CRC Construction Innovation

BUILDING OUR FUTURE

Report
Details of Building Component Selected for Inclusion into Learning System for Life Prediction of Infrastructure

Research Project No: 2005-003-B-1

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1 INTRODUCTION

In order to expand the number of components in the CRC for Construction Innovation project on Learning System for Life Prediction of Infrastructure a decision on which components to use has to be made.

1.1 Criteria for component selection

In order to select components to use in the current program of work, criteria for selection is needed to include specific components. The basis of these criteria is on three parameters.

- The possibility of corrosion of the component occurring. Components with higher possibility of corrosion are more likely to be included.
- The cost of maintenance or replacement required if corrosion occurs. Structural concerns are also considered here.
- Health and Safety: where a component would not need to be replaced even if it corrodes, but for health and safety reasons the component should be maintained it may be included in this work.

2 LIST OF COMPONENTS INITIALLY SELECTED

The following list of selected components is detailed in the following pages.

1. Gutters
2. Down pipes
3. Roof Sheeting (exposed and sheltered)
4. Fasteners (exposed and sheltered)
5. Ridge capping
6. Flashings
7. Window frames
8. Steel Supports (vertical/horizontal, sheltered/exposed)
9. Sub-floor members, stumps and support wires
10. Gang nail plates and strapping (sheltered)

Others left out at present include Brick ties and Lintels.

These selected components will be described and analysed for corrosion risk. Information about replacement costs will be listed where available. Photographs used to illustrate corrosion problems were taken during a survey of four schools in the Sunshine Coast area in September 2004 during the previous CRC project. Entries in the Delphi database (Cole, 2003) relevant to the chosen elements are listed in Appendix A.

2.1 Gutters

2.1.1 Description

Attached to edge of roof for drainage of rain water and condensation.

2.1.2 Corrosion risk

The corrosion risk of gutters is high due to the water flow from the roof and long drying times if leaf litter etc. is allowed to accumulate. Gutters tend to be wet often both from rain and overnight condensation from roof. Maintenance (removal of leaf litter etc.) is a crucial issue for corrosion risk as this significantly affects the drying time of gutters. (CRC report 2002-059-B No 16). Sheltered corrosion is also a problem for the underside of gutters where salt deposition is not removed by natural water flow. Poor installation practice can lead to cuts in the gutters or inappropriate choice of fasteners.

Examples of gutter corrosion are shown in Figures 1 and 2.

Figure 1 Underside of gutter showing significant corrosion.

Figure 2 Underside of gutters (example of sheltered corrosion).

2.1.3 Common materials

Galvanised steel, ZINCALUME®, COLORBOND®, Aluminium, painted steel.

2.1.4 Replacement costs

The following costs are based on the combination of the cost of the materials as at March 2006 and labour costs as at October 2003. Aluminium and painted steel are not commonly used for quad guttering.

Quad gutter	**Galvanized steel**	**ZINCALUME®**	**COLORBOND®**
115 mm quad gutter (per m)	$17.18	$16.90	$20.36
Stop end (each)	$7.96	$7.88	$9.05
Angle (2 pieces)	$27.92	$27.92	$29.32
Expansion joint	$22.66	$23.18	$24.45
Outlet (each)	$12.62	$12.54	$14.07

Ogee Hi-Back gutter	**Aluminium**
125 mm gutter (per m)	$19.57
Stop end (each)	$6.04
Angle	$27.54
Expansion joint	$24.43
Outlet (each)	$12.21

The following costs are based on the combination of the cost of the materials as at October 2003 and labour costs as at October 2003.

Box gutter	**Galvanized steel**	**ZINCALUME®**	**Aluminium**	**Stainless steel**
per m length	$34.92	$34.92	$46.74	$70.48
Stop end (each)	$27.27	$27.27	$35.46	$48.38
Angle	$37.80	$31.22	$45.56	$68.16
Expansion joint	$79.80	$79.80	$104.39	$143.14
Outlet (each)	$25.95	$25.95	$32.10	$41.78

The dimensions for the galvanized steel and **ZINCALUME®** box gutters considered here are 300 wide x 225 high x 0.55 mm thick / 750 mm girth.
The dimensions for the aluminium box gutter considered above are 300 wide x 225 high x 0.8 mm thick / 750 mm girth.
The dimensions for the stainless steel box gutter considered here are 300 wide x 225 high x 0.45 mm thick / 750 mm girth.

2.2 Down pipes

2.2.1 Description

A vertical pipe for drainage usually from gutter, illustrated in Figure 3.

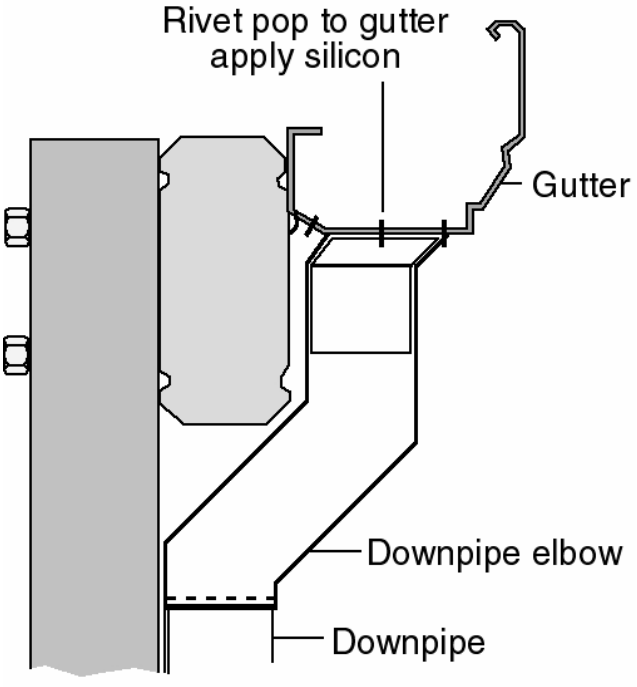

Figure 3. Illustration of a downpipe

2.2.2 Corrosion risk

The corrosion risk for downpipes is similar to gutters – maintenance is of high importance with regular removal of leaf litter. Sheltered corrosion is also an issue. There may be different issues at the edge of downpipes compared with the body of the pipe. Downpipe corrosion issues are illustrated in Figures 4 – 7.

Figure 4 Deterioration around joint between gutter and downpipe (note loss of rivet heads).

Figure 5 Rusting and deterioration on downpipe on modular classroom showing that problems are associated with the joints.

Figure 6 Bottom of square dpwnpipe, steel completely rusted away.

Figure 7 Top of downpipe also showing rusting of bracket from downpipe to support and stainless steel plates on walkway beams.

2.2.3 Common materials

Galvanized steel, Zincalume®, Colorbond® and aluminium

2.2.4 Replacement costs

The following costs are based only on the cost of the materials as at March 2006.

Rectangular downpipe	**Aluminium 100 x 55 mm**
per 3 m length	$20.87
S-Bend long	$5.86
Elbow shoe (std)	$4.48
Strap	$0.42

Rectangular downpipe 100 x 50 mm	**Galvanized steel**	**ZINCALUME®**	**COLORBOND®**
per 2.4 m length	$25.18	$24.26	$34.21
clip (each)	$1.99	$1.91	$2.02
pop (each)	$2.38	$2.30	-
offset (each)	$34.95 (zinc)		$37.66

Round downpipe 75 mm	Galvanized steel	ZINCALUME®	COLORBOND®
per 2.4 m length	$27.27	$26.27	$41.48
clip (each)	$2.19	$2.11	$3.34
pop (each)	$3.03	$2.92	-

2.3 Roof Sheeting (exposed and sheltered)

2.3.1 Description

Metal sheeting on top surface of building. Angle of sheeting may vary, recommended practice is >5°. Various different geometries eg round corrugated, angular, Klip-Lok, are available.

2.3.2 Corrosion risk

The roof angle is a critical parameter to determine the amount of drainage from the roof. The direction the roof faces (with respect to prevailing weather) and whether or not it is open or sheltered will also be factors to be considered in corrosion. Maintenance or lack thereof will also need to be included. Edge effects will need to be assessed.

Examples of roof sheeting corrosion are shown in Figures 8 and 9.

