformable lining. Allowing a convergence Δu reduces the ground pressure by Δp.

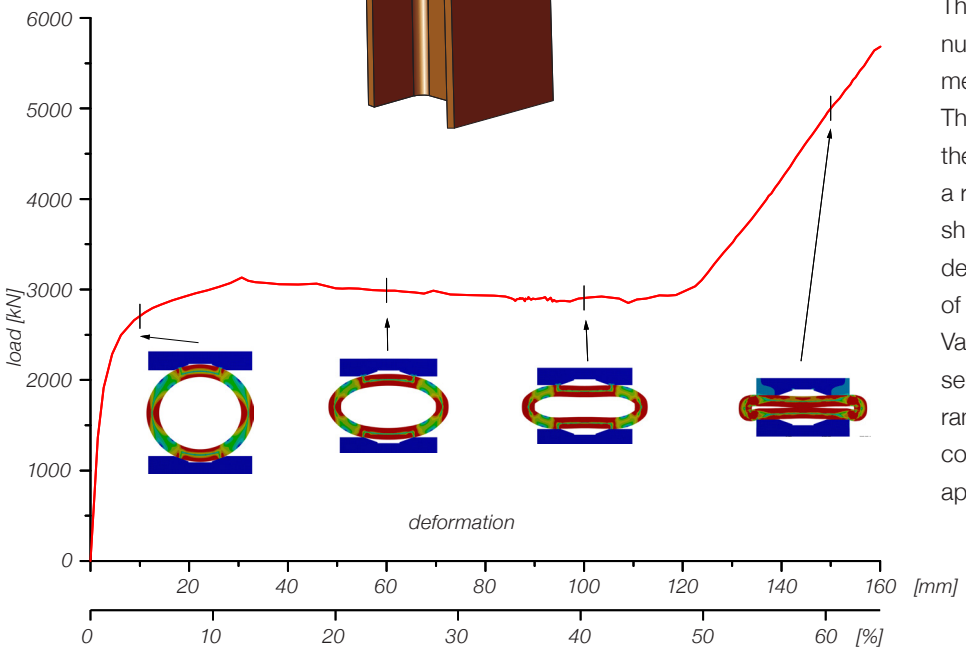
The combination of hiDCon and hiDSte elements in a lining is shown schematically in the picture above. It is possible to install the steel arches first directly at the tunnel face. The shotcrete support with the hiDCon elements is then installed later at a certain distance.

The hiDSte element



The hiDSte element is basically a thick-walled cylinder which deforms plastically. After an initial elastic deformation the stress- strain curve exhibits a large deformation capacity at a high load level. The properties of the element are based on the size of the I-section, the number of elements per arch and the required convergence.
The elements have a high structural stiffness. During assembly they can withstand high bending moments and lateral forces.
Even without shotcrete a high stability can be achieved with longitudinal bracing.





The adjacent figure shows the result of a numerical stress analysis of a hiDSte element designed for a HEB-240 section.
The development of the stress as well as the plastic zones in the cylindrical body - as a result of the increasing compression - are shown. Strain hardening begins only after a deformation of 50 %. The complete closure of the tube is reached at 67% deformation.
Varying the wall thickness allows for the selection of the yield force over a wide range. The external diameter of the cylinder corresponds to the size of the I-profile to be applied.

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