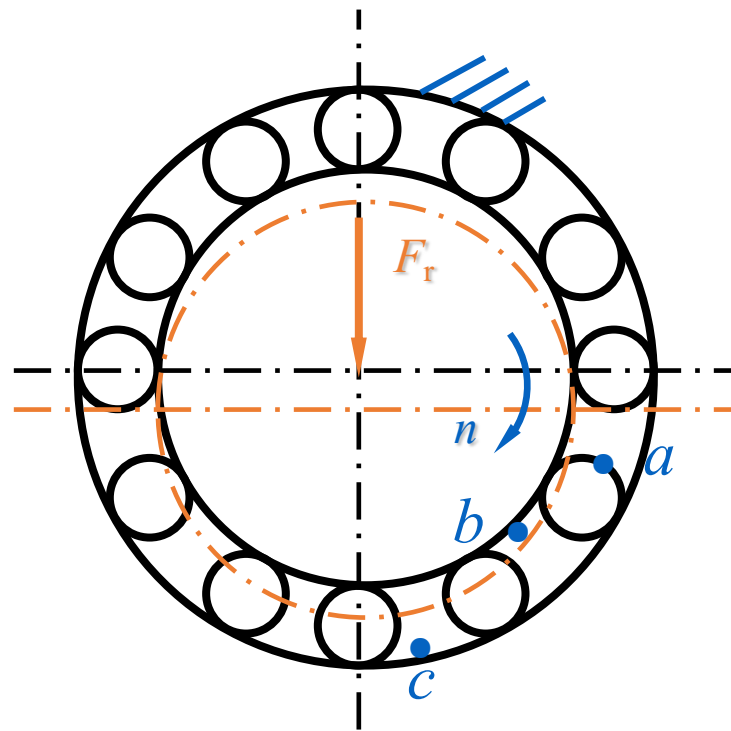仿生设计
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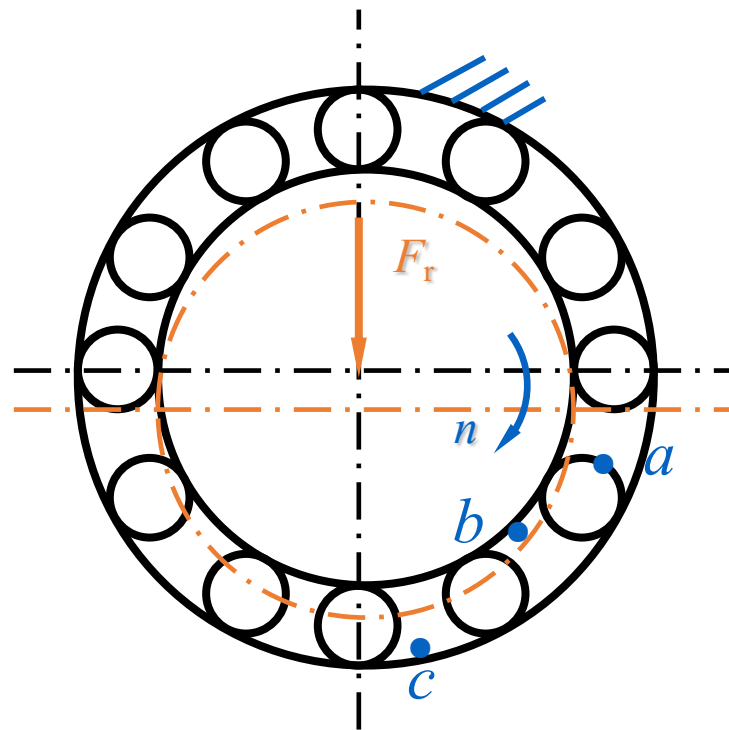
HW04
第04章 轴承及轴设计
作业

所有作业要求手写

Autumn 2024

HW 04.1

- 如右图所示，当轴承仅受到纯径向力作用时，对于滚动体上一点 a、内圈滚道接触点 b，以及外圈滚道接触点 c，请分别分析 a、b、c 三点的受力情况，并画出接触应力变化简图。

HW 04.1

• As shown in the figure on the right, when the bearing is only subjected to a pure radial force, analyze the force conditions at points a, b, and c on the rolling element, the inner ring raceway contact point, and the outer ring raceway contact point, respectively. Draw a simplified diagram of the contact stress variations
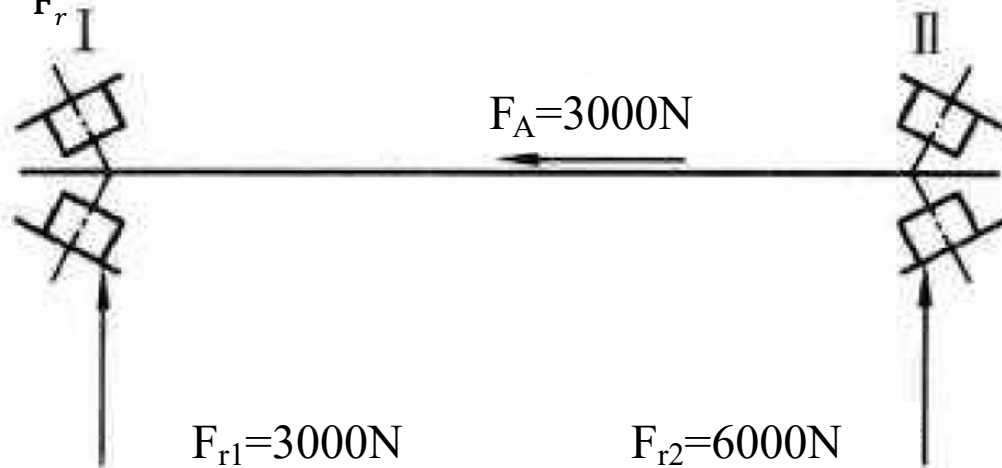
HW 04.2