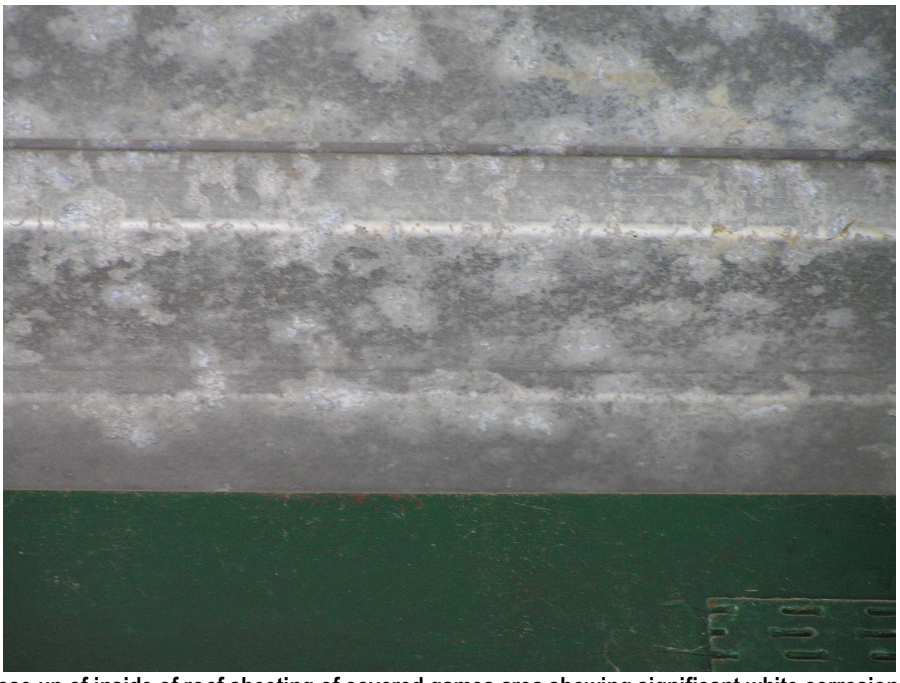

Figure 8 Close up of inside of roof sheeting of covered games area showing significant white corrosion product and some red rust.

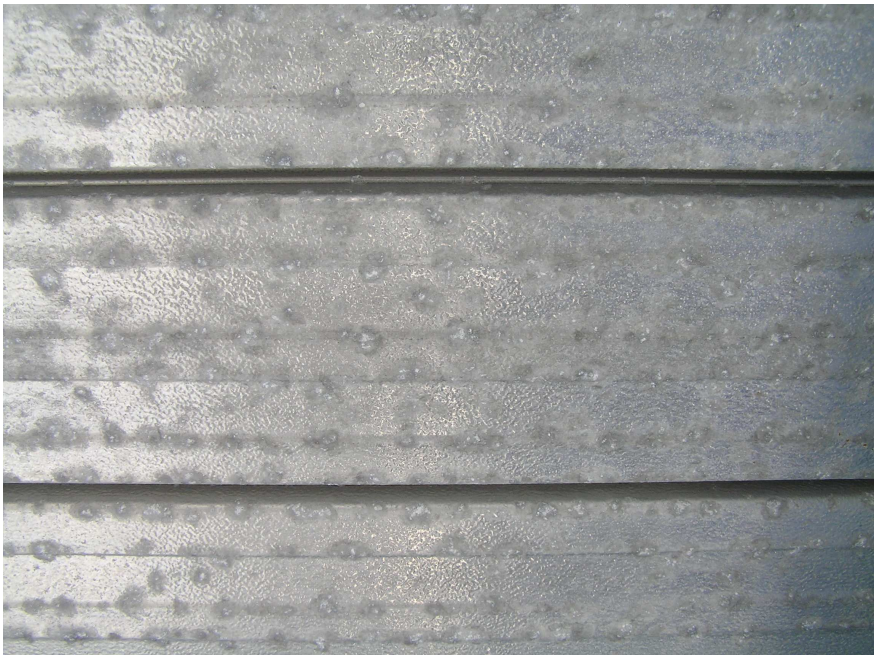

Figure 9 Close up of covered walkway showing significant white corrosion product, aluminium construction.

2.3.3 Common materials

Galvanized steel, Zincalume®, Colorbond® and aluminium.

2.3.4 Replacement costs

The following costs are based on the cost of the materials as at March 2006. Labour costs for a plumber at October 2003 rates are $40 per hour.

Roof sheeting (per m²)	**Aluminium**	**Aluminium painted**
1.2 mm thick standard / 0.9 mm colour coated	$33.72	$29.16
ridge/hip cap val (4 m length)	$14.74	-
ridge/hip cap v/gut painted (4 m length)	-	$55.65
ridge lap support (each)	$6.99	
apron flashing (3 m length)	$30.65	$30.44
fascia/barge cap (3 m length)	$9.45	$32.16

Roof sheeting (per m²)	**ZINCALUME®**	**COLORBOND® XRW**	**Colorbond® XRW D/S**
Custom orb 0.42 mm BMT	$10.92	$14.30	-
Custom blue orb 0.60 mm BMT	$19.10	$23.52	-
Trimdek Hi-Ten 0.42 mm	$10.19	$14.30	$16.28
Spandek Hi-Ten 0.42 mm	$11.79	$16.72	$18.36
Klip-Lok Hi-Ten 0.42 mm	$17.32	$24.03	-
Corodek Hi-Ten 0.42BMT	$15.66	$19.64	-

Roof sheeting (per m²)	**Galvanized**
Corrugated and Monoclad 0.42 mm	$17.11
Megaclad 0.42 mm	$16.77
Corodek Hi-Ten 0.42BMT	$20.11
Minirib 0.35 mm	$17.76
Corrugated 0.60 mm	$26.56

2.4 Fasteners (exposed and sheltered)

2.4.1 Description

Fasteners include bolts, nuts, screws and rivets. Brick ties are not included at this time.

2.4.2 Corrosion risk

There is a risk of galvanic corrosion if dissimilar metals are used. The formation of crevices associated with fasteners can also be a contributing factor to accumulation of moisture and increased risk of corrosion.

The critical issue for fasteners of all types is the placement – whether it is in roof sheeting or the building façade. This will determine whether it is in a sheltered environment or not.

The type and condition of the washer used is also of importance in considering corrosion risk.

A range of examples of fastener corrosion problems is illustrated in Figures 10 - 18.

Figure 10 Roof fasteners showing red rust and white corrosion product.

Figure 11 Covered walkway, fastener shanks are red rust and undercutting seen on Colorbond® sheeting.

Figure 12 Corroded fastener under covered area, sheeting also showing undercutting.

Figure 13 Heavily corroded fastener in sheeting of covered walkway.

Figure 14 Fasteners in sheeting on porch.

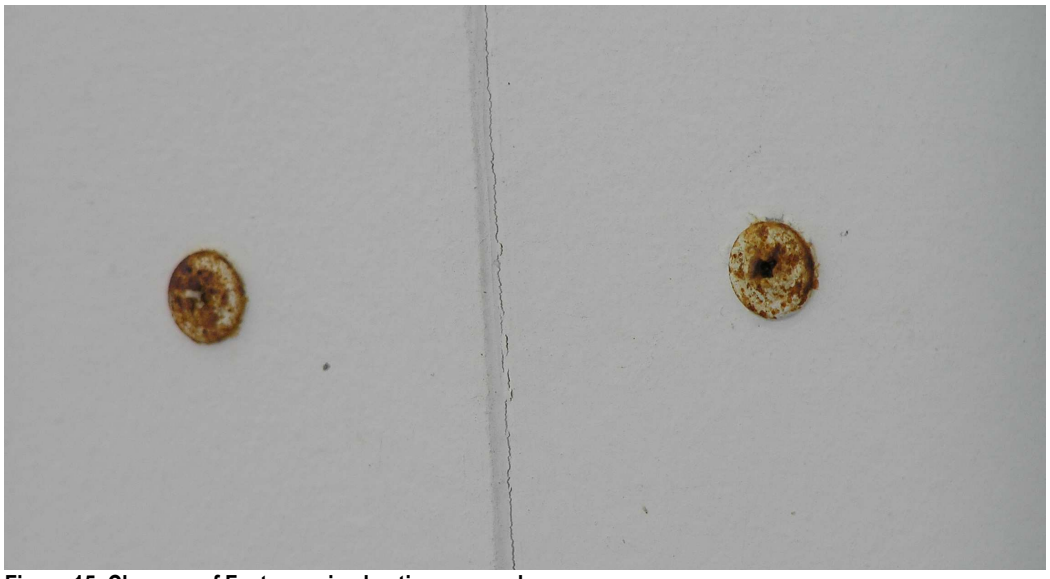

Figure 15 Close up of Fasteners in sheeting on porch.

Figure 16 Triple grips on structure of covered set down showing signs of deterioration and roof fastener shank to red rust.

