Thermal Expansion

Why materials expand, and the three coefficients.

Physics

Length change is proportional to original length, temperature change and the material's coefficient.

$$\Delta L = \alpha L \Delta T \cdot \beta \approx 2\alpha \cdot \gamma \approx 3\alpha$$

Steel bridge, 100 m, 30°C rise — **~36 mm expansion**

$\alpha \approx 12 \times 10^{-6}\ K^{-1}$.

Expansion joints — **Accommodate it**

Or the structure buckles.

Bimetallic strip — **Two metals, different α**

Bends with temperature.

THE COMMON MISTAKE

× **Assuming a hole shrinks when a plate expands**

✓ **The hole expands too**

Everything scales up together. A hole in an expanding plate expands as if it were made of the same material.

Water between 0°C and 4°C contracts as it warms. That anomaly is why lakes freeze from the top.