Sikaflex® Elastomeric Sealants

Joint design and movement calculation guide

1. Sealant Selection & Performance

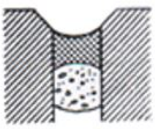
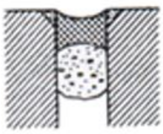
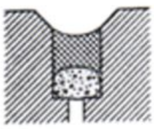
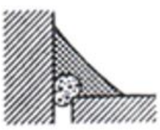
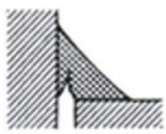
For satisfactory long-term joint performance in construction and civil engineering applications, an elastomeric sealant must have a combination of the following properties.

1) *Waterproof*- it must be an impermeable material.
2) *Durability*- not affected by aging, weathering or degradation for a reasonable service life.
3) *Permanent elasticity*- be able to sufficiently recover its original properties/shape after cyclical deformations. Deformation must be able to accommodate movement and rate of movement occurring at the joint.
4) *High cohesive strength*- must not tear easily.
5) *High adhesive strength*- must remain in intimate contact with the joint faces.
6) *Non toxic*- particularly in food processing areas or water treatment.
7) *User friendly*- easy to handle and install. Ideally one component. Safe for the environment.
8) *Fuel-oil resistant*- especially for roads, airports, oil installations, carparks, etc.
9) *Chemical resistance*- good resistance to dilute acids, dilute alkalis, fats and salt water. Especially in sewage treatment plants, chemical plants, effluent tanks, etc.
10) It is a matter of selecting a Sikaflex Sealant that offers the most suitable combination of properties required for each particular application. For information on Sikaflex Sealants refer to technical data sheets or contact the Sika Technical Department.

2. Elastomeric Sealant Limitations

- Long term chemical resistance of elastomeric sealants in highly corrosive environments is usually poor.
- Joints should be designed to ensure movement doesn't exceed the movement capability of the sealant.
- Elastomeric sealants have maximum joint width and joint depth limitations.

Note: For situations where any of the above three criteria cannot be met it is recommended that the *Sikadur Combiflex SG* jointing system be considered.

Right	Wrong	Remarks
		The edge of the joint is a weak point and is often interspersed with gravel pockets. A chamber or arris should be employed.
		Three-sided bonding impedes an uninterrupted even deformation of the sealant and leads to tearing of the sealant.
		Corner joints without backing rod or release tape lead to tearing of the sealant.

3. Criteria to be observed for flexible joint details

- Joint configurations for general use:

Joint Size	Width: Depth Ratio
Up to 12mm wide	1:1 i.e. W=D
Between 12mm and 24mm wide	Width x 12mm deep
Over 24mm wide	Width: depth ratio = 2:1 i.e. W = 2 x D

- Joints subjected to movement should have a minimum depth of 6 mm measured at the middle of the joint and a minimum width of 6 mm.
- Elastomeric sealants should not adhere to the base of a joint. Use a Sika PEF backing rod to form the joint base. If a solid formed joint base already exists as a result of the construction process it must be covered with a bond breaker tape.
- Joints subjected to hydrostatic pressure must have a solid formed base to provide sealant support. Do not use a PEF rod in this situation.

4. Joint Movement Calculations

Movement occurring in joints is the result of three alternating physical stresses. Each stress has a resultant affect on the sealant as shown.

1. Expansion of the component → compression of the sealant
2. Contraction of the component → elongation (expansion) of the sealant
3. Displacement (settlement) of the component → shear force on the sealant

5. Joint Movement Calculations

Joints between all building components will be subjected to thermal movement, as a result of temperature changes occurring within the element. This thermal movement can be calculated using the following formula:

$$\Delta L = \alpha \times L_o \times \Delta T$$

Where:

ΔL = change in length (in metres) of the element, due to thermal movement.

α = co-efficient of thermal deformation of the building material (i.e., the deformation in metres of a material 1m long at an increase in temperature of 1°C).

L_o = the length of the element measured (or distance between free joints) measured in metres.

ΔT = change in temperature of the element measured in Celcius (difference between the maximum and minimum temperatures expected to occur within the element).

- Consideration should be given to geographical locations when determining temperature values.
- It should also be remembered that ambient temperatures are not necessarily the same as temperature experienced within the element. Dark coloured elements, for example, may encounter considerably high temperatures.
- This formula can be used to calculate total thermal movement expected to occur in a free joint. It does not however make any allowance for long term drying shrinkage that may occur.

Example:

Concrete element L_o (more than 1 year old) = 3.0m in length (i.e. 3.0m between joints)

ΔT = say 40°C

α concrete = 10×10^{-6} (approx)

$$\Delta L = \frac{10}{1,000,000} \times 3.0 \times 40$$

$$= \frac{1200}{1,000,000}$$

$= 0.00120$m

$= 1.2$mm

For a sealant with total movement of 15% the joint width (B) can be calculated as follows:

$$B = \frac{100}{\text{total allowable sealant movement (15\%)}} \times \text{effective joint movement (1.2mm}$$

$$B = \frac{100}{15} \times 1.2$$

= <u>8.0 mm</u>

6. **Timing of sealant application**

This example assumes that the joint can be sealed at a temperature exactly midway between minimum and maximum service temperatures. In practice this will rarely happen, particularly on large projects where joints are sealed progressively during different seasons. A conservative way to allow for this situation, is to add to the calculated joint width (as above) the total calculated thermal movement (i.e., 1.2mm, using previous example), so:

