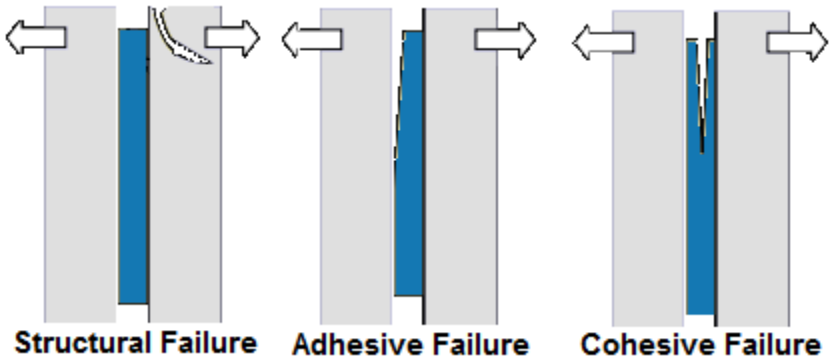
Below is a very high-level overview of some of the concepts involved in adhesive failure analysis.

Types of Adhesive Failures

When an adhesive bond fails, two of the three causes are related to the epoxy or adhesive. See below:

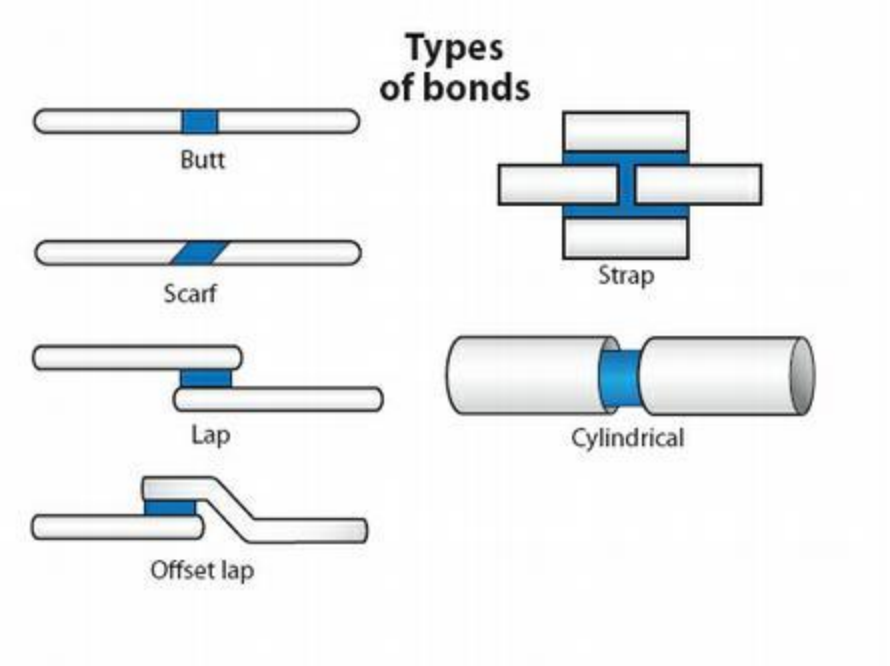
In the case of a structural failure, the adhesive is not at issue. In some cases a structural failure can be easily identified, but in other cases sophisticated analysis is required to make the distinction. Think, for example, of a sandwich cookie such as an Oreo. If you peel apart and the cookie breaks. That is a structural failure. If you peel apart and the filling remains attached to one side, that is an adhesive failure. For an example of a failure of cohesion, you will need to imagine peeling off a sticker intact where both the back of the sticker and the surface where it had been affixed both retain some of the adhesive.



Three Types of Adhesive Failure

Types of Adhesive Bonds

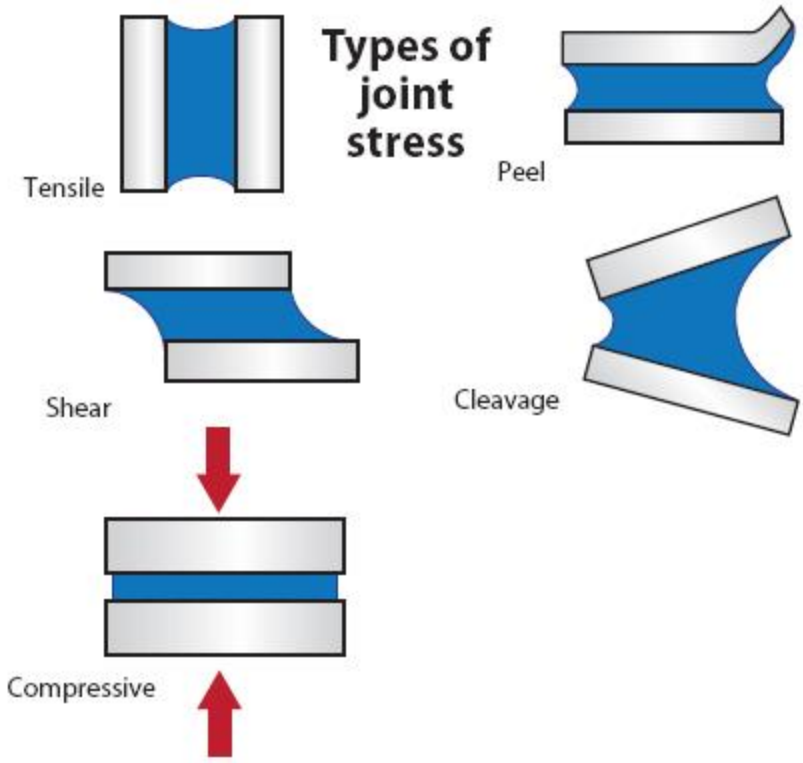
The analysis starts with identifying the type of adhesive bond, the stress on the bond, the type of adhesive, and the materials being joined.



Common Adhesive Bonds

Types of Adhesive Joint Stresses

The ideal bond type depends on many factors, but one of the primary considerations is type of stress the bond will need to withstand. Below are some common examples of joint stress:



Adhesive Stress Failure Points

Type of Adhesive Used

A major concern in the failure analysis is the identification of the type of adhesive used. Adhesives come in many types. They differ according to their chemical composition such as epoxies, polyurethanes, or polyimides. They differ in form such as paste, liquid, tape, film, or pellets. They differ according to application property such as hot melt, pressure sensitive, thermosetting, and contact. And they differ in their load carrying capability such as non-structural, structural, or semi-structural. The proper chemical composition, form, application property, and load carrying characteristics must be appropriate for the anticipated stresses, the type of materials being joined, and the operational environment.

There are many types of adhesives.

Failure occurs when the adhesive is not appropriate for the materials to be joined. At a broad level, there is a distintion between bonding porous and non-porous materials, but within those categories, the appropriate adhesive varies according to the specific material and type of material being bonded whether it be plastic, metal, rubber, glass, ceramic, wood, cardboard, leather.

Often, the appropriate adhesive is used for the materials being joined, but factors during the surface preparation, application, or curing contributed to weaken the bond. Other times, the use environment was not properly considered to take into account the strength, toughness, and flexibility needed for the specific instance.

In short, each situation of an adhesive or epoxy failure is unique. A detailed and through analysis from an expert is required to fully diagnose the causes and identify and recommend appropriate actions. Please contact me for an expert consultation if you have a serious adhesive failure or issue.