TECHNICAL NOTE

Suitable Fasteners, Metal Flashings, Studs and Joists for use in Conjunction with EWPAA Branded Preservative Treated Cladding, T&G Flooring and Structural Plywood

PRODUCT CERTIFIED

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Introduction

It is intended that this technical note be read in conjunction with the Engineered Wood Products Association of Australasia (EWPAA) design manual "Featuring Plywood in Buildings" and the FWPA Document Guide to the Specification and Use of Preservative Treated Engineered Wood Products (PR08.1062). The EWPAA recommends all plywoods used for exposed (to the weather) cladding be preservative treated to at least Exposure Class H3 in accordance with AS/NZS 1604.3. Exposure Class H3 is designated as "outside above ground" – the above ground requirement being at least 150 mm above soil, 100 mm above paving or 25 mm above protected paving (e.g. verandah).

The corrosion threats to metals in contact with treated timbers are galvanic in nature as opposed to the more commonly understood atmospheric corrosion of metals.

FIGURE ONE: Corroded Fasteners in Preservative Treated Plywood Cladding

Preservative Treatment

Plywood manufactured to AS/NZS 2269 uses a durable, permanent Type A glue bond to bond the timber veneers. However, the timber veneers presently used in plywood are not durable when used in weather exposed situations. To ensure the full service life of plywood in exposed applications it is essential to preservative treat the plywood against decay.

A wide range of treatments are possible, however, since the restriction of copper chrome arsenate (CCA) in applications, where frequent human contact may be prevalent the commonly available alternative treatments are light organic solvent preservatives (LOSP's), and the veneer treatments Ammoniacal Copper Quaternary Compounds (ACQ) and Copper Azole (CuAz). It is believed additional new treatment such as Micro Pro (Micronised Copper) will soon be available. The required level of preservative treatment is specified in AS/NZS 1604.3 -2010 *Specification for preservative treatment*, Part 3: Plywood for above ground, exterior use, the appropriate treatment level specified in AS/NZS 1604.3 is H3 hazard level.

Specifiers should be aware that LOSP is an envelope type treatment i.e. the outer veneers, edge and ends of the sheet are preservative treated but the preservative may not have penetrated to the middle veneers of the plywood. If the plywood sheet is cut then localised brush on remedial preservative treatment will be required to be applied to the cut edge. The ACQ and CuAz treatments usually require each individual veneer to be treated prior to assembly and no further treatment should be required if this type of preservative treated plywood is cut. It could be argued that the veneer treatments are superior as they by definition, they require full treatment of all the timber veneer; however, the downside is that same modern treatment chemicals used in this process may be more corrosive than the traditional CCA preservative, and also far more corrosive than LOSP. This factor of potential corrosion between metals and the metallic elements used in the preservative treatments is the prime driver behind the preparation of this Technical Note.

Durability Ratings for Fasteners for Treated Plywood

The FWPA report “Timber Service Life Design Guide” (PN07.1052) recommends via the hazard scores for sheltered or partly sheltered cladding non marine applications for the bulk of the populated regions of Australia that the hazard rating for fasteners in CCA timber is $HR_{tr}3$ (Tables 8.4 and 8.7). This, via Table 8.8, results in a typical service life for a 2.8 mm diam. galvanised nail with a 50 micron thick coating of 25 years. Plus, for the case of fully exposed cladding, (as it could be argued in the case of modern structures with little or no roof overhang), the hazard rating becomes $HR_{tr}4$ with a service life of 15 years.

This advice appears more conservative than the 42 microns thick hot dip galvanising recommended as corrosion resistant for treated plywood claddings fasteners in FWPA report “Guide to the Specification, Installation and Use of Preservative Treated Engineered Wood Products” (PR08.1062)

Service lives of 25 years or 15 years may not be adequate for many applications and the use of more durable fasteners should be considered.

