Photograph Internal- d 133

Damage to unit D lounge ceiling due to roof leak

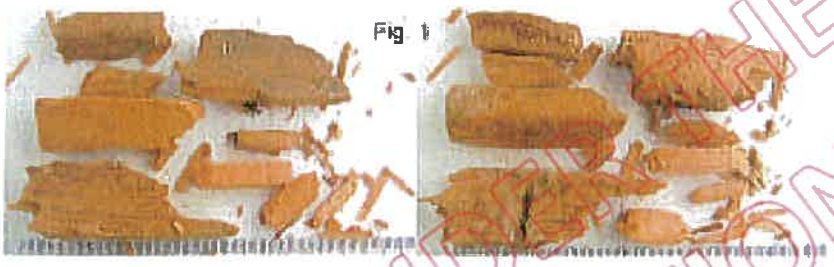
Photograph Internal- e 134

Elevated moisture reading in Unit E garage ceiling

APPENDIX H

Laboratory Reports **27 Pages**

Client: Building Industry Assessors (2007) Ltd.
WHRS no. 05533
Location: Unit B, 7 Tyburnia Avenue, Mt Roskill
Sample 1
LABEL: Cut out North wall at balcony wall junction
Substrate: Wood (Fig. 1 – top and bottom views of sample)



Condition: Moisture status: dry; Degradation: fungal and cubic rotting; Discoloration: light to moderate throughout

Microscopic observations: On the surface layers of the wood, there was present dark hyphae on a fungus that could not be identified (Fig. 2)

Within the degrading wood fibres, there was a sparse population of very fine hyaline septate of a possible white-rotting basidiomycete (Fig.) – smear – stained blue)

Conclusions

Although the substrate was dry on examination, moisture previously associated with the substrate has allowed the active growth on the surface of the dark fungal mycelium and throughout the wood of the white-rotting basidiomycete fungus. This latter colonisation has led, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the partial loss of structural integrity of the wood.

PLANT Pathe Services Ltd, Lincoln 15 October 2007

Client: Building Industry Assessors (2007) Ltd.
WHRS no. **05533**
Location: **Unit B, 7 Tyburnia Avenue, Mt Roskill**
Sample 12
LABEL: Cut out North wall at western corner above inter-storey
Substrate A: Wood (A in Fig. 1 – top and bottom views of sample)

Fig. 1

Condition: Moisture status: wet; Degradation: soft with fibres still in place. Discolouration: moderate and variable.

Microscopic observations: On the surface there was growth of the fungus *Hormonema* sp. (Fig. 2) and possible conidiophores of a *Leptographium* sp. (Fig. 3).

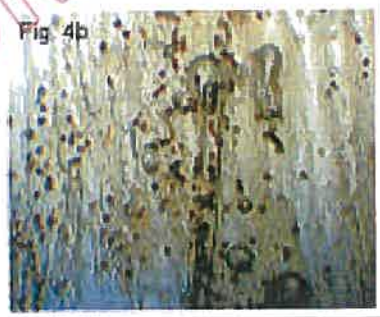
Fig. 2

Fig. 3

Substrate B: Particle board (B in Fig. 1 – top and bottom views of sample)
Condition: Moisture status: wet; Degradation: soft throughout and disintegrating. Discolouration: moderate.
Microscopic observations: Throughout the degrading tissues there was a very high population of the fungus *Monodictys pelagica* (Fig. 4a and 4b).

Fig. 4a

Fig. 4b



Conclusions: Moisture associated with both of the substrate has allowed the growth of the above fungi. Basidiomycete *Serpula* seems to have the capability of softening wood tissue through the action of exo-cellular enzymes. This growth was causing surface rotting in some parts of the wood sample and complete degradation in the particleboard sample. In this latter case, there has been a complete loss of structural integrity.

PLANTtobe Services Ltd, Lincoln 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: **Unit C, 7 Tyburnia Avenue, Mr Roskill**
Sample 1

LABEL: Cut out North East corner garage (internal below lintel)
Substrate: Wood (Fig. 1 – top and bottom views of sample)
Condition: Moisture status: damp; Degradation: extensive fibrous rotting throughout; Discoloration: dark throughout.

Fig. 1

Microscopic observations:
The fruiting bodies in the sample were of the common basidiomycete wood colonising fungus – *Schyzophyllum commune* (Fig. 2).

Fig. 2

On the surface of the wood, there was growth of several fungi. They were:

1. *Spadicoides atra* (Fig. 3)
2. *Alysidium* sp. (Fig. 4)
3. *Phialophora* sp. (Fig. 5)
4. *Rhinocladiella* sp. (Fig. 6)
5. A common but undescribed species in the genus *Chaetophoma* (Fig. 7).

Within the wood there was extensive and heavy colonisation by several types of fungal mycelium:

1. Dark hyphae of a possible brown – rotting basidiomycete (Fig. 8)
2. Dark hyphae of the *Chaetophoma* sp. (Fig. 9)
3. Hyphae and spores of the fungus *Scytalidium lignicola* (Fig. 10)
4. Hyaline (colourless) hyphae of a possible white-rotting basidiomycete (Fig. 11).

Fig. 3

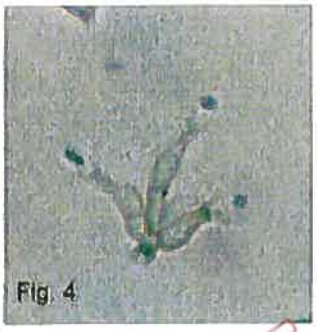


Fig. 4

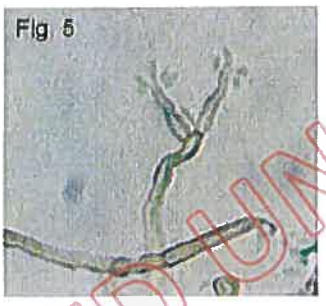


Fig. 5

Fig. 6

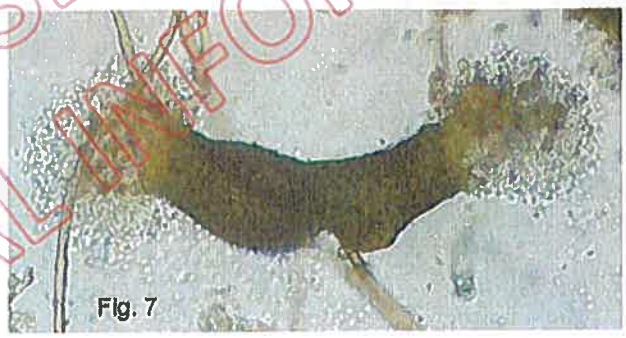
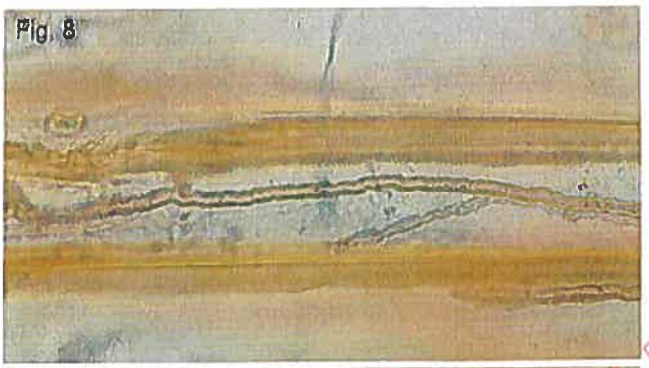


Fig. 7



Conclusions: Moulds associated with the oil the substrate has allowed the active growth high on the surface of the various fungi and throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

The presence of spores of *A. niger* did not appear to be of sufficient numbers to pose a problem. Substrate in the vicinity, however, may require examination to determine presence of this fungus.

Likewise, moulds associated with the black building paper has also allowed colonisation by a basidiomycete fungus that appears to be causing only incipient degradation at the time of examination.