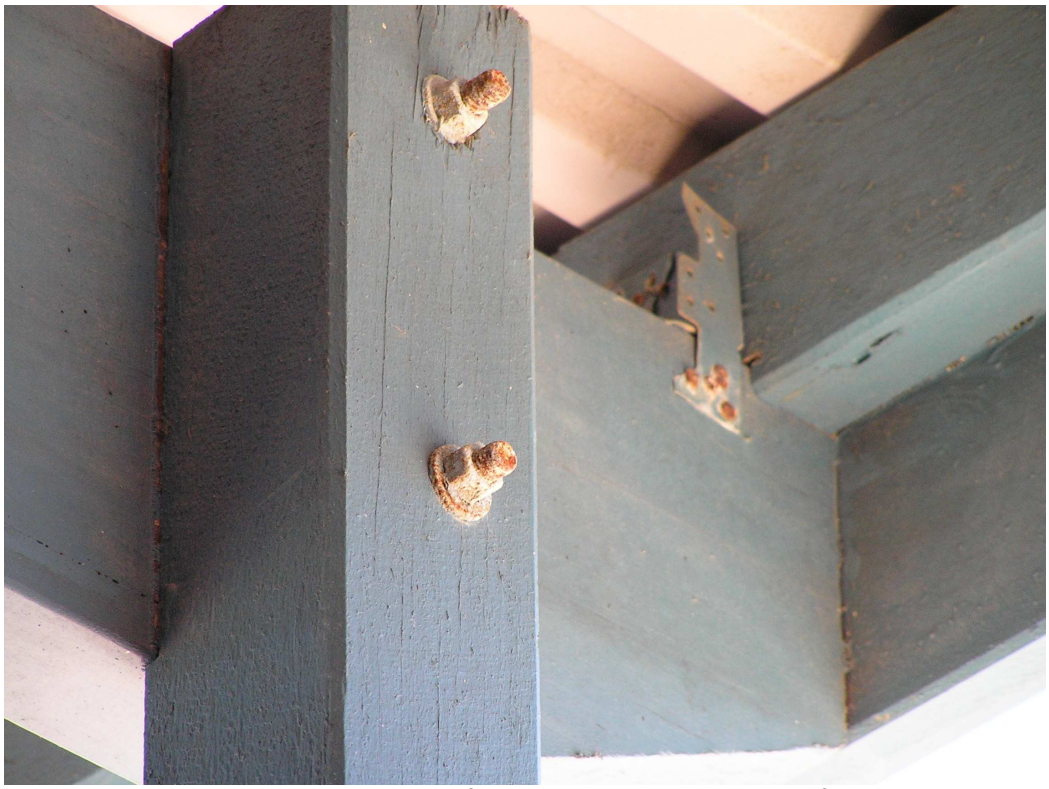

Figure 17 Triple grips and bolts on structure of covered set down showing signs of deterioration.

Figure 18 White corrosion product on painted steel brackets.

2.4.3 Common materials

Coated steel, paint, zinc and coatings

2.4.4 Replacement costs

The following costs are based on the cost of the materials as at March 2006.

Nails (per 15 kg pack)	Bright	Galvanized
Bullet head 150x5.6 mm	$40.85	$68.00
Flat head 100x4.5 mm	$39.95	$69.90
Roofing 75x3.25 mm	$71.55	-
Roofing 60x3.75 mm	-	$74.10
Clouts 65x2.8 mm		$75.65

Bolts	Zinc pack of 200	Galvanized pack of 100
MS hex head bolt nut M6x50 mm	$10.00	-
MS hex head bolt nut M10x50 mm	-	$23.95
MS cup head bolt nut M6x50 mm	$9.60	-
MS cup head bolt nut M10x50 mm	-	$20.05
Washers flat round steel M6 pack of 50	$1.00	-
Washers flat round steel M8 pack of 50	-	$1.70

Screws (per 1000)	Cost
Standard steel 8x12 SHS	$184.55
Painted head steel 12x20 SHS	$250.45
Steel screw 14x42 cyclonic unpainted	$732.86
Gal spiral clip fix nails 3.75x40 mm	$28.74
Blind rivet fastener 73AS4.3	$26.47

Fastener (per 100)	Cost
10x16 hex head SD (to steel)	$15.47

R & W Fasteners (per 1000)	Plain	COLORBOND®
corrugated steel 12x35HN	$224.49	$260.55
Metrospan steel 12x45HN	$246.58	$285.16
Trimclad timber 12x65HN	$207.04	$259.38

2.5 Ridge capping

2.5.1 Description

Ridge capping is the special tiles or metal sheeting that run along the top of the roof protecting the ridge join from water ingress (illustrated in Figure 19).

Figure 19. Illustration of metal ridge capping.

2.5.2 Corrosion risk

Ridge capping will have a corrosion risk similar to roof sheeting. It will generally be in an open exposed environment. There may be edge effects for the capping.

2.5.3 Common materials

Usually the same as the roof sheeting, usually galvanised, ZINCALUME® or COLORBOND®.

2.5.4 Replacement costs

For replacement costs see section on Roof sheeting (page 9).

2.6 Flashings

2.6.1 Description

A flashing is a strip of material, usually metal, that covers the junction between the roof sheeting and another surface, such as a pipe, chimney, roof light or a wall. This

is illustrated diagrammatically in Figure 20 and examples are shown in Figures 21 and 22.

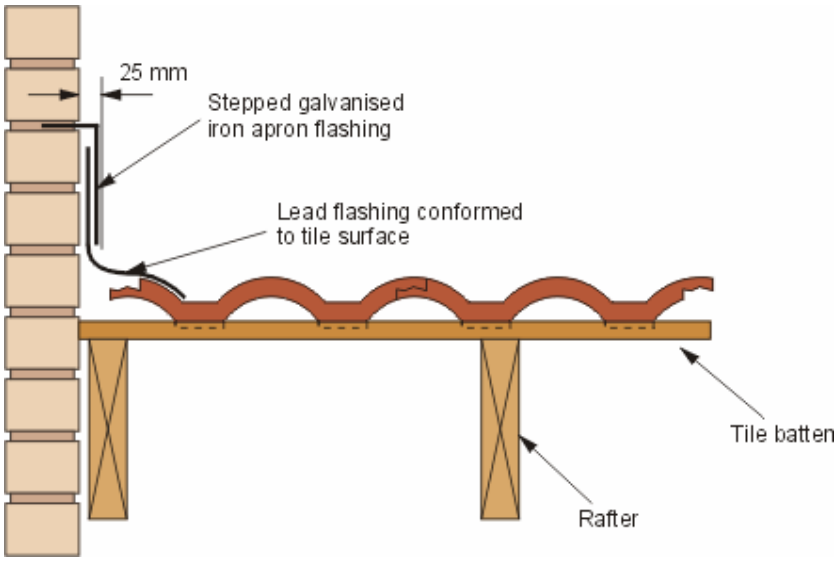

Figure 20, Diagram of flashing of a wall to roof

Figure 21, Flashing between wall and roof.

Figure 22. Flashing between wall and roof.

2.6.2 Corrosion risk

Flashings will generally be in an open exposed situation, but may be in a position where moisture can accumulate. There may also be material compatibility issues to consider as well.

2.6.3 Common materials

Copper, galvanised steel and lead.

2.6.4 Replacement costs

The following costs are based on the cost of the materials as at March 2006.

	Aluminium roof sheeting Alspan	**Aluminium LT7**
Apron flashing 3 m	$30.65	$30.65
Apron flashing painted 3 m	$30.44	$30.44
Flashing closure ext 2.16 m / 2.03 m	$16.51	$7.40
Flashing closure int 2.16 m / 2.03 m	$12.36	$10.21
Gutter flashing 2.16 m	$16.68	$7.88

Corodek flashing (per m)	**ZINCALUME®**	**COLORBOND®**
C2 square barge	$7.99	$9.49
C3 under flashing	$6.70	$8.59
C4 barge roll	$10.45	$16.58
C5 valley iron	$10.96	$14.91
C8 soaker	$8.09	$11.09
WDI barge	48.68	$11.24

Trimclad flashing (per m)	ZINCALUME®	COLORBOND®
T1 ridge	$12.66	$15.65
T2 capping	$9.89	$12.32
T3 under flashing	$9.14	$11.63
HDI barge	$8.93	$11.61

Metlok 500 flashing (per m)	ZINCALUME®	COLORBOND®
M1 ridge	$14.60	$18.61
M2 barge flashing	$11.33	$14.13
M3 under flashing	$9.49	$11.76

2.7 Window frames

2.7.1 Description

Window frames are metal structures (usually rectangular) in the wall to support panes of glass, see Figure 23.

Figure 23. Example of metal window frames.

2.7.2 Corrosion risk

The critical factor for window frames is the direction they face and whether this leads to exposure to prevailing salt carrying winds. The possibility of rain washing should also be considered. If window frames come in contact with the soil at the bottom of the building then this factor should also be included.

2.7.3 Common materials

Aluminium, painted aluminium, steel

2.7.4 Replacement costs

The following costs are based on the combination of the cost of the materials as at March 2006 and labour costs as at October 2003. The costs are for the supply of only one window.

Aluminium powder coated; timber reveal	**600x600 mm**	**1200x600 mm**	**2000x1200 mm**	**2000x1800 mm**
Awning	$169.84	$274.99	$669.67	$1136.96
Sliding	$141.49	$197.33	$384.94	$462.52
Double hung	-	$252.80	$441.64	$815.48

2.8 Steel Supports (vertical/horizontal, sheltered/exposed)

2.8.1 Description

Supporting beam structures for eg. covered walkways.

2.8.2 Corrosion risk

The parameters to be considered will be similar to those for downpipes, except that the base may be embedded in cement or in contact with soil in the ground. Corrosion issues are illustrated in Figures 24 - 27.

Figure 24 Covered walkway showing corrosion of galvanised support.

Figure 25 Footing of steel support showing red corrosion product.

Figure 26 End of steel beam showing red rust break through.

Figure 27. Galvanised post (right) and close up (left) showing signs of white corrosion product.

2.8.3 Common materials

ZINCALUME®, Galvanised Steel.

2.8.4 Replacement costs

The following costs are based on the combination of the cost of the materials as at October 2003 and labour costs as at October 2003.

