

me270hw8 Assembly

question

1 Bolt Tensile Stress

Question 1: Bolt Tensile Stress

A metric **12x1.75** bolt is subjected to a torque of **18 N-m** during tightening. If the torque coefficient is **0.2**, determine the tensile stress on the bolt (MPa).

Stress = MPa

sigma=

拉伸应力（Tensile Stress）计算公式：

$$\sigma = \frac{F}{A_s}$$

其中：

- (σ) 是拉伸应力。
- (F) 是最大负载，通常指的是“屈服强度”或“证明强度”。
- (A_s) 是螺栓的横截面积。

横截面积（Cross-Sectional Area）计算：

对于公制螺栓（ISO标准）：

$$A_s = \left(\frac{\pi}{4}\right)(D - 0.9382p)^2$$

其中：

- (D) 是直径。
- (p) 是螺距。

对于美国标准（ANSI）：

$$A_s = \left(\frac{\pi}{4}\right)\left(D - \frac{0.9382}{n}\right)^2$$

其中：

- (n) 是每英寸的螺纹数。

预紧力（Preload）计算：

$$T = C_t \cdot D \cdot F$$

其中：

- (T) 是在装配过程中施加的扭矩。
- (C_t) 是扭矩系数，通常在0.15到0.25之间。
- (D) 是螺栓或螺钉的名义直径。
- (F) 是预紧力。

示例计算：

对于一个公制6x1.0螺栓，预紧力为200 N，扭矩系数为0.20。

1. 计算扭矩 (Torque) :

$$\backslash [T = C_t \cdot D \cdot F = 0.20 \cdot 6.0 \cdot 200 = 240 \text{ N-mm} = 0.24 \text{ N-m}] \backslash$$

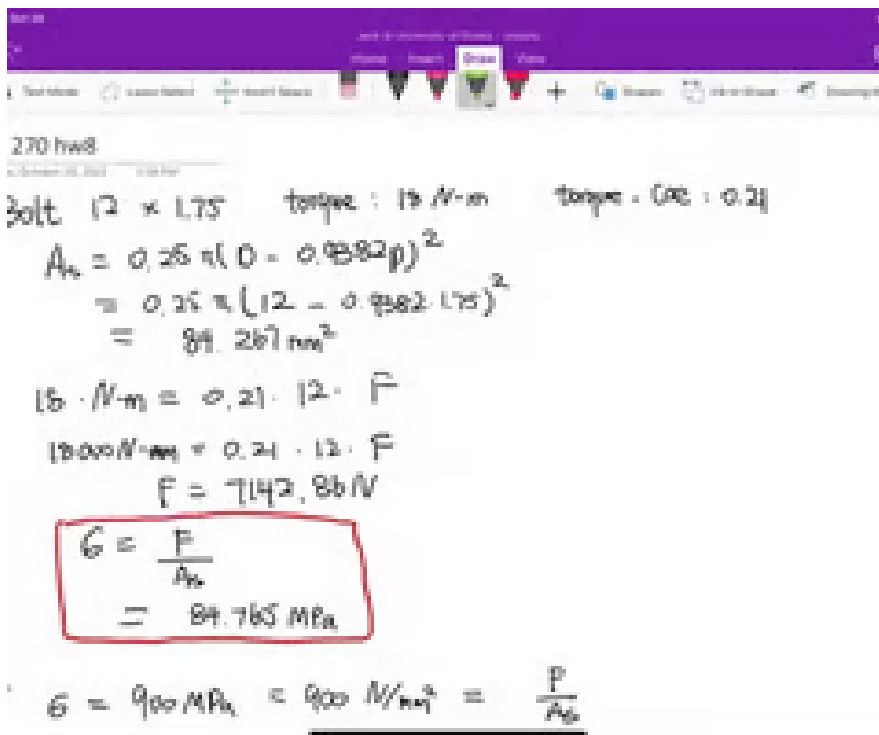
2. 计算横截面积 (Area) :

$$\backslash [A_s = 0.25\pi(6.0 - 0.9382 \cdot 1.0)^2 = 20.12 \text{ mm}^2] \backslash$$