PLANTwise Services Ltd, Lincoln 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. 05533
Location: **Unit C, 7 Tyburnia Avenue, Mr Roskill**
Sample 2
LABEL: Cut out base of wing wall adjacent to balcony wall

Substrate A: Wood (Fig. 1 – top and bottom views of sample)

Fig. 1

Condition: Moisture status: damp; Degradation: soft and rotted throughout; Discoloration: very dark on the surface and throughout the wood tissue.

Fig. 2

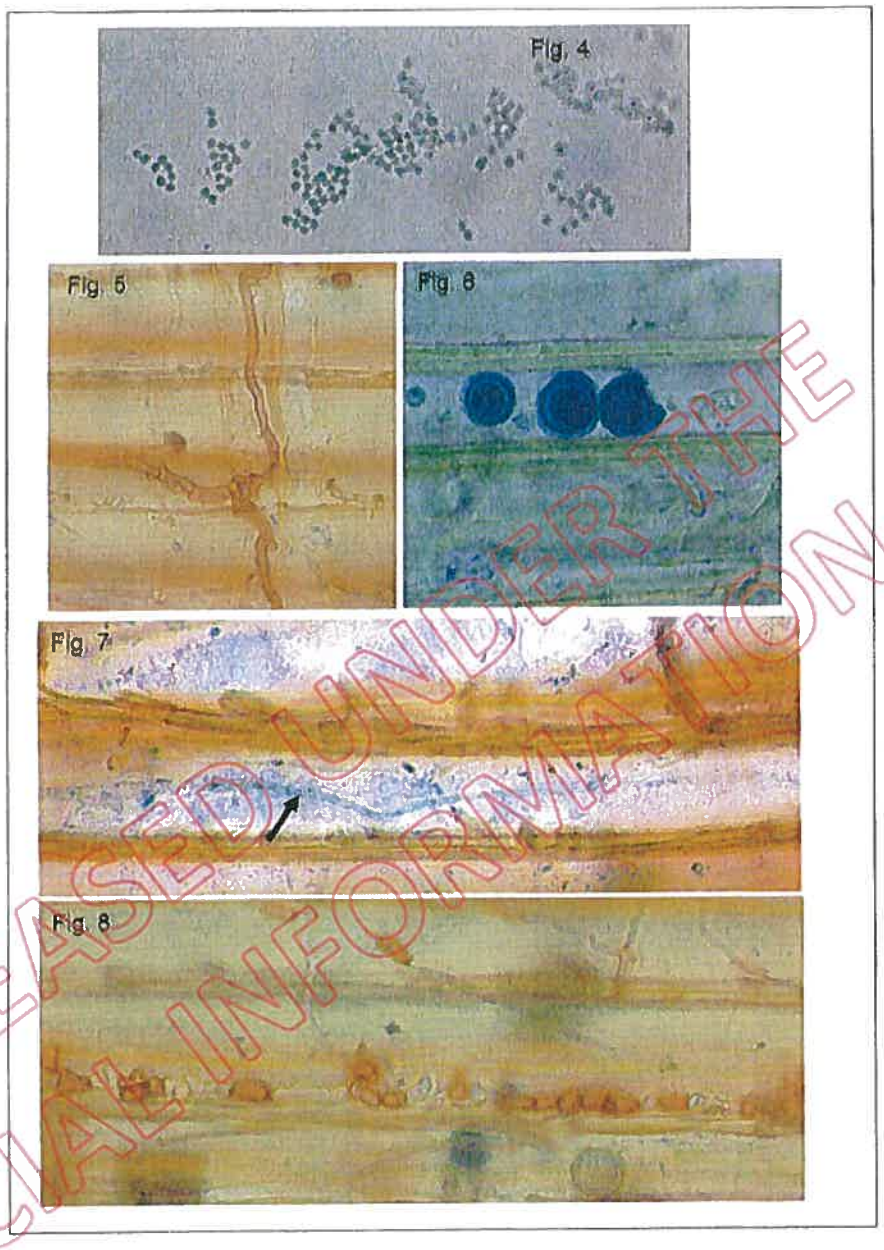
Microscopic observations: On the surface of the wood there was growth of several fungi, including:

1. Scattered spores of the common house – *Stachybotrys atra* (Fig. 2)
2. Conidiophores of a possible species of *Leptographium* (Fig. 3)
3. Masses of single celled spores (no identification possible – Fig. 4).

Fig. 3

Within the degrading wood there were several different types of fungal growth:

1. Dark hyphae of a possible brown-rotting basidiomycete (Fig. 5)
2. Unidentifiable hyaline thick-walled bodies (Fig. 6 – stained blue)
   Hyaline hyphae of a possible white-rotting basidiomycete (Fig. 7 - arrow)
4. Growth and sporulation of the fungus *Scytalidium lignicola* (Fig. 8)



Substrate B: Black building paper (Fig. 9 – top and bottom views of the numerous samples)

Fig. 9

Condition: Moisture status: damp; Degradation: possible incipient disintegration: Discoloration: Brown and white deposits, the latter appear to be gypsum wash-out from Gib board and basidiomycete fungal growth (yellow arrow in Fig. 9).

Microscopic observations: There was only growth on the paper was that of a un-identifiable basidiomycete (stained blue in Fig. 10).

Fig. 10

Conclusions: Moisture associated with the all the substrata has allowed the active growth both on the surface of the various fungi and throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This colonisation has lead, through the production of extra cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

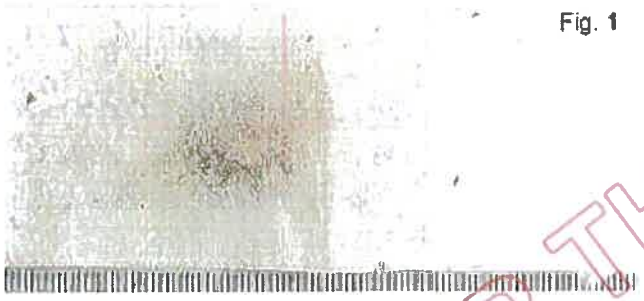
The presence of spores of *S. atra* did not appear to be in sufficient numbers to pose a problem. Substrata in the vicinity, however, may require examination to determine presence of this fungus.

Likewise, moisture associated with the black building paper has also allowed colonisation by a basidiomycete fungus that appears to be causing only incipient degradation at the time of examination.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: **Unit C, 7 Tyburnia Avenue, Mr Roskill**
Sample 3
LABEL: Back of Harditex at cut-out, top of wing wall
Substrate: Adhesive tape-lift (Fig. 1)

Fig. 1



Microscopic observations: The dark deposits on the adhesive tape were colonies of the common dark, asexual fungus – *Ulocladium chartarum* (Fig. 2). Note the fungal elements were somewhat degraded.

Fig. 2

Conclusions: Species of *Ulocladium* are commonly found colonising moist substrata. They cause only very slow substrate degradation but are the cause of type I reactions in hypersensitive individuals (hay fever and asthma). Topical application of a suitable fungicidal product will inactivate all growth.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Conclusions:
Moisture associated with the substrate has allowed the active growth on the surface of the various fungi. It also allowed growth throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This hyfer colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Client: Building Industry Assessors (2007) Ltd.
WHRS no. **05533**
Location: **Unit C, 7 Tyburnia Avenue, Mr Roskill**
Sample 4
LABEL: Cut out south wall at balcony wall junction

Substrate: Wood (Fig. 1 – top and bottom views of sample)

Condition: Moisture status: damp;
Degradation: softened throughout;
Discoloration: moderate and variable.

Microscopic observations: On the surface of the wood, there was colonisation by two fungi:
Cladosporium tenuissimum (Fig. 2 a & b)
Rhinocladiella sp. (Fig. 3)

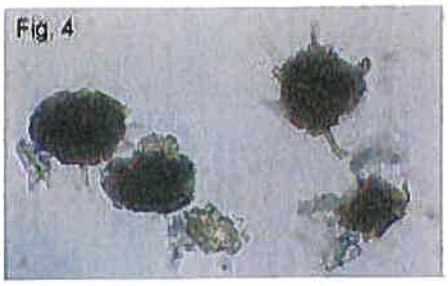

Fig. 1


Fig. 2a


Fig. 3


Fig. 2b

There was also evidence of insect activity, with the presence of frass (droppings) on the substrate surface (Fig. 4).



