ecoply®
Proven. Durable. Strong

Structural Plywood Properties & Applications Manual

March 2008

CarterHoltHarvey
Woodproducts New Zealand

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Contents

The information contained in this manual relates to specific Ecoply® branded plywood products manufactured by Carter Holt Harvey Woodproducts and their correct specification and installation. This manual cannot be relied upon when using other plywood products however similar they appear.

Alternative plywood products can differ in a number of ways which may not be immediately obvious and substituting them for Ecoply® products may not be appropriate and could in extreme cases lead to premature failure and/or buildings which do not meet the requirements of the New Zealand Building Code.

1.0 Ecoply® product range

Ecoply® is New Zealand's leading brand of structural plywood and is manufactured by Woodproducts NZ, a Carter Holt Harvey business, in Tokoroa and Mt Maunganui under a third party audited product quality control programme to monitor compliance with AS/NZS 2269:2004 Plywood Structural. As such these products carry Engineered Wood Products Association of Australasia (EWPAA) Joint Accreditation System – Australia and New Zealand (EWPAA/JAS-ANZ) certification.

This manual has a sister publication, the Ecoply® Appearance Product Manual, which covers Premium, BB, BD and grooved lining (often referred to as "Plygroove") Ecoply® products used in applications where visual appearance as well as structural performance is important.

For information relating to Shadowclad®, refer to the Shadowclad® Unlimited Possibilities consumer brochure and Shadowclad® Specification & Installation Manual.

1.1 The Ecoply® brand

The Ecoply® brand represents a range of appearance and performance rated plywood products which provide economy, durability, strength and design flexibility in a wide range of uses and applications in the building, agricultural, furniture, materials handling and transport industries.

1.2 Product description and range

Ecoply® Structural plywood is a layered panel made from *Pinus radiata* wood veneers.

The veneers are bonded together with synthetic phenolic (PF) resin set and cured under heat and pressure in controlled conditions to form a strong and durable Type A bond. Adjacent layers (veneers) are at right angles to each other to deliver two way strength and stability. Ecoply® strength is optimised for maximum performance parallel to the face grain with cross plies providing enhanced stability across the grain.

The Ecoply® plywood range can be specified for its:

- Surface grade (e.g. CD), where the first letter describes the face veneer appearance and the second letter describes the back veneer of the Ecoply® sheet. Surface grades are fully defined in AS/NZS 2269 and summarised in Table 2 on page 4.
- Stress grade that utilises the symbol F and a suffix e.g. F8 as a code to apply a full suite of strength and stiffness properties to plywood products of that stress grade. F8 is the standard stress grade for Ecoply® products with the exception of Ecoply® Longspan flooring which has higher stiffness than F8 and 15mm Ecoply® Roofing which is F11. See Tables 1, 4 and 5. Ecoply® Flooring products are also available in F11 on request.
- Thickness, ranging from 4mm to 25mm.
- Length, being 2400mm and 2700mm with a standard width of 1200mm.
- Preservative treatment, being untreated, H3 CCA or H3 LOSP Azole treated.
- Edge finish, being square edge or for Ecoply® Flooring, Ecoply® Roofing, routed on the long edges of the sheet with a polypropylene plastic tongue inserted into one side for a tongue-in-groove joint.

See Table 1 Ecoply® product range opposite.

Table 1: Ecoply® product range

Nominal thickness (mm)		4	6	7	9 (3 ply)	9 (5 ply)	12	15	17	19	21	25
Identification code*		4-14-3	6-14-5	7-24-3	9-30-3	9-18-5	12-24-5	15-30-5	17-24-7 17-24-6	19-30-7	21-30-7	25-30-9
Layup		1.4/1.4/1.4	1.4/1.4/1.0/1.4/1.4	2.4/2.4/2.4	3/3/3	1.8/1.8/1.8/1.8	2.4/2.4/2.4/2.4/2.4	3/3/3/3/3	2.4/2.4/2.4/2.4/ 2.4/2.4/2.4 2.4/3/3/3/3/2.4	3/2.4/3/2.4/3/2.4/3	3/3/3/3/3/3/3	3/2.4/3/2.4/3/2.4/3/2.4/3
Product and grade		Sheet sizes (mm)										
Ecoply® Structural (Square Edge)	Premium	2400x1200	2400x1200			2400x1200	2400x1200		2400x1200			
	BB						2400x1200		2400x1200			
	BD	2400x1200	2400x1200	2400x1200		2400x1200	2400x1200	2400x1200	2400x1200			
	BD						2700x1200					
	CD	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200
	CD			2700x1200	2700x1200		2700x1200	2700x1200	2700x1200	2700x1200	2700x1200	2700x1200
	DD	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200	2400x1200
	DD			2700x1200	2700x1200		2700x1200	2700x1200	2700x1200	2700x1200	2700x1200	2700x1200
Ecoply® Flooring	CD							2400x1200pt	2400x1200pt	2400x1200pt LS	2400x1200pt	2400x1200pt
	CD							2700x1200pt	2700x1200pt	2700x1200pt LS	2700x1200pt	2700x1200pt
Ecoply® Roofing	DD							2400x1200pt	2400x1200pt			
	DD							2700x1200pt	2700x1200pt			
Ecoply® Decking	CD								2400x1200pt			
Ecoply® Grooved Lining	CLASSIC					2400x1200	2400x1200pt					
	CLASSIC						2700x1200pt					
	PIONEER					2400x1200	2400x1200pt					
	PIONEER						2700x1200pt					

Available untreated only | Available H3 CCA | Available either untreated or H3 CCA | Available either untreated or H3 LOSP

* Identification code is Thickness (mm) – Face veneer thickness (mm x 10) – Number of veneers.

pt Machined grooves on both long edges with a plastic polypropylene tongue in one groove, 1200mm cover.

LS Longspan flooring, which has higher stiffness than F8 for superior spanning capability.

Note
- Full range may not always be available ex-stock, check with Ecoply® supplier to ensure availability.
- Non-standard specifications, including thicker sheets may be available to special order in significant quantities.
- All products are F8 stress grade except 15mm Ecoply® Roofing, which is F11 and Ecoply® Longspan flooring, which has higher stiffness than F8. Note, Ecoply® Flooring products are also available in F11 on request.

CLASSIC – Intended for clear finishing, premium grade face.

PIONEER – May contain traces of synthetic filler. Intended for paint finish.

1.3 Surface grades

Table 2 summarises the surface appearance grades in which Ecoply® Structural panels are available with some typical applications for each surface grade. The surface grade specifications are fully defined in AS/NZS 2269.

Table 2: Ecoply® Structural product information

Face Grade B	Face Grade C	Face Grade D
		
Ecoply® BD **Visual Grade of Face** Structural appearance grade with minor repairs. Suitable for high quality paint finish. **Some suggested uses** • Furniture • Joinery • Interior lining • Sheathing • Signs • Engineering components where a higher finish is required	**Ecoply® CD** **Visual Grade of Face** Solid sanded surface with filled holes and splits, with smaller intergrown knots. Suitable for a basic paint finish. **Some suggested uses** • Concrete formwork • Structural gussets • Roof decking under tiled systems • Bins, boxes, crates • Subsheathing • Hoardings • Stressed skin panels # **Colour code: blue**	**Ecoply® DD** **Visual Grade of Face** Usually sanded surface with unfilled holes up to 75mm across the face veneer. Splits and knots also allowable. **Some suggested uses** • Box and C beams • Portal frame webs • Gussets • Roofing under asphalt shingles • Crates • Strength critical pallets # **Colour code: green**
	Ecoply® Flooring CD (Has a higher quality crossband under the face) **Some suggested uses** • T&G Flooring • Roof decking under rubber membranes • Most other roofing • H3 CCA water based treated substrate for flexible membranes	**Ecoply® Roofing DD** (Unsanded to allow grip for workers on sloping roofs) **Some Suggested uses** • T&G underlay for asphalt shingles • Roof systems where a smooth substrate is not required

Colour code paint stripes indicating grade are applied to one end and one edge of each panel on Ecoply® Structural CD and DD only.

Note:

- A higher visual grade may be subsituted if required e.g. Ecoply® CD can be used anywhere DD is used. Ecoply® Flooring (CD grade) should be used rather than Ecoply® CD square edge panels as a substrate for membrane decks. See section 3.3 Floors, Roofs and Decks.
- The pictures shown above are a scaled down version of a typical sheet of Ecoply®. Grain pattern and colour may vary. If critical, select panels by hand.

1.4 Preservative treatment

Ecoply® Structural plywood is available untreated, or treated in accordance with AS/NZS 1604.3:2004. If treated, Ecoply® Structural plywood is most often impregnated with CCA (Copper Chrome Arsenate) water borne treatment for use in the H3 hazard class. H3 LOSP Azole clear treatment is the standard preservative treatment available on selected Ecoply® BB square edge, BD square edge and Ecoply® grooved lining products and on special request for other Ecoply® products. H3 CCA treated plywood in accordance with AS/NZS 1604.3:2004 is comparable to H3.2 and H3 LOSP is comparable to H3.1. H3 hazard class is described as: "outside, above ground, subject to periodic moderate wetting and leaching."

The characteristics of the treatments are shown in Table 3.

Table 3: Preservative treatment

	Untreated	H3 CCA	H3 LOSP (Azole)
Preservative carrier	N/A	Water	Light organic oil (white spirits)
Colour	Natural	Green	Clear (i.e. natural)
Fungicide	Heat treated dry wood	Copper	Propiconazole Tebuconazole
Insecticide	Heat treated dry wood	Arsenate	Permethrin
Other chemicals	N/A	Chrome (to fix preservative in wood)	Butyl Oxitol (co-solvent to assist active stability)
Mouldicide	N/A	Copper (limited efficacy)	IPBC
Notes	Plywood for dry interior use, supplied ex mill at <15% moisture content	Dried after treatment to average 18% moisture content for use in service at higher moisture contents	Solvent does not affect dimensions. Solvent smell disappears over time
Availability	Readily available	Standard treatment except for BB, BD, Ecoply® Grooved Lining and Shadowclad®	Treated to order for CD, DD, flooring, roofing and decking products. Standard treatment for BB, BD, Ecoply® Grooved Lining and Shadowclad®
Applications (Refer NZS3602)	Interior dry protected	Exterior/Interior damp (service performance subject to detailing and coatings), equivalent to H3.2 for timber in NZS 3640	Exterior claddings (service performance subject to detailing and coatings) equivalent to H3.1 for timber in NZS 3640

CCA

Ecoply® Structural plywood, which is H3 CCA treated (waterborne preservative with a green colour), is dried following treatment so that sheets may return to the correct dimensions. The moisture content after treatment with CCA and drying will be higher than the limits placed in AS/NZS 2269 on untreated product because treated plywood needs to be suited for use in the in-service hazard class environment. The target is for an average moisture content of approximately 18% to provide a panel closer to the expected equilibrium moisture content for most H3 applications.

The fillets used to separate sheets in drying may leave marks on the sheet surface. These will fade over time as the plywood weathers, and can be disguised with paint but may be visible under stain. The process of treating with CCA and subsequent drying is likely to increase the face checking† of the panel. Refer Woodproducts NZ Technical Note 01/06/62 "CCA Ecoply® plywood – surface quality."

LOSP, painting and gluing

LOSP treated Ecoply® uses colourless solvent to retain the wood colour and is moisture inert so the plywood remains at the same dimensions and moisture content. However, the plywood when freshly treated may contain more than 60 litres of organic fluid per cubic metre. Much of this needs to evaporate before painting to ensure adhesion of paint films. The solvent smells quite strong and venting is recommended for interior use or storage until most of the solvent has evaporated. Mechanical fasteners are recommended to fix LOSP treated Ecoply® to framing. If adhesives are required, thorough venting is recommended and LOSP tolerant adhesives should be applied according to adhesive manufacturers' instructions.
A suggested adhesive to fix LOSP treated Ecoply® to framing, or to fix untreated panels to LOSP treated framing, is Bostik GIBFix® All-Bond or Bostik Gold. (see page 12).

† *Face checking is caused by weathering, especially on northern facing exposures. Face checks are lengthwise separations of wood fibres in the face veneer of the plywood. They result from the normal swelling and shrinkage of wood as it gains and loses moisture. It is important to realise that these checks are superficial, being confined to the face veneer. They do not alter the structural integrity of the plywood. Because face checking is considered normal, it is not limited by the manufacturing specifications for Ecoply®.*

1.5 Section properties

Table 4a: Section properties of Ecoply® Structural plywood

				Section properties per mm width							
				Parallel to the face grain				Perpendicular to the face grain			
Nominal plywood thickness	Actual thickness	ID code*	Mass	Moment of Inertia	Section Modulus	Shear Constant	Cross Section Area	Moment of Inertia	Section Modulus	Shear Constant	Cross Section Area
(mm)	(mm)		(kg/m²)	I (mm⁴)	Z (mm³)	I/Q (mm²)	A (mm²)	I (mm⁴)	Z (mm³)	I/Q (mm²)	A (mm²)
7	7.2	7-24-3	4.0	30.0	8.33	5.19	4.87	2.05	1.71	2.30	2.54
9	9.0	9-30-3	5.0	58.6	13.0	6.48	6.09	4.01	2.67	2.87	3.18
12	12.0	12-24-5	6.6	115	19.2	9.26	7.34	33.4	9.27	5.45	5.02
15	15.0	15-30-5	8.3	225	29.9	11.6	9.18	65.2	14.5	6.81	6.27
17	16.8	17-24-7	9.2	285	33.9	12.2	9.82	122	20.4	9.47	7.49
17	16.8	17-24-6	9.2	273	32.5	12.3	11.0	134	22.3	9.50	6.30
19	19.2	19-30-7	10.6	451	46.9	13.7	12.2	157	23.8	10.7	7.60
19LS	19.2	19-30-7	10.5	476	50.1	13.3	13.8	113	18.5	10.4	5.80
21	21.0	21-30-7	11.6	556	52.9	15.2	12.3	239	31.9	11.8	9.36
25	24.6	25-30-9	13.5	897	72.9	17.8	15.3	381	41.0	13.9	10.1

Table 4b: Nominal strengths of sections of Ecoply® Structural plywood for Limit States Design: F8 grade

