



Specification and Welding High Tensile Bolts

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Bolts are a very important design issue in precast concrete and are often not well understood or well specified by design engineers. In recent years, it has become customary for engineers to specify grade 8.8 bolts for precast when in fact, they should only be used where appropriate.

Two main types of metric bolt are used in structural engineering and precast connections in Australia. They are:

- Commercial bolts to AS1111, strength grade 4.6; and
- High strength structural bolts to AS1252, strength grade 8.8.

Commercial bolts are made of low carbon steel with mechanical properties similar to Grade 250 steel plate. They can be welded as for Grade 250 steel. High strength bolts are made by heat treating, quenching and tempering medium carbon steel. Heating or welding can cause significant degradation of their mechanical properties and even failure.

Typical bolt sizes used in precast concrete are:

- M16 for lightly loaded connections;
- M20 for general structural connections;
- M24 for heavier structural connections; and
- M28 and above for special structural connections but the use of such bolts will need careful assessment.

Compliance with Australian Standards

Most bolts used in Australia are now imported. Concerns have also been raised that some batches of bolts, imported from overseas or from an unknown source of supply, do not comply with the relevant Australian Standards where the design has relied upon compliance with these Standards. Either these bolts are not accompanied by any evidence of compliance with the requirements

that apply in Australia or the supporting documentation is inadequate. In addition, concerns have been raised that some imported products may be stamped as complying, yet may not comply.



“We have seen projects where the grade 8.8 bolts were specified to be tack welded and they all had to be cut out at a very significant cost and replaced with grade 4.6 bolts which can be welded. In another example, M36 8.8 grade bolts were tack

welded in a cage prior to casting into a structural column and failed when tapped with a hammer at the time of erection. ” - John Woodside

Compliance with the Building Code of Australia

It is a requirement under the Building Regulations that all building work be carried out in accordance with the Building Code of Australia (BCA) and this includes structural bolts in precast concrete.

To achieve compliance with the BCA requirements the following actions should be taken:

Engineers must adequately specify the bolts to be used in the connection and erection of precast concrete, including the appropriate referenced Standards with which the bolts and their associated nuts and washers must comply;

- Suppliers need to source bolts that comply with relevant Australian Standards. Bolts are called up in AS4100 which in turn is called up in the BCA. Also look for bolt suppliers who are ISO 9001 certified.
- Delivery dockets should have a clear reference to relevant Australian Standards;
- Suppliers should provide a copy of the evidence of compliance to purchasers and end users on request;
- End users of bolts such as builders, erectors or precasters should request evidence of compliance with relevant Standards from their bolt supplier and ensure they comply with the specification and drawings;
- The relevant building surveyor may request a copy of that evidence, or request that the person issuing certification provide specific verification that the structural bolts (and their associated nuts and washers) used comply with the relevant standards (structural bolts are those bolts used in the structure as opposed to bolts that may be used in architectural elements or building services).

Summary

If any welding is required, including welding of the structural washer, then grade 4.6 bolts should be used. Where bolts are fixed into cast-in ferrules in precast, the ferrules will almost certainly be grade 250-300 so a Grade 8.8 bolt is no stronger than a Grade 4.6 bolt in tension. More importantly, welding (including positional or tack welds) of any high strength structural bolt, nut or washer will almost certainly result in brittle fracture and failure unless very specific welding techniques are used.

References

ASI Connections Design Guide 1 Bolting
1st Ed T.J. Hogan and S.A. Munter 2007

ASI TechNote #1-06, High strength bolt assemblies, Certification to AS/NZS 1252-1996.....Reject or Accept? S.A. Munter