



Use with care Grade 500E reinforcing steel in New Zealand

Recommended practice

Source of supply, method of manufacture and identification

Several steels marketed in New Zealand as Grade 500E are manufactured by the QT (quench and temper) process. This results in a bar with a hardened outer skin. As indicated below, QT steel is vulnerable to some fabrication processes. The identification markings on imported steels do not clearly identify the strength, grade or manufacturing process. This lack of information creates potential site difficulties.

Most Grade 500E reinforcing sold in New Zealand is locally manufactured by the microalloy process, conforms to AS/NZS 4671 and has clear identification markings.

Designers, building consent authorities and contractors are advised to satisfy themselves that any steel supplied as Grade 500E meets the requirements of AS/NZS 4671.

Bending Grade 500E reinforcing

A Department of Building and Housing investigation has established that many 'field failures' of Grade 500E reported were the result of bars being bent to smaller diameters than the minimums specified in NZS 3101 and NZS 3109. Grade 500E has less ductility than Grade 300E and therefore less tolerance of the permanent strains associated with tighter diameter bends.

It is imperative that all reinforcing bars are bent to diameters that conform to the requirements of NZS 3101 and NZS 3109. To emphasise the importance of this, Practice Advisory 1 'Bend the bar but not the rules' was issued by the Department in December 2004 and revised in June 2005.

Another useful guide was published by CCANZ in October 2004 as IB 79 'Recommended Industry Practice on Bending and Re-bending of Reinforcing Bars'.

Don't

- ✘ **Don't** bend Grade 500E bars to diameters less than those permitted by NZS 3101 and NZS 3109.
- ✘ **Don't** re-bend Grade 500E microalloy bars of 16 mm or less, unless the strict conditions of NZS 3109 can be met.
- ✘ **Don't** re-bend Grade 500E microalloy bars more than 16 mm diameter.
- ✘ **Don't** re-bend Grade 500E QT bars.
- ✘ **Don't** weld or thread Grade 500E QT bars.
- ✘ **Don't** weld Grade 500E microalloy bars if it can be avoided.

Do

- ✔ **Do** identify at the design stage how reinforcing steel will be used on site, so its appropriate manufacturing process can be specified.
- ✔ **Do** adopt design and detailing practices that avoid the need for re-bending reinforcing steel.

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Re-bending Grade 500E

Re-bending is the action of reversing the bend in a bar. Normally it involves straightening an already-bent bar. The need for re-bending usually arises to allow other site activities to proceed, or the transport of precast units.

Amendment 2 of NZS 3109 permits re-bending of microalloy Grade 500E bars under conditions of controlled heating and cooling. These conditions are very difficult to reproduce on site, so re-bending of this steel is discouraged.

Re-bending of QT Grade 500E bars is not permitted by NZS 3109.

Welding Grade 500E

Welding QT Grade 500E steel reduces the strength of the hardened outer skin, so this steel must not be welded.

There are some reservations about all forms of welding of microalloy Grade 500E. Successful welding of microalloy Grade 500E depends on a highly competent welder following carefully controlled procedures that are very difficult to produce on site. The electrodes available for butt welding cannot be relied upon to provide sufficient overstrength. Lap welds are eccentric and dependent on workmanship so are considered unreliable. There is also evidence that tack welding can lead to premature failure of Grade 500E bars. It is therefore recommended that all forms of welding of this type of steel be avoided.

Background

Introduction of Grade 500E

The joint Standard AS/NZS 4671 was published in 2001 and introduced Grade 500E to replace Grade 430E.

Failures reported of Grade 500E

Failures of Grade 500E reinforcing were reported in University of Auckland tests in 2003.

Other 'field failures' were subsequently reported to the Department both formally and informally.

Investigation of Grade 500E by Department of Building and Housing

In response to the reports of these failures, the Department commissioned an investigation which culminated in the 'Report on Grade 500E Steel Reinforcement'. Hard copies are available on request. The Report concludes that Grade 500E is a viable material, but it is essential to be aware of and address the issues of concern: source of supply, method of manufacture, bending, re-bending and welding. Grade 500E is a high-strength ductile steel. The ductility, which is essential to its satisfactory performance in earthquakes, must not be compromised by unsatisfactory construction procedures.

References

- 1 Department of Building and Housing. July 2005. Report on Grade 500E Steel Reinforcement.
- 2 Building Industry Authority. July 2003. BIA Update No. 9, Grade 500E reinforcing steel: advisory note.
- 3 Department of Building and Housing. June 2005. Practice Advisory 1, Bend the bar but not the rules.
- 4 Cement and Concrete Association of New Zealand. October 2004. Information Bulletin IB79, Recommended Industry Practice on Bending and Re-Bending of Reinforcing Bars.
- 5 Standards New Zealand. AS/NZS 4671 Steel Reinforcing Materials.
- 6 Standards New Zealand. AS/NZS 1554.3 Welding of Reinforcing Steel.
- 7 Standards New Zealand. NZS 3101 Concrete Structures Standard.
- 8 Standards New Zealand. NZS 3109 Concrete Construction.

Note that this Practice Advisory is issued as guidance information in accordance with section 175 of the Building Act 2004 and, if used, does not relieve any person of the obligation to consider any matter to which the information relates according to the circumstances of the particular case.