				Nominal strengths (Limit States) per mm width							
				Parallel to the face grain				Perpendicular to the face grain			
Nominal plywood thickness	Actual thickness	ID code	Weight	Bending Stiffness EI	Bending Moment fZ	Rolling Shear fI/Q†	Axial Compression fA‡	Bending Stiffness EI	Bending Moment fZ	Rolling Shear fI/Q†	Axial Compression fA‡
(mm)	(mm)		(kPa)	(1000 Nmm²)	(Nmm)	(N)	(N)	(1000 Nmm²)	(Nmm)	(N)	(N)
12	12.0	12-24-5	0.06	1046	479	15.74	147	304	232	9.26	100
15	15.0	15-30-5	0.08	2043	748	19.68	184	593	362	11.6	125
17	16.8	17-24-7	0.09	2589	847	20.66	196	1115	510	16.1	150
17	16.8	17-24-6	0.09	2484	813	20.91	220	1219	558	16.2	126
19	19.2	19-30-7	0.10	4104	1173	23.29	244	1429	595	18.2	152
19LS	19.0	19-34-7	0.10	4329	1252	22.68	275	1028	463	17.7	116
21	21.0	21-30-7	0.11	5057	1323	25.83	245	2177	797	20.1	187
25	24.6	25-30-9	0.13	8160	1823	30.26	306	3467	1025	23.6	202

Table 4c: Nominal strengths of sections of Ecoply® Structural plywood for Limit States Design: F11 grade

				Nominal strengths (Limit States) per mm width							
				Parallel to the face grain				Perpendicular to the face grain			
Nominal plywood thickness	Actual thickness	ID code	Weight	Bending Stiffness EI	Bending Moment fZ	Rolling Shear fI/Q†	Axial Compression fA‡	Bending Stiffness EI	Bending Moment fZ	Rolling Shear fI/Q†	Axial Compression fA‡
(mm)	(mm)		(kPa)	(1000 Nmm²)	(Nmm)	(N)	(N)	(1000 Nmm²)	(Nmm)	(N)	(N)
15	15.0	15-30-5	0.08	2362	1046	24.36	229	593	362	11.6	125
17	16.8	17-24-7	0.09	2992	1186	25.62	245	1115	510	16.1	150
17	16.8	17-24-6	0.09	2867	1137	25.83	275	1219	558	16.2	126
19	19.2	19-30-7	0.10	4736	1641	28.77	305	1429	595	18.2	152
21	21.0	21-30-7	0.11	5838	1851	31.92	307	2177	797	20.1	187
25	24.6	25-30-9	0.13	9418	2551	37.38	382	3467	1025	23.6	202

* Identification code: panel thickness – outermost veneer thickness x 10 – number of plies.
† I/Q values for rolling shear are for stress at the neutral axis calculated as in NZS3603.
‡ For tension, multiply compression values by 0.75.

- Use Tables 4a & b values for all F8 stress grade Ecoply® products including Ecoply® Longspan Flooring and Shadowclad® Texture.
- Use Tables 4a & c values for all F11 stress grade Ecoply®.
- Ecoply® 19mm Longspan Flooring has F8 strength properties but higher E of 10000 MPa.
- For Shadowclad® groove (a 5 ply grooved panel),
  - Use tabled values for F8 parallel to the face grain,
  - Perpendicular to the face grain multiply bending stiffness in Table 4b by 0.35, and use 3 ply values for strength.
- The section properties in Tables 4a, b & c have been calculated in accordance with AS/NZS 2269:2004.
- For other thicknesses, consult Woodproducts NZ on 0800 ECOPLY for section properties.
- For 19LS (i.e. Longspan), EI parallel to the grain in Table 4b may be increased by 10%. These panels are manufactured with stiffer face and back veneers to improve flooring performance.

1.6 Product identification

In accordance with AS/NZS 2269, every sheet of Ecoply® Structural plywood has the following information marked on the back:

- Brand name: ECOPLY®
- Panel construction code: e.g. 15-30-5 (Thickness (mm)-Face veneer thickness (mm x 10)-Number of veneers)
- Face grade, back grade, glue bond: e.g. CD A BOND
- Intended application: STRUCTURAL
- Australasian Standard: AS/NZS 2269:2004
- Date and time of manufacture: e.g. 16/08/07 19:45:45
- Stress grade: e.g. F8
- Formaldehyde emission class: (E0 for A Bond Ecoply®)
- The Engineered Wood Products Association of Australasia (EWPAA) brand and mill number: e.g. 911 (Tokoroa mill) or 915 (Mt Maunganui mill).

For example:

ECOPLY 15-30-5 CD A BOND STRUCTURAL
AS/NZS 2269:2004 PAT 16/08/07 19:45:45 F8 E0
911

If the plywood is treated, it will also be marked in accordance with the treatment Standard AS/NZS 1604.3:2004 Specification for Preservative Treatment, Part 3: Plywood.

1.7 Code compliance

Ecoply® manufacture is third-party audited through the product quality control programme of the Engineered Wood Products Association of Australasia (EWPAA) which is itself audited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Carter Holt Harvey is licensed by the EWPAA to stamp plywood with the PAA/JAS-ANZ Product Certification Mark. This certifies it has been manufactured under the third party audited Joint Product Certification programme to monitor compliance with joint Australian/New Zealand Standard AS/NZS 2269:2004 Plywood – Structural. Plywood to this Standard is referenced in NZBC Acceptable Solutions and Verification Methods through:

- NZS 3602:2003 The Use of Timber and Wood-based products for Use in Building
- NZS 3603:1993 Timber Structures
- NZS 3604:1999 Timber Framed Buildings
- AS/NZS 1604.3:2004 Specification for Preservative Treatment, Part 3:Plywood
- E2/AS1 External Moisture.

PRODUCT CERTIFIED paa ENGINEERED WOOD JAS-ANZ ©

WARNING: Plywood which is non-certified or is manufactured to standards other than AS/NZS 2269, such as US voluntary Standard PS1-95 (replaced by PS1-07), is not referenced in the NZBC. There are significant differences between the requirements of US voluntary Standard PS1-95 and AS/NZS 2269 around bond durability, structural ratings and veneer quality which are fully explained in a technical note titled "Warning Notice re substituting imported PS1-95 industrial plywood for AS/NZS 2269 structural plywood" published by the EWPAA. This can be downloaded from the EWPAA website at www.ewp.asn.au

Structure B1

Design to NZS 3603:1993 Timber Structures complies with the New Zealand Building Code in Verification Method B1/VM1 clause 6.0 Timber, Structural. Plywood is the only sheet material with properties listed in NZS 3603. Ecoply® Structural plywood is available in F8 stress grade with some specialty products available F11 or with specifically designed properties for specialised applications.

Structural properties of Ecoply® plywood

The majority of Ecoply® Structural plywood is F8 grade (exceptions are identifed in section 1.2 Product Description & Range) and the characteristic values may be used in conjunction with both NZS 3603 and AS 1720 for the design of timber components. The characteristic stress values in Table 5 have been used to provide nominal strengths in Tables 4b and 4c.

Table 5: Structural properties of Ecoply® plywood

	Characteristic stress value MPa	
	F8	F11
Bending	25	35
Tension	15	20
Panel shear	4.7	5.3
Rolling shear	1.9	2.1
Compression (in plane)	20	25
Bearing (normal)	9.7	12
Modulus of elasticity E	9100	10500
Modulus of rigidity R	455	525

Source: AS/NZS 2269:2004

Wood is strongest when stressed parallel to the grain and weakest across the grain, so the lay up or arrangement of veneers in the panel determines the properties. Because of its cross banded construction, plywood possesses significant strength and stiffness both parallel and perpendicular to the direction of the face grain, but is generally strongest and stiffest along the direction of the face grain.

The section properties of structural plywood in Table 4a are calculated in accordance with AS/NZS 2269:2004 to allow for the reduced contribution of veneers perpendicular to the direction of stress. For engineering design to NZS 3603, the section properties are multiplied by stresses and "k" factors to determine resistances for working stress design, or nominal strengths for limit states design.

Resistances and nominal strengths in Tables 4b and 4c assume all "k" factors are equal to 1.0. Multiply tabled values by the strength reduction factor ø and "k" factors for specific in-service conditions for design to a structural code such as NZS 3603.

Durability and exterior moisture E2

Ecoply® plywood is made from softwood solid radiata pine veneer. Designers should assess the level of exposure to biological, moisture, and other hazards and apply appropriate preservative treatment and detailing to minimise exposure to these hazards. The designer or builder can make or break durability compliance.

Information in this manual outlines suggested practices for detailing building components to exclude moisture to comply with the durability requirements of the NZ Building Code. Woodproducts NZ "Durability statement," 01/11/10 includes further guidelines for some environments and applications.

Formaldehyde

Ecoply® plywood is manufactured using phenol formaldehyde resins which are fully cured in the hot press. Cured resin is thermally and moisture stable and formaldehyde emissions for the glued plywood are similar to background levels for the wood by itself when tested to AS/NZS 2098.11 Determination of formaldehyde emissions for plywood. Accordingly every Ecoply® panel is branded with the lowest emission class (less than 0.5mg/litre for E_0). Actual emissions measured are usually much less than background levels in the air we breath (0.03 mg/litre).

Moisture content and dimensional change

At the time of leaving the factory, the moisture content of untreated Ecoply® plywood should generally be in the range of 8% to 15% as required by AS/NZS 2269. All wood products including plywood respond to changes in ambient humidity so the eventual moisture content of plywood varies according to how dry or how wet the environment is. After manufacture, the moisture content will move to equilibrium with the environment, and the veneers swell or shrink across the grain in response. The total expansion both along and across a 2400x1200mm panel can be in the order of 1.5mm to 3mm as the plywood changes from a dry to a saturated state.

Ecoply® that is treated with waterborne salts (e.g. CCA) is expected to be used in applications that have higher humidity than interior dry use, so following treatment it is dried to a higher average moisture content of approximately 18%. This provides for a more stable panel in service than placing a dry (less than 15%) sheet in a higher moisture environment.

Detailing and construction must allow for movement if the plywood will be subject to cycles of moisture change. Seasonal and daily cycles can be significant depending on the end use.

Temperature

Wood (and plywood) expand upon heating as do practically all solids. The thermal expansion of plywood is quite small and there is little effect on the structural performance or durability of plywood when used in temperatures below 54°C. The average co-efficient of thermal expansion of plywood is 4.5×10^{-6} mm/mm/°C. At temperatures above 55°C wood begins to deteriorate. Colours of coatings and finishes should be selected to reduce heat gain.

For extreme conditions, further technical information is available by calling 0800 ECOPLY.

The thermal resistance or insulating effectiveness of plywood panels can be calculated using NZS 4214:2006. e.g. Plywood has a conductivity (k) of 0.13 W/mK so a 12mm panel has a thermal resistance R = 0.012/0.13 = 0.09.

Aesthetics

Ecoply® products can be selected for decorative or weather protection functions as well as structural performance.

Acceptable Solution E2/AS1 External Moisture allows plywood manufactured to AS/NZS 2269, minimum CD appearance grade, minimum 5 ply, minimum 12mm thickness and treated as required by NZS 3602 to be used for exterior cladding. For exterior cladding applications Woodproducts NZ strongly recommends Shadowclad®, which has a bandsawn face to help reduce the incidence of face checking. See footnote† on page 5. Shadowclad® is available with and without vertical grooves.

1.8 Sustainability

Ecoply® is manufactured from radiata pine, a plantation grown medium density softwood. It is grown on tree farms which are tended and harvested to provide wood for plywood manufacture. The crop is managed on a sustainable basis to yield millable trees.

New Zealand plantations are managed in compliance with the New Zealand Forest Accord, a voluntary agreement signed in 1991 between NZ forest managers and environmental non-governmental organisations.

Ecoply® is manufactured in New Zealand at Woodproducts NZ's Tokoroa and Mt Maunganui plywood mills.

1.9 Health & safety

Ecoply® should be handled in accordance with the Material Safety Data Sheets (MSDS) for untreated, H3 CCA and H3 LOSP treated Ecoply®, which are available from Woodproducts NZ.

Always wear safety glasses or non-fogging goggles when machining Ecoply® panels.

If wood dust exposures are not controlled when machining (sawing, routing, planing, drilling etc) a class P1 or P2 replaceable filter or disposable face piece respirator should be worn.

Wear comfortable work gloves to avoid skin irritation and the risk of splinters. Wash hands with mild soap and water after handling panels.

1.10 Storage & handling

Ecoply® requires care in storage and handling. The following suggestions will help keep the plywood in good condition before use and after installation:

- The storage area should be protected from sun, rain and wind that would otherwise bring about rapid changes in temperature and humidity.
- Support for the sheets should be provided at both ends and middle to avoid distortion. Ensure bearers in packs above are aligned over bearers below (to avoid inducing curves in sheets).
- The stack should be kept dry and clear of ground contact, and placed so that it will not be exposed to mechanical damage.
- The sheets should be stacked flat, NOT on edge.
- To avoid staining, fading and surface checking, the sheets should not be exposed to the weather while awaiting installation.

1.11 Limitations

The information contained in this document is current as at March 2008 and is based on data available to Carter Holt Harvey at the time of going to print.

This publication replaces all previous Carter Holt Harvey design information and literature relating to Ecoply® Structural, Ecoply® Bracing, Ecoply® Flooring, Ecoply® Roofing & Decking and Origin® plywood. Carter Holt Harvey reserves the right to change the information contained in this document without prior notice. It is important that you call 0800 326 759 to confirm that you have the most up to date information available and refer to www.ecoply.co.nz.

Carter Holt Harvey has used its reasonable endeavours to ensure the accuracy and reliability of the information contained in this document and, to the extent permitted by law, will not be liable for any inaccuracies, omissions or errors in this information nor for any actions taken in reliance on this information.

2.0 General installation guide

The following is a general guide. See installation specific instructions under 3.0 Common applications.

2.1 Framing

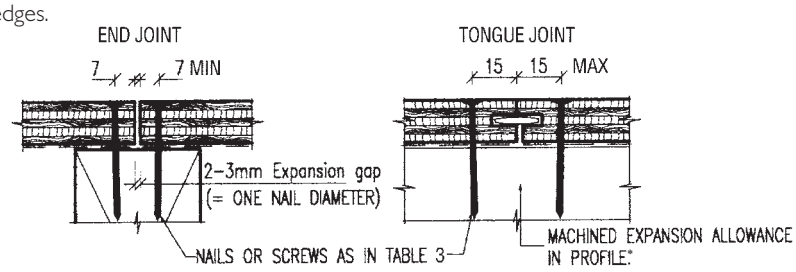
Use kiln dried framing e.g. Laserframe® in accordance with timber framing manufacturer's specifications and treated in accordance with NZS 3602. All timber frame sizes and set out must comply with NZS 3604 (or be specifically designed to NZS 3603). Ecoply® may be specified for frame spacing determined by design, or using tables in section 3 for specific product applications such as bracing, exterior cladding, flooring and as a substrate for shingle roofs or membrane roofs and decks.

LOSP treated framing should be vented before fixing and if construction adhesives are required (for example to screw and glue floor panels) the adhesive must be compatible with LOSP (See 1.4 Preservative treatment).