3. 计算拉伸应力 (Stress) :

$$\backslash [\sigma = \frac{F}{A_s} = \frac{200}{20.12} = 9.94 \text{ N/mm}^2 = 9.94 \text{ MPa}] \backslash$$

这个示例展示了如何使用给定的参数来计算螺栓在预紧过程中的扭矩和拉伸应力。通过这些计算，工程师可以确保螺栓在设计和应用中的安全性和可靠性。



Handwritten calculations for bolt torque and stress:

$$\begin{aligned} \text{Bolt } 12 \times 1.75 \quad \text{torque} &: 12 \text{ N-m} \quad \text{torque} \cdot C_t = 0.21 \\ A_s &= 0.25\pi(d - 0.9382p)^2 \\ &= 0.25\pi(12 - 0.9382 \cdot 1.75)^2 \\ &= 89.267 \text{ mm}^2 \\ 12 \text{ N-m} &= 0.21 \cdot 12 \cdot F \\ 12000 \text{ N-mm} &= 0.21 \cdot 12 \cdot F \\ F &= 7142.86 \text{ N} \\ \sigma &= \frac{F}{A_s} \\ &= 84.765 \text{ MPa} \end{aligned}$$

Check: $\sigma = 900 \text{ MPa} < 900 \text{ N/mm}^2 = \frac{F}{A_s}$

t=24

tc=0.24

d=12

p=1.75

As=pi*0.25*(d-0.9382*p)**2

sigma=t/tc/d*1000/As

print(sigma)

2# Bolt Torque

Question 2: Bolt Torque

An alloy steel metric **10x1.25** screw is used in a threaded hole and tightened to **20%** of its proof strength of **840 MPa**. Determine the maximum torque that should be used if the torque coefficient = **0.2**.

Torque = N – m

The image shows handwritten calculations for bolt torque within a software application window. The calculations are as follows:

$$\sigma = \frac{F}{A_t}$$
$$= 89.765 \text{ MPa}$$
$$\sigma = 900 \text{ MPa} = 900 \text{ N/mm}^2 = \frac{F}{A_t}$$
$$A_t = 0.25 \pi (D - 0.9382p)^2$$
$$= 0.25 \pi (10 - 0.9382 \cdot 1.25)^2$$
$$= 61.198 \text{ mm}^2$$
$$\sigma_{\text{max}} = 900 \cdot 0.45 = 405 \text{ N/mm}^2$$
$$F = \sigma_{\text{max}} \cdot A_t = 24785.19 \text{ N}$$
$$T = \frac{0.23 \cdot 10 \cdot F}{1000} = 57.006 \text{ N/m}$$

3 Shrink and Expansion Fits

The difference between a shrink fit and an expansion fit is that in a shrink fit the internal part is cooled to a sufficiently low temperature to reduce its size for assembly, whereas in an expansion fit, the external part is heated sufficiently to increase its size for assembly.

Answer

False

2. Shrink and Expansion Fits

Assembly of two parts (e.g., shaft in collar) that have an interference fit at room temperature

- *Shrink fitting* - *external* part is enlarged by *heating*; the other part either stays at room temperature
- *Expansion fitting* - *internal* part is contracted by *cooling* and inserted into mating component
- Change in diameter:

所以，答案是 **False**，因为扩张配合的描述不准确。正确的描述应该是：

收缩配合是一种装配方式，其中外部部件（如轴）通过加热膨胀，然后在冷却后与内部部件（如套筒或轴承座）紧密配合。这种配合在冷却过程中形成，因为外部部件的尺寸减小，从而与内部部件形成紧密的配合。【之后冷却孔缩小】

扩张配合涉及将内部部件通过冷却收缩，然后插入到外部部件中。在加热后，内部部件会膨胀，与外部部件形成紧密配合。【内扩张】

4 Adhesives 粘接

Select all of the following that are methods by which adhesives cure:

Electrical current

Catalyst

Pressure

Radiation

Evaporation

Heat

Answer

粘合剂固化方法（Adhesive Curing）

Catalyst

Pressure

Radiation

Evaporation

Heat

1. 在应用前将催化剂或活性成分与聚合物混合（**Mixing catalyst or reactive ingredient with polymer prior to applying**）：在粘合剂应用之前，将催化剂或活性成分与聚合物混合以促进固化。
2. 加热以启动化学反应（**Heating to initiate chemical reaction**）：通过加热来加速粘合剂的固化过程。