Within the degrading wood fibres, there was a sparse population of very fine hyaline hyphae of a possible white-rotting basidiomycete (Fig. 5 – arrow – stained blue).

Conclusions:
Moisture associated with the substrate has allowed the active growth on the surface by dark, sooty mould fungi and throughout the wood of the white-rotting basidiomycete fungus. This latter colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the partial loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln. 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. 05533
Location: **Unit D, 7 Tyburnia Avenue, Mr Roskill**
Sample 1
LABEL: Cut out north wall at north east corner: below top inter-storey joint

Substrate: Wood (Fig. 1 – top and bottom views of sample)

Condition: Moisture status: damp; Degradation: partially firm but with areas of fibrous rotting; Discoloration: moderate on the surface and variable in wood tissue.

Microscopic observations: On the surface of the wood there was growth of the following fungi:

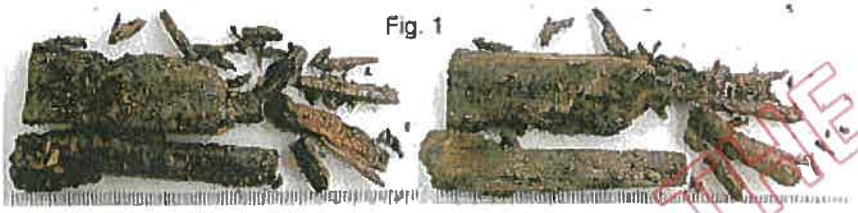
1. *Rhinocladiella* sp. (Fig. 2)
2. *Taeniolella exilis* (Fig. 3)
3. *Oidiodendron* sp. (Fig. 4)

Conclusions:
Moisture associated with the substrate has allowed the active growth both on the surface of the various fungi and throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This latter colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: Unit **D, 7 Tyburnia Avenue, Mt Roskill**
Sample 2
LABEL: Cut out north east corner at balcony wall junction
Substrate: Wood (Fig. 1 – top and bottom views of sample)

Fig. 1



Condition: Moisture status: damp; Degradation: softened throughout; Discoloration: very dark throughout.

Microscopic observations: On the surface of the wood there was a light population of the fungus *Hormiactis* sp. (Fig. 2 and 3).

Fig. 2

Fig. 3

Within the degrading wood tissue there was a high population of both hyaline (colourless – Fig. 4) and dark (Fig. 5) hyphae of possible white rotting and brown rotting basidiomycetes respectively.

Fig. 4

Conclusions:
Moisture associated with the substrate has allowed the active growth on the surface of the *Hormiactis* sp; a fungus reported to colonise soil and litter.

The moisture also allowed growth throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: **Unit D, 7 Tyburnia Avenue, Mr Roskill**
Sample 10

LABEL: Cut out at inter-storey N/west corner
Substrate: Wood (Fig. 1 – top and bottom views of sample)

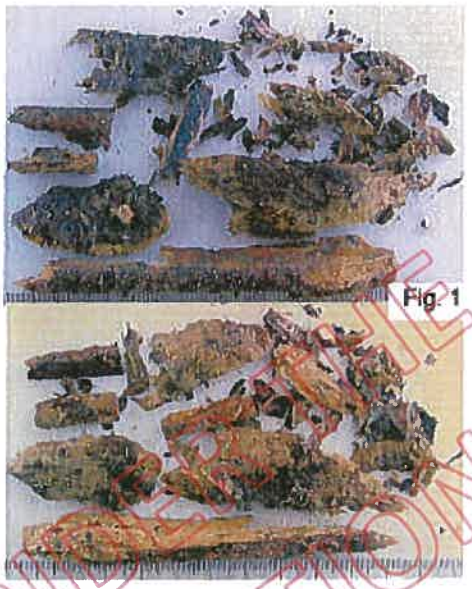


Fig. 1

Condition: Moisture status: very damp; Degradation: soft and rotten throughout; Discoloration: very dark on surface but variable below.

Microscopic observations: On the surface facets of the wood there were no identifiable fungal elements.

Within the wood, however, there were fungal mycelia (arrow in Fig. 2) and colonies of bacteria (oval in Fig. 2).

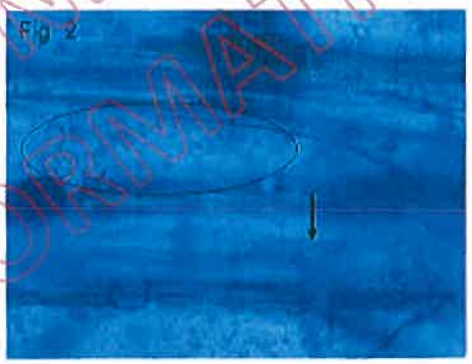


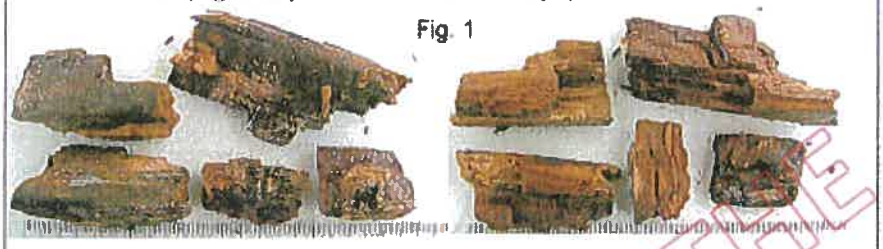
Fig. 2

Conclusions:
The moisture associated with the substrate has allowed the growth within the wood of fungi and bacteria. These have caused, though the release of enzymes, to the complete loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln: 23 October 2007

Client: Building Industry Assessors (2007) Ltd.
WHRS no. **05533**
Location: **Unit E, 7 Tyburnia Avenue, Mr Roskill**
Sample 1
LABEL: Cut out south wall at balcony wall junction
Substrate: Wood (Fig. 1 – top and bottom views of sample)

Fig. 1



Condition: Moisture status: damp; Degradation: softened throughout; Discoloration: very dark throughout

Microscopic observations: On the surface of the wood there was active growth of the basidiomycete fungus *Peniophora* (= *Gloeocystidiellum* sp.) (Fig. 2 and 3). Note the capitulate and crystalline metulae. Note the clamp connections (arrows). No other fungi were detected on the wood surface.

Fig. 2

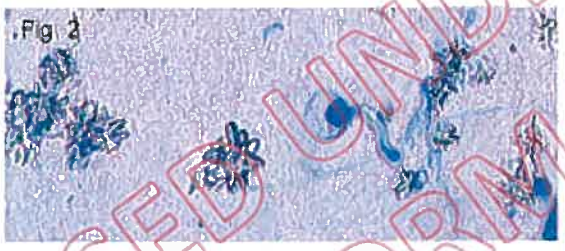


Fig. 3

Within the wood there was extensive growth of dark hyphae of a possible brown-rotting basidiomycete (Fig. 4).

Fig. 4

Conclusions: Moisture associated with the substrate has allowed the active growth on the surface of the *Peniophora* sp; a basidiomycete fungus that commonly colonisers and rots wet wood.

The moisture also allowed growth throughout the wood of the brown-rotting basidiomycete fungus. This colonisation and the growth on the surface of the *Peniophora* sp. has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the complete loss of structural integrity of the wood.

PLANTwise Services Ltd, Lincoln: 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: **Unit E, 7 Tyburnia Avenue, Mr Roskill**
Sample 2
LABEL: Cut out cast balcony wall south end
Substrate: Wood (Fig. 1 – top and bottom views of sample)

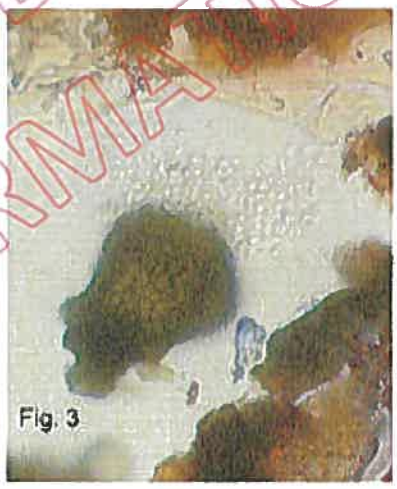
Fig. 1

Condition: Moisture status: dry; Degradation: firm-ish fibrous rotting throughout; Discoloration: moderately to heavy on surface but moderate within the wood tissue.