Conservative minimum joint width = 8.0mm + 1.2mm
= 9.2 (say 10mm)

- A quick 'rule of thumb' calculation to determine the minimum joint width required to accommodate thermal movement between concrete structural components is:

B_{min} = L x 3.5mm/m

Where

B_{min} = minimum joint width in mm

L = element length (distance between free joints in metres)

***so using the previous example*:**

B_{min} = 3.0m x 3.5mm/m
= 10mm

7. **Long term drying shrinkage (of concrete)**

- When sealing free joints in concrete elements a figure for long term drying shrinkage must also be added to the calculated joint width. When calculating joint dimensions in concrete components it must be remembered that long term drying shrinkage will occur over many months and sometimes even years - depending on conditions.
- A commonly accepted value for long term drying shrinkage occurring within concrete is approximately 600×10^{-6}. (This may be much higher in severe drying conditions). Therefore the potential long term drying shrinkage that develops in an element with joints at 5m spacing's will be:

$$\text{Shrinkage} = 5 \times \frac{600}{1{,}000{,}000}$$
$$= 0.0030 \text{ metres}$$
$$= 3.0\text{mm}$$

- Assuming 30% of long term drying shrinkage will occur in 1 month, a 6mm width saw cut could easily become7mm wide after 1 month and 9mm wide after 12 months.
- This shrinkage must be taken into consideration when determining suitable sealants for concrete floor joints.

8. **Summary of joint design considerations**

There are many factors that need to be taken into consideration when designing joints for flexible sealants. To ensure the successful performance of any one joint it may be necessary to consider a few, or all of these following factors:

Check list for sealant joint design:

- Joint width and type required.
- Spacing between joints - free joints and fixed joints.
- Type of sealant needed to satisfy expected requirements.
- Climatic conditions e.g. Auckland or Central Otago.
- Drying shrinkage that will occur in concrete elements.
- Cyclic shrinkage/swelling due to moisture absorption/evaporation within the component.
- Change in element length due to thermal movement.
- Age of concrete when sealant is applied.
- Time of year when sealant is applied i.e. ambient temperatures.

Note: The information contained in this article is intended for use as a basic guide to joint design and sealant selection. It is the responsibility of the designer to satisfy him/herself that any specified or selected joint sealant can perform in a satisfactory manner to accommodate the conditions to which it will be subjected. Sika (NZ) Ltd's liability is limited therefore only to the quality of the goods supplied.

9. Sealant selection guide

Joint Sealing		
Facade	Aluminium joinery | Aluminium cladding panels | High performance areas | Precast panels	Sikaflex® AT-Façade Sikaflex® MS SikaHyflex®-250 Facade
	Precast panels	Sikaflex® Construction AP
	Fire resistant	Sika® Firerate Sikaflex®-400 Fire
Floor Joints	Floors more than 18 months old	Sikadur® -51
	Floors - movement joints	Sikaflex®-11 FC
Underwater Joints	Drinking water Stormwater	Sikaflex®-11 FC
	Sewage	Sikaflex® -Tank N
	Swimming Pools	Sikasil® Pool
Secondary containment, roads, forecourts		Sikaflex® -Tank N
Bitumen-based joint sealant	*Sealing of:* Cracks and holes in bitumen felt roofs, bitumen roofing and tanking membranes, joints around chimneys and skylights, etc. Repairs to roofs and gutters	Sika® BlackSeal®-1
Silicone Sealants		
All purpose (neutral cure)	All common sealing jobs, inside and outside - roofing, control joints, sealing cavities, bathrooms / kitchens, around windows, vents and openings	Sikasil® General Purpose
Roofing & Plumbing (neutral cure)	Gutters, flashings, metal roofing, lap joints, skylights, refrigerated panels, etc.	Sikasil® Roofing & Plumbing Sikasil® N Sikasil® C (NZ)
Wet Areas (neutral cure)	Bathrooms, toilets, kitchens, wash down areas, laundries, etc.	Sikasil® NG Sikasil® Wet Areas Sikasil® RTV Bathroom & Tile
Glass & Glazing (acetic cure)	Glass sealing and glazing applications – joints between glass, sealing glass into frames, skylights, conservatories etc.	Sikasil® RTV Glass & Glazing
Gap Fillers		
Cracks & Joints	Low movement joints in materials such as brick, concrete, plasterboard, windows/doors, ceramic tiles etc.	Sika® FastGaps 20mins
Voids (Expanding foam)	To block out dust, noise, draft and vermin	Sika® Boom Range
Waterproofing		
Existing Cracks & joints (self-adhesive bituminous tape)	Terraces, roofs, exterior walls, flashings	Sika® MultiSeal® Tape
New Construction	Gun applied, swellable sealant	SikaSwell® S-2
	Pre-formed, swellable sealant	SikaSwell® -P 2010H SikaSwell® A

Notes

1. This Sealant Selection Guide gives general guidance on the appropriate sealants for use in various applications. For specific advice contact your Technical Sales Representative on 0800 SIKA NZ.
2. If the sealant is to be exposed to chemical contact, seek advice from your Technical Sales Representative.