3. **辐射固化，如紫外线（Radiation curing, such as UV light）**：使用紫外线或其他形式的辐射来固化粘合剂。
4. **水蒸发固化（Curing by of water evaporation）**：使用水蒸发来触发粘合剂的固化反应，这可能是指水基粘合剂。
5. **薄膜或压敏涂层（Films or pressure-sensitive coatings）**：使用薄膜或压敏材料，这些材料在压力下会固化。

5 Welding, Brazing and Soldering

Which of these joining processes does not require melting of the part metal, can be done at 500 C, and is used when joining dissimilar metals or those with poor weldability?

Brazing

Stick Welding

GMAW Welding

Soldering

Answer

Brazing

Brazing and Soldering do not melt metals, but brazing >450 while soldering <450

相关内容在L20

不需要熔化部分金属、可以在500°C下进行、并且用于连接不同金属或那些焊接性差的金属的 **Brazing（钎焊）**。钎焊是一种在低于母材熔点的温度下进行的连接过程，它使用填充金属（两种或多种金属，而不需要熔化基材金属。这种方法适用于连接不同金属或那些焊接性差的不依赖于基材金属的熔化，而是通过钎料在较低温度下熔化并流入接头间隙来实现连接。钎焊在较低的温度下进行，例如500°C，这使得它适合于热敏感材料的连接。

6 Welding

What joining process uses a tungsten electrode that does not touch the base material?

MIG

TIG

Wave soldering

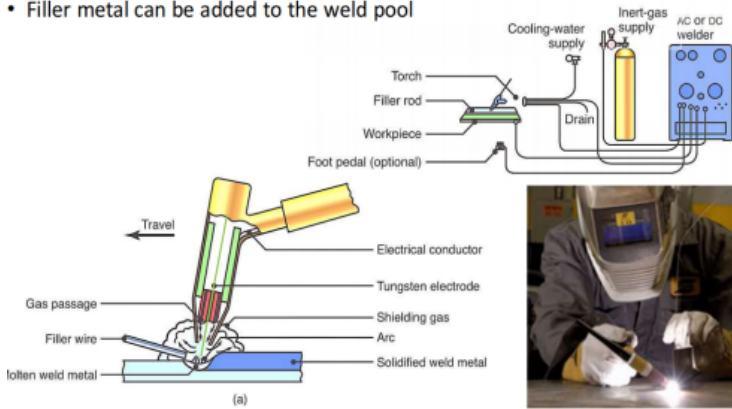
GMAW Welding

Answer

TIG

Gas Tungsten Arc Welding (GTAW, or TIG)

- Tungsten electrode acts as a cathode
- A plasma is produced between the tungsten cathode and the base metal which heats the base metal to its melting point
- Filler metal can be added to the weld pool



使用钨电极且不接触基材的焊接过程是TIG Welding (GTAW)。在TIG焊接中，使用的是非消耗性的钨电极，该电极不接触被焊接的基材，而是通过电弧产生的热量来熔化金属

7 HAZ

Failures within a weld typically occur in the columnar fusion zone due to embrittlement.

Answer: **False**

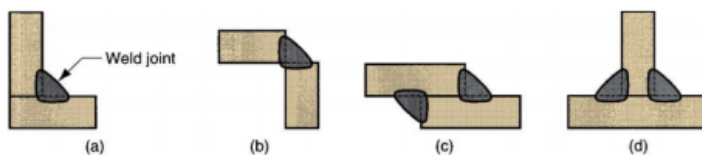
接头中的失败通常发生在熔合区 (Fusion Zone) 或热影响区 (Heat-Affected Zone, HAZ)，而不是柱状熔合区 (Columnar Fusion Zone)

8 fillet weld

A fillet weld has a cross sectional shape that is approximately which one of the following?

Fillet Welds

(a) Inside single fillet corner joint; (b) outside single fillet corner joint; (c) double fillet lap joint; (d) double fillet tee joint (dashed lines show the original part edges)



Round

Rectangular

Square

Triangular

Triangular