FIGURE TWO: Corroded Poorly Galvanised Nail – Extracted from Plywood Cladding – Unsuitable for Use in Exposed Treated Plywood

Corrosion of Metals

The corrosion of dissimilar metals is due to a process called 'galvanic corrosion' - this occurs when two different metals are in electrical contact with each other and are immersed in an electrolyte. For example, steel in contact with copper and water (especially with some dissolved salts) forms a galvanic couple (i.e. a simple electric cell or battery) resulting in the steel forming rust on its surface. The likelihood of the corrosivity of each metal can be determined by a list called the "galvanic series" or "electropotential series". As zinc is much lower (or less "noble") on this list than steel it is often used as a sacrificial anode for steel structures, and as hot dipped galvanising over steel. Copper is slightly higher than steel on this list (more "noble") thus the steel in the fastener can be electrically corroded by the copper in common wood preservatives CCA, ACQ or CuAz treatments. Aluminium, which is chemically part of the "zincalume" treatment of steel, falls between steel and zinc on this list so this metal becomes an integral part of the corrosion considerations.

304 grade stainless steel has excellent general resistance to the corrosion resulting from contact with treated timbers. As stainless steel is much more "noble" than steel, aluminium or zinc it reverses the electrical poles so it doesn't corrode. It is recommended that grades of stainless steel lower than 304 (including any of the less expensive but commonly used 400 grades) are not utilised. In marine applications, or in salty and industrial environments, 316 ('marine') grade is recommended to minimise corrosion.

A further factor in galvanic corrosion of metals is the relative area of the exposed size of the cathode and the anode. If the anode (active metal) is small, say a steel or galvanised fastener in a large copper treated timber the current is high and the anode will corrode quickly. However if the fastener is stainless steel the cathode is quite small in comparison to the anode thus any currents are small (in addition copper is only a little less "noble" than stainless steel). However, this reverse situation accounts for Industrial Galvanisers in their report "Galvanised Steel and Timber" stating *'Stainless steel has now been shown to be incompatible with Colorbond™ and can cause premature corrosion of the roofing sheet'*.

Zinc Coating Processes for Steel

There are five basic processes of zinc coating steel to resist corrosion, each having its own strengths and weaknesses and having differing mechanical and corrosion resistance. The most effective type of process varies for each application.

They are:

1. **Hot dip processes:**
   These involve the immersing of pre-treated steel in molten zinc or zinc alloys by batches or in a continuous process. The traditional process of batch galvanising is used for fabricated steel and for small items like nails, screws and bolts. These smaller items are generally centrifuged after dipping to remove excess coating.

   Due to the immersion time being several minutes the coating is largely comprised of zinc-iron alloys. This results in the coating being say 4 times harder than zinc and quite thick, say between 50 to 200 microns. The coating has a rough surface and is not uniform.
   Products such as steel sheet, wire and pipe are generally galvanised in a continuous galvanizing process. This manufacturing process at relatively high speed produces a coating that is generally smooth but relatively thin, say 25 microns.

2. **Chemical processes:**
   These involve the electro-deposition of zinc or zinc alloys from a chemical solution in combination with the application of an electric current. The process involves passing the cleaned steel parts through a zinc-bearing solution containing other chemicals to assist in levelling or brightening the coating. Zinc electroplating is widely used to coat small parts (like screws), appliance components and builders hardware. The coating is bright and uniform, but soft and relatively thin, usually less than 10 microns (making them unsuitable for exterior use), but conforms closely to the surface profile of the steel item, thus making it good for small threaded components like screws.

   Screws may also have a heavy chromate coating, giving them a brown/yellow appearance, to improve their corrosion resistance.

3. **Applied processes:**
   These involve the application of zinc in the form of zinc dust as a pigment in a paint coating, or as a momentarily molten metal spray using a hot metal spray gun.

   Zinc-rich paints can be applied to steel surfaces using either organic or inorganic binders heavily loaded with zinc dust as a pigment. They are well suited to the coating of large structures and for on-site application to structural steelwork of all types.

   Zinc metal sprayed coatings are applied by passing zinc dust or wire through an electric arc or gas flame. Very thick (up to 500 microns) coatings can be applied, but only the external surfaces of fabrications can be readily coated.

4. **Diffusion processes:**
   These involve the heating of the steel to below the melting point of zinc while in close contact with zinc dust.

Sherardizing is a diffusion process, where small parts are tumbled in a zinc/sand mixture at a temperature of around 380oC. It has low productivity but is well suited to small parts and threaded fasteners, as the coating conforms closely to the surface profile. The coating is 100% alloy layer containing no free zinc, is metallurgically bonded to the surface and is between 15 and 30 microns in thickness.

