

电测原理简介

一、概述

电测法：电阻应变测量法的简称。

基本原理：以电阻应变片作为传感元件，将构件的应变转换为电阻变化，通过电阻应变仪进行测量，从而得到应变值。

优点与特点：

- (1) 应变片的体积小，质量轻，能准确反映一点处的应变；
- (2) 测量精度高，抗干扰能力强；
- (3) 粘贴测量方便，广泛用于远距离、动静态、复杂环境等。

二、电阻应变效应与电阻应变片



$$R = \rho \frac{l}{A}$$

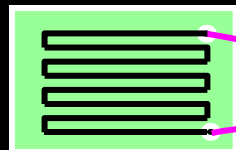
$$R' = \rho \frac{l'}{A'}$$

$$\Delta R \approx \rho \frac{\Delta l}{A} \approx k \Delta l$$

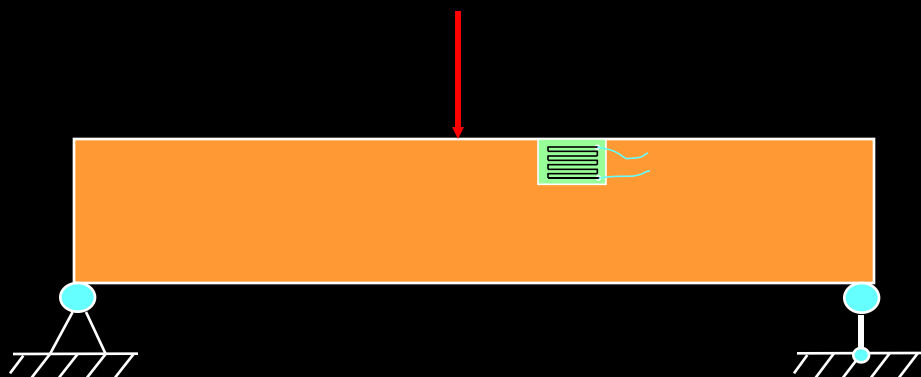
$$\frac{\Delta R}{R} = k \frac{\Delta l}{l} = k \varepsilon$$

电阻应变效应

k : 灵敏系数



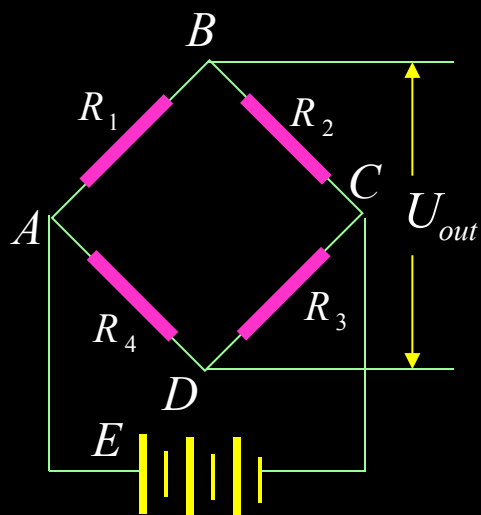
电阻应变片



应变片的设计要求:

- (1) 体积小,电阻大;
- (2) 导体横向变形小;
- (3) 便于粘贴测量。

三、惠斯登电桥与电阻应变仪



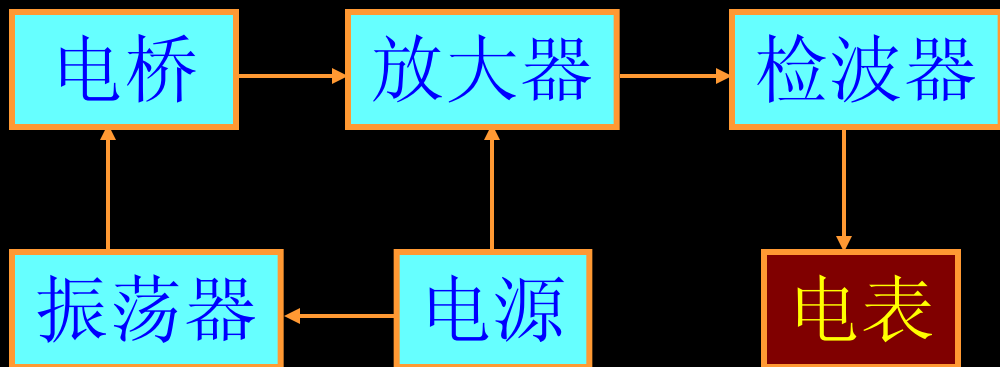
电桥平衡: $U_{out} = 0$ 平衡条件: $R_1 R_3 = R_2 R_4$

