

Ductility is Safety

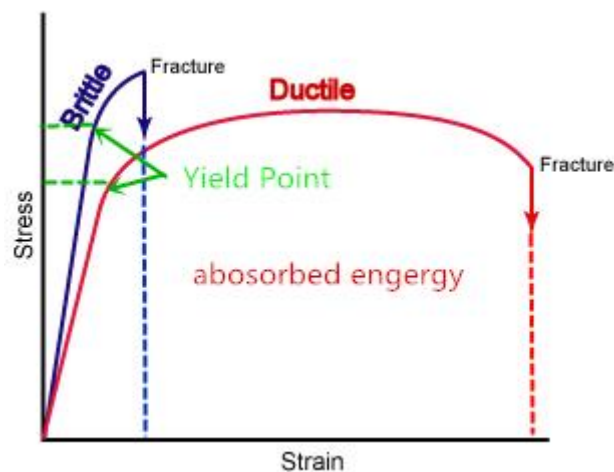
Every reinforced grouting hollow bar item, whether CTS, MAI or DYWIDAG systems, is composed of two materials: concrete and hollow steel bar.

The concrete is a kind of brittle material, which has a very low ductility. It means that the concrete structure without high ductile material would collapse suddenly when overloading.

And the high ductility hollow bar anchor acts as the role that supplies ductility. It can last much longer time under the stresses higher than yield strength with plastic deformation.

The stress-strain curve of a hollow bar anchor can represent its ductility clearly. In the case of low ductility (brittle) bar, once the yield stress is reached, the plastic deformation (non-linear) curve is short with the strain (NOT Time!) increase. The yield point is close to the fracture point.

For high ductility hollow bar anchor, it supplies ductility to concrete structure to achieve good ductility performance. If the structure is near break, it could warn through deflections or cracking, rather than sudden collapse.



Stress strain curve of a threaded hollow bar anchor

Bend Test

Bend test is a good way to measure the ductility of a grout boned anchors **on site**.

For the concrete reinforcement work of civil ground engineering, **ASTM A615** has proposed the details of a bending test for steel bars.

To be brief, the standard demands the reinforcing material shall withstand being bent around a pin without cracking on the outside radius of the bent portion.

The requirements for degree of bending and sizes of pins are below:

TABLE 3 Bend Test Requirements

Bar Designation No.	Pin Diameter for Bend Tests ^A		
	Grade 40 [300]	Grade 60 [420]	Grade 75 [520]
3, 4, 5 [10, 13, 16]	$3\frac{1}{2}d$ ^B	$3\frac{1}{2}d$...
6 [19]	$5d$	$5d$	$5d$
7, 8 [22, 25]	...	$5d$	$5d$
9, 10, 11 [29, 32, 36]	...	$7d$	$7d$
14, 18 [43, 57] (90°)	...	$9d$	$9d$

^ATest bends 180° unless noted otherwise.

^B d = nominal diameter of specimen.

Bend Test Requirements of Hollow Bar Anchors

For hollow bar anchors, bending around 180 degrees (U shape) over a pin diameter $D > 6 \times$ Diameter is required. Furthermore, there shouldn't be any visible cracks or hollow bar breaks.

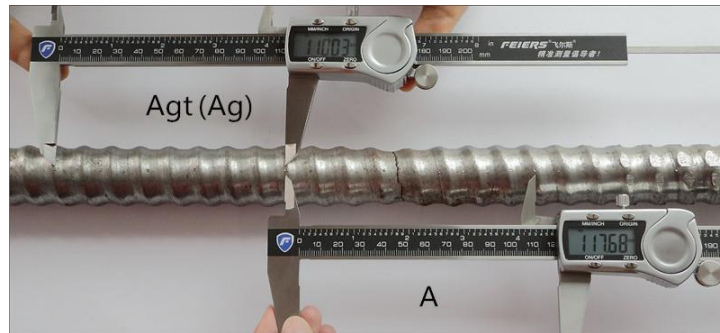
For the recent years, the grouting concrete anchor bars are applied in Micropiles (minipiles), soil nails, wall tiedown and tieback anchor systems, etc. And there have been existing standards in Europe and America for these applications.

Self-drilling hollow bars with high ductility are the reliable protections for civilians in case of earthquake and other disasters happen.

All ONTON hollow bar anchors can pass this bend test easily, benefiting by its high ductility. And in the same time, there isn't any loss of its strength performance.



Bend test of a hollow bar anchor



Calculating A and Agt of a hollow bar anchor

The ductility is paid more and more attention either in Europe or America. Whether from the standpoint of safety or market, people need High Ductility hollow bar anchors.

Ductility is Safety

