

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 $\alpha_{con} = 12 \cdot 10^{-6} K^{-1}$.

(Ref: http://en.wikipedia.org/wiki/Thermal_expansion)

Record high temperature in Sydney was $T_{max}=45.8$ °C, and record low temperature was $T_{min}=2.1$ °C (Ref: http://en.wikipedia.org/wiki/Climate_of_Sydney)

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

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

$L_0 = 75 m$ – the initial length of the footpath

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

Hence

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

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.