Stainless Steel Advisory Service
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A service provided by the
British Stainless Steel Association

Austenitic Stainless Steel for Timber Fixings

Austenitic Stainless steel types 1.4301 (304) and 1.4401 (316) can be considered for fixing applications in timber structures where the wood species, applied chemical treatments or the environment may give a corrosion risk.

Causes of Metal Corrosion in Wood

The single most important factor in determining the incidence of corrosion is moisture (The threshold moisture content below which no appreciable corrosion of embedded metal occurs, is the same as the safety limit for wood-rotting fungi i.e.; about 20%.) Above this level wood is always acidic due to the breakdown, by water, of wood cellulose to acetic acid, through natural ageing processes. No wood species can be regarded as "innocuous" but some are more aggressive, notably the heartwood of oak, sweet chestnut, western red cedar and Douglas fir. Acetic acid is volatile and, in poorly ventilated areas, can cause corrosion at sites away from the main wetted regions. Any soluble salts tend to increase the conductivity of moisture in the wood and thus the potential for corrosion. Wood naturally contains varying levels of mineral salts of which sulphate (1-10% of the ash) and chloride (0.1-5%) increase the corrosion hazard of the acetic acid.
If the timber has been in prolonged contact with seawater, or if the structure is exposed to coastal air, the chloride content and corrosivity of the wood can be increased. Where timber is immersed in seawater, a number of corrosion cells can be set up. The shaft of a fastener can become starved of oxygen and corrode whilst alkaline conditions produced at the head may degrade the wood. Cells may occur where fasteners connect two different woods

Additionally timber treatments can be potential corrosion hazards
Salt seasoning, used for drying certain hardwoods, including maple, and flame-retardant salt treatments, such as ammonium phosphate and sulphate and boric acid and borax can be a corrosion hazard

Treatments to prevent attack by fungi and wood-boring insects vary in their influence on corrosion. Creosote and tar oil can be beneficial, because of their waterproofing action. Boron compounds and organic solvent preservatives, such as pentachlorophenol and lauryl pentachlorophenate, present few problems, unless there are alkaline conditions which can result in reactions liberating soluble chlorides which can then attack stainless steels.

Choice of Fastener Materials

Austenitic stainless steels are considered by the UK National Corrosion Service to have

Group 4 (excellent resistance)

in the ranking of the resistance of common metals to corrosion by acetic acid emitted by wood

Where CCA preservative treatments have been applied, the timber should be aged for at least seven days before fasteners are inserted.
The UK National House-Building Council (NHBC) Standard for external timber framed walls recommends that the choice of materials for staples and nails for fixing sheathing and breather membranes and nails for fixing CCA treated wood and wall ties and fixings should include austenitic stainless steel.

External structures of woods such as cedar should have fasteners made from materials including stainless steel. For permanent structures (painted or oiled) stainless steel or other resistant metals should be considered the norm.

Immersed timber structures should have corrosion resistant fasteners, which includes stainless steel.

The choice of stainless steel will depend on water conditions such as: -
chloride level
water flow rates
temperature
oxygen levels
crevice conditions in the fastener system geometry

Stainless steels types 1.4301 (304) may be suitable for fresh water, but in higher chloride levels 1.4401 (316) is preferable
The conditions in tidal river estuaries and seawater where higher chlorides, low flow rates and low oxygen levels can predominate may require higher molybdenum grade stainless steels such as 1.4547 (254SMO)
Care must also be taken to avoid bi-metallic corrosion if combinations of dissimilar metals are to be used

Particularly aggressive internal environments can also exist in swimming pool buildings, especially for roof fixings, where applied loading can also give rise to stress corrosion cracking failure hazards
For these applications SCC resistant grades such as 1.4539 (904L) or 1.4547 (254SMO) should be considered

References

'Corrosion of Metals by Wood' Building Research Establishment Digest No. 301. (BRE, Garston, Watford, Herts WD2 7JR)

'Corrosion of Metals by Wood' Guides to Practice in Corrosion Control, No. 2, National Corrosion service, The National Physical Laboratory, HMSO, 1985.

Standard, Chapter 6.2, External Timber Framed Walls, April 1995.
(NHBC, 58. Portland Place, London W1 N 4BU.)

Stainless steels in Swimming Pool Buildings - NiDI Publication Number 12 010

These notes have been extracted from a paper prepared by D. R. Johns, of Corus (British Steel) Swinden Technology Centre in 1995