电阻改变: $U_{out} = \frac{E}{4} \left(\frac{\Delta R_1}{R_1} - \frac{\Delta R_2}{R_2} + \frac{\Delta R_3}{R_3} - \frac{\Delta R_4}{R_4} \right)$

$$\frac{\Delta R}{R} = k \frac{\Delta l}{l} = k \varepsilon$$

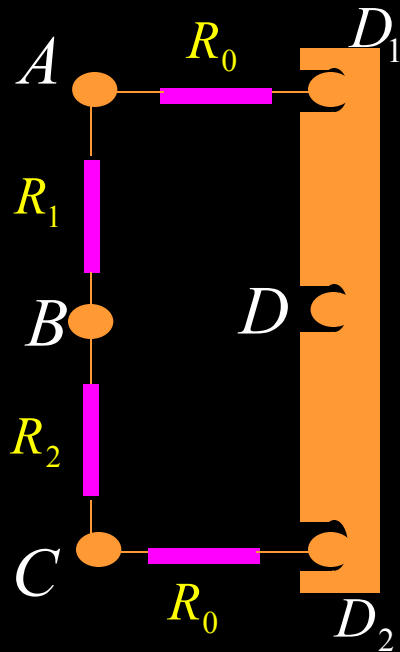
$$= K (\varepsilon_1 - \varepsilon_2 + \varepsilon_3 - \varepsilon_4)$$

K: 灵敏系数

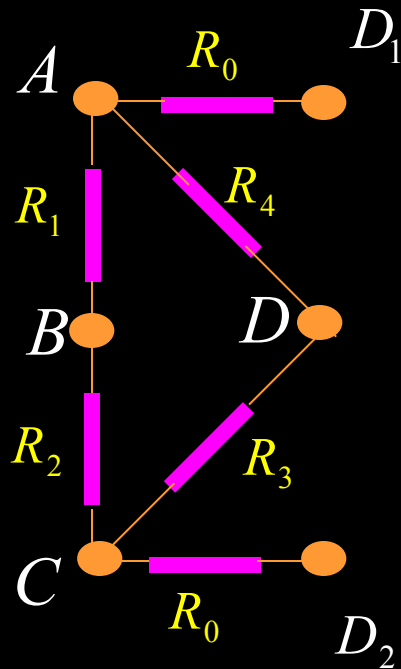


$$\varepsilon_{\text{读}} = \varepsilon_1 - \varepsilon_2 + \varepsilon_3 - \varepsilon_4$$

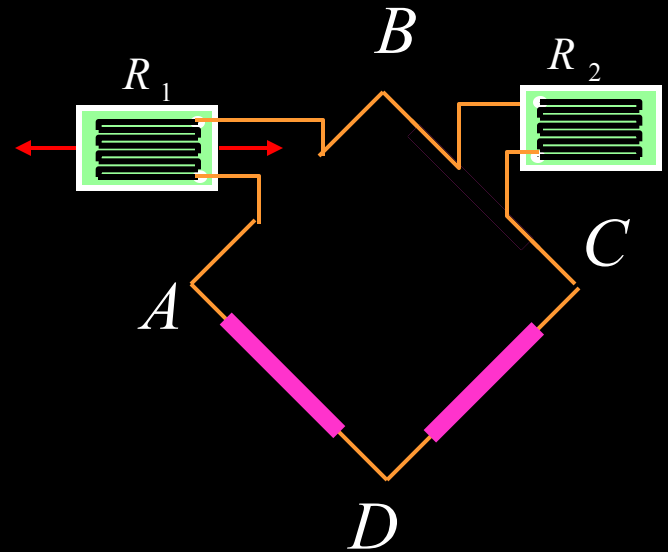
四、半桥电路与全桥电路



$$\varepsilon_{\text{读}} = \varepsilon_1 - \varepsilon_2$$



$$\varepsilon_{\text{读}} = \varepsilon_1 - \varepsilon_2 + \varepsilon_3 - \varepsilon_4$$



