Asset Lifecycle – Guidance Note

Threaded rods vs bolts rods for flanged assemblies

Overview

Instances of threaded rods being installed on projects in lieu of bolts with hexagonal heads is increasing in number. The predominant reason cited has been lead time and availability of bolts – generally large diameter bolts used on critical assets.

Section 2.8.3 of Watercare's *General Mechanical Construction Standard* notes that the "*tables in the document are for bolts, not threaded rod/bar*", and states that "*Threaded rod could reach the yield strength at a lower torque value by at least 12%*". This seems to be misinterpreted by designers and mechanical fabricators who suggest that because the standard does not explicitly exclude the use of threaded rods, they are implicitly permitted.

The above reference to threaded rods is not intended to suggest that these can be used as an alternative to bolts.

Evidence from bolt manufacturers have shown that when mechanical testing is carried out, a rod with a nut has approximately 20% less tensile strength than a comparable headed bolt. The primary reason for this is because the effective surface area subject to stress between the nut and the threaded rod is reduced to the inner thread diameter as opposed to a bolts shank (major) diameter.

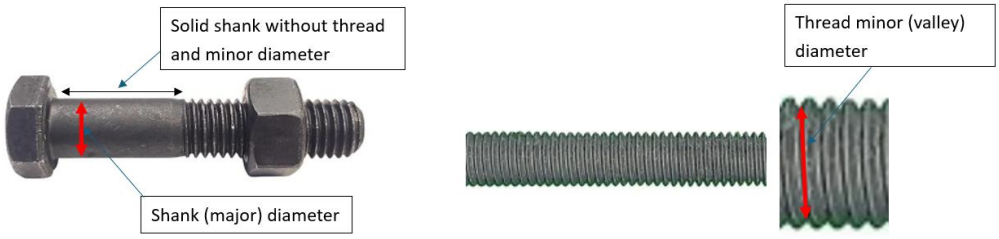

***Figure 1**: Comparison of cross sectional diameter of bolts vs threaded rods.*

Limitations of threaded rods

1) The common caues of bolt failure include fracture (tensile, fatigue, shear) and thread failure. Although care is taken to ensure that the likely forces on bolted assemblies are accommodated though thrust or restrained structures, designers must also consider that forces may vary over time, based on envrionmental factors, vibration, hydraulic exceptions etc.

References

Watercare

- **ME:** General Mechanical Construction Standard (Section M7)
- **MS:** Material Supply Standard

Other

- **AS/NZS 1252.1:** High-strength steel fastener assemblies for structural engineering – Bolts, nuts and washers
- **ASTM F606:** Standard test methods for determining the mechanical properties of externally and internally threaded fasteners, washers, direct tension indicators, and rivets.
- Portland bolt (https://www.portlandbolt.com/technical/faqs/substituting-a-rod-for-a-headed-anchor-bolt/)

2) It is likely that even if the rod with nut meets the specified yield strength it will typically fail at the junction where the nut acts as the head of the bolt. A failure like this where the nut comes off before the bolt breaks would effcetively fail the mechanicl tests in standards such as ASTM F606 which requires that the bolt yields along the threaded length (and not the junction with the bolt head).
3) A threaded rod may not achieve the required tensile resistance based on its geometry (minor diameter).
4) Threaded rods generally lack traceability which would provide evidence of place of manufacture, batch numbers, material composition etc.
5) Finally, threaded rods are generally cut to length which removes the corrosion resistant galvanising or protective film around the bolt (this also makes it difficult for future disassembly).

***Figure 2**: Examples of threaded rod corroding where it has been cut to length.*

For these reasons threaded rods shall NOT be substituted for bolts where:

- **Critical high-pressure assets, or transmission flanges are assembled**.
- **Flanges require precise bolt tensioning** (e.g., torque or tension control).
- **Where vibration or dynamic loading is present**, as rods may loosen more easily.

When can threaded rods be used

The use of threaded rods are often appropriate for structural designs (e.g. pipe supports mounted on concrete) where these are designed and certified by professional engineers.

For flanged mechanical assemblies, threaded rods may be considered in certain circumstances where:

- They are used temporarily for flanged installations whilst bolts are being procured.
- Non-critical or low-pressure systems where full bolt tensioning is not crucial.
- Custom requirements where standard bolts are not available, e.g. where it is not physically possible to install bolts due to spatial constraints.

Note: When specifying threaded rods, all risks should be considered and addressed, e.g. preventing dislodgement of nuts or rod failure.

The use of threaded rods shall only be granted through Watercare's dispensation process, where it must be demonstrated that the rods are appropriate for the intended application and meets the material class (e.g. 8.8) and loading requirements. Material certificates documenting the mechanical and chemical properties, including corrosion protection quality control must be submitted.

***Figure 3**: Example of incorrect material and grade of threaded rod installed leading to corrosion.*

Cold galvanizing of threaded rods is not allowed. The rod shall be procured black, cold-cut to length and then hot dip galvanized. The rod material grade shall also be stamped on both ends for identification purposes prior to galvanizing.

Recommended approach

The use of threaded rod in lieu of bolts is not preferred and is therefore considered a departure from Watercare Standards. They should not be considered an equivalent substitute for bolts. It is recommended that projects or maintenance activities proactively plan for the correct procurement of bolts where these are specified. Threaded rods shall generally not be allowed for flanged mechanical assemblies unless prior approval is granted through a dispensation.