Extending High Tensile Anchor Rods with Couplers

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Introduction

There are instances where high tensile anchor rods have been cast in with insufficient projection above the concrete. Extending the anchor rods by welding is generally not permitted. One method to extend the anchor rod is by the use of a threaded coupler. Checks are required to ensure that stripping of the threads and also tensile fracture of the coupler does not occur prior to the tensile fracture of the connected threaded rods. This article presents a method for these checks.

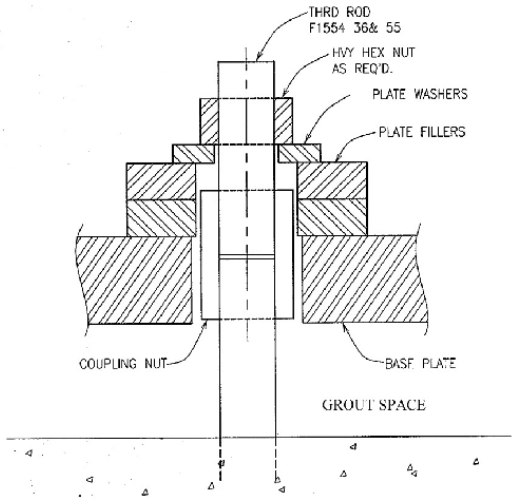

Figure 1: Threaded Coupler for Anchor Rod (AISC MSC Steel Interchange, 2004)

Check for Thread Stripping

The length of thread engagement required is based on equations from pages 1324 – 1325 of *Machinery's Handbook 24th Edition.* (Oberg et al, 1992)

If the coupler and threaded rod material have equal tensile strength then the length of thread engagement required to prevent thread stripping prior to tensile fracture of connected threaded rods is given by equation:

$$L_e = \frac{2A_t}{\pi D_{1\max}\left[\left(\frac{1}{2}\right) + \frac{n}{\sqrt{3}}\left(D_{2\min} - D_{1\max}\right)\right]}$$

where:

A_t = tensile stress area of anchor rod

n = number of threads per mm

D_{1max} = maximum minor diameter of internal thread, coupler

d_{2min} = minimum pitch diameter of external thread, anchor rod

For threaded rods that meet the requirements of the bolting standard AS/NZS 1252:1996 the values for these variables is found in Table 3.3 of AS 1275-1985 (SAA, 1985).