Microscopic observations: On the surface there was extensive growth of a common but undescribed sp. of *Chaetophoma* (Fig. 2 and 3). There was also evidence of insect grazing of the fungi on the substrate through the presence of frass (arrow in Fig. 2)

Fig. 2

Fig. 3



Within the degrading wood tissue there was a high population of both hyaline (colourless – Fig. 4) and dark (Fig. 5) hyphae of possible white rotting and brown rotting basidiomycetes respectively.


Fig. 4

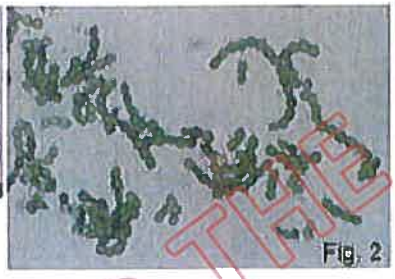

Fig. 5

Conclusions:
Although the substrate was dry on examination, moisture previously associated with the substrate has allowed the active growth on the surface of the *Chaetophoma* spp a fungus common but undescribed coloniser and degrader of wood.

The moisture also allowed growth throughout the wood of the brown-rotting and white-rotting basidiomycete fungi. This colonisation has lead, through the production of extra-cellular enzymes that degrade cellulose, hemicellulose and lignin, to the loss of structural integrity of the wood.

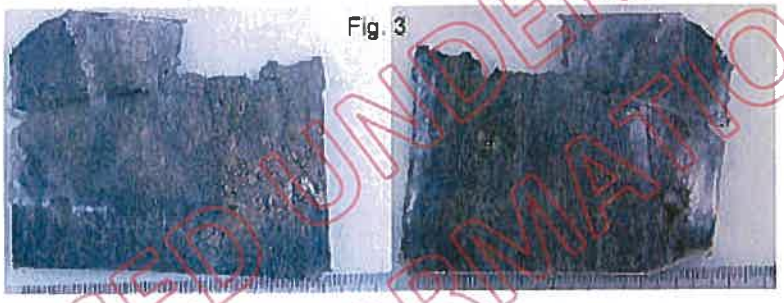
PLANTwise Services Ltd, Lincoln 15 October 2007

Client: Building Industry Assessors (2007) Ltd,
WHRS no. **05533**
Location: **Unit E, 7 Tyburnia Avenue, Mr Roskill**
Sample 11
LABEL: Cut out at party wall junction west wall
Substrate A: Adhesive tape-lift (Fig. 1)



Microscopic observations: Chains of dark grey-brown spores – probably a species of *Aspergillus* (Fig. 2).

Substrate B: building paper (Fig. 3 – top and bottom views of sample)



Condition: Moisture status: dry; Degradation: probably incipient; Discoloration: grey-brown deposits.

Microscopic observations: Fungal elements (single celled spores as in substrate A – arrow in Fig. 4); insect integument (**X**) and frass ( ).

Conclusions: The presence of spores that may be those of an *Aspergillus* spp. may cause a health problem in that they can induce asthma, hay fever and other allogenic reactions in hypersensitive individuals such as pneumonitis and sinusitis. The above fungus was also observed on the building paper and would appear to have attracted insect grazers.

PLANTwise Services Ltd. Lincoln: 15 October 2007

APPENDIX I

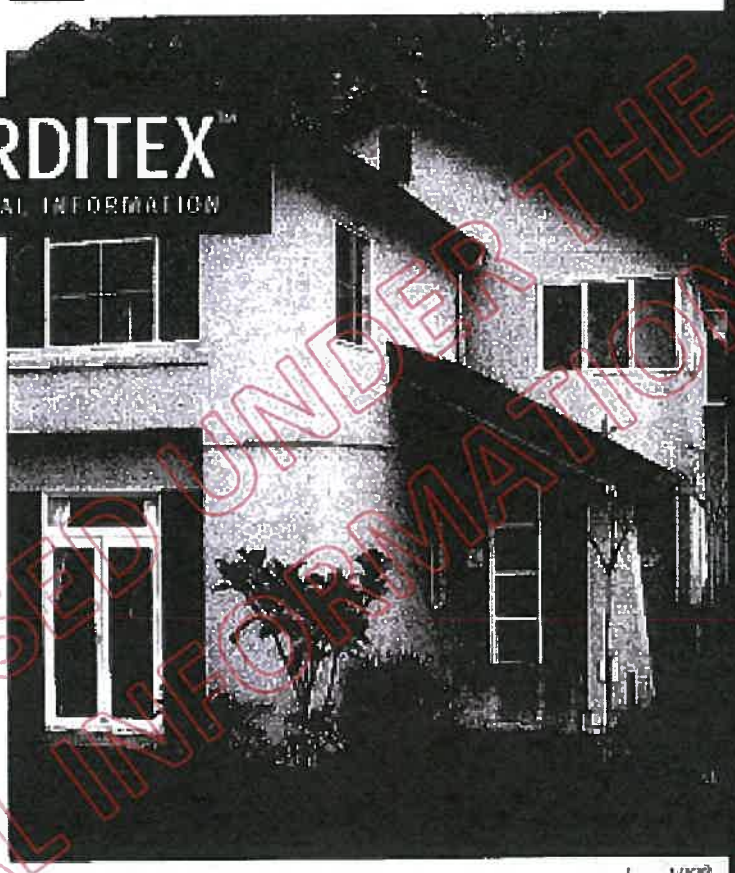
Manufacturer's Specifications **37 Pages**

I 1.1 Harditex

James Hardie
Building Products

HARDITEX™

TECHNICAL INFORMATION



June 1998

Harditex™ is the ideal lightweight cladding for a monolithic finish, yet it provides you with the comfort and peace of mind that comes with the stability and strength of James Hardie fibre cement.

The only limiting factor is your imagination.

JAMES HARDIE TECHNICAL INFORMATION

Contents

Cover: A Modern Builders Award winning Neighbourhood House by Fletcher Homes Ltd in Clement's Orchard Albany. The cladding selected is Harditex™ Premium, by James Hardie.

Introduction

Current design trends favour the texture-plastered look with monolithic walls frequently highlighted with a variety of architectural design features.

Harditex™ is the ideal cladding for a monolithic finish, because it provides you with the comfort and peace of mind that comes with the stability and strength of James Hardie fibre cement. In other words, the best of both worlds.

When using Harditex™ the only limiting factor is your imagination. It can be used to create anything from subtle beauty to strong bold statements that make the most of colour, texture and style. So the latest design trends are yours for the asking.

Design flexibility with Harditex™ is further enhanced with the use of polystyrene shapes which provide a wide range of options for architectural detail. Please phone the James Hardie Building Systems Helpline on 0800 PANEL 411 (726 3541) for more information on polystyrene shapes. Polystyrene shapes are applied by the coating contractor of your choice.

The Harditex™ has been readily identified by its pink colour in the past which has been developed to provide a durable substrate for a range of textured coatings. The coating of your choice is applied by a coating contractor licensed by the coating manufacturer. Section 7 gives further details.

Harditex™ is available in a regular 7.5mm sheet which is ideal for most residential applications. Where there is a need for added strength, finish and impact resistance, such as in light commercial construction, or some residential homes, 9mm Harditex™ Premium is the answer. Installation is the same as for 7.5mm Harditex™, so the choice is yours.

This document is divided into seven sections.

Sections 1 to 5 The selection, working, framing and installation of James Hardie Harditex™ sheets, including bracing applications.

Section 6 Requirements for complying with the New Zealand Building Code including fire resistance, acoustic and bracing ratings.

