Steel Reinforcement Institute of Australia

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BENDING REINFORCEMENT ON SITE

To create a bend or permanent deformation in a piece of steel reinforcement, the material must be plastically deformed or strained beyond its yield point. The minimum required internal diameter of bends or hooks in Clause 17.2.3.2 of AS 3600 is intended to limit the strain in the steel around both the outside and inside of the bar during the bending process to prevent not only fracturing of the bar, but ensure sufficient reserve is available to meet the minimum elongation and strength gain requirements set out in Table 2 of AS/NZS 4671: elongation of 1.5% for Ductility Class L and 5% for Ductility Class N reinforcement, and strength gain after yield of 3% and 8% respectively. The minimum internal diameters adopted are also intended to prevent crushing of the concrete.

Clause 17.2.3.2 of AS 3600 requires a minimum internal bend diameter of $4d_b$ for fitments made from D500N bars, $3d_b$ for 500L bars, and generally $5d_b$ for all other reinforcement. The smaller $3d_b$ internal diameter on the typical Ductility Class L fitments is intended to provide a neat 'corner' for enclosing the longitudinal bars. Internal diameters larger than $5d_b$ may be required if the bar is intended to be straightened or rebent or have an epoxy or galvanised coating applied.

Either special manual bending tools for bars up to about 16 mm in diameter and/or electric bending tools for larger bars are recommended for bending reinforcement on site. If such tools are being used, it is important to ensure that the pin diameter is suitable for the bar size (and coating) being bent. Poor bending practices on site involving inappropriate tools and methods is one of the major causes of bar failures (rather than the reinforcement materials) and resulting in SRIA technical enquiries.

If the bars are being heated to facilitate bending, Clause 17.2.3.1 limits the temperature to 600°C, but states that if heated above 450°C, the design yield strength of the steel should be taken as 250 MPa. The heating should also be uniform and no quenching (dipping in or spraying with cold water) of the bar is permitted. Note that at 450°C, no colour change (or redness) should be observed in the steel and if cogged ends of bars are being used to reduce the required development length by 50%, then considerable care is required if using heat to bend bars to ensure that the design strength of the bar is not reduced.

Rebending Reinforcement on Site

AS/NZS 4671 includes a rebend test in Clause 7.2.3 to ensure that deformed bars ≤16 mm in size and bent at 90° around a pin diameter of at least $4d_b$ can be rebent through a 90° angle ie straightened. Note that there is no test for bars ≥20 mm in size as rebending is only intended for smaller bars such as 'pull-out' bars connecting a slab to a wall or lift core. Larger bars should only be rebent to make minor adjustments.

Clause 17.2.3.1 of AS 3600 states that 'Reinforcement that has been bent and subsequently straightened or bent in the reverse direction shall not be bent again within 20 bar diameters of the previous bend'. This is to avoid strain hardening of the bar and consequent loss of ductility. It notes that 'bars should not be over-bent beyond the original bend, typically 90°'. While the clause suggests that bars can be bent in the reverse direction on site, the intention is that a 90° bend can only be straightened. Also, if bars have been cast into concrete, then the initial bend of the bar should be clear of the concrete.

Site bending or rebending should be carried out using special bending tools. The use of hammers is not permitted and pipes are not recommended for bending reinforcement as this may result in an uncontrolled bend diameter being produced or damage to the bar. Pipes of diameter at least $2d_b$ may however be used to straighten a previously bent bar, provided they are at least 1.2 m long and the required force is applied uniformly along the bar and the bending is carried out in a single smooth continuous action.

Further information on bending and rebending of reinforcement can be found in the SRIA's Technical Note 4 available free of charge on the web site at **www.sria.com.au** and AS 3600 Supplement 1: 2014 Concrete Structures – Commentary, which is now available.

UPDATES

AS 3727 Pavement Part 1: Residential

The revised AS 3727 Pavements Part 1: Residential is in the final stages of editing by Standards Australia following the review of public comments and should be available by the end of the year.

AS 5100 Bridge design

Public comments on Part 6 Bridge design Steel and composite construction have now been considered and the Standard has progressed to final edit.

AS 3600 Concrete structures

Revision of various parts of the Standard are continuing with completion of committee work expected mid-2017 and publication for referencing in NCC 2019.

AS/NZS 4671 Steel reinforcing materials

A proposal to update various parts of this Standard is being developed for lodgement with Standards Australia in 2017.

AS/NZS 1554.3 Structural steel welding – Welding of reinforcing steel

A kick off meeting for this Standard has been held and work on revised text amendments is progressing.

DR AS/NZS 2327 Composite structures – Composite steel-concrete construction in buildings

This revised Standard is available for public comment until the 24th January 2017.

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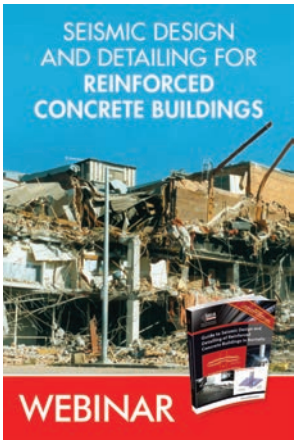
HISTORICAL DATA ON REINFORCEMENT

In response to the many questions we receive concerning previous reinforcing types, the SRIA have commenced drafting of a new publication covering the development of steel reinforcement in Australia from the first reinforced concrete structure in Australia in 1896 to the present. For those design professionals retiring and wanting to find a good home for any treasured textbooks and resource material that may assist in the development of this publication, or dealing with steel reinforcement in general, please contact the SRIA on (02) 9144 2602 or send us an email at **info@sria.com.au** and we will arrange to have the material collected and placed in the SRIA library.

Also, if you are aware of any older or historic buildings that are being demolished, please let us know so that we can make contact with the companies concerned to try and obtain samples of the early cold-formed reinforcement for our collection and possible testing of properties.

WEBINAR AVAILABLE



For those interested in learning more about the seismic design of reinforced concrete buildings in Australia, the SRIA has partnered with the CIA and a Webinar is available on the their web site (www.concreteinstitute.com.au) which is based on the SRIA's new publication Seismic Design and Detailing of Reinforced Concrete Buildings in Australia and the series of very successful national seminars held earlier this year.

The speakers included some of Australia's leading experts in the field of seismic design and a copy of the publication is included in the cost of the webinar. Additional copies of the publication can be downloaded for free as a pdf document or purchased as a full colour printed copy for a nominal cost of $37.00 including delivery anywhere within Australia from the SRIA's web site at **www.sria.com.au**.

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