

**QUESTION:**

1. A new 75 m long concrete footpath is constructed down a Sydney street. Estimate how many 2 cm thick expansion joints are required to accommodate the change in length of the path from the coldest midwinter's night to the hottest summer's day.

**SOLUTION:**

The coefficient of thermal expansion of concrete is  $\alpha_{con} = 12 \cdot 10^{-6} \text{ K}^{-1}$ .

(Ref: [http://en.wikipedia.org/wiki/Thermal\\_expansion](http://en.wikipedia.org/wiki/Thermal_expansion) )

Record high temperature in Sydney was  $T_{max} = 45.8 \text{ }^{\circ}\text{C}$ , and record low temperature was  $T_{min} = 2.1 \text{ }^{\circ}\text{C}$  (Ref: [http://en.wikipedia.org/wiki/Climate\\_of\\_Sydney](http://en.wikipedia.org/wiki/Climate_of_Sydney))

So, the change in the linear dimension of the footpath can be estimated to be

$$\Delta L = L_0 \alpha_{con} \Delta T$$

$L_0 = 75 \text{ m}$  – the initial length of the footpath

$$\Delta T = T_{max} - T_{min} = 43.7 \text{ K}$$

Hence

$$\Delta L = 75 \cdot 12 \cdot 10^{-6} \cdot 43.7 = 0.03933 \text{ m} = 3.93 \text{ cm}$$

So, two 2 cm thick expansion joints are enough to accommodate the change in length of the path from the coldest midwinter's night to the hottest summer's day.

**ANSWER:** two 2 cm thick expansion joints.