Architectural Sealants

Going about our daily business of inhabiting buildings, we should be blissfully unaware of the presence of sealants. Sealants fill in a building's gaps. These materials play a large role in making buildings weathertight but we seldom see them because they are hidden from view or, where visible, are purposely unobtrusive. Buildings protect their human occupants from the elements but must protect themselves, too. If water is allowed to penetrate into a building's structure, it can cause deterioration through rot, rust, or movement as it expands and contracts.

Movement itself is inherent in buildings. We may think of buildings as stationary objects, but in fact they move around a good deal: Different materials within buildings expand and contract at different rates depending on changes in temperature and moisture, buildings settle on their foundations over time, wind pushes buildings around, and earth movements can toss them in all directions. A building's structure also moves because of the ways in which the building is used. A high-rise building may need to accommodate car traffic in a basement parking garage, high volumes of pedestrian traffic in a mall on its street level, moderate pedestrian traffic and equipment loads in offices on the next few floors up, and light traffic in apartments in the uppermost floors. Sealants help buildings deal with movement by allowing separate parts to move independently without losing weathertightness or allowing sound to pass where it is unwanted.

Not all sealants perform all of the missions listed, but by definition they must maintain their integrity and shape while bridging some kind of gap. Elastomeric sealants are those which must be able to stretch, compress, and perhaps twist, yet return to their original form while accommodating movement. A sealant's capacity to do this is usually expressed as a percentage of the width of the gap being bridged. The movement that elastomeric sealants used in buildings can withstand ranges from 12.5% to 50% or more. Non-elastomeric sealants, traditionally called caulking, are not expected to withstand much movement (2–7.5%). The middle range of movement capability is covered by, you guessed it, semi-elastomeric sealants.

Sealants come in a variety of forms: flexible (elastomeric) gel-like polymers, gaskets, putties, tapes, and caulks. In addition to being able to remember their shape, sealants must be able to adhere to their substrates, such as glass, wood, concrete, stone, and metals both coated and uncoated; typically, a sealant must intervene between two different materials. Sealants must also resist cracking, crumbling, shrinking, and degradation in ultraviolet light if they are exposed to the outside. Since proper application is essential to a successful installation, sealants that are easy to install have an advantage.

In the United States, traditional building materials and techniques held sway until the middle of this century; most buildings were built of wood or masonry and rarely exceeded six stories. Until the 1930s, even most skyscrapers, although framed in steel, still possessed masonry exteriors that followed traditional fenestration patterns. Oil-based caulks and putties were used to help hold window panes in place, to keep air from seeping through, and to keep bathtubs from leaking. The oils used often derived from non-manufactured sources: Linseed, fish, soybean, and castor oils were common vehicles. Tar and asphalt-based materials have been used since antiquity. They have been found in near-East excavations and have been mentioned in the *Book of Genesis* and by Herodotus, and they are still employed today, especially in road-building and roofing.

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From the 1930s the modernist aesthetic, especially in the design of tall buildings, brought with it new technical demands. Skyscrapers faced with glass or metal panels were assembled by hanging the exterior skin on the structural frame. Unlike masonry, with its heavy mass and interlocking connections, these new curtain walls were lightweight, flexible, and subject to considerable movement. The gaps between panels and between panels and building structure had to be sealed in a way that would allow this movement to occur.

Polymer research begun in the 19th and early 20th centuries began to bear fruit during this period with the development of elastomeric sealants. Rubber, which had already been used to manufacture gaskets, possessed many desirable properties: Synthetic rubbers and latex-based polymers were important starting points for further developments. Natural rubber was watertight and flexible under the right conditions, but was subject to cracking and deterioration in cold temperatures; it also had no adhesive properties of its own. Sealants based on polysulfide rubbers and polymers were the first elastomeric sealants to hit the market in the early 1950s. In 1960, the first industry-wide standard stipulating the performance of polysulfide elastomeric sealants was developed. This set the stage for allowing builders and architects to know what to expect from this new family of materials.

Silicone, urethane, and acrylic sealants were developed concurrently with polysulfide but reached the market up to 20 years later. Silicone was first used as a high-temperature electrical insulation, and further developments yielded a material that would cure at room temperature, suitable for use in more general building applications. Each of these was able to surpass polysulfide's performance in various areas, particularly shape retention and resistance to ultraviolet light and ozone, and they are now more common. Urethanes recover their shape well and can be used in joints up to six inches wide, but do not do well in wet areas. Silicone sealants share many advantages of urethane but are incompatible with some substrates such as concrete. In such cases a primer would be used; new silicone products that adhere to concrete also have been developed in the last 15 years. Acrylic sealants have little movement capacity, but they adhere well to a variety of substrates and are very durable. There is no single miracle product, but each type of sealant has found its niche.

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For Further Reading: Julius R. Panek and John Philip Cook, *Construction Sealants and Adhesives*, 3d ed. (John Wiley & Sons: New York, 1991); *Masterspec, Evaluations for Sections 07901 and 07920—Joint Sealants* (American Institute of Architects: Washington, DC, 1997); *Encyclopedia Brittanica*, 11th ed., vol. IV, (The Encyclopedia Brittanica Company: New York, 1910).

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