- 某设备中的一转轴，两端用 30207E 型轴承（如图所示）。轴工作转速 n=1450 r/min，在常温下工作 f_1=1，轴所受轴向载荷 F_A=3000N，轴承所受的径向负荷 F_{r1}=3000N，F_{r2}=6000N，设计寿命 L_h=1500h，负荷系数 f_p=1.5。

（1）求轴承派生轴向力 S1、S2 的大小和方向

（2）试校核该轴承是否满足寿命要求？

附：30207E 型轴承有关参数如下：C_r=51500N，e=0.37，$S=\frac{F_r}{2Y}$，当 $\frac{F_a}{F_r}\leq e$ 时，X=1，Y=0；当 $\frac{F_a}{F_r}>e$ 时，X=0.4，Y=1.6。寿命计算式：$L_h = \frac{10^6}{60n}(\frac{C_r}{P_r})^\varepsilon(\varepsilon=10/3)$

HW 04.2

- A certain shaft in a piece of equipment is supported at both ends by 30207E-type bearings (as shown in the figure). The shaft operates at a speed of n=1450 r/min, works at normal temperature with f_1=1, and is subjected to an axial load of F_A=3000N. The radial loads on the bearings are F_{r1}=3000N and F_{r2}=6000N. The designed service life is L_h=1500 hours, and the load factor is f_p=1.5.

I F_A=3000N   Ⅱ

F_{r1}=3000N F_{r2}=6000N
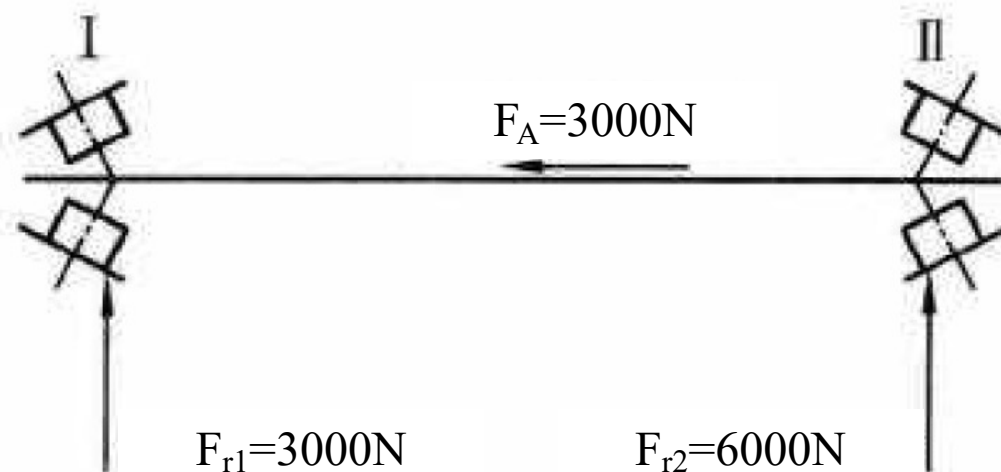
HW 04.2

- (1) Determine the magnitude and direction of the axial forces S1 and S2 derived from the bearing.

- (2) Please check whether the bearing meets the service life requirements.
  - Appendix: The relevant parameters for the 30207E type bearing are as follows:
  - Cr=51500N, e=0.37, $S=\frac{F_r}{2Y}$. When $\frac{F_a}{F_r} \leq e$, X=1, Y=0; When $\frac{F_a}{F_r} > e$, X=0.4, Y=1.6.

 - Service life calculation formula: $L_h = \frac{10^6}{60n}(\frac{C_r}{P_r})^\varepsilon$ （ε=10/3）