2.2 Nailing and fixing sheets

- Where there is risk of size change due to moisture cycling, allow a 2 to 3mm expansion gap between sheets.
- Use only flathead nails or screws, with or without construction adhesives.
- Nail length should penetrate at least 10 nail diameters into the framing or be three times the sheet thickness, whichever is the greater. Longer or ring shank nails may be specified.
- Nails must be at least 3 fastener diameters or 7mm from the edge of the sheet. Because of its cross banded construction, nails and screws can be placed close to the edge of the sheet to allow joining on narrow framing members.
- For standard nailing, nail edges and ends of sheets at 150mm centres, and within the panel at no more than 300mm centres.
- Use hot dipped galvanised fasteners or corrosion. resistant fasteners (i.e. stainless steel or silicone bronze) determined by design for specific hazards.
- Refer to Table 6 for minimum fastener sizes.
- Do not over-drive power driven nails.
- Fix no more than 15mm from sheet edges.

Figure 1: Fastening plywood



*Does not apply to all products with a tongue joint

Table 6: Fasteners and characteristic shear loads

Thickness (mm)	7 & 9mm	Load‡	12 & 15mm	Load‡	17mm	Load‡	19 to 21mm	Load‡	25mm	Load‡
Minimum nail size in timber studs	40 x 2.5mm	570	50 x 2.8mm	710	60 x 2.8mm	710	60 x 2.8mm	710	75 x 3.15mm	883
Screw size in timber studs	No.8 x 30mm	1230	No.8 x 40mm	1230	No.10 x 40mm	1650	No.10 x 45mm	1650	No.10 x 50mm	1650
Screw size in 1.15mm steel studs*	10-24-35†	1300	10-24-40†	2000	10-16-45†	2100	10-16-45†	2100	10-16-45†	2100
Screw size in 2.80mm steel studs*	10-24-35†	1200	10-16-40†	1200	14-20-45†	3000	14-20-45†	4000	14-20-45†	5000

* Self tapping, self countersinking screw

† Screw Numbers indicate: Gauge – Threads per inch – Length (mm)

‡ The load is the characteristic load (N) for one fastener in single shear

- Steel thickness, screw sizes, characteristic loads, refer to assemblies actually tested.
- Other screw sizes may be used. Screw properties vary between screw suppliers and the suitability of a particular size should be verified by the designer for performance under changing physical conditions and cyclic loading.
- Non-standard nailing may be specifically designed with NZS 3603 or similar.

2.3 Adhesives

Tube applied construction adhesives

Site applied construction adhesives may be used together with nails and screws for non permanent loads, reduced fastener popping, and to lower the risk of squeaking in floors. Available types include polyurethane (e.g. Hold fast Gorilla Nail Power) and elastomeric (e.g. Bostik Wallboard Gold) based adhesives.

Elastomeric adhesives should meet the requirements of APA Performance specification AFG 01 "Adhesives for field gluing plywood to wood framing". Other types should have appraisal from BRANZ or equivalent authorites for the specific applications proposed. Follow manufacturers' recommendations as follows:

- Use a bead or dabs of adhesive as per manufacturers' recommendations
- Apply pressure using fastener patterns outlined in section 2.2.
- Work from the middle of the sheet outwards to develop glueline pressure.
- Ensure adhesives are compatible with treatment in the framing timber (see page 5, LOSP, Painting, Gluing.)

Structural adhesive joints

Structural bonds are generally only achievable in factory controlled conditions using approved structural adhesives in accordance approved standards for glue lamination, e.g. Resorcinol formaldehyde joints made to AS/NZS 1328 "Glued laminated structural timber". Site gluing is not recommended for structural plywood components. Contact the Ecoply® help line for further information.

2.4 Durability

The durability of Ecoply® Structural plywood will depend on the application. Detailing, treatment and installation details need careful consideration to satisfy the requirements of the New Zealand Building Code.

Normally, 50 year durability can be achieved with untreated Ecoply® in dry, interior exposure. For internal environments subject to high humidity or condensation H3 treated Ecoply® should be used.

Unpainted H3 treated Ecoply® in exterior applications will weather and oxidise and although panels can be expected to last approximately 15 years, the lack of protection will lead to various shades of grey with surface checking and black surface mould growth.

Ecoply® should not be left unpainted if long term durability is required. Treatment can mitigate risk from fungal and insect organisms, but sun and rain can thermo-mechanically degrade the surface of panels and the surface veneer of plywood is often strength critical.

Light coloured, maintained, flexible acrylic paint systems offer best results for long term durability.

To achieve the 50 year durability requirement of the New Zealand Building Code in accordance with NZS 3602, H3 treated Ecoply® exterior cladding used as a bracing element, must be coated with a regularly maintained flexible paint system such as a three coat acrylic latex paint system with a light reflectance value (LRV) of 40% or more. For bracing in cavities behind another cladding system, e.g. brick veneer, H3 treatment without coating is sufficient.

For single story brick veneer houses with 450mm minimum eaves untreated exterior wall framing and bracing plywood is permitted in NZS 3602.

For further information, refer to the Woodproducts NZ "Durability statement", 01/11/10.

3.0 Common applications

This section provides additional detail and important instructions for using Ecoply® in the following applications:

- Structural bracing
- Linings and claddings
- Flooring substrate
- Substrate for rigid roofing (e.g. shingles)
- Substrate for membrane roofs & decks
- Plywood packaging

3.1 Structural bracing

3.1.1 Description and purpose

The Ecoply® Bracing system provides bracing resistance for walls and subfloor foundations for light timber framed buildings under wind and earthquake loading, to meet the requirements of the New Zealand Building Code Section B1 Structure, and NZS 3604:1999 'Timber Framed Buildings' or specifically designed to NZS 3603:1993 'Timber Structures Standard'.

Ecoply® used for bracing may also be a rigid air barrier and/or interior wall lining. Any Ecoply® structural panel may be used for bracing as long as it is equal to or greater than the minimum thickness shown in Table 8, treated for the specific application in accordance with NZS 3602 (summarised in Table 7) and fixed in accordance with the requirements below.

Shadowclad® exterior cladding, direct-fixed to framing or installed over 20mm cavity battens, may be used for bracing when installed with fasteners spaced as per the wall type codes in Table 8 and in accordance with the Shadowclad® Specification & Installation manual. When used as bracing as well as cladding, Shadowclad® must be:

- coated with an acrylic latex paint system which is maintained through the life of the building and has a light reflectance value of 40% or more
- fixed with stainless steel or silicon bronze annular grooved nails or screws

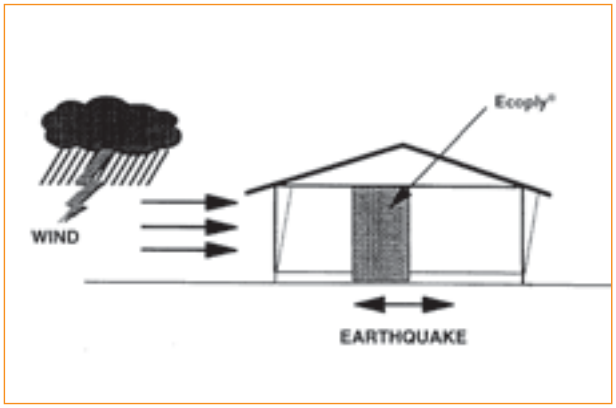
BRANZ Test Report STO593 (dated 20 December 2004) covers the use of Shadowclad® used as bracing when installed on a 20mm drained ventilated cavity. The test report can be downloaded from www.shadowclad.co.nz.

3.1.2 Design to comply with the New Zealand Building Code

Structure

Timber framed buildings to NZS 3604

NZS 3604:1999 'Timber Framed Buildings' is listed as an Acceptable Solution under clause 3.0 Timber in Acceptable Solution B1/AS1 Structure. Bracing unit ratings for an extended range of plywood wall bracing systems have been derived from tests according to clauses 5.5.2 and 8.3.1.2 of NZS 3604:1999 for walls and clauses 5.4.3 and 6.2.3 for subfloor timber framing.



Woodproducts NZ commissioned testing on over 50 different walls to develop a wide range of wall bracing element design options shown in Table 8, tested and analysed using the P21 testing and analysis methods referenced in NZS 3604. These tests included 7mm Ecoply® and Shadowclad® groove (12mm).

BRANZ has subsequently conducted testing to validate the bracing units for Shadowclad® exterior cladding used as bracing when installed onto 20mm cavity battens. Refer to the Shadowclad® Specification & Installation manual for fixing details.

Specific Design

Because Ecoply® is structural plywood manufactured to AS/NZS 2269, it is suitable for design and use in earthquake and wind bracing systems constructed in accordance with NZS 3603:1993 and NZS 4203:1992 or AS/NZS 1170.

Structural plywood to AS/NZS 2269 is the only sheet brace material with properties defined in a published New Zealand engineering design code, NZS 3603:1993 'Timber Structures', and so can be designed in compliance with Verification method B1/VM1 under clause 6.0 Timber, for use in buildings over three storeys in height.

Durability

Ecoply® plywood is manufactured to meet the requirements of NZS 3602 Timber and Wood based products for use in Buildings. If the product is used, handled and installed in accordance with Woodproducts NZ product literature it will meet the durability clauses of the NZ Building Code.

Table 7 summarises the applications in which Ecoply® and Shadowclad® can be used as structural bracing together with the preservative treatment requirement and fastener material for corrosion resistance.

Table 7: Ecoply® and Shadowclad® suitability for bracing applications including treatment type and fastener material

Application	Plywood Type	Fastener Description
Plywood bracing protected from the weather but with a risk of moisture penetration conducive to decay: e.g. plywood bracing and/or rigid underlay (air barrier), fixed to framing with/without building paper/wrap over, with/without cavity battens behind cladding	Ecoply® H3 treated[1], DD surface grade or better	Stainless steel[5] or silicone bronze
Plywood bracing exposed to exterior weather conditions and dampness but not in ground contact: e.g. plywood as both cladding and bracing (direct fixed to framing or over a 20mm drained ventilated cavity system)	Shadowclad®[1,2] Ecoply® H3 treated[1]	Stainless steel[5] or silicone bronze (as per Table 4.3 of NZS 3604:1999[3])
Bracing walls where the timber framing is not required to be treated in accordance with NZS 3602	Ecoply® untreated[4]	Hot dipped galvanised or better
Bracing on framing exposed to ground atmosphere (subfloor)	Ecoply® H3 treated[1]	Stainless steel[5] or silicone bronze
Bracing in wet process buildings	Ecoply® H3 treated[1]	Stainless steel[5] or silicone bronze

[1] Ecoply® H3 is plywood that has been preservative treated to the H3 hazard rating with CCA type preservative. Shadowclad® plywood cladding products are preservative treated to H3 hazard rating with a LOSP azole system. H3 CCA treated plywood in accordance with AS/NZS 1604.3:2004 is comparable to H3.2 and H3 LOSP azole is comparable to H3.1.

[2] Refer to the "Shadowclad® Specification & Installation Manual". Plywood used as both cladding and bracing must have a three coat maintained acrylic exterior paint system with a light reflectance value of 40% or greater for 50 year durability.

[3] Galvanised steel/protected galvanised steel nails are unsuitable for use with Ecoply® H3 CCA treated plywood.

[4] Moisture content in plywood and adjacent timber must be less than 18% in service.

[5] Stainless steel nails must have annular grooves to provide similar withdrawal resistance to hot dipped galvanised nails.

- Detailing near doors and other fittings must avoid the collection of debris which could damage the plywood surface.
- Battens and other items attached to the surface shall have capillary breaks and surfaces that encourage drainage of water and shedding of debris.
- Acceptable Solution E2/AS1 requires plywood claddings to be a minimum of 12mm in thickness and grade CD or better. Woodproducts NZ recommends the use of Shadowclad® rather than Ecoply® for exterior cladding (Refer page 24 and Shadowclad® Specification & Installation Brochure).

Rain wetting and construction bracing

Untreated Ecoply® will withstand rain and exposure during construction for up to 3 months. Rain and exposure can cause thinner plywood panels to buckle. Plywood stability is related to the number of veneers and thickness of the panel. Where panel stability is critical, consider using thicker panels e.g. Ecoply® 9mm 5 ply versus Ecoply® 7mm 3 ply and/or using temporary building wrap/tarpaulins to protect Ecoply® bracing panels from the weather.

Humidity and condensation

In uses where the moisture content may exceed 18% for prolonged periods, Ecoply® must be H3 treated to resist decay or insect hazard.

Subfloor sheet bracing

H3 treated Ecoply® can be used as sheet bracing where dampness does not allow the use of untreated plywood or other sheet materials (clause 5.4.3 of NZS 3604:1999). Where Ecoply® subfloor sheet bracing is exposed to both rain and sun, it must be coated with a three coat maintained acrylic exterior paint system with a light reflectance value of 40% or greater.

Cladding as bracing

H3 treated Ecoply® and Shadowclad® can be used as cladding as well as bracing. To achieve 50 year structural durability, it must be:

- Surface grade CD or better
- A minimum of 5 ply
- A minimum of 12mm thickness
- Coated with a three coat acrylic paint system with a light reflectance value (LRV) of 40% or more
- Fixed with stainless steel or silicone bronze fasteners

Refer to the Shadowclad® Specification & Installation Manual for details. Woodproducts NZ recommend Shadowclad® for exterior cladding. Shadowclad® has a bandsawn face which helps reduce the incidence of face checking (see footnote† on page 5) and is H3 treated with LOSP Azole, a clear preservative which does not leave fillet marks on the face of the panel.

12mm Ecoply® CD H3 CCA will meet the requirements of Acceptable Solution E2/AS1 and perform as a structural, durable and weathertight cladding and bracing element when correctly installed. However, Ecoply® BD H3 LOSP is recommended where a higher appearance grade is desired with a clear finish preservative treatment and no fillet marks. (H3 CCA has a green tinge and the treatment process leaves fillet marks on the face of the sheet).

Fasteners

Use corrosion resistant fasteners appropriate to the expected life cycle exposure for the bracing element.
Refer Table 7. Where H3 CCA Ecoply® is used, it must be fixed with stainless steel or silicone bronze fasteners.

Soil

Ecoply® (untreated or H3 treated) and Shadowclad® must not be allowed to come in contact with soil. The bottom edge of the plywood sheet must be a minimum of 100mm above decks or paved ground and a minimum of 175mm above unprotected ground.

For further information, refer to the Woodproducts NZ Ecoply® Durability Statement (see page 12).

