Mistakes in plant design are the most frequently cited (58%) cause of corrosion failure in chemical-process industries. Design mistakes are even blamed slightly more than incorrect materials selection. Although "get a better material" might seem to be the answer to any corrosion problem, it becomes obvious, as a failure is investigated, that in most cases the design could be improved.

Unfortunately, for corrosion engineers most plants are built at minimum cost with the idea that troubles will be met as they develop by upgrading the equipment as needed. Even so, careful design can overcome many of the shortcomings of materials.

Consumer goods, such as automobiles, outboard motors, or whatever, are offered in a highly competitive market where price is a major factor. In times past the manufacturers dodged corrosion problems by giving short-term guarantees. The manufacturers regarded corrosion as a process that operated in their favor, guaranteeing frequent replacement. Consumer groups changed all that with their unfavorable publicity, making consumers much more concerned about corrosion and other design problems. When manufacturers began trying to improve the corrosion resistance of their products, better designs solved many problems at no additional cost.

- Design engineers must understand corrosion or they become part of the problem. "As long as design engineers are around, corrosion engineers will always have jobs," one corrosion engineer remarked sarcastically.

All design engineers know that they are supposed to make allowances for corrosion by increasing wall thickness, and so on, but a generation ago that
was all they needed to know, or so they thought. The following points identify the major corrosion principles necessary for a successful design. They are arranged according to types of corrosion: chemical corrosion, electrochemical corrosion, and corrosive–mechanical interaction.

### 13.1 ALLOW FOR UNIFORM ATTACK

The design engineer selects a material with a satisfactory corrosion rate in the environment involved. Handbook data, results of lab tests, pilot plant and field tests, or previous service are considered. Any metals showing localized corrosion are eliminated at the start. Then, knowing the required life of the equipment and assuming uniform corrosion, the engineer calculates the corrosion allowance to be added to the metal thickness, plus a safety factor, because real life is not as precise as mathematics.

Remember that modern engineering equipment does not have to last as long as the pyramids. Corrosion at a reasonable rate can be tolerated unless the corrosion products themselves create a problem: contaminate the desired product, plug up flow lines, or the like.

### 13.2 MINIMIZE ATTACK TIME

Corrosion takes time. The design engineer tries to reduce the time that the environment will contact metal. If dirt and sediment can collect they hold moisture next to the metal long after the other metal surfaces are dry. Figure 13-1 shows how braces of channels and angle iron should be positioned to prevent liquids from sitting and corroding.

Corrosion is often particularly severe on sheltered surfaces where dirt and salts are not washed off and evaporation of moisture is slow. Avoid structural

![Figure 13-1](image)

**Figure 13-1.** Arrangement of steel shapes (a) that hold moisture and dirt and (b) those that do not.