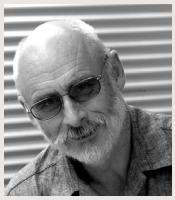

DURABILITY AND EXPOSED STEEL BEAMS

Mild steel structural components exposed to exterior moisture and contaminants, such as salt, need protection to prevent corrosion.

By Trevor Pringle, ANZIA, BRANZ Principal Writer

Steel is mainly iron with small amounts of other chemical elements known as alloys. Adding alloys to the iron changes its physical properties, as does shaping and processing it.

The pure iron in the steel is not a stable chemical and tends to form compounds of iron, oxygen and water – rust. This process, referred to as corrosion, occurs when there is moisture, oxygen and an electrolyte present on the surface of the steel. Generally, the longer moisture is in contact with steel, the more corrosion will occur.

How does steel deteriorate?

Rust forms on the surface of steel as a porous, loose layer with a denser layer below adhering more closely to the steel. Rust can form below paint films, especially old or damaged coatings, and shows on the surface as small red dots. Rust accelerates corrosion by holding moisture and airborne contaminants on the surface.

The corrosion rate varies considerably with environmental conditions, temperature and the amount of maintenance carried out. Water does not need to be in contact with the steel; corrosion can occur if the air humidity exceeds 65%. Continued high humidity can be more detrimental than occasional wetting due to the length of time moisture is in contact with the steel.

The corrosion process is accelerated by even very low concentrations of impurities in the atmosphere, such as sulphur (acid rain caused by industrial pollution and geothermal areas) and chlorides (sea salt). When chlorides are deposited on the steel surface, as occurs in coastal areas with wind-blown sea salts, corrosion may occur at a relative humidity as low as 34%. The salts absorb moisture, which form droplets and concentrates water on the surface of the steel.

The damaging effect of pollutants can be seen in external situations where steel that is washed by rain corrodes at a much lower rate than steel in places where salts and acid can accumulate, for example, under building eaves or on the underside of rails on steel balustrades.

Steel surfaces are often colder than the surrounding air temperature, which causes condensation and dew to form more readily, increasing the time the steel is wet.

The New Zealand atmosphere is relatively wet, the country has a long coastline in relation to its land area and most of the population (along with its associated buildings) is close to the coast. Therefore, most steelwork exposed to the environment in New Zealand will be subjected to potentially high corrosion.

Minimising deterioration

Steel component performance will be enhanced where the building design:

- allows steel components to be regularly rain washed
- does not create crevices and ledges where moisture and airborne contaminants can accumulate
- allows ready access for maintenance.

INITIAL SPECIFICATION

The initial specification of steel components should consider:

- the environment
- the grade and type of steel, for example, specifying the correct grade of stainless steel to provide sufficient durability for the environment
- the size of the steel components, which influences the amount of hot-dip galvanising and protective paint system that can be applied
- whether components can be fabricated before hot-dip galvanising – site treatment of welds is not as durable as hot-dipping the whole component
- the compatibility of the steel component with adjacent materials
- the paint system, if required, to protect the steel.

PAINT COATINGS

High-performance coatings can be used to control corrosion by isolating the steel from the environment. New paint coatings can offer an effective barrier, but this effect decreases with time, UV exposure and physical wear and tear. Eventually, the paint film ages, and breakdown and corrosion begins on the steel surface. Rust has a much greater volume than steel, and as it expands beneath the paint film, it causes blistering, cracking and flaking allowing the entry of moisture, which causes the process to accelerate.

The length of time a coating provides protection is influenced by:

- whether or not the detailed design of the steelwork allows salts and contaminants to accumulate
- the type of coating used
- its adhesion to the steel, which is dependent on the steel surface being clean and free from loose matter
- adhesion between successive coats in the system
- the thickness of the coating
- the applied paint system's ability to withstand the environment, including ultraviolet radiation and abrasion.

AS/NZS 2312:2002 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings* can be used as a guide to the correct selection of a protective paint system.

Maintenance

Fundamental to an effective corrosion protection system is a regular inspection programme and keeping accurate records. Maintenance of paint coatings is most economically achieved by repainting before there is any serious deterioration of the existing coating or rusting of the underlying steel.

Inspections should be carried out at regular intervals determined by the environment but not less than:

- 6-monthly for a severe marine environment
- yearly in a moderate environment away from the coastal salt spray
- every 2 years for mild sheltered inland areas.

Part of maintenance should be:

- a regular cleaning schedule
- a preprogrammed repainting plan where corrosion protection is provided by a coating system.

STEEL AND TIMBER

In some situations, such as a timber slat deck, steel-supporting beams support timber treated with copper-based treatment chemicals, which will be damp in use and therefore more corrosive to the steel.

In these situations, the steel should:

- be hot-dip galvanised after manufacture – all cleats and the like are attached before the member is galvanised
- have a specialist anti-corrosive coating system applied to the galvanised steel
- have an isolating layer, such as a DPC, between the steel and the timber when in close contact
- be fixed to the timber with 304 stainless steel bolts and washers
- have the bolts sleeved where they pass through the timber
- be checked annually for any deterioration.

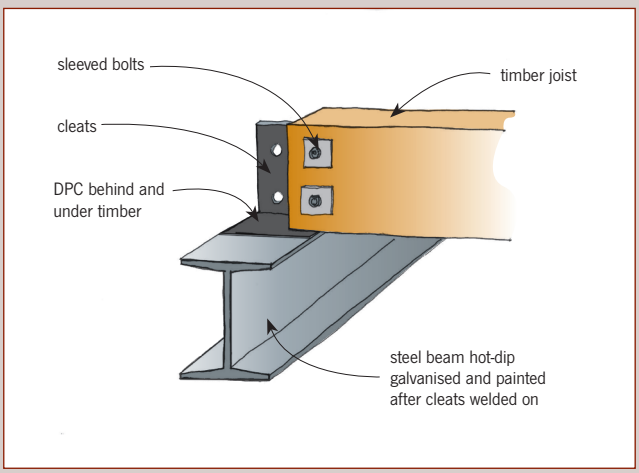

Figure 1: Steel supporting beams with treated timber.