

Joints

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Where concrete units butt up against each, or other elements of construction, it is necessary to provide a gap. This serves several purposes: a) it allows for manufacturing tolerances, b) it provides room for positional adjustment, c) it allows room for thermal movement, d) it allows sealant to be introduced to seal against moisture. Each of these is important, but when considering details, it is often easier to group joints into two types, those with no movement, and those where movement may occur.

By definition, no vertical movement should occur at the support since this is a fixed point. Thus the joint at the level of the supports should not need to take movement. The main factors determining size will be visual impact and practicalities of introducing sealants. From a visual point of view it is nearly always preferable for these joints to be the same width as those taking movement.

Joint Width Design

Where thermal movement is anticipated, it is necessary to carry out designs to ensure that the joint is wide enough to accommodate the movement. As with all materials, concrete expands and contracts with varying degrees of heat. Standards (BS8297) requires designers to allow for a temperature range of -20°C to $+45^{\circ}\text{C}$ for light coloured cladding, and of -20°C to $+60^{\circ}\text{C}$ for dark coloured cladding. Concrete can have a coefficient of thermal expansion between 7 (limestone) & 14 (gravel) 10^{-6}K^{-1} . What this means is that a unit will change its length by (say) 7 millionths for every degree centigrade change. Taking the range $-20 / +45$ for a 7.5m long unit gives a figure of

$$(7 / 1000000) \times 7500 \times (20 + 45) = 3.4 \text{ mm}$$

However, this is not a true figure since the temperature at the time of installation will almost certainly not be one of the extremes. For a typical installation temperature of (say) $+20^{\circ}\text{C}$, the maximum temperature change will be from $+20$ to $-20 = 40^{\circ}\text{C}$, giving movement of $(7 / 1000000) \times 7500 \times 40 = 2.1 \text{ mm}$

The width of joint needed to be to take this movement depends on the capability of the sealant to move. This is the Movement Accommodation Factor (MAF), which is defined as 'the total movement that a sealant is capable of tolerating, expressed as a percentage of theoretical minimum joint width.

$$\text{i.e. } \text{MAF} = (M / W) \times 100 \text{ or } W = (M \times 100) / \text{MAF}$$

To allow for the fact that installation may be in mid winter, and sealing in midsummer when the joints have closed to the minimum, the above equation is changed to $W = [(M \times 100) / \text{MAF}] + M$

MAFs can vary between 25 and 70%, although values over 25% have to be proven by test.

This thermal movement is only one of the factors that a joint must allow for. As well as accommodating the sealant gun, the joint must be wide enough to accommodate deviations in the size and position of the units.

An allowance is made for these in accordance with BS8297. For the example above, BS8297 gives size deviation = 8mm and erection deviation = 6mm. These will be split between the two ends, i.e. 50% per joint

Thus the total joint width = $(2.1 \times 100) / 50 + 2.1 + 4 + 3 = 13.2\text{mm} = \text{say } 14\text{mm}$ in practice.

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It is better to round joint widths up to an even number since this does away with 'half millimetres' on drawings.

A simple 'rule of thumb' to initially estimate the joint width is to take the total length of the units at the joint (in m), change it to (mm) and round up, e.g. $(6.5\text{m} + 6.5\text{m}) = 13\text{mm} = \text{say } 14\text{mm}$

Care must be taken if units are stacked. Since all the movement goes from the bottom support upwards, three storey-height units could mean a length of say 12.6m. In addition 'shuffling' cannot reduce tolerances. Applying the above theory to this situation would give a joint width of 43mm. Clearly such a large joint would need careful consideration and discussions with the Client at an early stage.