五、温度补偿

$$\varepsilon_{\text{读}} = \varepsilon_{1P} + \varepsilon_{1T}$$

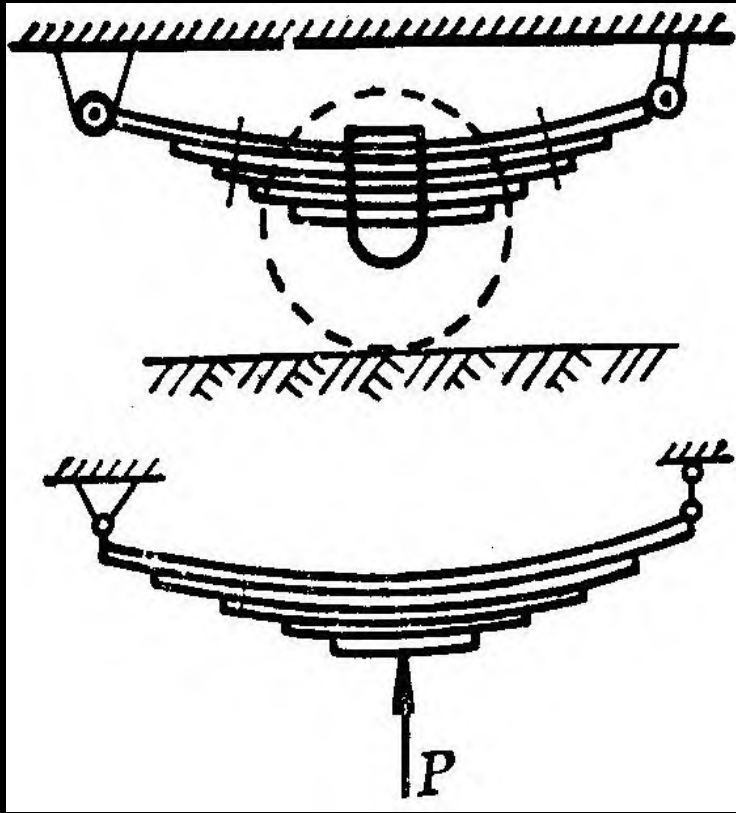
$$\varepsilon_2 = \varepsilon_{2T}$$

$$\varepsilon_{\text{读}} = \varepsilon_{1P} + \varepsilon_{1T} - \varepsilon_{2T} = \varepsilon_{1P}$$