- Providing the sheets are installed and maintained in strict accordance with this specification the Harditex™ sheet performance will be warranted by James Hardie in terms of the requirements of the New Zealand Building Code for 15 years.

Section 7 The joint and coating systems applied by specialist independent contractors.

- **The proprietary jointing and coating procedures are outside the control of James Hardie, therefore all warranties for performance of the coating systems must be given by the independent jointing and coating manufacturers and their licensed applicators.**

NOTE: It is important that you refer to 'Working Safe with Silica-dusted Products' prior to working with this product. From more information or a copy of the leaflet, contact James Hardie Helpline on 0800 809 909.

Refer also to pages 6 and 7 of this brochure.

CHECKLIST

Harditex™ 7.5mm and Premium 9mm Checklist

James Hardie Harditex™ 7.5mm and 9mm is temporarily coloured pink to identify the product

FRAMING

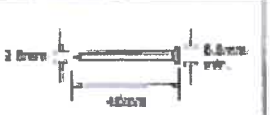
- Framing – studs, plates and noggs must be dry, true and straight prior to fixing sheets *(page 8)*
- All sheet edges must be fully supported by framing *(page 8)* (generally sheets are fixed vertically).
- Studs 600mm centres maximum, noggs 1200mm centres maximum *(page 8)*

INSTALLATION

- Sheets are to be fixed, stopped and cutted only when dry *(page 5)*
- Stack sheets flat in a dry area and protect from damage *(page 5)*
- When cutting, drilling, or grinding, safety glasses and an approved dust mask must be worn *(pages 6 and 7)*
- A breather-type building paper complying with NZS 2295 must be used behind Harditex™ sheets *(page 5)*
- In non-masonry constructions a horizontal control joint must be used at floor joist level *(page 8)*
- Sheet edges should not coincide with jambs of doors and windows unless they are control or expansion joints. Control joints 5.4m centres, expansion joints 16.4m centres *(page 10)*
- Vertical joints are to be offset when walls are more than one sheet high *(page 10)*
- The tops of windows and doors must have head flashings *(page 10)*
- Gap between sheets is 3-5mm *(page 11)*
- Nail sheets from the centre of the sheets outward to avoid distortion *(page 12)*
- Nailing – 150mm centres to perimeter and centre of sheet. 12mm from edges and 50mm from corner (nails 40 x 2.8 mm galvanised flat head or annular steel deform flush with sheet surface) *(page 12)*
- Internal corners – use Level 3259 (80mm wide and 1.5mm thick perforated sheet) *(page 18)*
- Bracing ratings have been determined by BRANZ tests and ratings are shown on *page 19*
- Stainless steel nails (40mm x 3.8mm) must be used for all bracing panels and in severe coastal environments *(pages 21 and 34)*

JOINTING & COATING

- All stopped joints must have both edges stopped. Control joints should have square edges *(page 15)*
- Sheets must be coated within 3 months of fixing *(page 34)*
- External corners – use PVC external corner mould – perforated *(page 18)*
- Colours must have a light reflective value (LRV) of 40% minimum regardless of gloss level *(page 37)*

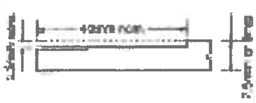
	Accessory	Size (mm)	Material/Appearance
	Accessories for 7.6mm and 9mm Hardiflex™		
	Butynol insert strip 12 metre roll	Width 50 80 (corner joints)	Black
	Insert 3109 sealing strip 12 metre roll	6 x 10	Black compressible foam (self-adhesive one side)
	Insert 3058 sealing strip 60 metre roll	1.5 x 50 1.5 x 80 (corner joints)	Black compressible foam (self-adhesive one side)
	Hardiflex™ nails: galvanised flat-head stainless steel Note: These nails are not stocked by James Hardie Refer to your distributor.	40 x 2.8 40 x 2.8	Hot-dipped galvanised steel 316 stainless steel
	Weatherboard nails: galvanised flat-head stainless steel Note: These nails are not stocked by James Hardie Refer to your distributor.	50 x 2.8 50 x 2.8	Hot-dipped galvanised steel 316 stainless steel
	3.5mm horizontal flashing	Length 3000	PVC/Stone
	6mm horizontal flashing	Length 3000	PVC/Stone
	External corner mould	Length 3000 Length 2700 Length 2400	PVC/White
	Stainless steel wood screw 100 screw bag 5 kg screw boxes	30 x 4.2	316 stainless steel

Section 1: Product information • Handling and cutting • Safety

Table 2: Harditex™ sheet sizes

Thickness (mm)	Width (mm)	Length (mm) 1800	2400	2700	3000
7.5	1200	✓	✓	✓	✓
9	1200		✓	✓	✓

Fig. 1 SHEET EDGE FINISH – STEPPED RECESS



Note: The stepped recessed edge avoids joint detail to set and finish. It gives a flatter, neater and stronger joint.

Fig. 2 HANDLING HARDITEX™ SHEETS

Note: Sheets must be stored in dry conditions. Damage to edges can occur and this will be detrimental to the finished job.

Product description

Harditex™ is a sheet material manufactured in New Zealand by James Hardie from fibre cement which is a composition of treated cellulose fibre, Portland cement, finely ground sand and water. Following forming into sheets the product is cured by high-pressure steam autoclaving.

Harditex™ 7.5mm and 9mm thick is used as the exterior cladding to timber and steel framing whilst also being the exterior bracing system (for timber frame only) when jointed and coated.

The product is identified by the fixing pattern printed on the face of the sheets, by a pink colour tint throughout the thickness and by the name Harditex™ printed on the reverse face of the 7.5mm sheet.

Harditex™ Premium 9mm sheets have the name Harditex™ Premium printed on the face side of the sheet.

Harditex™ Premium has a sanded face and is used where superior finish, strength and impact resistance are demanded.

New Zealand Standard

Harditex™ is manufactured to conform to NZS/AS 2908.2-1992: Cellulose Cement Products – Flat Sheets.

Installation – technical details

Harditex™ must be installed in accordance with the details of the specification. James Hardie has evaluated a number of proprietary joint and coating systems. These systems must be applied by licensed applicators nominated by the coating manufacturer. A list of proprietary jointing and coating systems is given on page 42. A Harditex™ installation video is available on request from James Hardie.

Sheet bracing

Harditex™ 7.5mm and 9mm sheets are suitable sheet materials for wall bracing in terms of NZS 3604. For full details of the Harditex™ bracing systems refer to pages 19-22.

Sheet properties

The Harditex™ cladding sheet is a lightweight fibre cement substrate which is resistant to permanent moisture damage, and which will not rot or burn. The sheet is securely fixed to the timber or steel framing by nailing or screwing.

Any special conditions or unusual applications must be referred to the technical staff of James Hardie Building Products Ltd. Phone the James Hardie Helpline 0800 808 868.

NOTE: Steel framing is not included in this brochure. Information is available from James Hardie on request.

Sheet sizes

Harditex™ sheet lengths and widths are given in Table 2.
NOTE: All dimensions are nominal.

All these specifications can be used for 7.5mm and 9mm thickness Harditex™.

Sheet edge finish

The sheets have stepped recesses on both sides and one end to take a reinforced flush joint detail applied by the coating contractor. This allows for a monolithic finish of both vertical and horizontal joint details. (Refer Fig. 1)

Sheet mass and moisture content

The approximate mass of 7.5mm Hardiflex™ at equilibrium moisture content (EMC) is 10.7 kg/m². 9mm is 12.4 kg/m².

Hardiflex™ sheets must be allowed to dry to EMC before fixing or framing, otherwise drying shrinkage can occur which will be detrimental to the finished job.

NOTE: Dry Hardiflex™ sheets say to moisture content with the seasons and prevailing weather conditions. As a guide, a dry sheet can vary between 6% moisture content in summer and 14% in winter.

The sheets are also defined as having an equilibrium moisture content when the sheet is under conditions of 23°C and a 50% relative humidity.

Moisture content at EMC	7%
Moisture content at saturation	33%

Fire properties

Hardiflex™ will not burn and has the following Early Fire Hazard Indices tested to AS 1530 part 3 1982:

Ignition Index	0
Flame Spread Index	0
Heat Evolved Index	0
Smoke Developed Index	0.1

NOTE: Zero is the best possible result.