3.1.3 Bracing ratings for Ecoply® & Shadowclad®

Table 8: P21 ratings for 2.4m high Ecoply® and Shadowclad® wall elements

Wall Type Code (Floor type)	Minimum Wall Length (m)	Minimum Ecoply® Thickness (mm)	Nail** Spacing (mm)	Hold Down Type***	Maximum Stud Spacing (mm)	Bracing Unit/m (20 bracing units = 1KN)	
						Wind	Earthquake
Ratings for Ecoply® component on one side only							
SP4	0.45	7	75	1	450	70	85
SP2* (Timber)	0.6	7	150	1	600	90	80
(Concrete)	0.6	7	150	1	600	90	105
SP1* (Timber)	0.9	7	150	1	450/600	110/100	105/100
(Concrete)	0.9	7	150	1	450/600	100/100	115/100
SP6	0.9	12	150	1	450 or 600	115	110
SP8D	0.9	7	150	2	450	125	135
SP5D	1.2	7	75	2	600	130	135
SP10	1.8	7	75	1	450	135	135
SP12* (Timber)	1.8	7	150	1	600	120	105
(Concrete)	1.8	7	150	1	600	115	105
Ratings for Ecoply® one side and GIB® plasterboard on the other side‡							
SP2G‡	0.6	7	150	1	600	95	95
SP1G‡	0.9	7	150	1	450 or 600	110	105
SP11G‡	1.8	7	150	1	450 or 600	140	120
BLP† (Timber)	0.9	7	150	1	450 or 600	130	100
(Concrete)	0.9	7	150	1	450 or 600	135	140
SP6G	0.9	12	150	1	450 or 600	120	110
SP6GD	0.9	12	150	2	450 or 600	145	135

Wall type codes

SP = Structural Plywood

D = Double hold down strap (i.e. 2 x 6kN hold down straps at each end of the wall bracing element). Where wall type code does not include a 'D', a single 6kN hold down strap is required at each end of the wall bracing element.

G = 10mm GIB® Standard plasterboard or any other GIB® plasterboard, nailed as per GIB® Standard plasterboard.

BLP = Winstone Wallboards bracing element - refer Winstone Wallboards Ltd literature.

* These walls on timber and concrete floors reviewed by BRANZ. Where floor type is not specified, use the lower value.

** Use these nail spacings at all sheet edges. Within the sheet, nail spacings may be double that specified.

*** See Installation section on page 19. '1' denotes a single 6kN hold down strap is required at each end of the wall bracing element and '2' denotes two 6kN hold down straps are required at each end of the wall bracing element. Straps are not required for every Ecoply® bracing panel, only at each end of the wall bracing element.

† BLP denotes Ecoply® on one side in accordance with this literature and 10mm GIB Braceline® in accordance with Winstone Wallboards Ltd instructions.

‡ The GIB® may be 10mm GIB® Standard plasterboard or any other GIB® plasterboard except system BLP where 10mm GIB Braceline® is required. GIB® may be fixed horizontally or vertically (refer to 'GIB® Bracing Systems' manual for installation details and limitations, available at www.gib.co.nz or by calling 0800 100 442).

Fasteners

Use any of the following fasteners with untreated Ecoply® 7mm bracing. For H3 CCA treated Ecoply® bracing required for those applications shown in Table 7, the stainless steel or silicone bronze fastener options must be used. For fixing Shadowclad® used as bracing as well as cladding, refer to the 'Shadowclad® Specification & Installation Manual'.

- 30 x 2.5mm galvanised clouts (flat head)
- 40 x 2.5mm galvanised clouts (flat head)
- Paslode Impulse RounDrive (full round head) 50 x 2.87mm, Hot Dip Galv. ring nail (B20557)
- 40 x 2.8mm stainless steel annular grooved nails (flat head)
- 40 x 2.8mm silicone bronze annular grooved nails (flat head)
- Paslode 55 x 2.8mm Lense Head (Full Round Head) 304 stainless steel ring nails, plastic collated (B20572)

For 9mm Ecoply® use minimum length 40mm nails. For 12mm Ecoply® use minimum 50mm length nails.

Adjustments for wall height

Use clause 8.3.1.4 of NZS 3604:1999 to calculate bracing values:

"Adjustment of bracing capacity of walls of different heights and walls with sloping top plates shall be obtained by the following method:

(a) For wall bracing elements of heights other than 2.4m, the bracing rating determined by test or from Table 8.1 should be multiplied by 2.4 ÷ element height in metres, except that elements less than 1.8m high shall be rated as if they are 1.8m high.
(b) Walls of varying heights, should have their bracing capacity adjusted in accordance with 8.3.1.4(a) using the average height."

Joining panels for walls higher than maximum sheet length

Ecoply® bracing panels must be fixed from top plate to bottom plate. For wall heights over 2.4m, Ecoply® is available in 2.7m sheet lengths. Alternatively, a part sheet can be stacked above a full sheet, butt joined on a single row of nogs with each sheet/part sheet independently nailed off as per the nail spacing in Table 8 (e.g. 2.4m x 1.2m sheet with a 0.3m x 1.2m part sheet above it to give a 2.7m x 1.2m bracing element).

Ecoply® Bracing

3.1.4 Installation

Framing

Framing must be in accordance with NZS 3604. Before placing the frame in position, check the hold-down requirements to enable positioning of any straps required. Refer to Figure 2 for detailing of expansion gaps and framing alignment. Nogging for horizontal joints between sheets should be at least 35mm wide to enable nailing of both sheet edges.

Hold-down details

Hold-down straps are available through builders supply merchants in a range of lengths from 200mm to 600mm. A standard 6kN hold down strap is pre-galvanised 25mm x 0.91mm (nominal 1mm). Straps are also available in 0.91mm stainless steel 304-2B which must be used if the strap will be exposed to the weather or will be in direct contact with H3 CCA treated Ecoply® or other corrosive timber. Fix pre-galvanised hold-down straps with 30 x 3.15mm flat head galvanized nails and stainless steel straps with 30 x 3.15mm flat head stainless steel. Refer to Figure 2. Where strap projects into subfloor space, use additional protection in accordance with NZS 3604:1999 clause 4.4.5.

Type 1 (6kN) hold-down

At each end of the wall, use either:

- A single 25mm x 0.91mm sheet brace strap. Refer to: Figure 2 or,
- The dropped panel detail, requiring no straps. Refer to: Figure 2(a) and 2(c)

Type 2 (12kN) hold-down

- Higher wall ratings are possible with double hold-down and/or double nailing.
- For Type 2 hold-down use two 25mm x 0.91mm straps, one on each side of the end stud.
- On concrete floors, a single strap may fold under the plate and up both sides of the stud.

Nailing and fixing of sheets

Refer Figure 2(a). Nail according to the desired bracing rating in Table 8 and the notes with the table.

- Allow a 2 to 3mm wide expansion gap between sheets (Figure 2(b)).
- Nails must be at least 7mm from the edge of the sheet for square edge sheets and 7mm plus the width of the top lap for Shadowclad® shiplap edges.
- Do not nail through the top laps of Shadowclad® shiplap edges (Figure 2(b)). For more detailed instructions refer to the Shadowclad® Specification & Installation Manual.
- Nail all sheet edges (including those with plastic tongue-in-groove joints) and all ends of the sheets used as bracing to the requirements of Table 8. Sheets with plastic T & G joints will require solid blocking behind joints if use for bracing.
- Do not foul hold-down straps and nails used to fix the plywood. This weakens the strap below specification.
- For power driven nails, use the Paslode Impulse Compact Nailer fitted with a No Mar(k) work contact element. Adjust work contact element to the flush position and drive nail flush with the plywood surface. Hammer any nails flush which are left proud. Do NOT overdrive power driven nails.

Openings in bracing elements

Small openings (e.g. power outlets) of 90 x 90mm or less may be placed no closer than 90mm to the edge of the braced element, or waste pipe outlets of max. 150mm diameter placed at no closer than 150mm to the edge of the braced element.

Figure 2(a): Fixing of Ecoply® bracing sheets

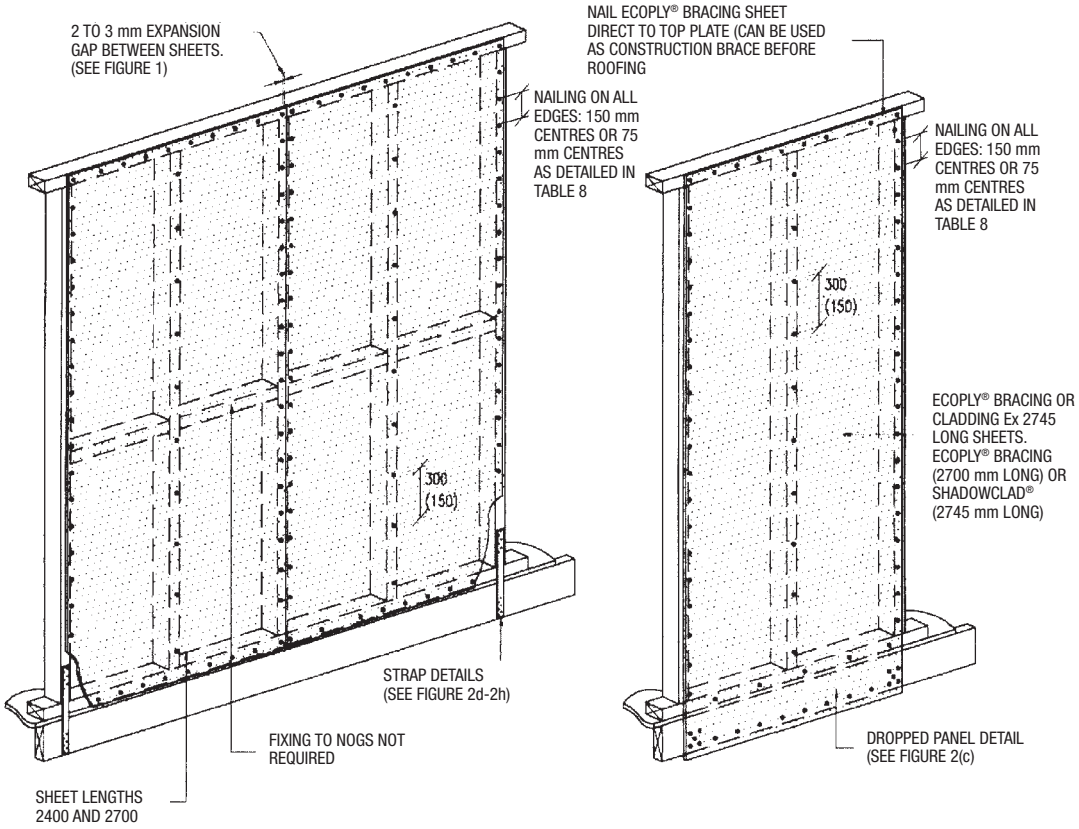
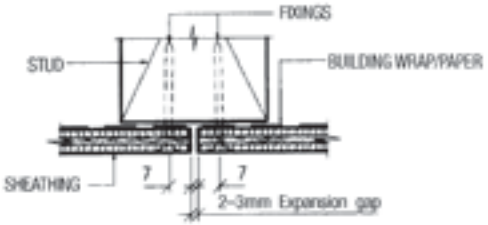
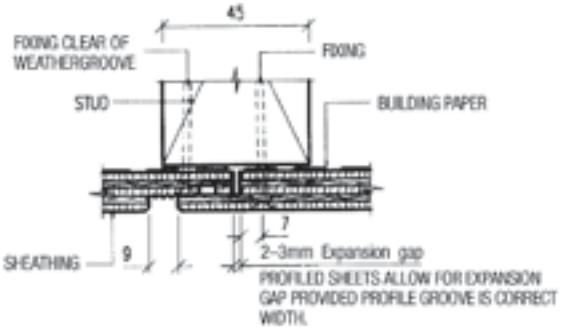


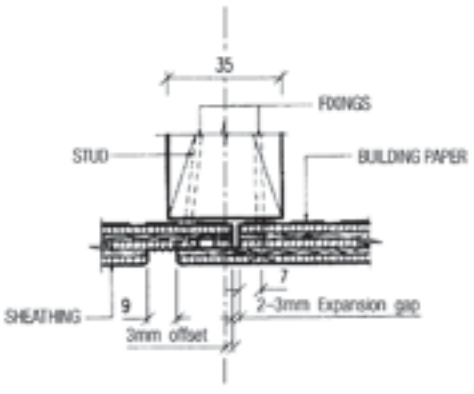
Figure 2(b): Typical detailing for expansion gaps



(i) Ecoply® to stud

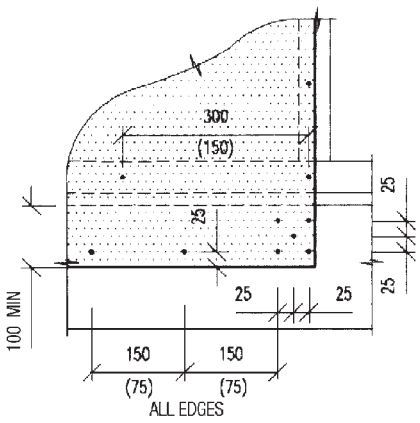


(ii) Shadowclad® to 45 mm stud

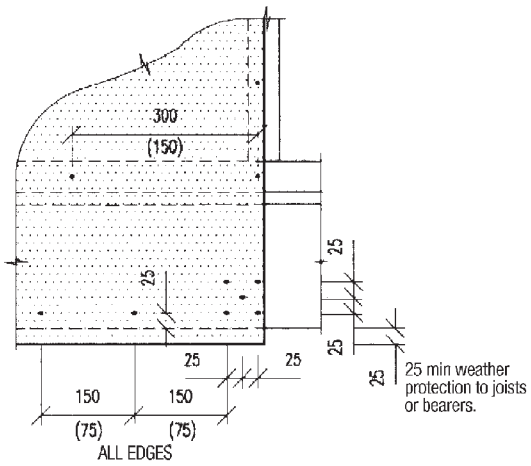


(iii) Shadowclad® to 35 mm stud

Figure 2(c): Type 1 dropped panel fixing for timber frames



(a) Dropped panel for brace under other cladding

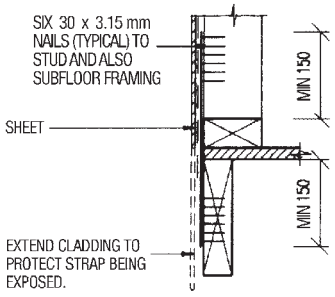


(b) Dropped panel for Shadowclad®/ Ecoply® cladding brace

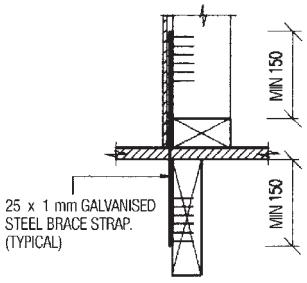
Note

1. Nail centres given for standard nailing, refer Table 8.
2. Extra hold-down nails are same size as for rest of sheet.

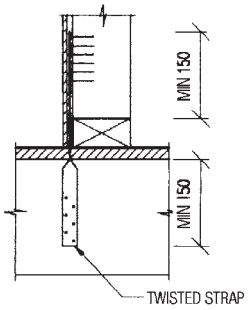
Figure 2(d): Type 1 strap fixings to each end stud of plywood sheet braces for timber ground floor and upper storey



