Adhesives for Building Construction

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Glues and sealants have been used in construction since Biblical times; but the synthetic adhesives achieved prominence only after World War II. Even in recent decades, however, changes have been dictated by new adhesive materials and new building materials.

Today, many types of adhesives are in use throughout industry, including the construction industry. Some adhesives require sophisticated application techniques while others can be put in place by trowel, brush, spray, or spot application. This chapter will concentrate on the latter, since most construction applications are carried out at the job site, or at best under rather nontechnical factory applications. Thus in this chapter we will be looking at the factors involved in selecting an adhesive for a particular application, whether it be under factory controlled conditions, by the builder at the job site, or even by the novice do-it-yourselfer.

Areas to be examined where adhesives are commonly used include a variety of materials for floors, subfloors, walls, and ceilings. In addition, we will look at the match between adhesives, construction materials, and substrate to which they will be bonded. Toward the end of the chapter we shall seek to determine why adhesives sometimes do not perform well. In short, this chapter will take an elementary and practical approach to the use of adhesives in construction, leaving the more technical considerations to other chapters in this book.

BASIC CONSIDERATIONS IN ADHESIVE SELECTION

Selection of an adhesive starts with the answers to five basic questions:

1. What do we want the adhesive to do for us? Start by listing all of the requirements expected of the adhesive formulation: the drying time, the ultimate strength needed in the bonded assembly, the years of service expected, the conditions to which the bonded assembly will be subjected, etc.

2. Is it reasonable or practical to expect all of our basic requirements to be fulfilled by an adhesive formulation? For example, most adhesives will not perform satisfactorily when subjected to constant submersion under water. Neither will most of the adhesives encountered in the construction industry perform continuously at extremely high temperatures in excess of 300 or 400°F. It is necessary to write down all the factors which, although desirable, could be sacrificed if necessary.

3. Will you be limited by available equipment, plant layout, production requirements, construction design, special job site tools, etc. in adhesive selection?

4. Will insurance rates, local building codes, OSHA, or other government agencies restrict your adhesive selection?
5. *What effect will the cost of the adhesive formulation, the necessary special equipment required, alterations in construction design, etc. have in the initial selection of a suitable formulation?*

The answers to these basic questions will help narrow the vast field of available formulations to those several to be evaluated further according to (1) application, (2) performance, and (3) cost.

**APPLICATION**

Here the main considerations are:

1. *Nature of the substrate and the materials being bonded.* What is the texture of the surfaces—are they smooth, rough, uneven, out of plumb, etc.? A surface that is relatively uneven cannot be bonded to a very smooth surface with a low viscosity adhesive. If one must bridge certain irregularities that are quite common in construction, then heavier viscosity formulations are needed.

   The surfaces being bonded may not be dusty, dirty, oily, greasy or wet. The strength of the bonded assembly will never be any greater than the weakest link. When a piece of wood is covered with sawdust, if it is bonded to a concrete substrate, the application is doomed to failure at the sawdust layer.

   The adhesive must be compatible with the surfaces being bonded. Polystyrene foam is attacked by some solvent based adhesives. Also, plasticizers can migrate between adhesive and vinyls, or other plastic substrates.

   It is important also to consider the internal strengths of the materials being bonded. Most wood fractures internally at shear strengths of 200–400 psi. Thus it makes no sense to select an adhesive that would develop shear strengths of 1000 psi or more. The bond between a low density blanket-type fiberglass and a concrete or metal surface need be no stronger than the bond holding the glass fibers together.

2. *Porosity of the surfaces.* Most adhesives must depend on the release of either a solvent or water to accomplish drying and setup of the glue line. Such adhesives cannot be used to bond two nonporous surfaces. To bond two nonporous surfaces, one must consider a product that can be predried and perform either as a contact-type cement or a pressure-sensitive adhesive. Other alternatives are catalytically cured systems and hot melts.

   The degree of porosity of the substrates will also have a great effect on the drying rate. Both wood and gypsum wallboard are porous, but the drying time will generally be more rapid on the more porous gypsum wallboard.

   Some applications may depend on the absorption or penetration of the adhesives into some of the pores of the materials being bonded. An extreme example is a paper honeycomb, where the pores are quite large and deep. The adhesive bed must be sufficiently thick to bond to the edges and sides of the honeycomb pores. Certain types of cinder block also develop superior bonds as there is a degree of absorption or penetration into the surface by the adhesive. Where there is high absorption, the formulation must be sufficiently viscous to assure that there is adequate adhesive at the interfaces.

3. *Preferred systems of application.* The nature of the materials being bonded will many times dictate the preferred method of application. Large surfaces may require a spray or roller coat application. Thin plastics or fabrics may require also a roller or spray. Other applications call for an extrusion, while even others will lend themselves better to trowel, spot, spatula, brush, or other types of application.

4. *Methods available for application.* Any one of the preferred systems of application may have available a number of different systems of varying sophistication. Where an application would require extrusion, for example, a factory controlled situation may dictate a capital expenditure for automatic equipment. At the other end of the scale, the do-it-yourselfer would find a cartridge his best method of extrusion, with a caulking gun. Often an application system already in use can be