C1 Spread of Fire

The Hardiflex™ substrate for exterior paint coatings with a surface finish coating of not more than 1mm in thickness is considered to meet the performance provisions of AS/NZS C1.2.5 when used to clad all buildings.

When the applied surface finish coating is more than 1mm in thickness, the coating manufacturer must be consulted to obtain flammability Index and/or non-combustibility data for the substrate coating system. Performance requirements are given in C1/AS1 Table 2.

Handling and storage

Hardiflex™ sheets must be stacked on a smooth, level surface. Edges and corners must be protected from damage. Carry sheets on edge. (Refer Fig 2) Store under cover and keep dry prior to fixing, jointing and cutting.

Cutting

Suitable cutting methods are 'score-and-snap' hand guillotine, hand sawing, power sawing and the Hardiflex™ power cutter.

Score-and-snap

'Score-and-snap' is a fast and efficient method of cutting thin sheets. Hardiflex special tungsten tipped 'score-and-snap' knife. (Refer Fig 3)

- Preferably score from the face side of the sheet.
- Position the straight edge along the line of the cut.
- Score against the straight edge and repeat the action to obtain adequate depth for a clean break – normally one-third of the sheet thickness.
- Snap upwards to achieve break.
- Clean up edges with a rasp if necessary.

Hand guillotine

The Bentley™ hand guillotine produces clean, straight edges. Make the guillotine cut on the off-cut side of the line to allow for the thickness of the blade. (Refer Fig 4)

Hand sawing

Hand sawing is suitable for general cutting operations and for small cut-outs, notchings or small penetrations.

Fig. 3 SCORE-AND-SNAP METHOD

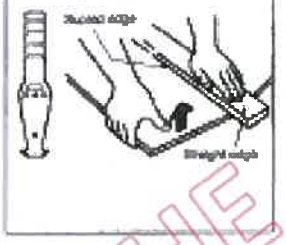


Fig. 4 HAND GUILLOTINE METHOD

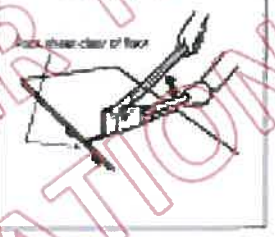
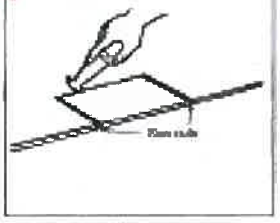


Fig. 5 HAND SAWING METHOD



Preferably use an old handsaw. A quick forward jabbing action is best.

For neatness, mark out the cuts to be made on the face side of the sheet. Where small notches are to be made, cut the two sides with the Hardiflex or hand guillotine, score along the back with the 'score-and-snap' knife and snap upwards. (Refer Fig 5)

Fig. 6 HARDISHEAR® POWER CUTTER

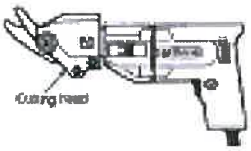


Fig. 7 SITE-GROUND RECESSED-EDGE DETAIL

Fig. 8 HITACHI EASY CUT-VAT

Power sawing, site recessing and hole forming

Safety precautions

When cutting, drilling or grinding, safety glasses and a dust mask must always be worn. This can be either a disposable P2 dust mask or a half mask with a disposable cartridge. The mask must fit properly and be approved for use with dust. The mask must be repaired or replaced as necessary and cleaned often.

All dry power-cutting operations must be carried out in open-air situations, or in well ventilated spaces and dust extraction equipment must be fitted to the dry-cutting tool.

All aspects of wet and dry cutting must comply with the latest regulations of the Occupational Safety and Health (OSH) division of the Labour Department. (Refer to Recommended site working practices, page 7.)

Power sawing

Power cutting using a dry diamond or carborundum saw blade gives an accurate edge.

Clamp a straight-edge to the sheet and run the saw base plate along the straight edge when cutting the cut.

Hardishear® power cutter

A Hardishear® power-cutting tool can be used for 7.5mm and 9mm Harditex. (Refer Fig. 6)

For details and availability of the Hardishear®, please contact James Hardie Helpline on 0800 808 868.

Site recessing

Where it is necessary to produce a ground recess detail on site, use a portable angle grinder fitted with a strong, thick carborundum blade or similar and a dust extraction unit fitted to a vacuum cleaner. Do all edge grinding outside in a well ventilated area. Rout down the edge of the face to produce a ragged recess approximately 40mm wide but not exceeding 2/3rds of its depth. (Refer Fig. 7)

A suitable tool for this is the Hitachi Easy Rout (refer Fig 8), available from Access Tools, 232 Rosebank Rd, Avondale, Auckland, phone (09) 815-2545, or major Hitachi distribution outlets.

Hole forming

Small rectangular or circular holes can be achieved by drilling a series of small holes around the perimeter of the hole then tapping out the waste piece from the sheet face. Tap carefully to avoid damage to sheets, and clean rough edges with a rasp. (Refer Fig 9)

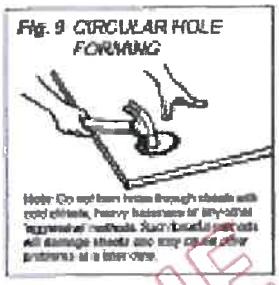
Large rectangular openings, such as for wall ventilators, can be made by the following method:

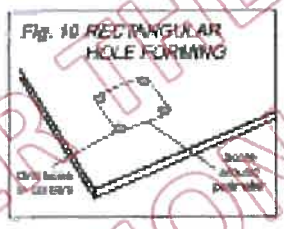
- Mark out the hole on the face side of the sheet.
- Drill a hole in each corner as shown in Fig 10.
- Score to the outside of the holes to half the sheet depth.
- Turn sheet over and score the reverse face to half the depth using the drilled holes as a reference.
- Knock out the waste material to form the hole. (Refer Fig 10)

Alternatively, large rectangular holes can be formed with a 110mm diameter diamond-blade saw.

For smooth, clean-cut circular holes:

- Mark the centre of the hole on the sheet.
- Pre-drill a 'pilot' hole.
- Using the pilot hole as a guide, cut the hole to the appropriate diameter with a tungsten-tipped ring cutter fitted to a heavy-duty electric drill. Sandvik ring-cutting kits or similar are available for this purpose.





Recommended safe working practices

Breathing in fine silica dust released when working with products such as fibre cement, clay and concrete is hazardous. Over time, usually a number of years, this may result in lung fibrosis, silicosis and lung cancer. **Work safely** with fibre cement sheets by following the precautions described below.

- Minimise dust when cutting sheets by using either Score-and-Snap knife, Barrley™ hand guillotine or Heavy Duty Hardiebox™.
- When using other power tools or abrasive hand tools, wear approved personal protective equipment, i.e. P1 or P2 dust mask and safety goggles.
- Ensure containment of dust during clean-up and disposal.

These precautions are not necessary when stacking, unloading or handling fibre cement products.

For more information contact the James Hardie Helpline 0800 808 868

Section 2: Framing

General requirements

NOTE: For Hardiflex™ bracing systems bracing requirements refer to page 20.

Correct design of the framework and careful consideration of the sheet layout (refer page 10) to minimise joints will significantly contribute to the long-term success of all butt-jointed wall systems. Allowance must be made for the provision of both horizontal and vertical control joints and expansion joints at the design stage (refer pages 15-17).

All Hardiflex™ sheet edges must be fully supported by the framing. Framing must be rigid and not rely on the Hardiflex™ for stability.

All studs and nogs must be checked with a long straight edge for line and face accuracy to ensure the timber and walls has a true and accurate outside face before the Hardiflex™ sheet is fixed (refer Table 3, page 8).

Hardiflex™ sheet must not be used in full pole house construction where external structural elements must be encased. It can be used in the upper level of pole platform construction where the poles terminate at the underside of the floor level.

Timber frame

All timber framing must be in accordance with NZS 3604 Code of Practice for Light Timber Frame Buildings.