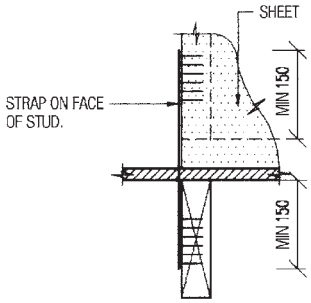
(a) Exterior or edge detail



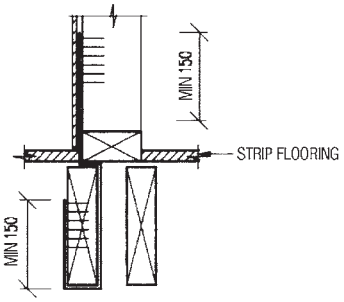
(b) Internal detail over continuous floor – wall parallel to joists



(c) Internal detail over continuous floor – wall across joists



(d) Alternative to detail (c)

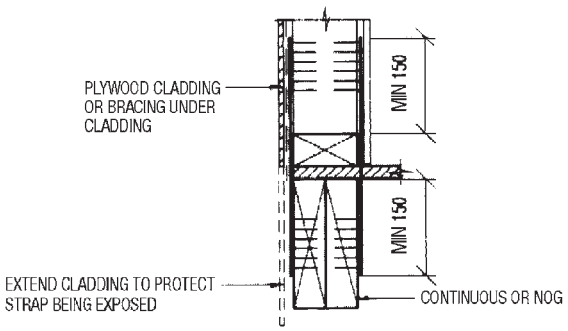


(e) Strip flooring detail

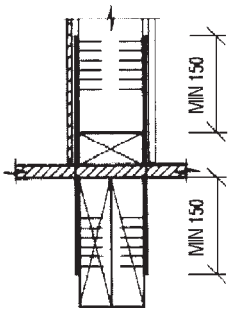
Note:

1. Detail (a) can be replaced by a dropped panel fixing with no straps. See Figure 2(c).

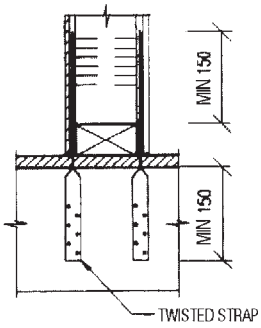
Figure 2(e): Type 2 strap fixings to each stud of plywood sheet braces for timber



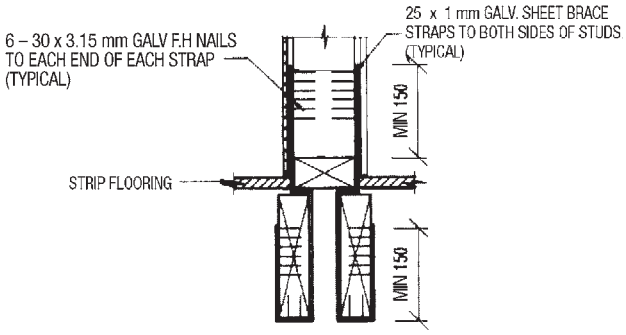
(a) Exterior or edge detail



(b) Internal wall over continuous floor - wall parallel to joists

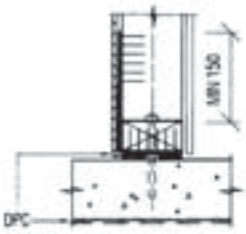


(c) Internal detail over continuous floor - wall across joists

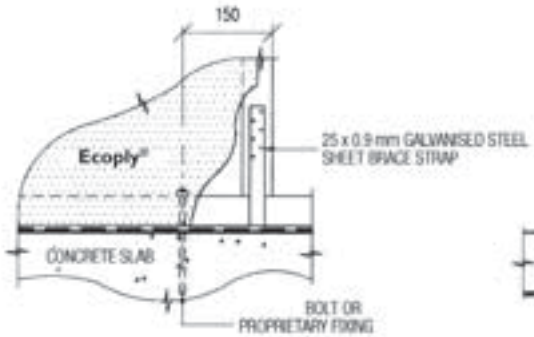


(d) Strip flooring detail

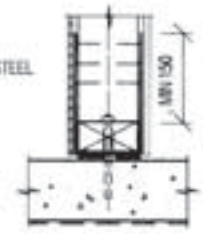
Figure 2(f): Type 1 strap fixings and capacities to each end stud of braced panels on concrete



(a) Type 1 strap one side and under plate 6 – 30 x 3.15mm dia. Galv. F.H. nails each end

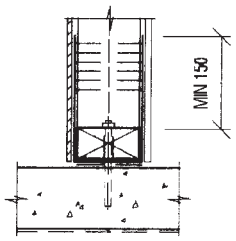


(b) Embed M12 bolt with 50 x 50 x 3mm washer, cranked and embedded 75mm into concrete or proprietary fixing

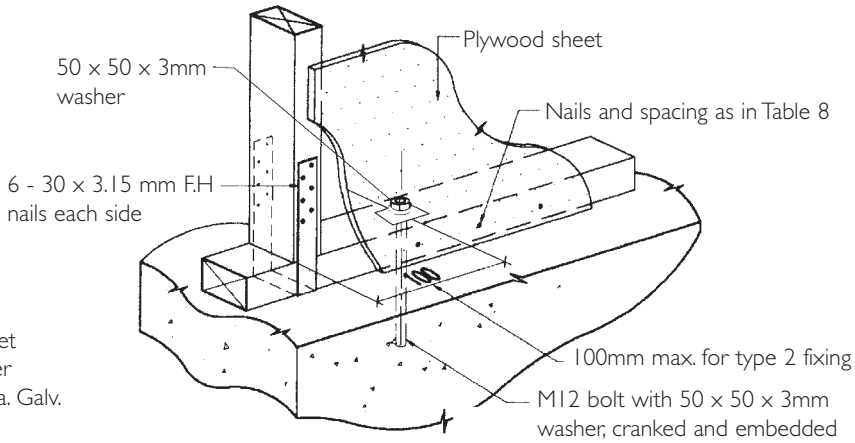


(c) Type 1 strap wrapped under plate 3 – 30 x 3.15mm dia. Galv. F.H. nails each end of strap

Figure 2(g): Type 2 strap fixings to end studs of plywood sheet braces for concrete floors

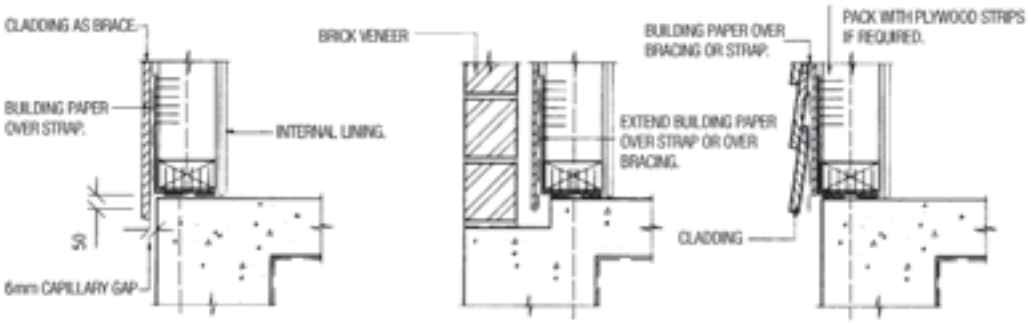


(a) 25 x 1 mm galvanised sheet brace strap wrapped under plate 6 - 30 x 3.15 mm dia. Galv. F.H. nails each side of stud



(b) Concrete base

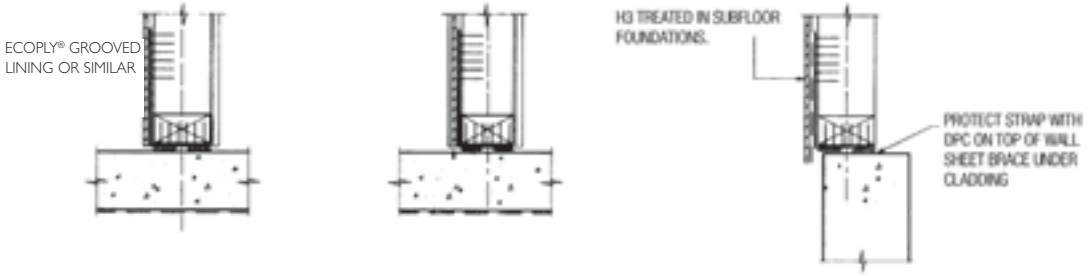
Figure 2(h): Typical detailing for wall and subfloor framing on concrete floor and foundations



(a) Exterior cladding as sheet brace

(b) Sheet brace under brick veneer

(c) Sheet brace under cladding



(d) Plywood internal lining as sheet brace

(e) Plywood sheet under internal lining

(f) Foundation Wall

Note: Modify these details for either Type 1 or Type 2 fixings according to Figure 2(f) or Figure 2(g)

3.2 Linings and claddings

For exterior wall cladding applications, this section should be read in conjunction with the Shadowclad® Specification & Installation Manual and for interior wall and ceiling lining applications, with the Ecoply® Appearance Products Manual.

Acceptable Solution E2/AS1 does not allow plywood claddings less than 12mm thickness, minimum 5 ply. Thinner Ecoply® is permissible on buildings outside the scope of E2/AS1 (e.g. sheds and outbuildings); however, thinner Ecoply® panels require closer frame centres (see Table 9) and are more susceptible to buckling and distortion.

3.2.1 Frame spacings

Table 9 shows recommended maximum spacing for framing in walls supporting Ecoply®.

Table 9: Recommended maximum spacings for wall framing

	For Ecoply® under stucco		For Ecoply® under paint or textured coating finishes on residential or office buildings	
Thickness (mm)	Frame spacing when sheets are fixed:		Frame spacing when sheets are fixed:	
	Along framing (mm)	Across framing	Along framing (mm)	Across framing
7	200	450	240	480
9	240	**480**	400	600
12	**480**	**600**	600	900
15	**600**	900	750	1050
17	750	1000	900	1200
21	900	1200	1200	1200

Note: Sheets are fixed along framing when applied vertically to studs and across framing when applied vertically to girt or horizontally to studs.

3.2.2 Curved shapes with Ecoply®

Shaped top and bottom plates or nogs may be jigsaw cut from thick (17, 19, 21 or 25mm) Ecoply® or wide sections of hySPAN® LVL. The Ecoply® lining can then be fixed over the shaped framework. Attach the outer edges with tack nails or clamps first to develop the curve and then fix sheets from the centre out. Higher face grades should be considered for tight radius curves. Knotty face grades (C or D) may distort at the weaker knotty zones.

Use the nail sizes recommended, but nail at 150 mm centres on all frames. Longer nails, screws, ring shank or annular groove nails will provide improved resistance to tension. Adhesives are not normally good in tension.

For load bearing curves check capacity using structural design.

Table 10: Recommended minimum bending radii for Ecoply®

Thickness (mm)	7	9	12	15	17	19	21
Along face (m)	1.8	2.3	3.6	4.6	5.9	6.7	7.4
Across face (m)	0.6	1.0	2.2	2.9	4.2	4.6	5.2

3.2.3 Stucco

Stucco claddings should be installed in accordance with the requirements of NZS 4251:2007 and NZBC Acceptable Solution 'E2/AS1 – External Moisture' or the relevant manufacturer's Alternative Solution.

Ecoply® Structural plywood is an effective rigid backing sheet. Use Ecoply® H3 CCA treated DD grade or better.

All stucco claddings should be used over a drained cavity with:

- building wrap fixed to the framing and
- building wrap as an overlay to the Ecoply® rigid backing to provide a slip layer that permits the independent movement of plaster and backing.

Table 9 provides more plywood thickness options and spans than NZS 3604 or E2/AS1, including specifications for thinner Ecoply® backings which may be more practical for curved walls and thicker Ecoply® for greater spans between girts.

Paragraph 11.8.2 of NZS 3604:1999 requires rigid backings to be supported on studs at 600mm maximum centres with evenly spaced rows of dwangs at maximum 800mm centres.

Paragraph 9.3.6.1 of E2/AS1 refers to Table 5 of NZS 4251 to determine required plywood sheet thickness. Spans shown in bold in Table 9 for 9mm, 12mm and 15mm Ecoply® thicknesses are in accordance with NZS 4251. All other spans in Table 9 are based on Woodproducts NZ calculations and designers should satisfy themselves these are suitable for the specified coating.

It is critical to provide expansion gaps (3mm) between at all sheet edges for Ecoply® rigid backings under stucco.

All edges of Ecoply® sheets must be supported and fixings must be 10mm from sheet edges.

Ecoply® must be fixed with stainless steel fasteners at 150mm centres around the perimeter and at 300mm centres within the body of the sheet.

All timber battens must be:

- nominal 20mm (between limits of 18mm and 25mm in thickness)
- at least the same width as the stud
- H3.1 treated in accordance with NZS 3640:2003 Chemical Preservation of Round and Sawn Timber.
- fixed over the building wrap to all studs.
- at 300mm centres vertically where studs are at 600mm centres, (i.e. a batten on studs and one in between the two studs fixed to top and bottom plates and nogs)
- on the studs only where studs are at 400mm centres

Cavity spacers (i.e. short sections of cavity batten) set to min 5˚ slope (1:12) must be used to support the top and bottom sheet edge or provide intermediate support where required (e.g. above window openings). A min 50mm air gap must be allowed at either side of the cavity spacer to allow ventilation and water drainage down the cavity to the exterior.

Where cavity battens are fixed by the Ecoply® rigid backing fixings (i.e. cavity battens are temporarily fixed during construction as per Acceptable Solution E2/AS1), through the building wrap into the framing, flat head nails must be used which penetrate framing by a minimum 35mm e.g. for Ecoply® thicknesses up to 15mm onto a 20mm cavity batten, use 70 x 2.8mm flat head stainless steel nails or Paslode Impulse 75 x 3.06 mm RounDrive ring nail B20573 stainless steel. Battens must be temporarily fixed to the framing during construction using 40 x 2.5mm galvanised flat head nails or Paslode Impulse 50 x 2.8mm (D flat head) power-driven galvanised nails at a maximum of 800mm centres or for intermediate battens between studs, to top and bottom plates and at nogs only.

