BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE, INDIA

SEALANTS FOR JOINTS AND CRACKS IN BUILDINGS

Introduction

Use of modern building materials such as steel, concrete, aluminium, glass and plastics makes buildings vulnerable to the entry of rain water through joints and cracks. This is because building units are large in size. They possess high coefficients of thermal expansion and are of impervious nature so that rain water sweeps down the wall in a regular sheet that can get sucked in by pressure difference at any accidental gap. The answer to the problem is to seal all joints of the building.

Sealant materials such as building mastics or caulking compounds and gaskets are commonly used to fill and seal joints against rain penetration and air infiltration. Traditional jointing and sealing materials such as mortar, putty and bituminous materials are not entirely satisfactory as they become hard on setting, often lose bond with adjacent wall or roof panels and develop cracks. Bituminous compositions become brittle on ageing and break down under the influence of sunlight. Several sealant materials have been developed in recent years which are to a great extent free of such drawbacks.

Requirement of a Sealant Material

A good sealant material should not only fill the gap in a joint or crack but continue to fill it for a considerable period through all changes in atmospheric conditions such as heat, cold, rain, sunshine, hail and atmospheric pollution. It must do this without hardening, cracking, melting, squeezing or slumping. Additionally it should be paintable, possess non-staining characteristics, alkali resistance and easy applicability.

Application Methods

A mastic can be formulated so as to make it suitable for application by gun, knife or trowel, or by pouring. Some mastics are supplied in the form of stiff tape or strip and are protected until immediately before use by a non-adherent wrapping. The material for knife or trowel application is of a consistency that it can be dug out of the container and pressed into the joint or crack to be sealed. [illegible] using a solvent as a release agent for knife or trowel.

The gun grade material is soft enough so that it can be easily extruded from the nozzle of a gun. A hand pressure gun operated by a simple trigger mechanism with friction drive on the plunger rod is suitable. The pressure on the trigger produces a continuous flow of mastic through the nozzle. Mastics for pouring into joints in horizontal surfaces are usually based on bitumen and require heating before they can be poured into a joint. Mastics for pouring cold are based on thiokol or urethane.

Some mastics such as thiokols are normally provided in two separate parts. One is the base compound which is a low molecular weight polysulphide synthetic rubber and the other is a curing agent. It is essential that all the curing agent is added to the base compound as both components are accurately measured. They should also be mixed intimately. Undermixing will prevent proper curing, whilst overmixing may cause the compound to heat up and shorten the application life. A moistened finger should not be used to smoothen a polysulphide seal as water in contact with uncured material will be absorbed and adversely affect curing.

Gaskets are applied by inserting them under compression in a joint. They rely for their efficiency on continuing pressure on the sides of the joint rather than on adhesion.

Preparation of Joint

Joints and cracks must be completely dry and clean. All dirt, dust, laitence and loose material should be removed by vigorous wire brushing and, wherever possible, cleaning with compressed air. Metal surfaces must be free from scale, rust and protective lacquers. A wet joint must be thoroughly dried before filling it with mastic. Metal surfaces contaminated with grease must be degreased with a clean solvent such as xylol.

While sealing cracks, these should be first widened after cutting a V-shaped groove along the entire length of the crack. It is however, not wise to attempt to seal narrow cracks (less than 3 mm [illegible] with mastics unless it is certain that all

movement of the panels adjoining the crack has ceased.

Types of Sealants

A large number of sealant materials are being used abroad which may be broadly classified into the following three types:

(1) *Plastic mastics*

Mastics based on natural and processed oils, bitumen and polyisobutylene belong to this type. Mastics based on oils such as linseed oil gradually dry and harden because of the oxidation of the oil. They are blended with other ingredients such as solvents, driers, fibres and fillers to impart the requisite characteristics. Polybutylenes and asphalt caulking compounds are of the non-oxidising type. They usually set through the evaporation of a solvent. The asphalts are also blended with semi-drying oils and pigmented to produce a good quality gun or pouring grade material. These are used where dark colours are acceptable. Plastic mastics possess plastic flow and their functioning in a joint depends mainly on their ability to maintain flow with the movement of the joint. Thus adhesion and cohesion of the mastic are of lesser importance.