Specific design to NZS 4203:1992 and NZS 3603:1985 can also be undertaken providing:

- The framing centres do not exceed those given in this specification.
- The framing member width conform to this specification.

Standard green frame or kiln dried timber can be used for single-storey or double-storey constructions with the following exceptions:

1. Where the inter-storey wall height exceeds the sheet length and horizontal joints need to be introduced, all timber framing must be kiln dried to minimise vertical shrinkage as this can cause horizontal joint pooling.
2. Where the one sheet spans from top to bottom plate of the area using standard green frame can be used.
3. Standard green frame or kiln dried timber can be used for floor joists. Because green floor joists can have significant shrinkage and kiln dried joists can also move, a horizontal control joint must be located at the floor joist level as shown in Figs 25, 26 or 27.
4. Hardiflex™ must not be fixed to timber framing with a moisture content in excess of 24% and for fully air-conditioned buildings moisture content must not exceed 18% in accordance with NZS 3602:1995.

NOTE: Kiln-dried timber will exhibit shrinkage. This is particularly important for multi-storey buildings and applications which are more than one level in height.

Refer also to 'Structural details', page 12 for further information. Timber framing must be at least 45mm wide or when kiln-dried is used, 35mm minimum finished size. Intermediate studs and 45mm wide at all sheet joints to give sufficient width to fix sheets at joints. Studs must be at maximum 600mm centres between continuous top and bottom plates and nogs at maximum 1200mm centres. (Refer Fig. 22.)

SPECIAL NOTE: Plaster-wide kiln-dried timber must not be used at any sheet cladding or lining joints because of insufficient nailing width.

Steel frame

Details for steel frame can be obtained by phoning the James Hardie Helpline on 0800 808 868.

Frame set-out

It will be more economical when the timber is pre-cut or set out to suit the exterior cladding rather than the interior lining. For a typical example of this refer *Fig 11*.

Batten requirements

Battens for fixing the sheets are required when the sheets are fixed over:

- Gypsum board or fire-rated gypsum board
- Softboard, polystyrene or similar sheets
- Concrete, masonry block or brick walls.

Batten specification

- Timber battening is to have a minimum thickness of 45mm to give adequate sheet nail penetration.
- Steel battens are to be a minimum of 70mm wide x 22mm deep x 0.55mm thick and to have a bearing surface of 37mm. Battens are to be galvanised steel (Z275g/m² zinc coating) and fixed to manufacturer's specification.

All battening centres and sheet fixing is to be strictly in accordance with the framing and fixing required by this specification. Care must be taken to ensure the battens are packed out aligned to give a true even surface for the sheet to be fixed. Check the face of the battens with a long straight edge before fixing the sheets.

Building paper

A breather-type building paper complying with NZS 2295 is required by NZS 3604, must be fixed to the outside face of timber framing before fixing the Hardiflex™ sheet.

Note that for clarity building paper is generally not shown in the drawings in this brochure.

Curved applications

Hardiflex™ can be used for curved applications. The minimum recommended radius for convex or concave fixed sheets of 7.5mm and 9mm thickness is 1800mm. The sheet must be bent only along the length.

NOTE: The framing is to be closed up to 400mm centres for curved applications to give extra support to the sheet.

Kiln-dried framing must be used when horizontal sheet joints are required and on the height of the curved frame.

Exterior frame straightness

To achieve a visually acceptable finish to the restored Hardiflex™ the frame straightness tolerances listed in Table 3 must be met.

Bracing sheets stopped below top plate

Where bracing sheets are stopped below the level of the top plate, refer to *Fig 40* for framing details.

Fig. 11 *FRAME AND STUD SET-OUT*

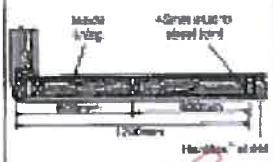


Table 3: Frame straightness tolerances

Straight-edge (mm)	Tolerance (mm)
Good finish	
600	2
1200	3
1800	4
Measured across plasterline tile joints:	
200	0.5
Excellent finish	
600	1
1200	2
1800	3
Measured across plasterline tile joints:	
200	0.5

Note: these tolerances apply to any point on the face of the Hardiflex™ cladding when measured with a straight-edge in any direction.

Section 3: Sheet layout + Fixing

Fig. 12 SHEET LAYOUT FOR OPENINGS

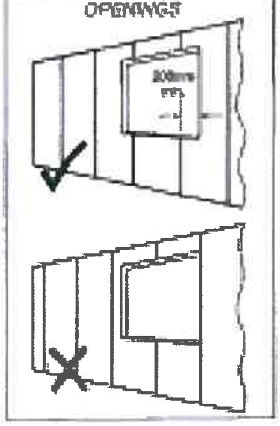


Fig. 13 OFFSET SHEET SET-OUT

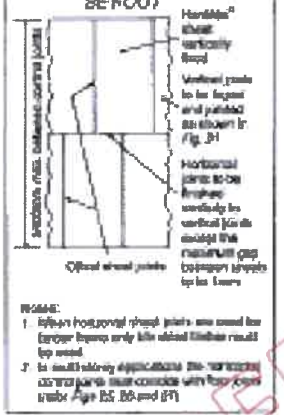
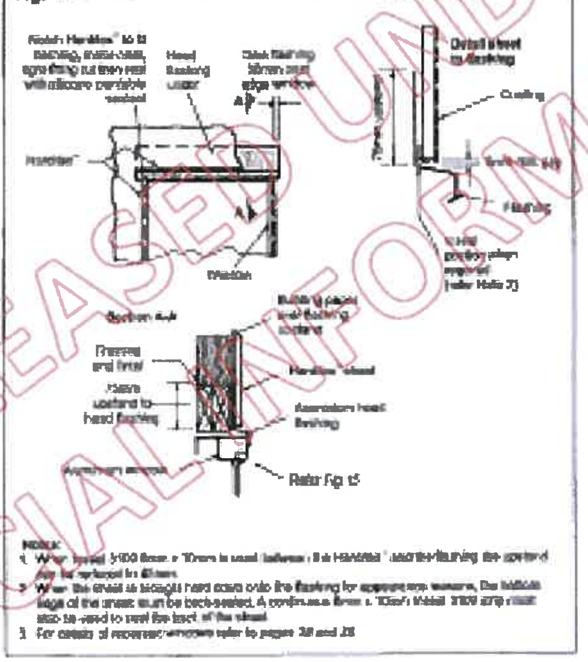


Fig. 14 STANDARD WINDOW OR DOOR HEAD DETAIL



Structural details

- Harditex™ cladding systems are suitable for both commercial and domestic applications. These must be limited to two storeys in height unless specific design is undertaken for the attachment of the Harditex™ sheets to the structure. This is because the Harditex™ sheets form a very rigid element and will act as a structural diaphragm. If a high wall is incorrectly designed the lateral forces on the building may be absorbed by the Harditex™ sheets before the designed structural bracing systems, which could lead to serious damage to the sheet fixing and jointing. This aspect must be structurally considered by an engineer before work of greater than two storeys is undertaken. Harditex™ has substantial sheet bracing performance (refer to page 19).
- All sheets must be installed vertically for timber frame construction as this method gives the best overall performance.
- Sheets may, however, be laid horizontally for timber frame when a depth of cladding not more than 1200mm high is required (one width of sheet). Examples are fascias, spandrels or narrow bands of cladding along the building. Refer also to 'Curved applications', page 9.

Door and window openings

Where sheet joints are above and/or below door or window sills, joints may crack due to structural movement. Fix sheets across door and window openings so sheet edges do not coincide with the side of the window or door, then cut away excess (refer Fig 12).

An alternative method to accommodate this possibility is to provide an expansion joint at window edges flashed with flexseal or a resilient-filled joint. (Refer Figs 23 and 24)

When Hardiflex™ is fixed more than one sheet high on large walls the joints must be offset. (Refer Fig. 13)

Flashings

The tops of windows and doors must be flashed with a head flashing (refer Figs 14 and 15). Use pre-shaped aluminium flashings. The sides of the windows must be sealed with flexseal 3109 6mm x 10mm strips or a paintable silicone.