叠梁弯曲正应力测定

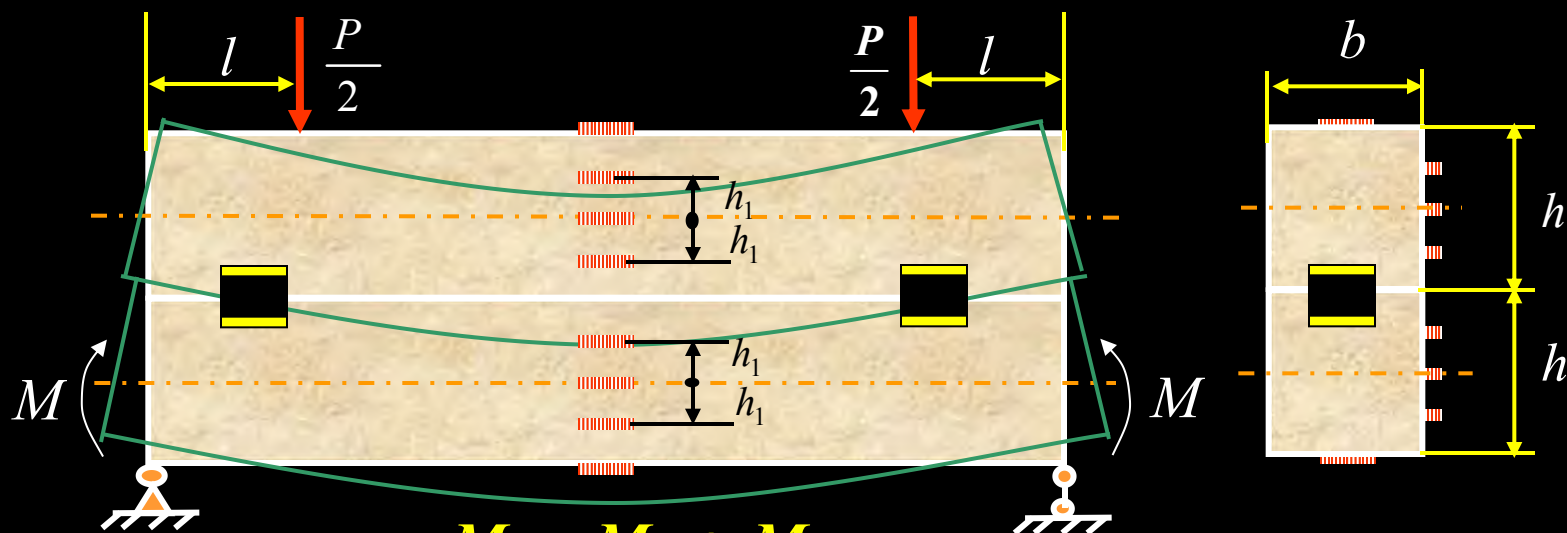
一、概述

二、实验目的



1. 掌握电测法测量应变的基本原理和电阻应变仪的使用。
2. 用电测法测定叠梁横截面上的应力分布规律，并根据测定结果建立力学模型。

三、实验原理



$$\sigma_{\text{理}} = \frac{M}{I_z} y$$

$$\begin{cases} M = M_1 + M_2 \\ \frac{1}{\rho} = \frac{M}{EI} \end{cases} \Rightarrow M_1 = M_2 = \frac{M}{2}$$

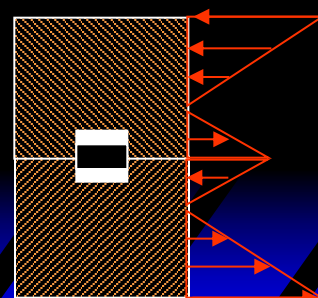
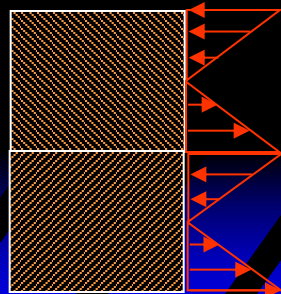
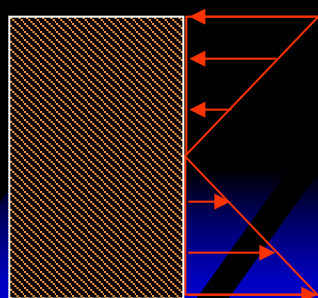
$$\sigma_{\text{实}} = E \cdot \varepsilon_i$$

单梁

叠梁

楔块组合梁

各种形式
梁的应力
分布规律



四、实验仪器设备

1. 多功能实验台
2. 静态电阻应变仪及预调平衡箱
3. 拉压力传感器及数字测力仪





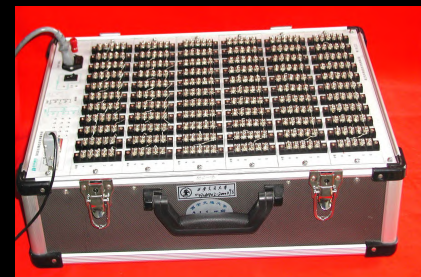
YJ-25型静态
电阻应变仪



M72动态电阻
应变放大器



YD-28动态
电阻应变仪



DH3816多测点
静态电阻应变仪

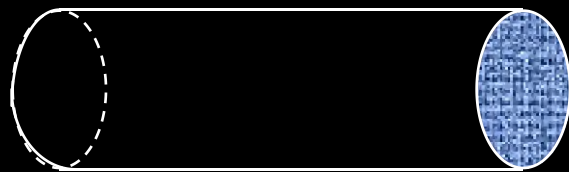


弯曲应力
测定
试验台

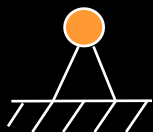
材料力学图形元素库

公式框 $\sigma = \frac{N}{A}$

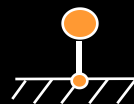
圆柱



固定支座



可动支座



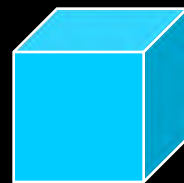
固定端



均布载荷



单元体



字母框

σ α τ \ll

$<$ $>$ \leq \geq \neq \nrightarrow \leftarrow \curvearrowright \curvearrowleft \curvearrowright \curvearrowleft \bullet