(2) *Elastic mastics*

This type includes mastics based on thiokol, neoprene, silicones and polyurethanes. Of these, the thiokol or polysulphide type has been used over the longest period of time It is a two component system suitable for pouring or gun application. Silicone sealant is a one part material which reacts with atmospheric moisture to form a rubber. Neoprene sealant is a solvent type and cures by evaporation of solvent. Most of the elastic mastics, although plastic when applied, cure within a few days, producing a rubber-like mass.

(3) *Gaskets*

These are preformed strips usually made of fully cured elastic compounds such as natural rubber, neoprene, polyvinyl chloride (flexible) or polyethylene (crosslinked). They do not require any curing or setting time and are functional as soon as installed. An adhesive or mastic is, however, necessary when using gaskets on rough or irregular surfaces. The functions of gaskets are essentially similar to those of mastics. Stiff type mastics or bitumen felt on which concrete panels are bedded are in many ways fulfilling the functions of a gasket.

Sealant Developed at CBRI

A sealant material developed at this Institute is based on cashew nut shell liquid and other indigenous raw materials. It is suitable for filling cracks in walls and roofs. It is a one component elasto-plastic material free of solvents and is easy to prepare. It possesses very low shrinkage and does not sag or flow in sections upto 12 mm at temperatures upto 70°C. It does not become hard or lose resiliency to any noticeable extent when heated in small quantities at 70°C for 14 days. The material is essentially a knife or trowel grade sealant and can be easily applied in a crack or joint.

Choosing a Mastic

Before making a choice, one should know the movements that are expected to occur in a particular situation and also the amount of movement the particular mastic can withstand without the risk of failure. Ordinary putty used generally as a glazing sealant can take up strains of the order of one per cent. The plastic mastics can take up strains upto 15 per cent whereas elastic mastics take up to 50 per cent. Since the movement a mastic will tolerate is related to joint width, moderate movement in a joint of substantial width can be usually provided by the plastic mastics. Where extreme joint movement is to be accommodated in narrow joints it may be necessary to use elastic mastics. When it is permissible to vary the width of the joint over a wide range, a choice may be made between the use of a mastic of moderate or low elongation in a wide joint or of a highly elastic material in a narrow joint .

Aids to the Durability of Mastics in Joints

Depth of mastic

Since many mastics harden from the surface they should not be applied too thin and too shallow. In shallow joints they may harden quickly and lose their efficiency. This is particularly true of mastics based on drying oils or on bitumen. The depth of the mastic should normally not be less than 12 mm.

Shielding mastics

Joints should be so designed as to afford maximum protection to the mastic. shielding it as far as possible from light and air Shielding can be done by the use of cover strips, overhangs, drips, etc.

Compatibility with other mastics

If more than one type of mastic is used in a joint, the materials must be compatible with one another.

Width of joint

The width of the joint must be sufficient to accommodate the expected movement and appropriate to the movement properties of the mastic. It must not be too wide to cause slumping of the mastic.

Lap versus butt joints

For equal movement of the joint, the extension of a mastic in a lap or shear joint is about half that in a butt joint. In the lap joint, therefore, the demands on the mastic are also reduced and the mastic is better protected from the weather. Further if the mastic fails in adhesion to one side of the joint or in cohesion, only slight leakage is likely to occur, since the mastic remains in place and continues to fill the joint.

Mixing of two-part compounds

Two part sealing compounds must be very thoroughly mixed in the right proportions.

Surface preparation

Surface of joint should be thoroughly prepared to ensure a clean dry joint. Surfaces may need priming or sealing to avoid troubles that may occur due to loss of medium from the mastic, alkali attack by cement products, loss of adhesion to oily woods etc.

Proper application

The mastic must be firmly forced into contact with the surfaces of joint to give good adhesion.

There is a demand for short notes summarising available information on selected building topics for the use of engineers and architects in India. To meet the need, this Institute is bringing out a series of Building Digests from time to time and the present one is the 77th in the series. Readers are requested to send to the Institute their experience of adopting the suggestions given in this Digest.

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