As an Alternative Solution, cavity battens may be structurally fixed using No 1 framing grade and fixed to the framing with 60 x 2.8mm or 75 x 3.15mm, jolt or flat head, hot dipped galvanised nails or Paslode Impulse 65 x 2.87mm (D flat head) power-driven, galvanised nails at a maximum of 300mm centres and staggered 12mm either side of the batten centreline. BRANZ Bulletin 475 (August 2006) provides full details on the structural fixing of battens. Ecoply® rigid backing sheets up to 15mm thickness are then fixed to the structural cavity battens using 50 x 2.8mm flat head stainless steel nails or Paslode Impulse B20572 55 x 2.8mm, lense head (full round head), stainless steel, plastic collated ring nails. For 17mm and 21mm, use 60 x 2.8mm flat head stainless steel nails or Paslode Impulse B20573 75 x 3.06mm RounDrive ring nail stainless steel.

Ensure that the backing deflection is limited to a maximum of 5mm at the time of plastering. All stucco surfaces shall be sealed by applying a minimum of 2 coats of a latex exterior paint system complying with any of Parts 7, 8, 9 or 10 of AS 3730. Finish colours must have a light reflectance value of 40% or more when measured in accordance with ASTM C1549 or ASTM E903.

3.3 Floors roofs and decks

3.3.1 Span tables

Table 11 is a revision of floor and roof spans in previous brochures following a change in the plywood stress grade from F11 to F8, and a move to the new loadings code AS/NZS 1170.

Roof frame spacings were determined in consultation with roofing tile and membrane suppliers and using the limit states design method in accordance with AS/NZS 1170 and NZS 3603:1993 Timber Structures Standard. These comply with verification method B1/VM1 clauses 2.0 Loadings and 6.0 Timber in the NZBC clause B1 Structure.

Design criteria

Roofing Live Loads have increased

NZS 4203 had a live load of 0.25kPa. AS1 170.1 clause 3.6.1 has a load that increases for small areas. For an assumed half sheet of plywood continuously supported over two or more spans this results in a load of 1.4 kPa. This is similar to a live load used by the American Plywood Association (30 pounds per square foot) so the new tables are effectively calibrated to North American practice where asphalt tile roof systems on plywood originated. The spacing is the next lowest natural fraction of a sheet length giving a deflection limit of less than spacing/240. These criteria were used for row 2 and the heavier dead load in row 3.

Roofing Wind Loads

Row 1 of the table is for sheathing protected from the wind.

Row 2 of the table has the widest frame spacing and the plywood capacity has been checked for a serviceability wind pressure of 2.5 kPa and ultimate pressure of 4.5 kPa. This covers terrain category 3 for urban sites in Wellington (and thus the rest of New Zealand) for a combined Cpe and Cpi of -3.2 (determined for the highest suction zone in roof) and building height 10m. Check nail or screw withdrawal capacity and spacing for site specific conditions and support framing materials (timber, LVL, steel). See page 33.

Roofing Snow Loads

Ground snow loads of up to 2.5 kPa (sub-alpine to 500m altitude).

Floor loads

Concentrated loads in AS/NZS 1170 are applied to a smaller area 100mm x 100mm (0.01m^2) to clause 3.2(b) compared with NZS 4203 of 300mm x 300mm. The imposed actions in the table were checked by calculation for span/250 with 0.01m^2. For domestic house floors, structural testing has been carried out with a 21mm diameter tool, and the strength is sufficient for a concentrated load up to 3.6 kN.

For domestic garage floors, the loading has not changed, but blocking is required under all edges to control wheel loads on the tongue. Testing with 113mm diameter load head (0.01m^2) confirms commercial floor capacities.

The plywood must be continuous over at least two spans and laid with face grain across framing.

Figure 3: Ecoply® Flooring layout

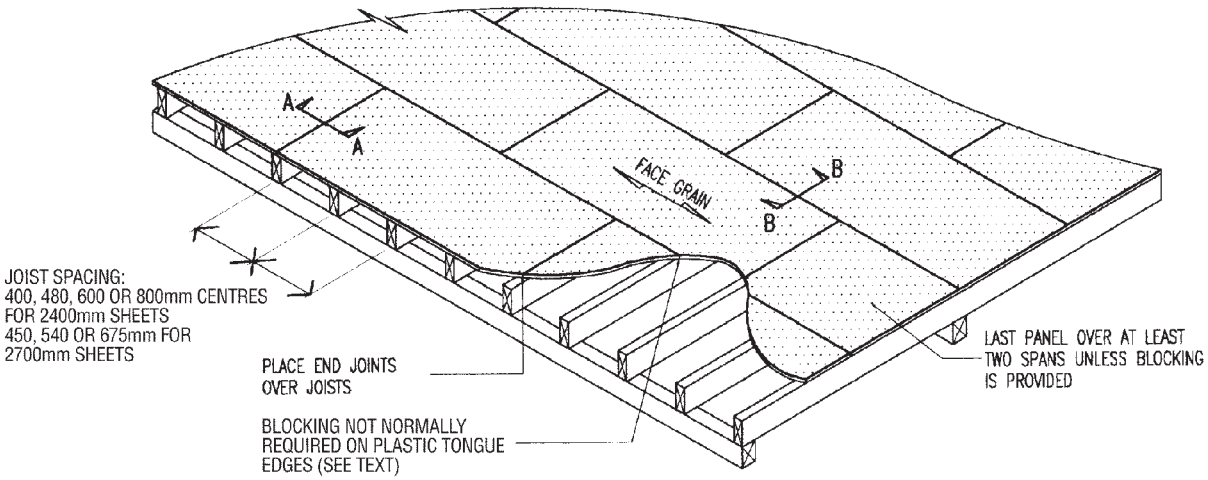


Table 11: Frame spacing for plywood roofs, decks and floors

	Recommended maximum frame centres (mm) for plywood with face grain across framing					
	Plywood thickness (mm)					
Application	12	15	17	19#	21	25
1. Sub-sheathing Under steel or self supporting cladding for support of building paper or lateral diaphragm action. Sag not critical	800	1200				
2. Sheathing non-trafficable sloping roof >30° Suitable for asphaltic tile or similar roughness roofing mass to 15kg/m^2	600	800 F8# 900 F11 roofing	900	900	1200	1350
3. Sheathing non-trafficable low slop roof >10° Suitable for roofing mass to 50kg/m^2	540	675	800	900	1200	1350
4. Subsheathing non-trafficable flat roof >1.5° Suitable for roofing mass to 50kg/m^2	480	540	600	800	800	900
5a. Trafficable roof decking Limited by dynamic response of roof as floor		480	540	600	600	750
5b. Roof decking to clause 8.5.5.1 c) of E2/AS1*			400	400	400	400
6. Domestic flooring 2kPa – 1.8kN		480	540	600 F11 or LS# 540 F8	600	750
7. Institutional and public assembly up to 4kPa – 2.7kN			300	480	540	750
8. Institutional and crowd assembly up to 5kPa – 3.6kN				400	450	600
9. Corridors, industrial up to 5kPa – 4.5kN				300	400	540
10. Domestic garage floor ** 2.5kPa – 9kN				300	400	480

* The current requirement in AS1 of E2 is extremely conservative when compared with calculations determined for other applications using VM1 Clause 6 and calibrating the spans against codes of practice from North America and Australia. CHH Woodproducts recommends designers consider the alternative solution in row 5a of Table 11 for membrane roofing.

** Provide blocking to all edges of the sheet.

Spans apply to F8 plywood except: spans for 19mm apply to F8 and F11 or LS (which has higher stiffness, but F8 strength values) and 15mm roofing T&G is also F11.
Spans otherwise apply equally to square edge or tongue and groove panels.
Check Table 1 for availability of grades and lengths to match span multiples in Table 12.

- Use the next lower recommended frame spacing or thicker Ecoply® where appearance is critical.
- Where 12 and 15mm Ecoply® is used on flat roofs, use blocking at 600mm centres to avoid ponding.
- To suit trusses at 900 centres, 2700 long sheets are available. See Table 12.

Table 12: Frame set outs (mm) to match 2400mm and 2700mm sheet modules

2400mm long	400	480	600	800
2700mm long	450	540	675	900

Limitation for the use of Table 11

Woodproducts NZ does not have access to information about specific designs for specific sites. Table 10 is a guide to estimate the initial selection of a span for design. Each site should be evaluated by qualified persons to ensure all loading parameters and site conditions have been considered, and appropriate changes should be made by the building designer. Many spans have reduced from previous brochures because of more stringent engineering loading requirements in AS/NZS 1170. For some roofing systems, established practices have shown that longer spans are possible. For some exposed sites it may be necessary to use framing at closer spacing. Check fastener requirements as per details on page 33.

3.3.2 Plywood selection

Product choice depends on the requirements of the specific roof, floor or deck covering. See 3.3.3 Roofing types.

Ecoply® Structural (BD, CD, DD grades)

- Sanded surface: B, C, or D grade face.
- D grade cross band under the face veneer contains knot holes and can be used for underlay under rigid coverings like ceramic tiles, parquet, or other use where surface indentation from concentrated loads is shielded by the covering.
- Standard Ecoply® Structural panels can be used for roof coverings under flexible coverings; however where appearance is critical use Ecoply® Flooring (CD grade).
- Edges have no tongue and groove and require blocking support at all edges.

Ecoply® Flooring (CD grade)

- Sanded surface C grade face.
- Solid cross band for additional support of the face veneer to minimise indentation and surface bubbling.
- Best for use under flexible coverings like deck membranes, linoleum, cork tiles, thin tiles as well as rigid coverings.
- Use where the covering needs tight control of bubbles or surface indentation (e.g. deck membranes).
- Plastic tongue and grooved long edges. No blocking needed under edges unless required by engineer for diaphram bracing or by membrane supplier.

Ecoply® Roofing (DD grade)

- Unfilled D grade face contains knot holes, left unsanded for extra strength and grip for installers on steeper roofs.
- 15 mm panel specifically designed for use under shingles and tiles that have a coarser texture.
- Ecoply® Roofing (DD grade) **is not recommended under flexible membrane coverings.** Use Ecoply® Flooring (CD grade).
- Plastic tongue and grooved long edges. No blocking needed under edge joints unless required by engineer for roof diaphram bracing.
- Where the covering will have a coarse texture or is strong enough to span the holes in the D grade face (e.g. asphaltic roof tiles, torch welded polyester reinforced membranes).

Do not use Ecoply® Structural or Ecoply® Roofing (DD grade)

- Where avoidance of surface indentations is critical. Deflection is less visible in steeper roofs and shingles that have a rougher surface or heavier texture. With flat profile shingles (such as three tab) or membrane roofs, deflection is more visible.

Exposed ceilings and soffits

For roof, soffit, or ceiling lining visible from underneath, Ecoply® Grooved Lining or Shadowclad® installed with the face down provide textured or groove options for clear finishing or painting. Grooves can be routed through to get ventilation. Exposed ceilings will usually require framing battens above to provide for insulation and an exterior layer of plywood for the roof itself. Some tile systems require that tile nails penetrate the Ecoply® sheathing rendering the roofing unsuited to a visible finish from the underside.

Curved roofs

Ecoply® plywood may be curved when supported on adequate framing and fastened with longer or ring shank nails to maintain the curve. See section 3.2.2

Rubber membrane on plywood

Durability of roofing systems using plywood substrates

In general, H3 treatment of the plywood with waterborne preservatives is recommended for roofing.

Roofing materials

Various roofing materials used over Ecoply® plywood have different durability expectations, normally in excess of the 15 years required by the Building Code clause B2.3.1b. Durability of the roofing is subject to the specifications, installation and maintenance requirements of the roofing manufacturer. The durability of the Ecoply® can only be assured as long as the overlying roofing and detailing excludes moisture. With good building practice and maintenance, roofing materials can be repaired or replaced at regular intervals to achieve life from the Ecoply® in excess of the original roofing. With this proviso the durability of Ecoply® Structural plywood will be in excess of 50 years if installed in accordance with instructions and limitations in this brochure.

Insect resistance

Low moisture content of untreated Ecoply® must be maintained (by adequate ventilation) for the life of the building. H3 treated Ecoply® provides extra protection where necessary.

High humidity, condensation and solar driven moisture

Where the moisture content of wood may exceed 18% for prolonged periods, Ecoply® must be H3 treated with water-borne CCA (Copper Chrome Arsenic) preservative in compliance with NZS 3602:1995 Timber and Wood-based Products for Use in Building, to resist decay hazard. This includes Ecoply® used under roof coverings that may be subject to condensation, or where rain moisture soaked in the roof covering can be driven into the Ecoply® by the sun. Appropriate building detailing and ventilation is recommended. See the section on ventilation on page 31 in this manual. Good ventilation design can reduce the need for treatment.

Bubbling

Plywood bubbling occurs when moisture trapped in knot holes in inner veneers expands as the temperature rises. This moisture will dissipate through the face veneer and will not affect the structural integrity of the plywood panel. As membrane coverings can prevent moisture dissipation, Ecoply® Flooring (which has a solid cross band veneer) is recommended if the visual appearance of bubbles is not acceptable. Where rubber membranes are being applied, care must be taken to ensure the adhesive is sufficiently dry to prevent trapped glue solvents from causing blistering.

Soil

Ecoply® plywood (untreated or H3 treated) must not be allowed to come in contact with soil. Surfaces, flashings and gutters should be detailed to avoid trapping detritus and moisture.

Rain wetting and construction time

Untreated Ecoply® will withstand a reasonable amount of rain wetting and exposure during construction for up to three months. In extreme weather conditions of high temperature and/or high rainfall this period may be less. Some discolouration and minor checking of the face veneers can be expected if Ecoply® is exposed for extended periods. For roofs uncovered for longer periods use H3 treated Ecoply® to lower the risk of decay. Return Ecoply to below 18% moisture content before installing moisture sensitive materials, coverings, coatings or adhesives. For best results, protect the Ecoply®.

Exterior decking

Ecoply® Structural plywood is not normally recommended for decks where it is permanently exposed to the weather. Exposed Ecoply® for decking must be preservative treated to at least H3 hazard class. However a properly detailed Building Code compliant barrier material eg. butyl rubber, vinyl or E.P.D.M should be used to protect Ecoply® from rain and sunlight (weathering) exposure.

Gutter details

Where Ecoply® Structural plywood sub-sheathing supports roofing at gutters, a metal drip edge must be provided with appropriate gaps to shed water. Gutters should have a front edge overflow or ends lower than the back to shed water overflow away from framing and sub-sheathing Ecoply® (see details on page 31). H3 treatment is recommended for Ecoply® sheets that protrude into gutters, with regular maintenance to avoid leaf mould (soil) development. Do not expose untreated Ecoply® to gutter splash or moisture. For more information consult the CHH Woodproducts Durability Statement, 01/11/10.