Universal section beams	Cost (each)
200 UB 18	$86.77
200 UB 22	$92.24
200 UB 25	$96.08
250 UB 31	$104.56
310 UB 32	$105.38

Parallel flange beams	Cost (each)
150x75 mm	$110.68
200x75 mm	$125.75
250x90 mm	$162.29
300x90 mm	$175.60

Bracing (each)	12 mm diameter	16 mm diameter
Steel; bolted; threaded rod and turnbuckle	$17.24	$20.50

Trusses (15º roof pitch) purlin cleats at 1500 mm centres; bracing & fixings	9 m span	12 m span
Angle section	$1265.92	$1778.31
Universal section	$1208.31	$1697.39

Open web joists shop primed ROZC; purlins and cleats @ 1500 mm centres	6 m span	9 m span
Steel; angle/square edge flat	$283.76	$460.57

The following costs are based on the combination of the cost of the materials as at March 2006 and labour costs as at October 2003.

Purlins/girts, gal steel (per m)	C or Z section
100x1.2 mm	$12.88
100x1.5 mm	$15.62
100x1.9 mm	$17.98
150x1.5 mm	$19.17
200x1.9 mm	$26.93
250x2.4 mm	$37.53

2.9 Sub-floor members, stumps and support wires

2.9.1 Description

Supports for building frame and floor.

2.9.2 Corrosion risk

The main issue is likely to be the level of ventilation and natural drying that can occur. If these elements are in contact with the soil this is another issue to be considered. Corrosion issues are illustrated in Figures 28 and 29.

Figure 28. Significant deterioration of sub-floor metallic components on modular classroom.

Figure 29 Two views of the corroding stump support of a modular classroom.

2.9.3 Common materials

Steel.

2.9.4 Replacement costs

The following costs are based on the combination of the cost of the materials as at October 2003 and labour costs as at October 2003.

Steel column, hollow section; top & bottom plates; shop primed; bolts nuts & washers	**Cost per set**
75 x 75 x 3.0 mm	$210.99
100 x 100 x 4.0 mm	$261.34
Galvanised steel column, adjustable head; base plate; set on and incl. 450x450x450 mm deep concrete footing	Cost per set 65x65x2 mm section
500 mm above ground	$236.73
1000 mm above ground	$244.22
2500mm above ground	$307.38

2.10 Gang nail plates and strapping (sheltered)

2.10.1 Description

Metal plate with rows of sharp points that are hammered into butt-jointed timber to secure the join, illustrated in Figure 30.

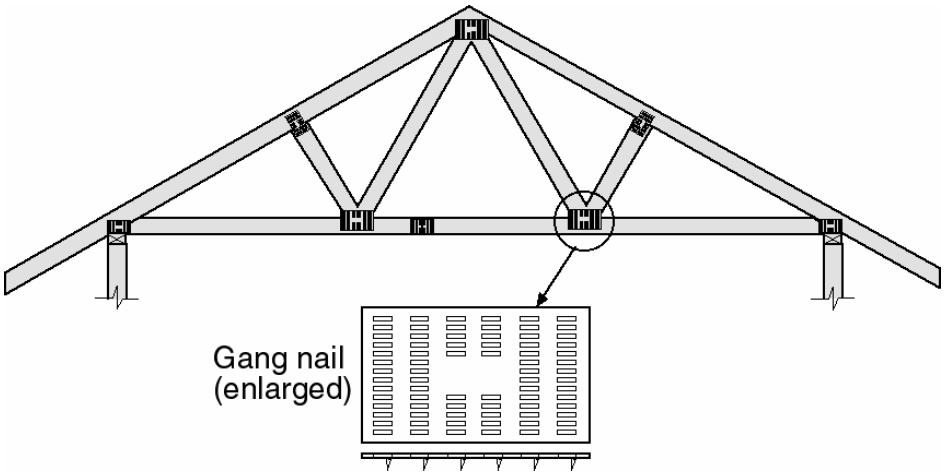

Figure 30. Illustration of a gang nail and how it might be used.

2.10.2 Corrosion risk

The critical issue with gang nail plates is the different timbers that may be used as the substrate. Also whether the plate is sheltered or non-sheltered should be considered. An example of a gang nail subject to sheltered corrosion is shown in Figure 31.

Figure 31 Close up of gang nail plates on inside of covered games area.

2.10.3 Common materials

Galvanised steel.

2.10.4 Replacement costs

No costs could be located for gang nails.

3 REFERENCES

Cordell Building Materials Price Index, New South Wales, March 2006, Volume 33 Issue 2, published by Reed Construction Data, Chatswood NSW 2067
Cordell Housing Building Cost Guide, Victoria October 2003, Volume 26 Issue 4, published by Reed Construction Data , Chatswood NSW 2067
Cole I., Trinidad G., Bradbury A., McFallen S., Chen S-W., MacKee J., Gilbert D. and Shutt G. 2004 “Component Life – A Delphi Approach to Life Prediction of Building Material Components” 2002-010-B Final Report.
Cole I., Ganther W., Paterson P., Corrigan P., Chan WY., Muster T., Trinidad, G., Ball M., Carse A., Maher M-L., Liew PS. 2005, Report 2002-059-B No 7 “Trip to Sunshine Coast September 2004.”
Cole I., Ganther W., Paterson P., Corrigan P., Chan WY., Muster T., Trinidad, G., Ball M., Carse A., Maher M-L., Liew PS. 2005, Report 2002-059-B No 16 “Case-based Reasoning in Construction and Infrastructure Projects – Final report”

APPENDIX

Relevant entries from the Delphi Database for gutters, roof sheeting, flashing, fasteners (nails, bolts), window frames, sub-floor structures and gang nail plates.