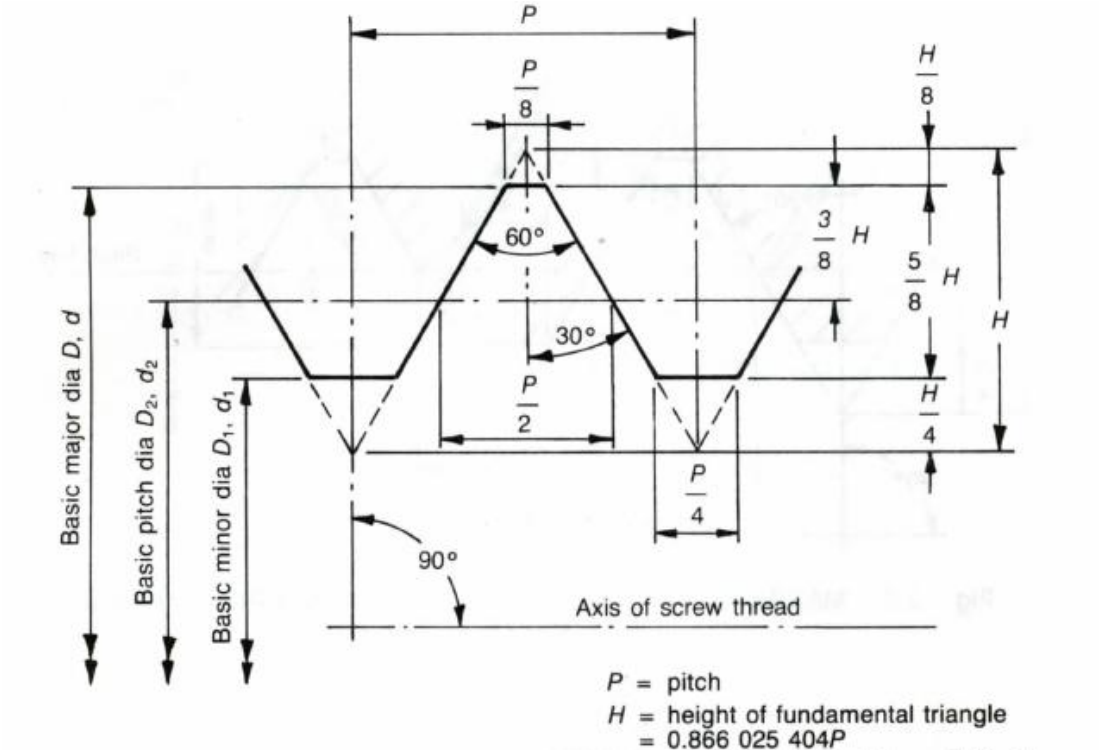

Figure 2: Basic Profile (SAA, 1985)

If the coupler internal thread is made of material of lower strength than the external thread of the anchor rods, stripping of the internal thread may take place before the fracture of the anchor rod. To prevent this occurring, a greater length of thread engagement is required. The adjusted length of thread required is given by equation:

$$Q = JL_e$$

Where:

$$J = \frac{A_s \text{ x tensile strength of external thread material}}{A_n \text{ x tensile strength of int ernal thread material}}$$

A_s = Shear area of external threads, anchor bolts

A_n = Shear area of internal threads, coupler

$$A_s = \pi n L_e D_{1max}\left[\left(\frac{1}{2n}\right) + \frac{1}{\sqrt{3}}\left(d_{2min} - D_{1max}\right)\right]$$

$$A_n = \pi n L_e d_{min}\left[\left(\frac{1}{2n}\right) + \frac{1}{\sqrt{3}}\left(d_{min} - D_{2max}\right)\right]$$

The tensile strength of the anchor rod may be stronger than expected. The Steel Structures Standard NZS 3404:1997 requires a strength reduction factor equal to 0.8 to be applied to take into account material variations within the property class.

Substituting and simplifying

$$J = \frac{D_{1max}\left[\left(\frac{1}{2n}\right) + \frac{1}{\sqrt{3}}\left(D_{2min} - D_{1max}\right)\right] x \frac{f_{u,rod}}{\phi}}{d_{min}\left[\left(\frac{1}{2n}\right) + \frac{1}{\sqrt{3}}\left(d_{min} - D_{2max}\right)\right] x \phi f_{u,coupler}}$$

d_{min} = minimum major diameter of external thread, anchor rod

D_{2max} = maximum pitch diameter of internal thread, coupler

$f_{u,rod}$ = anchor rod ultimate tensile strength

$f_{u,coupler}$ = coupler ultimate tensile strength

ϕ = 0.8

If the connected rods meet at the midpoint length of the coupler than the total length of coupler required is 2 x Q.

Check for Tensile Fracture of Coupler

Tensile fracture of the coupler must not occur prior to the tensile fracture of the connected threaded rods. The design tensile fracture strength of coupler is given by:

$$\phi N_{coupler} = \phi f_{u,coupler} \text{ x } A_{t,coupler}$$

where:

$A_{t,coupler}$ = Tensile stress area of coupler

$$A_{t,coupler} = \frac{\pi D_{Coupler}^2}{4} - \frac{\pi D_{max}^2}{4}$$

$D_{coupler}$ = outside diameter of coupler

D_{max} = maximum major diameter of internal thread, coupler

The tensile fracture strength of the anchor rod being stronger than expected is:

$$N_{rod,max} = \frac{f_{urod}}{\phi} \text{ x } A_t$$

If $\phi N_{coupler} \geq N_{rod,max}$ then tensile fracture will occur in the anchor rod and the coupler is satisfactory.

References

AISC, Modern Steel Construction Steel Interchange – Threaded Coupler for Anchor Rods, www.mordernsteel.com, posted on May 1, 2004, website accessed April 2009

Oberg, E., Jones, F. D., Horton, H. H., Ryffel H. H., Editor – Green, R., Machinery's Handbook 24th Edition, New York, 1992

SNZ, Steel Structures Standard (Incorporating Amendments 1 and 2), NZS 3404:1997, Standards New Zealand, Wellington, 2007

SAA/SNZ, High-Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering, AS/NZ1252: 1996, Standards Australia / New Zealand, North Sydney, 1996

SAA, Metric Screw Threads for Fasteners, AS1275-1985, Standards Australia, North Sydney, 1985