5. **Mechanical processes:**
These involve the application of zinc or zinc alloy coating to the surface of small steel parts by rumbling them in a rotating vessel causing the part-to- part impacts to apply an adherent zinc-based coating to the parts

Mechanical plating of zinc and zinc alloys is now widely used for the protective coating of high strength fasteners such as self-drilling TEC screws. Batches of components are cleaned of oxide deposits and organic contamination and loaded into a rotating barrel with a carefully controlled mixture of metal dust and reaction chemicals. Glass beads are also used to assist in peening the metal particles on to the surface. The mechanically plated coatings are relatively thin – usually less than 20 microns. Also note that the coating may be thinner on edges and corners due to the mechanical impacts intrinsic to the process.
The characteristic that determines durability of zinc coatings in any given environment is relative to the thickness of the coating. Thus the only processes of zinc coating generally considered suitable for metals in contact with copper rich treated plywood claddings are hot dipping. Some nails have thick zinc coatings but commercially available screwed mild steel fasteners do not – thus are not recommended for fixing copper rich treated plywood. Galvanised, Zincalume or Colorbond flashings, studs or joists may not have coatings thick enough for permanent contact with copper rich treated plywood claddings. If these products are used then it is recommended that direct contact is prevented by say a plastic film or coating.

Corrosion Resistant Metals

The corrosion resistant metals which could be considered as fasteners or metals for treated plywood claddings are stainless steel (304 or the more resistant 316 grade), monel (a nickel alloy), silicon bronze, copper and brass. Generally hot dipped galvanised steel fasteners, with a minimum coating thickness of at least 42 microns, could be considered as a corrosion resistant metal in these applications (see FWPA report PR08.1062 quoted above). Unfortunately, this coating thickness is not achieved with plated fasteners. In fact, some imported fasteners are reported as having only 2 – 3 microns of zinc coating.

BlueScope Steel are guarded on their advice on the use of treated (CCA) timber in contact with galvanised or “zincalume’ coated steel sheet. They specifically recommend against the use of treated timber for applications with high moisture contents (such as roof or ceiling battens). In fact, they recommend the timber and/or the coated (galvanised, Zincalume or Truecore) steel be sealed by fully painting prior to installation.

The zinc coating information is a little vague but it is understood that 42 microns thickness per side equates to 300g/m^2 mass of Zinc Coating (total both sides). Zincalume is promoted as being much more durable (two or more times) than galvanising and it is understood the coating is AZ150, apparently one half of the 42 microns galvanising limit. Consequently this Technical Note recommends caution when using continuously coated hot dipped steel products.

Recommendations

- Stainless fasteners, flashings (minimum 304 grade stainless steel) are recommended for use in contact with copper based preservatives ACQ, CCA and CuAz treated material in the following circumstances :

    - Coastal areas (within 5km of the coast);
    - High rainfall areas > 1000mm/year;
    - In buildings with little or no eve overhang;
    - Where there are potential moisture traps such as decking and exposed flooring, or where treated flooring is exposed for an extended period during construction;

- For metal studs and joists apply a prophylactic to contact surfaces to prevent galvanic reactions

- Stainless fasteners, flashings, studs and joists (minimum 316 grade stainless steel) are recommended for marine environments.

- Hot dip galvanised (minimum 42 microns of zinc coating) fasteners, flashings, studs and joists are recommended for :

    - LOSP treated products (excluding use in coastal areas);
    - Products treated with copper based preservatives (ACQ, CCA, CuAz) where:
        1. The building is protected by a eve overhang of minimum 600mm;
        2. Average rainfall does not exceed 1000mm;
        3. The building or structure is designed and built to exclude 'moisture traps' both during erection and in subsequent use.

- This advice is general and specific information and advice must be sought from suppliers of fasteners, flashings, studs and joists.