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Commercial	Gutters	Service Life	Marine	Galvanised Steel	Yes	10-15			2
Commercial	Gutters	Service Life	Marine	Galvanised Steel	No	5-10	5	9	2
Commercial	Gutters	Time to First Maintenance	Marine	Galvanised Steel	Yes	<5	4	6	2
Commercial	Gutters	Aesthetic Life	Marine	Galvanised Steel	Yes	10-15	6	11	2
Commercial	Gutters	Service Life	Industrial	Galvanised Steel	Yes	10-15	9	15	2
Commercial	Gutters	Service Life	Industrial	Galvanised Steel	No	5-10	5	10	2
Commercial	Gutters	Time to First Maintenance	Industrial	Galvanised Steel	Yes	5-10	5	8	2
Commercial	Gutters	Aesthetic Life	Industrial	Galvanised Steel	Yes	5-10	6	10	2
Commercial	Gutters	Service Life	Benign	Galvanised Steel	Yes	30-50	16	32	2
Commercial	Gutters	Service Life	Benign	Galvanised Steel	No		14	23	3
Commercial	Gutters	Time to First Maintenance	Benign	Galvanised Steel	Yes	10-15	15	17	2
Commercial	Gutters	Aesthetic Life	Benign	Galvanised Steel	Yes	20-30	13	22	2
Commercial	Gutters	Service Life	Marine	Colorbond	Yes	10-15	12	21	3
Commercial	Gutters	Service Life	Marine	Colorbond	No	5-10	12	18	2
Commercial	Gutters	Time to First Maintenance	Marine	Colorbond	Yes	5-10	7	10	2
Commercial	Gutters	Aesthetic Life	Marine	Colorbond	Yes	15-20	11	16	3
Commercial	Gutters	Service Life	Industrial	Colorbond	Yes	15-20	14	26	2
Commercial	Gutters	Service Life	Industrial	Colorbond	No	10-15	12	21	2
Commercial	Gutters	Time to First Maintenance	Industrial	Colorbond	Yes	5-10	7	12	2
Commercial	Gutters	Aesthetic Life	Industrial	Colorbond	Yes	15-20	10	17	2
Commercial	Gutters	Service Life	Benign	Colorbond	Yes	20-50	16	36	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Commercial	Gutters	Service Life	Benign	Colorbond	No	30-50	16	35	2
Commercial	Gutters	Time to First Maintenance	Benign	Colorbond	Yes	10-30	13	20	4
Commercial	Gutters	Aesthetic Life	Benign	Colorbond	Yes	30-50	14	29	2
Commercial	Gutters	Service Life	Marine	Zincalume	Yes	15-20	12	21	4
Commercial	Gutters	Service Life	Marine	Zincalume	No	10-15	11	15	2
Commercial	Gutters	Time to First Maintenance	Marine	Zincalume	Yes	5-10	8	10	2
Commercial	Gutters	Aesthetic Life	Marine	Zincalume	Yes	5-10	12	15	3
Commercial	Gutters	Service Life	Industrial	Zincalume	Yes	15-20	10	24	2
Commercial	Gutters	Service Life	Industrial	Zincalume	No	10-15	10	16	2
Commercial	Gutters	Time to First Maintenance	Industrial	Zincalume	Yes	5-10	8	12	2
Commercial	Gutters	Aesthetic Life	Industrial	Zincalume	Yes	10-15	10	17	2
Commercial	Gutters	Service Life	Benign	Zincalume	Yes	30 - 50	16	42	2
Commercial	Gutters	Service Life	Benign	Zincalume	No		16	29	3
Commercial	Gutters	Time to First Maintenance	Benign	Zincalume	Yes	20-30	15	21	3
Commercial	Gutters	Aesthetic Life	Benign	Zincalume	Yes	20-50	16	28	2
Commercial	Gutters	Service Life	Marine	Galvanised Steel	Yes	10-15	9	13	2
Commercial	Gutters	Service Life	Industrial	Galvanised Steel	Yes	10-15	9	15	2
Commercial	Gutters	Service Life	Benign	Galvanised Steel	Yes	30-50	15	30	3
Commercial	Gutters	Service Life	Marine	Colorbond	Yes		13	23	4
Commercial	Gutters	Service Life	Industrial	Colorbond	Yes	15-20	14	26	2
Commercial	Gutters	Service Life	Benign	Colorbond	Yes	20-50	16	36	2
Commercial	Gutters	Service Life	Marine	Zincalume	Yes	15-20	12	21	2
Commercial	Gutters	Service Life	Industrial	Zincalume	Yes	15-20	10	24	2
Commercial	Gutters	Service Life	Benign	Zincalume	Yes	20->50	16	39	3
Residential s	Gutters	Service Life	Marine	Galvanised Steel	Yes	5-10	7	11	2
Residential s	Gutters	Service Life	Marine	Galvanised Steel	No	<5	5	10	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential s	Gutters	Time to First Maintenance	Marine	Galvanised Steel	Yes	<5	3	4	1
Residential s	Gutters	Aesthetic Life	Marine	Galvanised Steel	Yes	<5	8	7	1
Residential s	Gutters	Service Life	Industrial	Galvanised Steel	Yes	10-15	6	14	1
Residential s	Gutters	Service Life	Industrial	Galvanised Steel	No	5-10	3	9	1
Residential s	Gutters	Time to First Maintenance	Industrial	Galvanised Steel	Yes	<5	4	5	1
Residential s	Gutters	Aesthetic Life	Industrial	Galvanised Steel	Yes	5-10	7	8	1
Residential s	Gutters	Service Life	Benign	Galvanised Steel	Yes	15->50	18	33	2
Residential s	Gutters	Service Life	Benign	Galvanised Steel	No	10-15	16	21	2
Residential s	Gutters	Time to First Maintenance	Benign	Galvanised Steel	Yes	10-15	19	15	1
Residential s	Gutters	Aesthetic Life	Benign	Galvanised Steel	Yes	5-20	19	20	3
Residential s	Gutters	Service Life	Marine	Colorbond	Yes	10-15	10	18	2
Residential s	Gutters	Service Life	Marine	Colorbond	No	5-10	8	12	2
Residential s	Gutters	Time to First Maintenance	Marine	Colorbond	Yes	<5	9	8	1
Residential s	Gutters	Aesthetic Life	Marine	Colorbond	Yes	<5-10	9	11	2
Residential s	Gutters	Service Life	Industrial	Colorbond	Yes	15-30	15	24	2
Residential s	Gutters	Service Life	Industrial	Colorbond	No	10-15	10	16	2
Residential s	Gutters	Time to First Maintenance	Industrial	Colorbond	Yes	5-10	8	12	1
Residential s	Gutters	Aesthetic Life	Industrial	Colorbond	Yes	20-30	10	14	2
Residential s	Gutters	Service Life	Benign	Colorbond	Yes	30->50	18	40	2
Residential s	Gutters	Service Life	Benign	Colorbond	No		20	29	2
Residential s	Gutters	Time to First Maintenance	Benign	Colorbond	Yes	10-15	17	20	1
Residential s	Gutters	Aesthetic Life	Benign	Colorbond	Yes		19	24	2
Residential s	Gutters	Service Life	Marine	Zincalume	Yes	15-20	7	15	2
Residential s	Gutters	Service Life	Marine	Zincalume	No	5-10	7	11	2
Residential s	Gutters	Time to First Maintenance	Marine	Zincalume	Yes	<5	8	7	1
Residential s	Gutters	Aesthetic Life	Marine	Zincalume	Yes	<5-10	8	9	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential s	Gutters	Service Life	Industrial	Zincalume	Yes	15-20	9	19	1
Residential s	Gutters	Service Life	Industrial	Zincalume	No	5-15	7	14	2
Residential s	Gutters	Time to First Maintenance	Industrial	Zincalume	Yes	5-10	7	9	1
Residential s	Gutters	Aesthetic Life	Industrial	Zincalume	Yes	5-10	7	12	1
Residential s	Gutters	Service Life	Benign	Zincalume	Yes	20-30	18	36	1
Residential s	Gutters	Service Life	Benign	Zincalume	No	15-20	17	26	1
Residential s	Gutters	Time to First Maintenance	Benign	Zincalume	Yes	10-15	17	18	1
Residential s	Gutters	Aesthetic Life	Benign	Zincalume	Yes	<5-15	12	14	3
Commercial	Roof Sheeting	Service Life	Marine	Galvanised Steel	Yes	10-20	6	12	3
Commercial	Roof Sheeting	Service Life	Marine	Galvanised Steel	No	20-30	10	19	2
Commercial	Roof Sheeting	Time to first maintenance	Marine	Galvanised Steel	Yes	5-10	4	7	2
Commercial	Roof Sheeting	Aesthetic Life	Marine	Galvanised Steel	Yes	<5	7	11	2
Commercial	Roof Sheeting	Service Life	Industrial	Galvanised Steel	Yes	10-15	13	23	2
Commercial	Roof Sheeting	Service Life	Industrial	Galvanised Steel	No	5-15	9	16	2
Commercial	Roof Sheeting	Time to first maintenance	Industrial	Galvanised Steel	Yes	5-10	9	10	1
Commercial	Roof Sheeting	Aesthetic Life	Industrial	Galvanised Steel	Yes	5-10	12	15	2
Commercial	Roof Sheeting	Service Life	Benign	Galvanised Steel	Yes	30-50	13	43	1
Commercial	Roof Sheeting	Service Life	Benign	Galvanised Steel	No	30-50	13	35	1
Commercial	Roof Sheeting	Time to first maintenance	Benign	Galvanised Steel	Yes	15-20	12	19	2
Commercial	Roof Sheeting	Aesthetic Life	Benign	Galvanised Steel	Yes	15-30	15	29	2
Commercial	Roof Sheeting	Service Life	Marine	Colorbond	Yes	20-30	10	26	2
Commercial	Roof Sheeting	Service Life	Marine	Colorbond	No	15-20	6	17	2
Commercial	Roof Sheeting	Time to first maintenance	Marine	Colorbond	Yes	10-15	5	12	1
Commercial	Roof Sheeting	Aesthetic Life	Marine	Colorbond	Yes	10-15	7	16	2
Commercial	Roof Sheeting	Service Life	Industrial	Colorbond	Yes	20-30	12	29	2
Commercial	Roof Sheeting	Service Life	Industrial	Colorbond	No	15-20	10	22	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Commercial	Roof Sheeting	Time to first maintenance	Industrial	Colorbond	Yes	10-15	6	13	1
Commercial	Roof Sheeting	Aesthetic Life	Industrial	Colorbond	Yes	20-30	9	19	2
Commercial	Roof Sheeting	Service Life	Benign	Colorbond	Yes	30-50	13	46	1
Commercial	Roof Sheeting	Service Life	Benign	Colorbond	No	30-50	16	39	2
Commercial	Roof Sheeting	Time to first maintenance	Benign	Colorbond	Yes	20-30	16	24	2
Commercial	Roof Sheeting	Aesthetic Life	Benign	Colorbond	Yes	20-30	17	31	2
Commercial	Roof Sheeting	Service Life	Marine	Zincalume	Yes	15-20	13	26	2
Commercial	Roof Sheeting	Service Life	Marine	Zincalume	No	15-20	7	17	2