Fire

Plywood is combustible but may be used as a roof substrate for all purpose groups subject to the provisions of Department of Building and Housing Acceptable Solution C/AS1: clause 7.1 and 7.9. For purpose groups SC and SD a 19 mm Ecoply® panel complies with the requirement of 7.11.1.

Many different roofing products are now available for use and installation over a plywood substrate. The choice of plywood grade depends on the type of roofing, and on the level of finish required. Ecoply® Roofing provides a safe substrate for roofing crews and can eliminate tile battens or purlins from the framing cost.

3.3.3 Roofing types

Membrane systems

Roofing membranes may comprise synthetic rubber sheeting glued to the Ecoply®, or torch welded bitumen membranes.

Follow the membrane supplier's specifications for membrane fixing, surface preparation, dryness and cleanliness.

Smooth, rubber membranes highlight any trapped dust or blemishes in the subsheathing. For best results, protect the surface from weathering before applying membrane.

- **Use Ecoply® Flooring (CD grade) under rubber or similar surfaces** that may show blemishes. This provides a smooth sanded C face to bond the membrane, and a solid cross band under the face to reduce the possibility of surface bubbling over holes in the interior veneers.
- Ecoply® Structural (CD grade) can be used on roof areas where the possibility of some surface bubbling is acceptable.
- Keep Ecoply® dry and clean.
- Minimum 17mm Ecoply® thickness is recommended by most rubber membrane suppliers.
- Lightly arris all edges before fixing.
- Use countersunk stainless steel screws fixed with adhesive on framing to avoid head popping. Apply adhesive between screw locations.
- Use kiln dry or dry engineered hyJOIST® framing to reduce head popping.
- Tape over all joints to provide a bond break under the membrane to allow elongation with moisture induced movement in the Ecoply®.
- If treatment is required use water-borne treatments only (no solvent based treatments). LOSP solvent treated plywood is not compatible with many adhesive systems. Ecoply® waterborne CCA treated panels are kiln dried after treatment so should be at the right moisture content for gluing. If there is evidence of treatment salt crystals on the surface, scrub with a minimum quantity of water and allow the surface to dry before spreading membrane adhesive.
- Prepare the surface with hot air or gas blow driers to ensure wash, dew or rain water is driven off.
- Clear away even the smallest of dust particles as these show up clearly under the membrane.
- Apply adhesive and allow to dry to prevent trapped glue solvents from causing blistering.

Some polyester reinforced modified bitumen membranes will tolerate DD grade surface characteristics and unsanded Ecoply® Roofing (DD grade), may be used.

Allowing for moisture expansion of plywood under roof and floor coverings

Membrane suppliers have strongly held different views on the requirements for plywood substrates. The fixing instructions on page 11, 32, and 33 are the starting point but designers must detail joints that allow for expansion in accordance with practices recommended by the chosen membrane supplier.

The Woodproducts NZ view, and the recommendation of a number of suppliers here and in North America, has been to allow for expansion and contraction at sheet edges by loosely butting tongue and grooved edges so that the tongues can absorb movement and providing a small gap (2 to 3 mm) between square sawn edges. Use a bond breaking tape over these joints to spread elongation in the membrane over a longer distance than the narrow gap in the joint itself. This tape can double as a rain seal over the sheet edges during construction.

Other membrane suppliers believe that sheets should be tightly butted and glued and screwed hard up to each other. This practice constrains movement at the small joint between sheets, but over a wider area requires significant allowance for movement around the perimeter of a roof segment. Junctions between the roof slopes and walls need careful detailing to allow for the potential movement, and movement control joints should be provided at regular intervals to the recommendation of the membrane manufacturer, especially if this method is adopted.

Roof tile systems

Most fibreglass, asphalt or wooden shingle or tile systems will tolerate DD grade surface characteristics.

- Use unsanded Ecoply® Roofing (DD grade), or sanded Ecoply® of the required thickness in Table 11.
- The unsanded surface provides extra grip on steeper roofs for roofing crews.
- A plywood substrate can avoid the cost of battens.
- Fix tiles according to tile manufacturers specification.
- Under asphalt shingles use saturated felt underlay over the Ecoply®.

Check and confirm all of the recommendations above with the manufacturer of the chosen roofing type.

Ventilation and preservative treatment

Poorly ventilated spaces can develop very high temperature and moisture levels. The most likely source of moisture is the condensation of vapour from warm interior air on the underside of cold roofing. Good ventilation can remove the need for treatment by removing excess moisture vapour in warmer climates but in regions where winter nights are consistently colder, H3 treated Ecoply® is recommended. However, the use of H3 treated Ecoply® is not an excuse for poor ventilation design. Moisture induced decay is only one issue. If incorrectly detailed, roof spaces can be very tight and the dark colour of many roofing materials means that excessive heat can build up causing distortion in plywood or even framing members. Use the suggested details or alternatives to suit. Designers must consider roofing type, seasonal conditions, wind effects and the intended use of the building.

As a minimum, Woodproducts NZ recommends a vent area of 1/300th of the ceiling plan area (approx 3350mm^2 per square metre of ceiling) equally distributed at the eaves and ridge to allow free flow under the Ecoply®, up the roof slope, and out.

Roofing material suppliers should detail vent systems suited to their specific membrane or tile roofing. Proprietary ridge capping profiles or vents are available from roofing suppliers.

Detail gaps of 25mm in the plywood at ridges, and at walls where a roof slopes up to an upper storey. For flat roofs, natural ventilation flows may be impeded. Use proprietary roof vents. Consider forced ventilation as appropriate.

Figure 4: Ridge detail with ridgeboard
(use also with Hip Rafter if extra ventilation required)

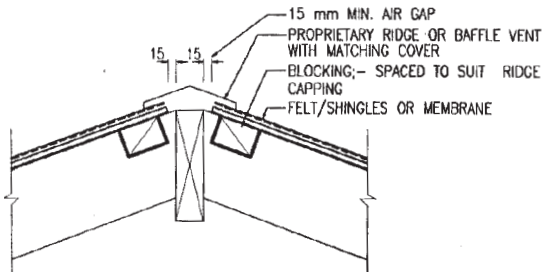


Figure 5: Roof to wall junction vent

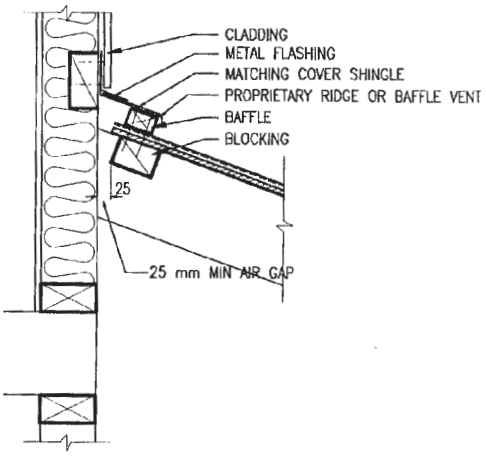
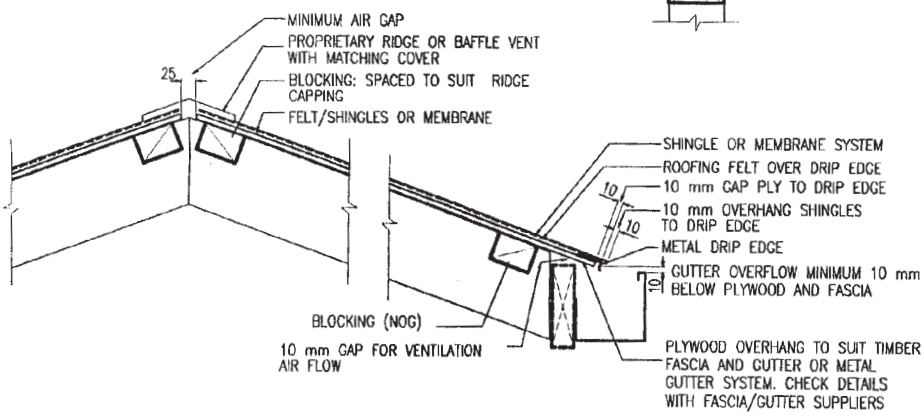


Figure 6: Truss ridge detail



3.3.4 Installation

Framing

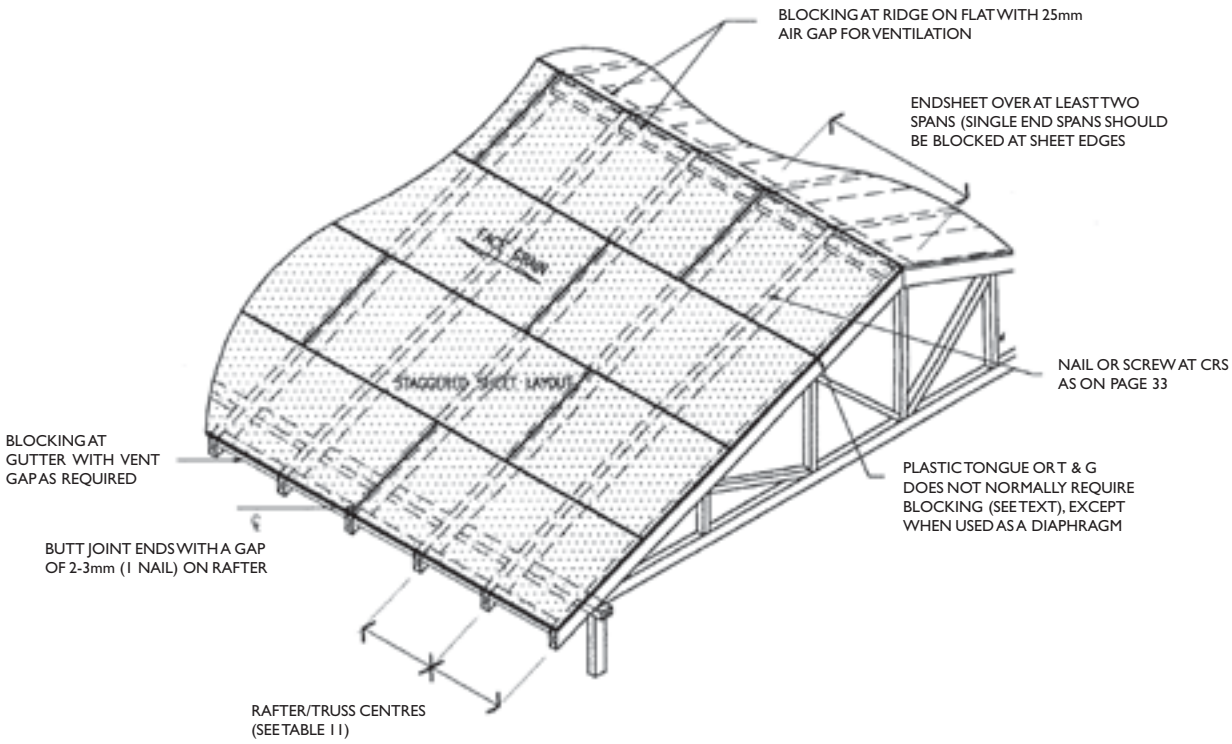
Frames should be at spacings to suit plywood thicknesses in Table 11. Additional requirements for roof and floor framing are:

- Ensure top edges of framing are properly aligned.
- Use dry Laserframe®, hyJOIST® or hySPAN® framing to lower moisture level in roof spaces, second floor spaces, and reduce differential truss, rafter or joist deflections.

Blocking (nogs, dwangs):

- Block all edges of standard square edge Ecoply® Structural plywood.
- Block all edges at the ridge and gutter lines to prevent sag at capping or gutters.
- Block for high face loads or under areas accessed for maintenance.
- Blocking within the body of the roof or floor is not required for tongue and grooved edges, unless required for framing stability or the plywood is being used as a diaphragm to resist horizontal wind or earthquake loads. In this case fixings transfer shear across the joints and details should be specified on drawings.
- Use blocking on the flat to provide gaps where air flow is needed for ventilation.
- A specific membrane roofing supplier may require blocking.

Figure 7: Sheet and framing layout



Sheet layout

- Ensure Ecoply® sheets are dry before installation.
- Place face grain at right angles to supports.
- Sheets must be continuous over at least two spans (three framing members).
- Lay the sheets in a staggered pattern.
- Follow the recommendations in "Allowing for moisture expansion of plywood under roof coverings".
- Allow sufficient clearance inside confining structure such as concrete or brick walls adjacent to the roof. Use extra allowances with large areas.
- Allow clearance for ventilation as required.

Fixing of sheets

Ecoply® may be fixed to different types of framing with nails or screws or a combination of fasteners and construction adhesives. See section 2.2, 2.3 and Figure 1.

Fasteners should be corrosion resistant to a level appropriate to the end use, life expectancy (15 or 50 years) and expected exposure to moisture during construction and service. Galvanised fasteners are the minimum recommendation and are normally satisfactory in dry wood. Where Ecoply® or framing may become damp or is H3 treated, use stainless steel screws or annular grooved nails for maximum durability. Follow the recommendations of the fastener manufacturer and membrane or floor covering supplier.

The integrity of a plywood based floor or roof system is directly related to how well the panels are fixed to the framing. Ecoply® must be fixed to resist wind suction loads, and to maintain surface qualities of the overlying roofing or covering. The minimum fastener specifications are in Table 6 and section 2.2.

- For roofing, check the additional requirements according to wind exposure.
- For high wind zones (over 44 m/s), very exposed sites, cyclonic conditions or roofs above 10 metres height, carry out specific structural design to the relevant standards.
- Screw fixing must be used for membrane roofing, and is preferred for all systems because of increased holding power and avoidance of head popping.

Fixing to timber

- Ring shank nails or annular grooved nails or screws are recommended for additional holding power.
- For flooring, punch nails and apply floor sealant before filling holes with a suitable putty.
- For roofing, use flathead nails. Do not use jolt or bullet head nails.
- Stainless steel nails must be annular grooved.
- Ensure fastener is compatible with the roofing cover (consult roofing suppliers).
- Staples may be used provided that the withdrawal load is equivalent to the hand driven galvanised flathead nail. A suggested minimum is a 50mm long staple with 12mm crown and legs 1.8mm diameter. Space staples 20% closer than nails. Refer manufacturer for corrosion resistance and durability.

Fixing to steel:

- Fix directly to roll formed steel (up to 2mm thick) with self-drilling, self-tapping screws. If plywood gets damp and expands, screws in thicker steel may break. Keep Ecoply® dry or use larger screws or;
- Bolt or screw battens to the steel and apply Ecoply® as above for timber. Ensure that battens have adequate thickness for the minimum nail or screw length.

