



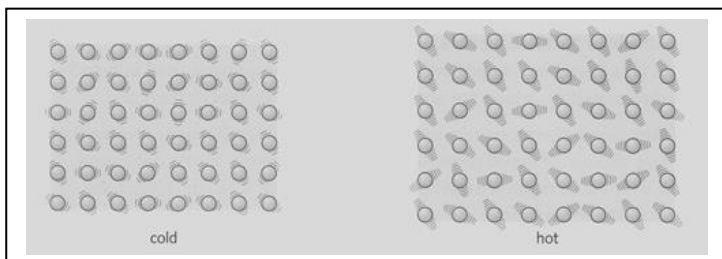
If a concrete or steel bar is heated, its volume will increase slightly. The effect is called **thermal expansion**.

It is usually too small to notice, but unless space is left for it, it can produce enough force to crack concrete or buckle the steel.

Most solids expand when heated. So do most liquids – and by more than solids. If liquid is stored in a sealed container, a space must be left at the top for expansion.

**Kinetic Theory**

According to the kinetic theory, solids and liquids are made up of tiny, vibrating particles (atoms or molecules) which attract each other. The higher the temperature the faster the particles vibrate.

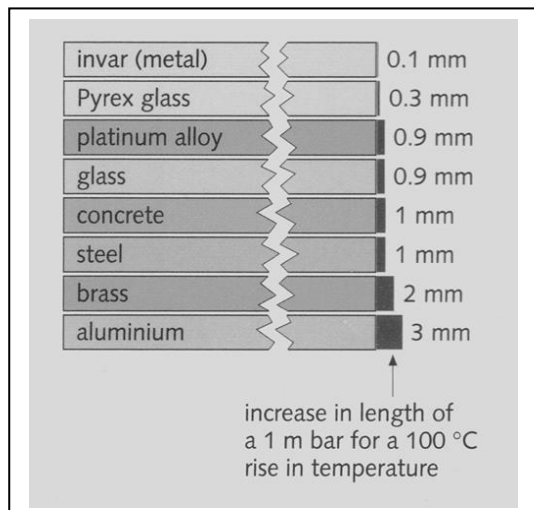


The kinetic theory explains thermal expansion as follows.

When, say a steel bar is heated, its particles speed up. Their vibrations take up more space, so the bar expands slightly in all directions. If the temperature falls, the reverse happens and the material contracts (= gets smaller).

**Comparing expansions**

The chart shows how much 1 metre lengths of different materials expand when their temperature goes up by 100°C. For greater lengths and higher temperature increases, the expansion is more.



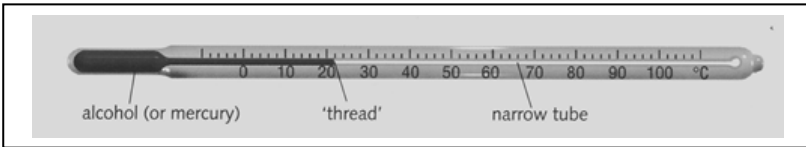
When choosing materials for a particular job, it can be important to know how much they will expand. Here are two examples:

Steel rods can be used to reinforce concrete because both materials expand equally. If the expansions were different, the steel might crack the concrete on a hot day.

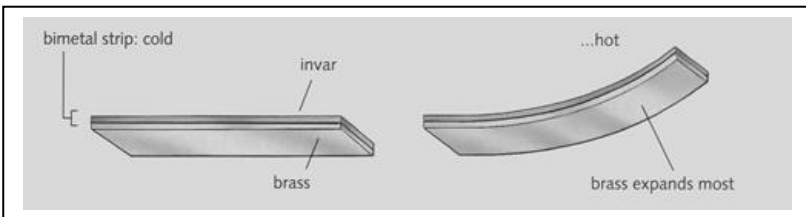
If an ordinary glass dish is put straight into a hot oven, the outside of the glass expands before the inside and the strain cracks the glass. Pyrex expands much less than ordinary glass, so should not crack.



### Using Expansion



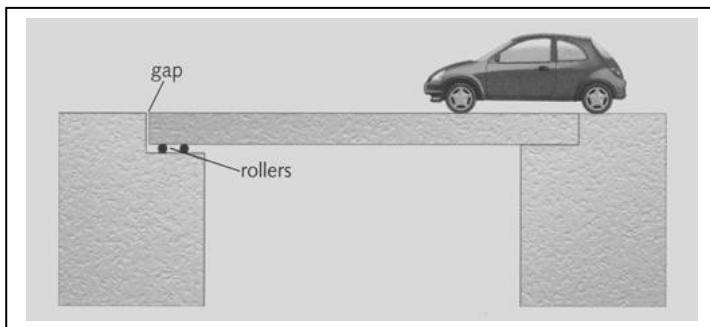
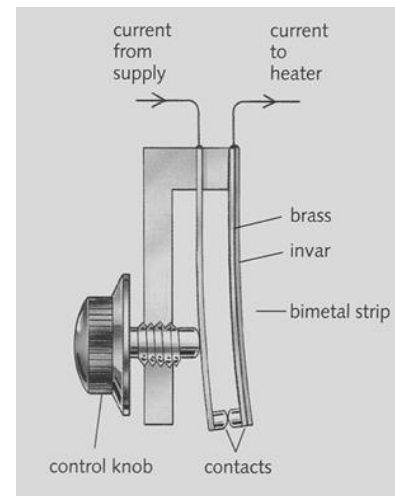
In a thermometer the liquid in the bulb expands when the temperature rises. The tube is made narrow so that a small increase in volume of the liquid produces a large movement along the tube.



In the bimetal strip, thin strips of two different metals are bonded together. When heated, one metal expands more than the other. This makes the bimetal strip bend. Bimetal strips are used in **thermostats** - devices for keeping a steady temperature.

### Bimetal Thermostat

When the temperature rises, the bimetal strip bends, the contacts separate, and the current to the heater is cut off. When the temperature falls, the bimetal strip straightens and the current is switched on again. In this way an approximately steady temperature is maintained.

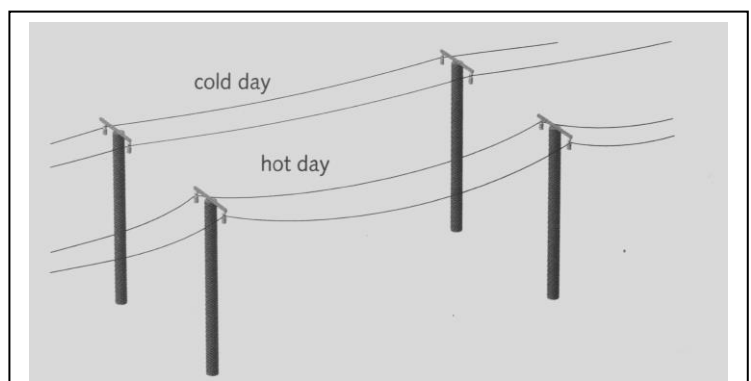


### Allowing for expansion.....

Gaps are left at the end of bridges to allow for expansion. One end of the bridge is often supported on rollers so that movement can take place.

### Allowing for contraction.....

When overhead cables are suspended from poles or pylons, they are left slack, partly to allow for the contraction that would happen on a very cold day.





**Explain why:**

1. ... it would **not** be a good idea to reinforce concrete with aluminium.

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2. ... concrete roads have bitumen filled gaps between the plates of concrete.

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3. ... railway lines have gaps between the lengths of track.

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4. .... metal pipes in large factories have loops in them.

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