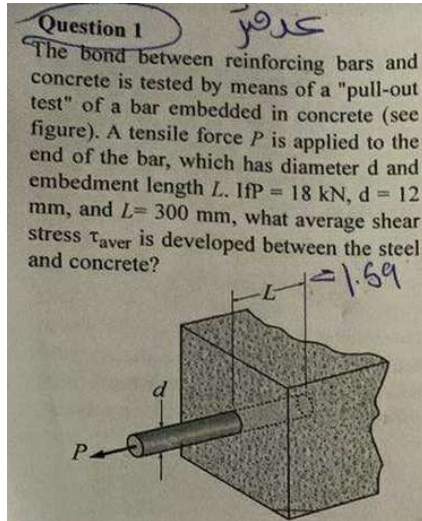


Question: The bond between reinforcing bars and concrete is tested by means of a "pull-out test" of a bar embedded in concrete (see figure). A tensile force P is applied to the end of the bar, which has diameter d and embedment length L . If $P = 18 \text{ kN}$, $d = 12 \text{ mm}$, and $L = 300 \text{ mm}$, what average shear stress is developed between the steel and concrete?



$$\tau_{\text{Avg}} = \frac{P}{A}$$

$$P = 18 \text{ kN}$$

$$A = \pi d L$$

$$d = 12 \text{ mm}$$

$$L = 300 \text{ mm}$$

$$\Rightarrow A = \pi \times 12 \times 300 = 11309.733 \text{ mm}^2$$

$$\Rightarrow \tau_{\text{Avg}} = \frac{18 \text{ kN}}{11309.733 \text{ mm}^2} = 0.00159 \text{ kN/mm}^2 = 1.59 \text{ N/mm}^2$$

This problem was solved by Civil Thinking (<https://civilthinking.com>)

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