Further information may be obtained from the main preservative chemical suppliers and can also be found on internet web sites, e.g. http://www.tpaa.com.au/fastenerscca.htm; http://www.branz.co.nz/cms

References

- EWPAA design manual “Featuring Plywood in Buildings”
- FWPA report “Timber Service Life Design Guide” (PN07.1052)
- FWPA Document “Guide to the Specification and Use of Preservative Treated Engineered Wood Products” (PR08.1062)
- AS/NZS 1604.3 – 2010 Specification for preservative treatment, Part 3: Plywood
- “Galvanised Steel and Timber” – Industrial Galvanizers – INGAL Specifiers Manual Section 45
- “Corrosion – Contract with Steel” BlueScope Steel Technical Bulletin CTP-13
- “Corrosion – Dissimilar Metals” BlueScope Steel Technical Bulletin CTB-12
- “Corrosion of Mild Steel HDG Steel and 316 Stainless Steel in CCA CuAz and ACQ Treated Pinus Radiata” by G Kear, MS Jones & PW Haberecht – BRANZ Porirua City New Zealand Report
- “Evergrip 304 Stainless Steel Bi-Metal Fasteners” – SFS intec Brochure
- Osmose Australia Brochure – “NatureWood ACQ” www.osmose.co.nz
- Stanley Bostitch Innovation Spotlight – “Thickcoat Galvanization” www.bostitch.com
- Buildex brochures – “Stainless Steel Screws” www.buildex.com.au

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Revision History

Revision	Changes	Date	Who
2	Updated logos and member list	07-02-12	MB
1	Initial Release	30-09-11	LP

EWPAA Members

Plywood and Laminated Veneer Lumber (LVL)				
Member Name	**Location**	**Phone**	**Fax**	**Web**
Ausply	NSW	+61 2 6922 7274	+61 2 6922 7824	www.ausply.com
Austral Plywoods Pty Ltd	QLD	+61 7 3426 8600	+61 7 3848 0646	www.australply.com.au
Big River Group Pty Ltd	NSW	+61 2 6644 0900	+61 2 6643 3328	www.bigrivergroup.com.au
Carter Holt Harvey Woodproducts Australia (Plywood) – Myrtleford	VIC	+61 3 5751 9201	+61 3 5751 9296	www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts Australia – Nangwarry LVL	SA	+61 8 8721 2709		www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts - Marsden Point LVL	NZ	+64 9 432 8800	+64 9 432 8830	www.chhfuturebuild.co.nz
Carter Holt Harvey Woodproducts (Plywood) - Tokoroa	NZ	+64 7 886 2100	+64 7 886 0068	www.chhwoodproducts.co.nz
Fiji Forest Industries	FIJI	+67 9 8811 088	+67 9 8813 088	
IPL (West Coast) Ltd	NZ	+64 3 762 6759	+64 3 762 6789	
Juken New Zealand Ltd (Gisborne)	NZ	+64 6 869 1100	+64 6 869 1130	www.jnl.co.nz
Juken New Zealand Ltd (Wairarapa)	NZ	+64 6 377 4944	+64 6 377 1166	www.jnl.co.nz
Nelson Pine Industries Ltd	NZ	+64 3 543 8800	+64 3 543 8890	www.nelsonpine.co.nz
PNG Forest Products Ltd	PNG	+67 5 472 4944	+67 5 472 6017	www.pngfp.com
RH (PNG) Ltd	PNG	+67 5 325 7677	+67 5 323 0522	www.rhpng.com.pg
Valebasoga Tropikboards Ltd	FIJI	+67 9 8814 286	+67 9 8813 848	
Wesbeam Pty Ltd	WA	+6 18 9306 0400	+61 8 9306 0444	www.wesbeam.com

Particleboard and MDF				
Member Name	**Location**	**Phone**	**Fax**	**Web**
Alpine MDF Industries Pty Ltd	VIC	+61 3 5721 3522	+61 3 5721 3588	www.alpinemdf.com.au
Borg Panels Pty Ltd	NSW	+61 2 6339 6111	+61 2 6339 6220	www.borgs.com.au
Carter Holt Harvey Woodproducts Australia	NSW	1800 891 881	+61 2 9468 5793	www.chhwoodproducts.com.au
D & R Henderson Pty Ltd	NSW	+61 2 4577 4033	+61 2 4577 4759	www.drhenderson.com.au
Laminex	VIC	+61 3 9848 4811		www.thelaminexgroup.com.au
Tasmanian Wood Panels (Aust)	TAS	+61 3 9460 7766	+61 3 9460 7268	
Weathertex Pty Ltd	NSW	1800 040 080		www.weathertex.com.au

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