F_A=3000N

F_{r1}=3000N F_{r2}=6000N
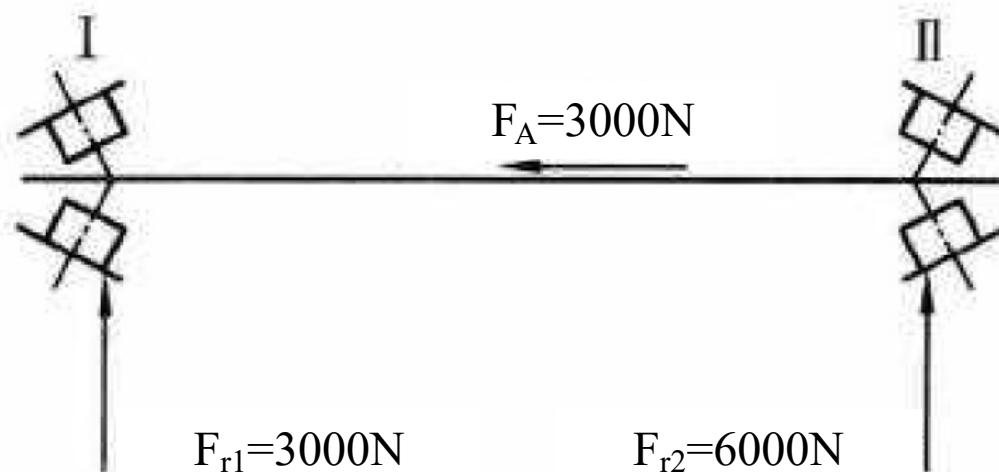
HW 04.3

两级标准圆柱齿轮减速器输出轴的结构如图所示。已知齿轮分度圆直径$d = 332$ mm, 作用在齿轮上的圆周力$F_t = 7780$ N, 径向力$F_r = 2860$ N, 轴向力$F_n = 1100$ N, 单向工作。支点与齿轮中点的距离$L_1 = 140$ mm, $L_2 = 80$ mm。
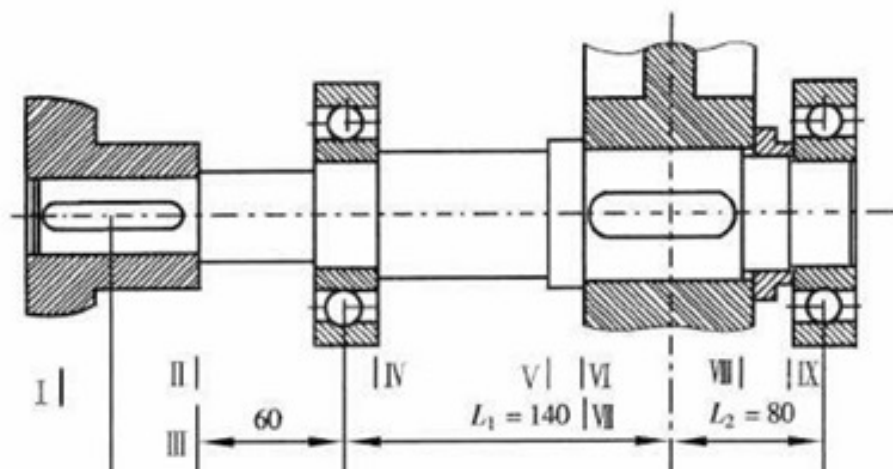
a) 画出轴的受力简图;

b) 计算支承反力;

c) 画出轴的弯矩图、合成弯矩图及转矩图;

d) 指出危险剖面的位置。

HW 04.3

The structure of the output shaft of a two-stage standard cylindrical gear reducer is shown in the Figure. It is known that the diameter of the gear indexing circle $d = 332$ mm, the circumferential force $F_i = 7780$ N, the radial force $F_r = 2860\ N$, and the axial force $F_n = 1100$ N, which is working in one direction. The distance between the pivot point and the midpoint of the gear $L_1 = 140$ mm, $L_2 = 80$ mm.
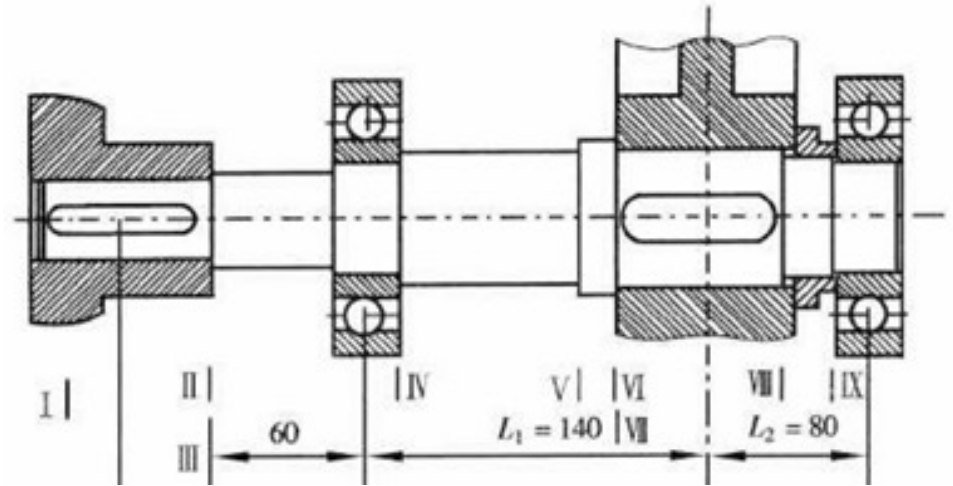
a) Draw a force sketch of the shaft;

b) Calculate the support reaction force;

c) Draw the bending moment diagram, synthetic bending moment diagram and torque diagram of the shaft;

d) Indicate the location of the hazardous profile.

Thank you~

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