Commercial	Roof Sheeting	Time to first maintenance	Marine	Zincalume	Yes	5-10	7	11	2
Commercial	Roof Sheeting	Aesthetic Life	Marine	Zincalume	Yes	15-20	8	15	2
Commercial	Roof Sheeting	Service Life	Industrial	Zincalume	Yes	20-30	13	28	2
Commercial	Roof Sheeting	Service Life	Industrial	Zincalume	No	15-20	10	22	2
Commercial	Roof Sheeting	Time to first maintenance	Industrial	Zincalume	Yes	5-10	9	14	2
Commercial	Roof Sheeting	Aesthetic Life	Industrial	Zincalume	Yes	20-30	9	19	2
Commercial	Roof Sheeting	Service Life	Benign	Zincalume	Yes	>50	13	49	1
Commercial	Roof Sheeting	Service Life	Benign	Zincalume	No	30-50	15	39	1
Commercial	Roof Sheeting	Time to first maintenance	Benign	Zincalume	Yes	15-20	14	24	2
Commercial	Roof Sheeting	Aesthetic Life	Benign	Zincalume	Yes	20-30	16	33	2
Residential	Roof Sheeting	Service Life	Marine	Galvanised Steel	Yes	10-15	6	18	1
Residential	Roof Sheeting	Service Life	Marine	Galvanised Steel	No	5-15	5	9	2
Residential	Roof Sheeting	Time to first maintenance	Marine	Galvanised Steel	Yes	<5	5	6	1
Residential	Roof Sheeting	Aesthetic Life	Marine	Galvanised Steel	Yes	5-10	5	9	2
Residential	Roof Sheeting	Service Life	Industrial	Galvanised Steel	Yes	20-30	8	23	1
Residential	Roof Sheeting	Service Life	Industrial	Galvanised Steel	No	10-15	5	13	1
Residential	Roof Sheeting	Time to first maintenance	Industrial	Galvanised Steel	Yes	10-15	4	9	1
Residential	Roof Sheeting	Aesthetic Life	Industrial	Galvanised Steel	Yes	10-15	7	12	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential	Roof Sheeting	Service Life	Benign	Galvanised Steel	Yes	>50	15	47	1
Residential	Roof Sheeting	Service Life	Benign	Galvanised Steel	No	30-50	19	34	2
Residential	Roof Sheeting	Time to first maintenance	Benign	Galvanised Steel	Yes	5-30	16	21	4
Residential	Roof Sheeting	Aesthetic Life	Benign	Galvanised Steel	Yes	10-20	16	24	2
Residential	Roof Sheeting	Service Life	Marine	Colorbond	Yes	20-30	10	24	2
Residential	Roof Sheeting	Service Life	Marine	Colorbond	No	5-20	7	16	4
Residential	Roof Sheeting	Time to first maintenance	Marine	Colorbond	Yes	<5-20	6	10	4
Residential	Roof Sheeting	Aesthetic Life	Marine	Colorbond	Yes	5-15	7	12	2
Residential	Roof Sheeting	Service Life	Industrial	Colorbond	Yes		15	31	4
Residential	Roof Sheeting	Service Life	Industrial	Colorbond	No	5-10	14	20	4
Residential	Roof Sheeting	Time to first maintenance	Industrial	Colorbond	Yes	5-10	8	11	2
Residential	Roof Sheeting	Aesthetic Life	Industrial	Colorbond	Yes	20-30	9	14	2
Residential	Roof Sheeting	Service Life	Benign	Colorbond	Yes	30->50	13	47	2
Residential	Roof Sheeting	Service Life	Benign	Colorbond	No		19	38	3
Residential	Roof Sheeting	Time to first maintenance	Benign	Colorbond	Yes	10-50	19	26	4
Residential	Roof Sheeting	Aesthetic Life	Benign	Colorbond	Yes		17	26	4
Residential	Roof Sheeting	Service Life	Marine	Zincalume	Yes	20-30	8	22	2
Residential	Roof Sheeting	Service Life	Marine	Zincalume	No	5-15	6	13	2
Residential	Roof Sheeting	Time to first maintenance	Marine	Zincalume	Yes	5-15	5	9	2
Residential	Roof Sheeting	Aesthetic Life	Marine	Zincalume	Yes	15-20	6	12	2
Residential	Roof Sheeting	Service Life	Industrial	Zincalume	Yes	20-30	8	26	2
Residential	Roof Sheeting	Service Life	Industrial	Zincalume	No	5-30	8	17	4
Residential	Roof Sheeting	Time to first maintenance	Industrial	Zincalume	Yes	5-20	8	12	4
Residential	Roof Sheeting	Aesthetic Life	Industrial	Zincalume	Yes	15-20	8	14	2
Residential	Roof Sheeting	Service Life	Benign	Zincalume	Yes	>50	13	49	2
Residential	Roof Sheeting	Service Life	Benign	Zincalume	No	20-30	18	38	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential	Roof Sheeting	Time to first maintenance	Benign	Zincalume	Yes	10-20	16	24	2
Residential	Roof Sheeting	Aesthetic Life	Benign	Zincalume	Yes	20-30	16	27	2
Connectors	Nails	Service Life	Marine	Steel in Softwood	Yes	<5	11	10	2
Connectors	Nails	Service Life	Marine	Steel in Softwood	No	<5	5	6	2
Connectors	Nails	Time to First Maintenance	Marine	Steel in Softwood	Yes	<5	2	4	2
Connectors	Nails	Aesthetic Life	Marine	Steel in Softwood	Yes	<5	2	3	3
Connectors	Nails	Service Life	Industrial	Steel in Softwood	Yes	15-20	10	15	2
Connectors	Nails	Service Life	Industrial	Steel in Softwood	No	<5	6	9	2
Connectors	Nails	Time to First Maintenance	Industrial	Steel in Softwood	Yes	5-10	3	5	3
Connectors	Nails	Aesthetic Life	Industrial	Steel in Softwood	Yes	<5	3	5	3
Connectors	Nails	Service Life	Benign	Steel in Softwood	Yes	>50	23	38	1
Connectors	Nails	Service Life	Benign	Steel in Softwood	No	30-50	21	30	2
Connectors	Nails	Time to First Maintenance	Benign	Steel in Softwood	Yes		17	16	
Connectors	Nails	Aesthetic Life	Benign	Steel in Softwood	Yes	5-10	14	21	4
Connectors	Nails	Service Life	Marine	Steel in Hardwood	Yes	10-15	12	19	2
Connectors	Nails	Service Life	Marine	Steel in Hardwood	No	10-15	7	12	1
Connectors	Nails	Time to First Maintenance	Marine	Steel in Hardwood	Yes	<5	6	8	1
Connectors	Nails	Aesthetic Life	Marine	Steel in Hardwood	Yes		6	8	1
Connectors	Nails	Service Life	Industrial	Steel in Hardwood	Yes	15-20	15	22	3
Connectors	Nails	Service Life	Industrial	Steel in Hardwood	No	5-15	10	14	3
Connectors	Nails	Time to First Maintenance	Industrial	Steel in Hardwood	Yes	-5-15	7	10	2
Connectors	Nails	Aesthetic Life	Industrial	Steel in Hardwood	Yes		5	8	1
Connectors	Nails	Service Life	Benign	Steel in Hardwood	Yes	50>	20	45	3
Connectors	Nails	Service Life	Benign	Steel in Hardwood	No	>50*	19	32	2
Connectors	Nails	Time to First Maintenance	Benign	Steel in Hardwood	Yes	5-15	20	24	1
Connectors	Nails	Aesthetic Life	Benign	Steel in Hardwood	Yes	15-30	21	31	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Connectors	Nails	Service Life	Marine	Galvanised Steel in Softwood	Yes	20-30	12	17	2
Connectors	Nails	Service Life	Marine	Galvanised Steel in Softwood	No	<5	8	10	2
Connectors	Nails	Time to First Maintenance	Marine	Galvanised Steel in Softwood	Yes	<5	4	7	2
Connectors	Nails	Aesthetic Life	Marine	Galvanised Steel in Softwood	Yes	<5	6	7	1
Connectors	Nails	Service Life	Industrial	Galvanised Steel in Softwood	Yes	10-15	9	17	1
Connectors	Nails	Service Life	Industrial	Galvanised Steel in Softwood	No	5-15	8	12	2
Connectors	Nails	Time to First Maintenance	Industrial	Galvanised Steel in Softwood	Yes	10-15	5	9	2
Connectors	Nails	Aesthetic Life	Industrial	Galvanised Steel in Softwood	Yes	10-15	5	8	2
Connectors	Nails	Service Life	Benign	Galvanised Steel in Softwood	Yes	>50	20	46	1
Connectors	Nails	Service Life	Benign	Galvanised Steel in Softwood	No	30-50	18	34	1
Connectors	Nails	Time to First Maintenance	Benign	Galvanised Steel in Softwood	Yes		16	20	3
Connectors	Nails	Aesthetic Life	Benign	Galvanised Steel in Softwood	Yes	15-20	17	21	2
Connectors	Nails	Service Life	Marine	Galvanised Steel in Hardwood	Yes	10-15	7	10	2
Connectors	Nails	Service Life	Marine	Galvanised Steel in Hardwood	No	<5	5	6	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Connectors	Nails	Time to First Maintenance	Marine	Galvanised Steel in Hardwood	Yes	<5	2	4	2
Connectors	Nails	Aesthetic Life	Marine	Galvanised Steel in Hardwood	Yes	<5	6	7	1
Connectors	Nails	Service Life	Industrial	Galvanised Steel in Hardwood	Yes		8	14	2
Connectors	Nails	Service Life	Industrial	Galvanised Steel in Hardwood	No		7	9	2
Connectors	Nails	Time to First Maintenance	Industrial	Galvanised Steel in Hardwood	Yes	<5	4	6	3
Connectors	Nails	Aesthetic Life	Industrial	Galvanised Steel in Hardwood	Yes	<5	5	6	3
Connectors	Nails	Service Life	Benign	Galvanised Steel in Hardwood	Yes		19	32	1
Connectors	Nails	Service Life	Benign	Galvanised Steel in Hardwood	No	5-10	17	22	3
Connectors	Nails	Time to First Maintenance	Benign	Galvanised Steel in Hardwood	Yes	5-10	17	13	2
Connectors	Nails	Aesthetic Life	Benign	Galvanised Steel in Hardwood	Yes	>50	18	30	2
Connectors	Bolts	Service Life	Marine	Brass in Hardwood	Yes	>50	21	29	3
Connectors	Bolts	Service Life	Marine	Brass in Hardwood	No	5-10	21	21	2
Connectors	Bolts	Time to first maintenance	Marine	Brass in Hardwood	Yes	<5	18	12	2
Connectors	Bolts	Aesthetic Life	Marine	Brass in Hardwood	Yes	5-10	16	14	1
Connectors	Bolts	Service Life	Industrial	Brass in Hardwood	Yes	20-30	16	23	3
Connectors	Bolts	Service Life	Industrial	Brass in Hardwood	No	15-20	13	19	2
Connectors	Bolts	Time to first maintenance	Industrial	Brass in Hardwood	Yes	5-10	7	10	2
Connectors	Bolts	Aesthetic Life	Industrial	Brass in Hardwood	Yes		8	12	3

