PART 9 CONNECTIONS

9.1 Bolts

9.1.1 AS 4100 Requirements

The general requirements and definitions for connections are set out in Clause 9.1 of AS 4100. Clause 9.3 of AS 4100 considers the requirements for the design of bolts. Clause 9.4 of AS 4100 should be used for assessing the strength of a bolt group. Design detail requirements for bolts are given in Clause 9.6 of AS 4100.

9.1.2 Detailed Information on Bolts and Bolting

Reference [9.1] Design Guide 1 'Bolting in Structural Steel Connections' contains detailed information on:

– characteristics of structural bolts, including dimensions

– bolting categories

– thread lengths

– detailing

– bolt installation and dimension of wrenches

– corrosion protection

Reference [9.2] Handbook 1 'Design of Structural Steel Connections' contains detailed information on design requirements for bolts and the design of bolt groups.

This Part of this publication only includes the basic elements involved with bolting of steel structures. For more detailed information, refer to References [9.1] and [9.2].

9.1.3 Bolt Types and Bolting Categories

The system of bolting category designation identifies the bolt being used by specifying its Property Class designation (4.6 or 8.8) and the installation procedure (by a supplementary letter /S- snug /T- full tensioning to AS 4100). For 8.8/T categories, the type of joint is identified by an additional letter (F- friction type joint; B- bearing type joint). See Table 9.1 for a summary of bolt types and bolting procedures.

Category 4.6/S refers to commercial bolts of Property Class 4.6 conforming to AS/NZS 1111 [Ref.9.19] tightened by a standard wrench to a "snug tight" condition.

Category 8.8/S refers to any bolt of Property Class 8.8, tightened by a standard wrench to a "snug tight" condition in the same way as for category 4.6/S. Essentially, these bolts are used as higher grade commercial bolts in order to increase the capacity of most connection types. In practice they will normally be high strength structural bolts to AS/NZS 1252 [Ref.9.20].

Categories 8.8/TF and 8.8/TB (or 8.8/T when referring generally to both types) refer specifically to high strength structural bolts of Property Class 8.8 conforming to AS/NZS 1252, fully tensioned in a controlled manner to the requirements of AS 4100 (Clause 15.2).

Note that neither type of structural bolt is presently manufactured in Australia, all being imported. Certification of bolts for compliance with AS 1111 and AS 1252 is an issue of some importance which is discussed in detail in Reference [9.1].

TABLE 9.1: Bolt Types and Bolting Categories

Bolting Category	Details of bolt used for each category					Method of Tensioning/ Remarks
	Property Class	Minimum Tensile Strength (MPa)	Minimum Yield Strength (MPa)	Bolt Name	Australian Standard	
4.6/S	4.6	400	240	Commercial bolt	AS 1111 [Ref.9.19]	Use **S**nug tightened. Least costly and most commonly available Grade 4.6 bolt
8.8/S	8.8	830	660	High Strength Structural Bolt	AS/NZS 1252 [Ref.9.20]	Bolts used are **S**nug tightened. The most common category used in flexible connections in Australia
8.8/TF	8.8	830	660	High Strength Structural Bolt – Fully **T**ensioned **F**riction Type Joint	AS/NZS 1252 [Ref.9.20]	In both applications, bolts are fully **T**ensioned to the requirements of Section 15 of AS 4100. Cost of tensioning is an important consideration in the use of these bolting categories. 8.8/TB procedure is the most common procedure used in rigid connections in Australia
8.8/TB	8.8	830	660	High Strength Structural Bolt – Fully **T**ensioned **B**earing Type Joint	AS/NZS 1252 [Ref.9.20]	

Generally, bolting categories 4.6/S and 8.8/S are used in simple (flexible) connections while category 8.8/TB is used in rigid connections and bolted splices. Category 8.8/TF is recommended only for use in connections where a no-slip connection under serviceability loads is essential. 8.8/TF is the only bolting category which requires consideration of the condition of the contact surfaces in a bolted connection.

Design drawings and shop detail drawings should both contain notes summarising Table 1.

Two additional symbols are incorporated into the bolting category designations 4.6/S, 8.8/S and 8.8/TB. They are:-

N: bolt in shear with threads i**N**cluded in the shear plane (e.g. 8.8 N/S)

X: bolt in shear with threads e**X**cluded from the shear plane (e.g. 8.8 X/S)