

## **Swimming pool steel reinforcement – 250 and 400 grade steels**

Questions have been asked recently about the recommended strength of swimming pool steel. The following information is provided for Design Engineers and Pool Builders to consider. We welcome further discussion on this topic.

Australian Standard AS 2783-1992, Use of Reinforced Concrete for Small Swimming Pools, sets out the minimum requirements for steel reinforcement to control shrinkage and temperature stresses (see Table 2 in AS2783).

For pools in ground the reinforcement is the same for both 250 and 400 grade steel. Note that 400 Grade rebar was replaced by 500 Grade rebar with the introduction of AS4671-2001 Reinforcing Materials.

For pools that are more than 900mm out of ground and for cantilevered walkways the steel intensity is increased - there are differences in the requirements for 250 and 400 grade steel suggesting that there are apparent savings to be made using 400 grade rebar.

The control of cracking in a pool shell is really dependent on the area of steel in the concrete wall section rather than the yield stress of the reinforcing steel. It is paramount that the tensile stress developed in the steel is kept below a level of stress that will control crack widths to prevent leakage of water from the pool and prevent long term corrosion of the reinforcement and also remain below the actual yield strength of the steel.

The Concrete Structures Standard, AS3600-2001 limits the working stress (at serviceability) in the reinforcement to 300 MPa and even at this level crack widths 0.3mm and greater can develop in the concrete. Also, there are rules regarding bar spacing that limit steel stress similarly. For instance, the maximum steel stress at a bar spacing of 200 mm is 240 MPa and at a bar spacing of 300 mm it is 160 MPa.

The Standard, Concrete Structures for Retaining Liquids, AS3735-2001, limits reinforcing steel stress to 150 MPa in the structure to ensure that cracks are controlled to prevent any leakage of water and corrosion of reinforcement. In fully restrained situations the minimum steel requirement is 0.48%.

Thus it is essential to keep reinforcing steel stress in the structure below 300 MPa otherwise significant and deleterious concrete cracking may occur.

The current 250 grade S12 rebar used for pool reinforcement is really a 300 Grade steel. OneSteel Reinforcing 12D250N (S12) bar produced over the last 6 months has a characteristic minimum yield stress in excess of 300 MPa and a mean yield stress of more than 320 MPa.

Our advice is that the apparent allowable reduction in steel intensity of 400 Grade over 250 (300) grade steel in AS2783 cannot be justified because the extra yield strength cannot be utilised as this could result in excessive crack sizes.

Experience has shown that relatively high steel reinforcement contents should be used in pools to maintain the integrity and performance of the pool shell in most typical applications.

Our recommendation is to use S12, 250 grade bar because it has adequate strength and is easier to bend on site.

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