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Connectors	Bolts	Service Life	Benign	Brass in Hardwood	Yes	>50	18	46	1
Connectors	Bolts	Service Life	Benign	Brass in Hardwood	No	30-50	16	36	1
Connectors	Bolts	Time to first maintenance	Benign	Brass in Hardwood	Yes	10-20	15	19	2
Connectors	Bolts	Aesthetic Life	Benign	Brass in Hardwood	Yes	20-30	17	22	2
Connectors	Bolts	Service Life	Marine	Brass in Softwood	Yes	30 - 50	21	32	2
Connectors	Bolts	Service Life	Marine	Brass in Softwood	No	5-10	19	17	2
Connectors	Bolts	Time to first maintenance	Marine	Brass in Softwood	Yes	<5	5	7	2
Connectors	Bolts	Aesthetic Life	Marine	Brass in Softwood	Yes	<5	9	10	2
Connectors	Bolts	Service Life	Industrial	Brass in Softwood	Yes	30-50	18	28	2
Connectors	Bolts	Service Life	Industrial	Brass in Softwood	No	10-15	14	18	3
Connectors	Bolts	Time to first maintenance	Industrial	Brass in Softwood	Yes	5-10	6	10	2
Connectors	Bolts	Aesthetic Life	Industrial	Brass in Softwood	Yes	<5	17	15	2
Connectors	Bolts	Service Life	Benign	Brass in Softwood	Yes	>50	23	43	1
Connectors	Bolts	Service Life	Benign	Brass in Softwood	No	30->50	21	35	2
Connectors	Bolts	Time to first maintenance	Benign	Brass in Softwood	Yes	15-20	17	17	2
Connectors	Bolts	Aesthetic Life	Benign	Brass in Softwood	Yes	10 - 15	15	21	2
Connectors	Bolts	Service Life	Marine	Hot dipped gal in Hardwood	Yes	20-30	18	24	2
Connectors	Bolts	Service Life	Marine	Hot dipped gal in Hardwood	No		9	13	3
Connectors	Bolts	Time to first maintenance	Marine	Hot dipped gal in Hardwood	Yes	<5	9	10	2
Connectors	Bolts	Aesthetic Life	Marine	Hot dipped gal in Hardwood	Yes	<5	11	12	2
Connectors	Bolts	Service Life	Industrial	Hot dipped gal in Hardwood	Yes	20-30	15	24	2
Connectors	Bolts	Service Life	Industrial	Hot dipped gal in Hardwood	No		11	15	3
Connectors	Bolts	Time to first maintenance	Industrial	Hot dipped gal in Hardwood	Yes	<5	9	9	2
Connectors	Bolts	Aesthetic Life	Industrial	Hot dipped gal in Hardwood	Yes	<5	11	12	2
Connectors	Bolts	Service Life	Benign	Hot dipped gal in Hardwood	Yes	30->50	14	48	2
Connectors	Bolts	Service Life	Benign	Hot dipped gal in Hardwood	No	>50	20	38	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Connectors	Bolts	Time to first maintenance	Benign	Hot dipped gal in Hardwood	Yes		23	28	3
Connectors	Bolts	Aesthetic Life	Benign	Hot dipped gal in Hardwood	Yes	30-50	18	30	2
Connectors	Bolts	Service Life	Marine	Hot dipped gal in Softwood	Yes	20-30	10	19	2
Connectors	Bolts	Service Life	Marine	Hot dipped gal in Softwood	No	<5	8	11	1
Connectors	Bolts	Time to first maintenance	Marine	Hot dipped gal in Softwood	Yes	<5	7	7	1
Connectors	Bolts	Aesthetic Life	Marine	Hot dipped gal in Softwood	Yes	<5	5	7	2
Connectors	Bolts	Service Life	Industrial	Hot dipped gal in Softwood	Yes	10-30	11	21	3
Connectors	Bolts	Service Life	Industrial	Hot dipped gal in Softwood	No	15-20	7	12	2
Connectors	Bolts	Time to first maintenance	Industrial	Hot dipped gal in Softwood	Yes	<5	7	9	2
Connectors	Bolts	Aesthetic Life	Industrial	Hot dipped gal in Softwood	Yes	10-15	7	9	2
Connectors	Bolts	Service Life	Benign	Hot dipped gal in Softwood	Yes	30-50	18	38	2
Connectors	Bolts	Service Life	Benign	Hot dipped gal in Softwood	No	30-50	18	27	2
Connectors	Bolts	Time to first maintenance	Benign	Hot dipped gal in Softwood	Yes	5-10	19	20	3
Connectors	Bolts	Aesthetic Life	Benign	Hot dipped gal in Softwood	Yes	20 - 30	17	21	2
Connectors	Bolts	Service Life	Marine	Steel in Hardwood	Yes	5-10	7	8	2
Connectors	Bolts	Service Life	Marine	Steel in Hardwood	No	<5	3	5	1
Connectors	Bolts	Time to first maintenance	Marine	Steel in Hardwood	Yes	<5	3	4	1
Connectors	Bolts	Aesthetic Life	Marine	Steel in Hardwood	Yes	<5	3	4	1
Connectors	Bolts	Service Life	Industrial	Steel in Hardwood	Yes	5-15	10	12	2
Connectors	Bolts	Service Life	Industrial	Steel in Hardwood	No	<5	7	7	1
Connectors	Bolts	Time to first maintenance	Industrial	Steel in Hardwood	Yes	<5	5	6	1
Connectors	Bolts	Aesthetic Life	Industrial	Steel in Hardwood	Yes	<5	5	7	1
Connectors	Bolts	Service Life	Benign	Steel in Hardwood	Yes	>50	21	46	1
Connectors	Bolts	Service Life	Benign	Steel in Hardwood	No	10-15	21	22	2
Connectors	Bolts	Time to first maintenance	Benign	Steel in Hardwood	Yes	<5	17	13	2
Connectors	Bolts	Aesthetic Life	Benign	Steel in Hardwood	Yes	<5-10	16	14	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Connectors	Bolts	Service Life	Marine	Steel in Softwood	Yes	5-10	7	9	2
Connectors	Bolts	Service Life	Marine	Steel in Softwood	No	<5	3	4	1
Connectors	Bolts	Time to first maintenance	Marine	Steel in Softwood	Yes	<5	2	4	1
Connectors	Bolts	Aesthetic Life	Marine	Steel in Softwood	Yes	<5	2	4	2
Connectors	Bolts	Service Life	Industrial	Steel in Softwood	Yes	5-10	15	14	1
Connectors	Bolts	Service Life	Industrial	Steel in Softwood	No	<5	7	7	1
Connectors	Bolts	Time to first maintenance	Industrial	Steel in Softwood	Yes	<5	5	5	1
Connectors	Bolts	Aesthetic Life	Industrial	Steel in Softwood	Yes	<5	4	5	1
Connectors	Bolts	Service Life	Benign	Steel in Softwood	Yes	10-15	16	24	2
Connectors	Bolts	Service Life	Benign	Steel in Softwood	No	10-15	16	20	2
Connectors	Bolts	Time to first maintenance	Benign	Steel in Softwood	Yes	5-10	11	12	1
Connectors	Bolts	Aesthetic Life	Benign	Steel in Softwood	Yes	<5-10	16	13	2
Commercial	Flashing	Service Life	Marine	Copper	Yes	<50	17	41	2
Commercial	Flashing	Service Life	Marine	Copper	No	20-30	16	33	2
Commercial	Flashing	Time to First Maintenance	Marine	Copper	Yes	20-30	19	26	2
Commercial	Flashing	Service Life	Industrial	Copper	Yes	>50	18	41	2
Commercial	Flashing	Service Life	Industrial	Copper	No	30-50	16	35	2
Commercial	Flashing	Time to First Maintenance	Industrial	Copper	Yes	20-30	19	26	3
Commercial	Flashing	Service Life	Benign	Copper	Yes	>50	11	55	1
Commercial	Flashing	Service Life	Benign	Copper	No	>50	14	50	1
Commercial	Flashing	Time to First Maintenance	Benign	Copper	Yes	>50	19	38	2
Commercial	Flashing	Service Life	Marine	Galvanised Steel	Yes	5-10	9	16	2
Commercial	Flashing	Service Life	Marine	Galvanised Steel	No	<5	9	11	2
Commercial	Flashing	Time to First Maintenance	Marine	Galvanised Steel	Yes	<5	7	7	1
Commercial	Flashing	Service Life	Industrial	Galvanised Steel	Yes	15-20	8	18	2
Commercial	Flashing	Service Life	Industrial	Galvanised Steel	No	10-15	8	13	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Commercial	Flashing	Time to First Maintenance	Industrial	Galvanised Steel	Yes	5-10	6	9	1
Commercial	Flashing	Service Life	Benign	Galvanised Steel	Yes	20-30	17	38	2
Commercial	Flashing	Service Life	Benign	Galvanised Steel	No	15-20	18	32	4
Commercial	Flashing	Time to First Maintenance	Benign	Galvanised Steel	Yes	10-15	18	22	2
Commercial	Flashing	Service Life	Marine	Lead	Yes	>50	16	43	2