Fastener Spacing for Wind Suction

Wind pressure applies withdrawal loads to nails holding plywood to purlins and trusses. For the frame spacing in Table 11 designers may use the following guidelines for frame spacing up to 900mm throughout New Zealand for normal urban wind conditions.

The main body of the roof

2.8mm nails spaced at 150mm centres on all cross framing.

Roof edges

All plywood at higher suction zones at the roof edges at gutters, eaves and gable ends must be supported on framing, and fixed at 100mm centres with 3.05mm diameter nails. Suction zones are interpreted from AS 1170 as being within 20% building length or width of a gable end, or gutter or ridge.

Designers and builders should review site conditions to ensure adequate fixing is applied. Buildings in exposed sites and lee zones should be specifically designed using the loading standard (AS/NZS 1170) and the timber structures standard NZS 3603. In some wind conditions, the tiles themselves may be sucked from the plywood. Use a consulting engineer to assess site conditions, calculate wind pressures for the specific site, and determine the fastening and span requirements, and to check that the truss system can resist the loads being applied through the plywood.

Fixing of roofing

Fixing methods for tile, shingle and membrane systems must be designed for the expected wind and weather exposure to protect the Ecoply® substrate. Some shingle systems may not be used in very high or cyclonic wind zones.
Follow the specifications of the roofing manufacturer and refer to the appropriate BRANZ Appraisals.

3.3.5 Finishing Floors

- Paints and coatings should be applied following the manufacturer's instructions.
- Avoid heavy sanding that may remove the critically important structural face veneer.
- For floor coverings and roofing, adhesives must be compatible with CCA (Copper Chrome Arsenic) treatment salts in H3 treated sheets. Compatibility can often be improved by lightly washing, scrubbing and drying the plywood surface prior to fixing.
- Use the detailing requirements for rubber or similar membrane roofing if the floor is to be covered with linoleum or similar membrane.
- Where clear or stained finishes are desired, designers should select sheets and protect the floor during construction, or install after the floor is protected from the weather and construction activities.
- Ecoply® Flooring is a CD grade product with filled knot holes in the face veneer. If a superior face is required for clear finishing, Ecoply® Structural (BD grade) plywood panels are recommended.
- Ecoply® is made from relatively soft radiata pine. Ecoply® Flooring is a good substrate for harder wearing flooring overlays, and is not really suited to clear finishing, especially if it gets exposed to construction moisture first.
- Ceramic tiles can be laid directly onto 17mm Ecoply® Flooring over joists at 450mm centres (without the use of tile underlay board) for domestic (housing) applications. Refer to Technical Note 'Laying Ceramic Tiles over Ecoply® Flooring.'

3.6 Plywood packaging

Ecoply® is regularly used to manufacture boxes, bins, pallets and crates including packaging for export. Ecoply® is relatively lightweight whilst providing excellent racking resistance and outstanding strength and durability. Ecoply® is easily cut and can be drilled and slotted to manufacture ventilated bins.

International Standards for Phytosanitary Measures ISPM No. 15 'Guidelines for Regulating Wood Packaging Material in International Trade' does not regulate wood packaging made wholly of plywood, which is considered sufficiently processed to have eliminated the risk associated with the raw wood.

However, different countries do impose certain restrictions on plywood; for example, the Australian Quarantine Inspection Service (AQIS) requires certification that plywood packaging is newly manufactured and shipped within 90 days of manufacture. Exporters are able to provide their own certification based on the plywood date of manufacture which is printed on the back of Ecoply® sheets.

For the individual requirements of countries to which Ecoply® is being exported go to www.biosecurity.govt.nz and click on 'Commercial Exports' followed by 'Forestry Exports'.

Packaging

4.0 Frequently asked questions

Q: How much should be allowed for expansion?
A: Allow 2 – 3mm between square edges of Ecoply® sheets. If using T & G flooring or decking, a 5mm expansion gap is recommended at the perimeter of the floor or deck. Check by calculation for large areas.

Q: Can power driven nails be used to fix Ecoply®?
A: Paslode power driven nails have been tested for fixing Ecoply® and Shadowclad® products for particular bracing and cladding applications. Refer to section 3 Structural bracing and/or the Shadowclad® Specification & Installation Manual for nail specifications. Use the Paslode Impulse Compact Nailer fitted with a No Mar(k) work contact element to eliminate any contact marks on the plywood. Adjust the work contact element to the flush position and fire the nail at 90˚ to the work surface. Hammer any nails flush which are left proud.

Q: How close to sheet edges can I nail?
A: Fixings can be placed a minimum 7mm from the sheet edge. Under Stucco, use 10mm.

Q: Do I have to use stainless steel nails when using Ecoply® for bracing?
A: Stainless steel nails must be used with H3 CCA treated Ecoply® or Shadowclad® used for structural bracing. Where untreated Ecoply® is used for structural bracing in interior dry situations hot dipped galvanised nails may be used.

Q: What is the weight of Ecoply®?
A: Refer to Table 4a for weight (kg/m^2) of different Ecoply® thicknesses.

Q: What is the R-value of Ecoply®?
A: The thermal resistance or insulating effectiveness of plywood panels can be calculated using NZS 4214:2006. e.g. plywood has a conductivity (k) of 0.13 W/mK so a 12mm panel has a thermal resistance R = 0.012/0.13 = 0.09.

Q: What radius can I bend Ecoply® to?
A: Refer to Table 10 on page 24. Ecoply® bends easier and to tighter radii when bending across the face grain direction.

Q: Are there any compatibility issues when using Ecoply® with other materials?
A: Adhesives for flexible rubber membranes may react with LOSP treatment and should therefore only be applied to H3 CCA treated Ecoply® unless the membrane supplier advises differently. Check with the membrane manufacturer if in doubt. CCA treatment is also corrosive and this must be taken into account when specifying CCA treated plywood next to metals. For example, stainless steel flashings should be used in conjunction with H3 CCA treated plywood; other types of metal must be isolated to prevent corrosion.

For further guidance, refer to Tables 21 and 22 in Acceptable Solution E2/AS1.

Q: Can Ecoply® be used as a rigid sheathing (air barrier)?
A: H3 treated Ecoply® can be used as a rigid sheathing (air barrier). Refer to section 3.1 Structural bracing and Table 23 of Acceptable Solution E2/AS1 for details.

Q: What is the relevance of AS/NZS 2269?
A: Ecoply® structural plywood is manufactured to AS/NZS 2269 Plywood Structural. This Standard is referenced by the New Zealand Building Code Compliance Documents including NZS 3602 Timber and Wood-based Products for Use in Building, NZS 3603 Timber Structures, NZS 3604 Timber Framed Buildings, AS/NZS 1604.3 Specification for Preservative Treatment, Part 3:Plywood and Acceptable Solution E2/AS1 External Moisture. Plywood not manufactured to AS/NZS 2269 does NOT meet the requirements of these NZBC Compliance Documents.

Q: What is the relevance of the PAA stamp?
A: Ecoply® is manufactured under a third party audited, product quality control programme by the Engineered Wood Products Association of Australasia (EWPAA) to monitor compliance with AS/NZS 2269. Given that compliance with Standards is not actively policed by Standards New Zealand, this third party auditing provides important peace of mind for users and consumers of Ecoply® products.

Q: What is marine ply?
A: Marine plywood manufactured to AS/NZS 2272 Plywood Marine may contain species of low durability (source: BRANZ Good Practice Guide – Timber Cladding). Whilst marine plywood has a Type A glue bond, it is generally specified for its high surface appearance grade and lack of core knots as opposed to structural performance. AS/NZS 2272 limits marine plywood to a number of approved species that pass stringent property requirements for things like moisture permeability. These requirements are different from those in standards from other countries. Marine plywood is rarely treated as it is usually coated with resin or fibreglass or a paint finish for long term durability.

Q: What should a specification for structural plywood include?

A: A specification for structural plywood should include:

Specification check list	Example
Quantity/size	20 sheets of 2400x1200
Thickness	12mm
Edge finish	Square edge
Brand name	Ecoply® structural plywood
Reference to Standard	To AS/NZS 2269
Stress grade*/layup	F8 (12-24-5)
Surface grade/bond type	CD A-Bond**
Accreditation	EWPAA product certified***

* Stress grades may vary between different manufacturers and products.

** Type A-bonds are suitable for permanent exposed applications and structural applications.

*** The EWPAA JAS-ANZ Product Certification Mark certifies that Ecoply® structural plywood products have been manufactured under a third party audited joint product certification programme to monitor compliance with AS/NZS 2269.

Q: What are F-grades?

A: The stress grading system is a ranking system which utilises the symbol F and a suffix 8, 11, 14 etc as a code to apply a full suite of strength and stiffness properties to plywood products of that stress grade. For plywood of a given thickness, the higher the F-grade, the further it will span. For load bearing applications (e.g. flooring, roofing) the required F-grade as well as the plywood thickness must be specified to achieve the required span. F8 is the most common structural plywood grade found in New Zealand. All Ecoply® structural products are F8 with the exception of 15mm Ecoply® roofing which is F11 as standard and Ecoply® Flooring which is available as F11 on request. Note, the standard Ecoply® Flooring range is F8 for all thicknesses except 19mm (Longspan), which has higher stiffness for superior spanning capability. The F-grade is printed on the back of all Ecoply® products in accordance with AS/NZS 2269.

Q: What are surface/appearance grades (eg CD)?

A: Appearance grades (eg BB, BD, CD, DD) denote the appearance grade of the plywood including the number and size of knot holes as defined in AS/NZS 2269:2004 and summarised in Table 2 of this manual. The first letter describes the appearance of the face veneer and the second letter describes the back face.

Q: How long can Ecoply® be left exposed to the weather?

A: Untreated Ecoply® will maintain its structural integrity when exposed to the weather during construction for up to 3 months. The surface colour will start to silver off and surface checking cracks will become evident; where the finished appearance of the Ecoply® is important, it should be protected during construction. Ecoply® is also available H3 treated to resist decay or insect hazard. When used in accordance with this manual, it can be specified to meet the durability requirements of the New Zealand Building Code.

Q: What treatment levels and types are used for Ecoply®?

A: Ecoply® is available untreated or preservative treated. Ecoply® is treated to the H3 hazard class for above ground use. The standard Ecoply® treatment type is CCA (Copper Chrome Arsenate) although LOSP Azole (Liquid Organic Solvent Preservative) may also be specified where a clear treatment is required. LOSP Azole is the standard treatment type for BB, BD, Ecoply® Grooved Lining and Shadowclad®. CCA treatment gives the plywood sheets a green tinge and the drying process after CCA treatment may leave fillet marks on the face of the sheet.

Q: Does Ecoply® have to be treated when used as structural bracing?

A: Ecoply® used as bracing must be treated unless it is installed in an interior dry situation. Note, behind exterior cladding and in cavities (even if the Ecoply® is covered with building wrap) are not considered to be an interior dry situation.

Q: Do I have to re-treat cut edges of treated Ecoply®?

A: It is important to re-treat any cuts and holes with a brush on remedial treatment such as Metalex Clear.

Q: What type of glue is used to manufacture Ecoply®?

A: Phenol formaldehyde (PF) resins are used to bond the plywood veneers. This forms a Type A (Marine) bond suitable for structural applications and exterior use. Phenol formaldehyde resins are dark red/brown in colour. Product details printed on the back of Ecoply® sheets indicate the 'A Bond'.

Q: Does Ecoply® emit formaldehyde?

A: Formaldehyde occurs naturally in the environment and is emitted by processes such as combustion, decay and naturally by all timber species. It is present in the air we breathe at natural background levels of about 0.03 parts per million (ppm) and often up to 0.08ppm in outdoor urban air. The Japanese currently have the most stringent regulations which restrict emissions to 0.03ppm, equivalent to background levels.

On-going testing and a recent survey of newly manufactured plywood and LVL products from EWPAA certified producers showed the average emission in laboratory conditions to be only 0.006ppm. This emission level is 5 times less than the naturally occurring background level of 0.03ppm.

Q: How should Ecoply® be installed to maximise its stiffness properties?

A: Structural plywood has greatest stiffness along the long grain of the sheet (i.e. along its length). Therefore, flooring/roofing should be laid across joists/rafters rather than parallel to them.

5.0 References and sources of information

- New Zealand Building Code
- CHH Woodproducts technical notes
- NZS 3640:2003 "Chemical Preservation of Round and Sawn Timber"
- NZS 3602:2003 "Timber and Wood-based products for use in Buildings"
- NZS 3603:1993 "Timber Structures Standard"
- NZS 3604:1999 "Timber Framed Buildings"
- NZS 3606:1987 "Specification for the Manufacture of Glue Laminated Lumber"
- NZS 4203:1992 "General Structural Design and Design Loadings for Buildings"
- NZS 4251.1: 2007 "Cement Plasters for walls, ceilings and soffits"
- AS/NZS 1170:2002 "Structural design actions"
- AS/NZS 2269:2004 "Plywood – Structural"
- AS/NZS 1604.3:2002 "Specification for Preservative Treatment, Part 3: Plywood"
- AS/NZS 4200.1:1994 "Pliable building membranes and underlays – Materials"
- AS/NZS 2272:2006 "Plywood Marine"
- AS 1684:1999 "Residential Timber Framed Construction"
- AS 1720:1997 "Timber Structures Code"
- US Product Standard PS1-95
- Acceptable Solution 'E2/AS1 – External Moisture'
- Acceptable Solution 'B2/AS1 – Durability'
- BRANZ P21, A wall bracing test and evaluation procedure. R C Cooney and M J Collins, 1979: Revised 1988.
- BRANZ TR10, Supplement to P21. An evaluation method of P21 test results for use with NZS3604:1999.
- BRANZ Report STO449 - Nail slip and P21 rating of plywood bracing panels.
- BRANZ Report STO593 – Bracing Rating of timber framed walls sheathed with a 12mm thick plywood over a cavity.
- BRANZ Bulletin 345: Flat membrane roofs – design and installation
- BRANZ Bulletin 346: Flat membrane roofs – materials
- BRANZ Bulletin 289: Asphalt shingle roofing
- BRANZ Appraisals 307, 404, 411
- Forest Research Institute (Ltd), Wood Products Division Reports: P21 wall brace tests with Shadowclad® plywood. HB94/2/1, FRI 1994. Performance of standard plywood clad wall panels in racking to P21 test WTC 1786/1, WTC 1786/2, WTC 1786/3, FRI 1991.
- Ecoply® Appearance Product Manual
- Shadowclad® Specification & Installation Manual
- Material Safety Data Sheets
- APA (www.buildabetterhome.org)
- EWPAA (www.ewp.asn.au)

Standards can be purchased online at www.standards.co.nz

Building Code Compliance Documents can be downloaded free of charge at www.dbh.govt.nz

NOTES

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