

Failure of Structural Bolts

ACT WorkCover's investigation into the collapse of a steel structure identified a number of safety issues relating to metric Property Class 8.8 structural bolts, in particular:

1. The availability of relevant documentation/compliance certificates that relate to a specific batch number.
2. The structural integrity and physical dimensions of certain types of M20 structural bolts.

Documentation and verification

The investigation revealed that importers and suppliers of bolts could not provide relevant compliance certificates to verify that a specific batch of bolts met the performance standard of *AS/NZ 1252 – 1996: High-strength steel bolts with associated nuts and washers for structural engineering*.

It was also difficult to accurately identify the importers of some of the bolts (identified by head markings). When asked, importers were unable to provide relevant and accurate certificates because they could not relate the certificates back to specific batches of bolts. Furthermore, some compliance certificates stated that bolts comply with Australian Standard *AS 1252 – 1983: High-strength steel bolts with associated nuts and washers for structural engineering*, which was superseded in 1996. Therefore the statement being made is not accurate against the current standard.

Structural Integrity

A NATA accredited testing facility reported on the results of proof load and wedge tests conducted on a set of six bolts. These bolts, which displayed two different head markings, were supplied in sizes M20 and M24 metric 8.8 with lengths ranging from 60 – 70 millimetres.

Proof Load Test

Both the M20 and M24 bolts showed elongation under proof load (147 000N for the M20 and 21 000N for the M24). As per *AS 4291.1 Mechanical properties of fasteners made of carbon steel and alloy steel - Bolts, screws and studs* an increase of 3% initial proof load was reapplied, and only one of the M24 bolts passed the test. The other 5 bolts did not meet the minimum requirements.

Wedge Test

Of the six bolts tested, only the two M24 bolts passed the wedge test. The four remaining M20 bolts fell short of the minimum tensile loading of 203 000N, therefore these bolts did not meet the minimum requirements of either the 1996 or 1983 Standards.



Specifications

A range of bolts, which included the types of bolts referred to in the proof and wedge test were measured for some of their other physical dimensions. These bolts failed to meet at least two of the dimensions set out in table 2.1 of *AS/NZ 1252 – 1996*, being the width across the bolt head and the width across the corners. However, these two bolt dimensions did meet the previous version of *AS 1252- 1983*.

Certain dimensions of the associated washers and nuts also failed to meet *AS/NZ 1252 – 1996*, but did comply with the previous version of this standard.

Recommendations

Bolted connections have the potential to be the weakest link in any structural steel framework if the incorrect type of bolt is used.

Engineers and fabricators of structures should correctly specify bolts in relevant documentation to ensure compliance with current Australian Standards. Suppliers need to source bolts that comply with the design specifications.

Importers and local manufacturers should have independent NATA or equivalent certified testing conducted on each batch of structural bolts to ensure inferior products do not enter the market. This testing procedure should ensure that the relevant sections of *AS/NZ 1252:1996* and *AS/NZS 4291.2* are met. Particular consideration should be given to the following:

- Tensile strength
- Proof Load – bolts and nuts
- Hardness for nuts, washers and very large bolts
- Chemical composition from original heat certificate

End users of structural bolt sets should insist on receiving test certificates and statements of conformance specific to the batch of bolts being used.

Duties under the ACT Occupational Health and Safety Act 1989

The *Occupational Health and Safety Act 1989* places obligations on manufacturers and suppliers to take all reasonably practicable steps to ensure that plant they design, construct or supply is safe; and to:

- carry out research, testing or examination necessary to discover, and eliminate or minimise, any risks that may arise from the use or condition of the plant; and
- provide information about the use or condition of the plant.

Further information

For further information, contact:

- ACT WorkCover on 6205 0200 or
- the Australian Steel Institute on (02) 9929 6666.