The example below is for a ball bearing encased in a "pillow block" supporting one end of a rotating shaft. The shaft applies a static load of 9kN to the block. Select appropriate screws for the pillow block attachment and specify an appropriate torque.

In the analysis, assume each bolt carries one-half the load. (Some design criteria will specify one bolt carry the entire load as a fail-safe measure.) We will also specify a factor of safety of 4 for the design. Bending loads will not be considered, all loads will be assumed to be axial. Furthermore, to simplify the problem, the loading will be assumed to be static; i.e., no fatigue considerations.

As an initial step, select a class 5.8 steel bolt.

Proof stress \( = 380 \text{ MPa}\)  
Ultimate stress \( = 520 \text{ MPa}\)  
Yield Strength \( = 420 \text{ MPa}\)

\[
\begin{align*}
S_p & := 380 \cdot 10^6 \\
\sigma_{ult} & := 520 \cdot 10^6 \\
\sigma_{yp} & := 420 \cdot 10^6 \\
F_{max} & := 4 \cdot 4500 \quad \text{Newtons} \\
F_{max} & = 1.8 \cdot 10^4 \\
A_t & := \frac{F_{max}}{S_p} \\
A_t & = 4.737 \cdot 10^{-5} \quad \text{Minimum allowable stress area.}
\end{align*}
\]
From table 14-2, text page 896, we find the required bolt to be

\[
\begin{align*}
M10 \times 1.5 \\
\text{Stress area} = 58
\end{align*}
\]

Assuming we torque to the maximum value of preload, we can then calculate the required torque.

\[
\begin{align*}
A_t & := 58 \cdot 10^{-6} \\
F_i & := 0.9 \cdot A_t \cdot S_p \\
F_i & = 1.984 \cdot 10^4 \quad \text{Newtons} \\
d_{maj} & := 0.010 \\
T & := 0.2 \cdot F_i \cdot d_{maj} \\
T & = 39.672 \quad \text{Newton - meter Required torque}
\end{align*}
\]