Commercial	Flashing	Service Life	Marine	Lead	No	30-50	17	38	3
Commercial	Flashing	Time to First Maintenance	Marine	Lead	Yes	30-50	19	33	2
Commercial	Flashing	Service Life	Industrial	Lead	Yes	<50	17	45	2
Commercial	Flashing	Service Life	Industrial	Lead	No	30->50	17	40	2
Commercial	Flashing	Time to First Maintenance	Industrial	Lead	Yes	>50	20	33	2
Commercial	Flashing	Service Life	Benign	Lead	Yes	>50	11	55	1
Commercial	Flashing	Service Life	Benign	Lead	No	>50	13	51	1
Commercial	Flashing	Time to First Maintenance	Benign	Lead	Yes	>50	21	42	1
Residential	Flashing	Service Life	Marine	Copper	Yes	>50	24	37	1
Residential	Flashing	Service Life	Marine	Copper	No	>50	25	31	2
Residential	Flashing	Time to First Maintenance	Marine	Copper	Yes		24	23	4
Residential	Flashing	Service Life	Industrial	Copper	Yes	>50	22	40	1
Residential	Flashing	Service Life	Industrial	Copper	No		24	33	4
Residential	Flashing	Time to First Maintenance	Industrial	Copper	Yes	5-10	23	25	2
Residential	Flashing	Service Life	Benign	Copper	Yes	>50	15	51	1
Residential	Flashing	Service Life	Benign	Copper	No	>50	22	46	1
Residential	Flashing	Time to First Maintenance	Benign	Copper	Yes		22	29	4
Residential	Flashing	Service Life	Marine	Galvanised Steel	Yes	>50	12	17	1
Residential	Flashing	Service Life	Marine	Galvanised Steel	No	<5-10	13	14	2
Residential	Flashing	Time to First Maintenance	Marine	Galvanised Steel	Yes	<5	9	11	2
Residential	Flashing	Service Life	Industrial	Galvanised Steel	Yes	20-30	9	22	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential	Flashing	Service Life	Industrial	Galvanised Steel	No	5-15	12	16	2
Residential	Flashing	Time to First Maintenance	Industrial	Galvanised Steel	Yes	5-10	8	13	2
Residential	Flashing	Service Life	Benign	Galvanised Steel	Yes	>50	20	40	2
Residential	Flashing	Service Life	Benign	Galvanised Steel	No	30-50	16	22	3
Residential	Flashing	Time to First Maintenance	Benign	Galvanised Steel	Yes	10-15	22	28	2
Residential	Flashing	Service Life	Marine	Lead	Yes	20-30	18	38	1
Residential	Flashing	Service Life	Marine	Lead	No	15-20	23	33	1
Residential	Flashing	Time to First Maintenance	Marine	Lead	Yes	10-15	22	26	2
Residential	Flashing	Service Life	Industrial	Lead	Yes	30-50	10	48	1
Residential	Flashing	Service Life	Industrial	Lead	No	20-30	18	34	2
Residential	Flashing	Time to First Maintenance	Industrial	Lead	Yes	15-20	20	28	1
Residential	Flashing	Service Life	Benign	Lead	Yes	>50	7	58	1
Residential	Flashing	Service Life	Benign	Lead	No	>50	14	48	2
Residential	Flashing	Time to First Maintenance	Benign	Lead	Yes		20	36	3
Residential	Window Frames	Service Life	Marine	Aluminium	Yes	20-30	11	21	1
Residential	Window Frames	Service Life	Marine	Aluminium	No	5-10	12	16	1
Residential	Window Frames	Time to First Maintenance	Marine	Aluminium	Yes	<5-10	5	8	2
Residential	Window Frames	Aesthetic Life	Marine	Aluminium	Yes	<5-15	12	14	3
Residential	Window Frames	Service Life	Industrial	Aluminium	Yes	20-30	10	26	1
Residential	Window Frames	Service Life	Industrial	Aluminium	No	20-30	9	17	2
Residential	Window Frames	Time to First Maintenance	Industrial	Aluminium	Yes	5-15	7	10	2
Residential	Window Frames	Aesthetic Life	Industrial	Aluminium	Yes		12	16	4
Residential	Window Frames	Service Life	Benign	Aluminium	Yes	30-50	14	44	1
Residential	Window Frames	Service Life	Benign	Aluminium	No	20-30	17	29	2
Residential	Window Frames	Time to First Maintenance	Benign	Aluminium	Yes	15-20	17	24	1
Residential	Window Frames	Aesthetic Life	Benign	Aluminium	Yes	30-50	13	24	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential	Window Frames	Service Life	Marine	Colour Coated Aluminium	Yes	20-30	12	24	2
Residential	Window Frames	Service Life	Marine	Colour Coated Aluminium	No		12	17	2
Residential	Window Frames	Time to First Maintenance	Marine	Colour Coated Aluminium	Yes	<15	8	11	3
Residential	Window Frames	Aesthetic Life	Marine	Colour Coated Aluminium	Yes	5-10	12	15	1
Residential	Window Frames	Service Life	Industrial	Colour Coated Aluminium	Yes	20-30	14	28	1
Residential	Window Frames	Service Life	Industrial	Colour Coated Aluminium	No		13	21	4
Residential	Window Frames	Time to First Maintenance	Industrial	Colour Coated Aluminium	Yes	5-15	7	14	2
Residential	Window Frames	Aesthetic Life	Industrial	Colour Coated Aluminium	Yes	5-10	14	18	2
Residential	Window Frames	Service Life	Benign	Colour Coated Aluminium	Yes	3-50	12	45	2
Residential	Window Frames	Service Life	Benign	Colour Coated Aluminium	No	10->50	19	34	2
Residential	Window Frames	Time to First Maintenance	Benign	Colour Coated Aluminium	Yes		13	24	4
Residential	Window Frames	Aesthetic Life	Benign	Colour Coated Aluminium	Yes	30-50	13	25	2
Commercial	Purlins -Horizontal	Service Life	Marine	Galvanised Steel	No	20-30	8	17	2
Commercial	Purlins -Horizontal	Service Life	Industrial	Galvanised Steel	No	20-30	12	23	4
Commercial	Purlins -Horizontal	Service Life	Benign	Galvanised Steel	No		18	37	2
Commercial	Purlins -Vertical	Service Life	Marine	Galvanised Steel	No		12	19	2
Commercial	Purlins -Vertical	Service Life	Industrial	Galvanised Steel	No	15-50	16	25	3
Commercial	Purlins -Vertical	Service Life	Benign	Galvanised Steel	No	>50	19	39	2
Commercial	Purlins -Horizontal	Service Life	Marine	Zincalume	No	5-10	10	17	1
Commercial	Purlins -Horizontal	Service Life	Industrial	Zincalume	No	5-10	12	22	2
Commercial	Purlins -Horizontal	Service Life	Benign	Zincalume	No	2-30	18	35	2
Commercial	Purlins -Vertical	Service Life	Marine	Zincalume	No	10-15	11	19	2
Commercial	Purlins -Vertical	Service Life	Industrial	Zincalume	No	20-30	11	23	2
Commercial	Purlins -Vertical	Service Life	Benign	Zincalume	No	30->50	17	37	2
Residential	Deck for Sub floor	Service Life	Marine	Steel	No	15-30	9	25	2
Residential	Deck for Sub floor	Service Life	Industrial	Steel	No	20-30	16	29	2

Building type	Component	Measure	Environment	Material	Maintenance	Mode (years)	SD (years)	Mean (years)	Criteria
Residential	Deck for Sub floor	Service Life	Benign	Steel	No	>50	17	48	1
Commercial	Piles	Service Life	Marine	Steel	No	15-50	14	19	4
Commercial	Piles	Service Life	Industrial	Steel	No	2-30	15	25	2
Commercial	Piles	Service Life	Benign	Steel	No	30-50	14	38	2
Residential	Gang Nails	Service Life	Marine	Galvanised Steel-Hardwood	No	-	11	14	2
Residential	Gang Nails	Service Life	Industrial	Galvanised Steel-Hardwood	No	20-30	10	19	2
Residential	Gang Nails	Service Life	Benign	Galvanised Steel-Hardwood	No	30-50	14	38	1
Residential	Gang Nails	Service Life	Marine	Galvanised Steel-Softwood	No	<5	7	8	1
Residential	Gang Nails	Service Life	Industrial	Galvanised Steel-Softwood	No	20-30	11	17	2
Residential	Gang Nails	Service Life	Benign	Galvanised Steel-Softwood	No	30-50	18	40	2

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