The flexseal strips are adhered to the window overlap before installation (refer Fig. 16).

When silicone sealant sealants are used the continuous bead of sealant is applied under the window overlap before the window is fixed (refer Fig. 16).

NOTE: Silicone applied as a fillet to the window edge and onto the cladding is not an effective weathering method and must not be used.

Fig. 15 HEAD FLASHING DETAIL

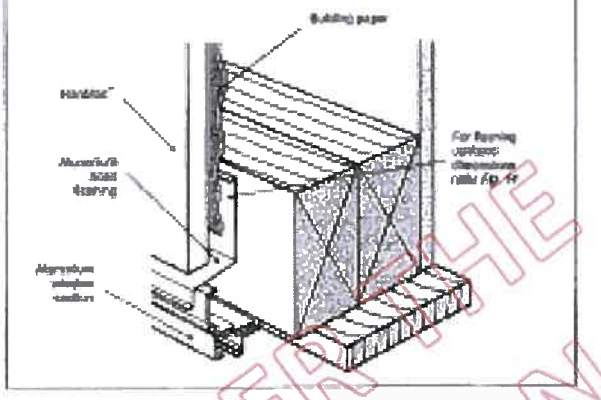


Fig. 16 SIDE FLASHING DETAIL (FLEXSEAL OR SEALANT SEAL)

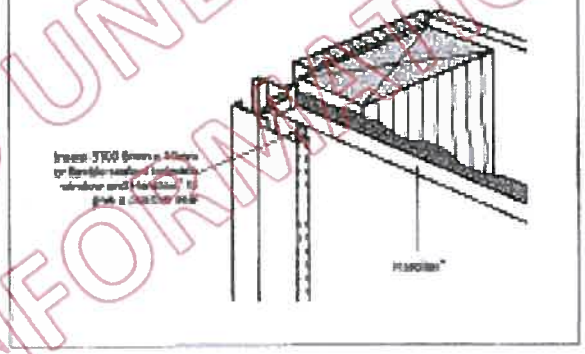


Fig. 17 SILL FLASHING DETAIL

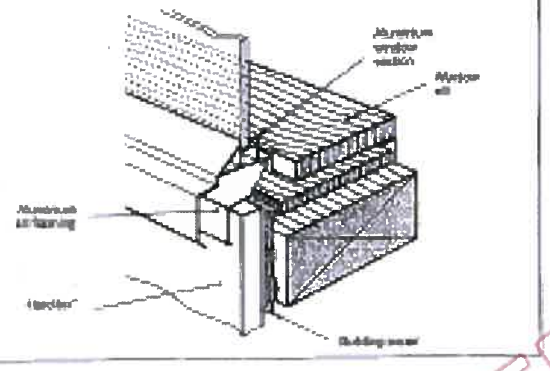
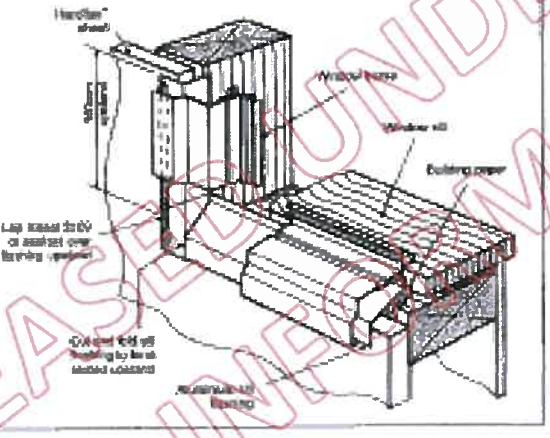


Fig. 18 SILL FLASHING UPSTAND



When aluminium joinery is used it is desirable to give good long-term protection (refer Fig 17).

The sill flashing needs the end turned up to be effective (refer Fig 18).

Ground clearance

Slab on ground

The minimum slab floor-to-ground dimension must be 150mm minimum to comply with paragraph E2/AS1 2.0.1(a) of the New Zealand Building Code.

The sheet must finish no closer to the ground than shown in Fig 19 or the alternative detail in Fig 20 or, on timber piles as shown in Fig 21. In no case can the Hardiflex™ be taken closer than 50mm to the finished ground, whether paved or unpaved.

Timber piles

When timber-piled foundations are used the Hardiflex™ can be carried to within 50mm of the finished ground level (refer Fig 21).

Fixing

Nail at 150mm centres to the perimeter of sheets and intermediate studs and noggs (refer Fig 22). Nails must be hammer driven flush with the sheet surface. Do not fix closer than 12mm to the sheet edge or 50mm to the corner of the sheet. Do not overdrive the nails below the sheet surface as this can weaken the nails' holding.

Commence fixing from the centre of all sheets and work outwards to ensure they are held against the framing to eliminate any dimpling.

The sheet must be held firmly against the stud when nailing to minimize break-out at the back of the sheet.

Refer to the fixing pattern on the sheet which is set out for normal vertical sheet fixing. Use 40mm x 3.15mm galvanized flat-head HardiFlex™ or 316 stainless steel nails (refer Table 1, page 3).

Hot-dipped galvanized nails and screws have a durability of 50 years in very severe coastal conditions of New Zealand. Therefore in these locations alternatives such as stainless steel fixings available from stockists of James Hardie products must be used. Refer also to the New Zealand Building Code requirements (page 36).

Hardiflex™ 7.5mm and 9mm sheets can also be fixed to timber frames with 30mm x 4.2mm 316 stainless steel wood screws (refer Table 1, page 3).

NOTE: These screws can only be used for design wind pressures up to 2 kpa.

These screws drill through the sheet and self-countersink into the sheet. Embed the screws 1-2mm in the body of the sheet and ensure they are flush to the sheet to avoid over embedding.

Fig. 19 HARDITEX™ OVERHANG DETAIL TO CONCRETE OR BLOCKWORK BASE

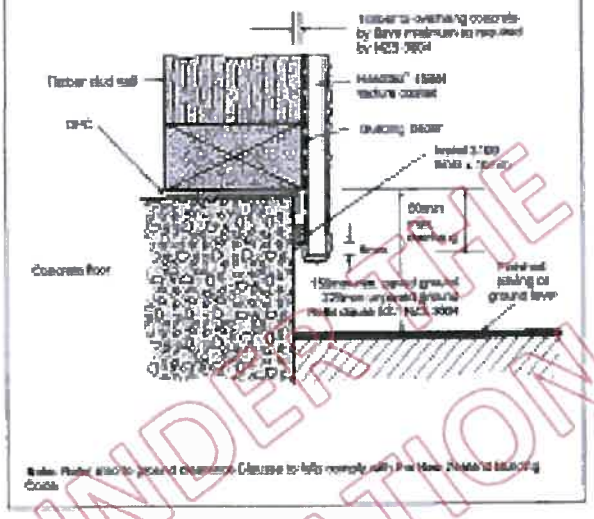


Fig. 20 BASE DETAIL FOR HARDITEX™ ON CONCRETE SLAB WITH CAST-IN BEARER

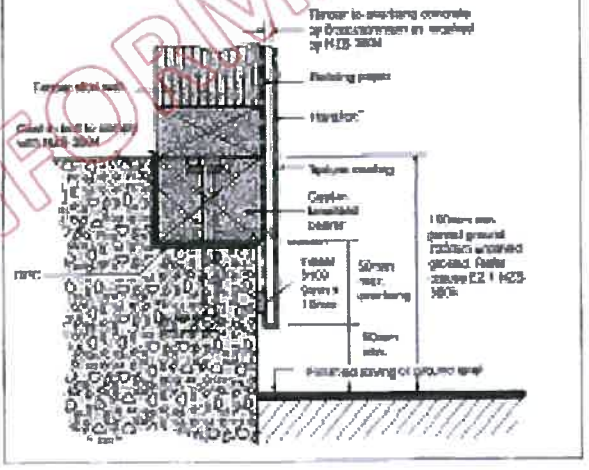
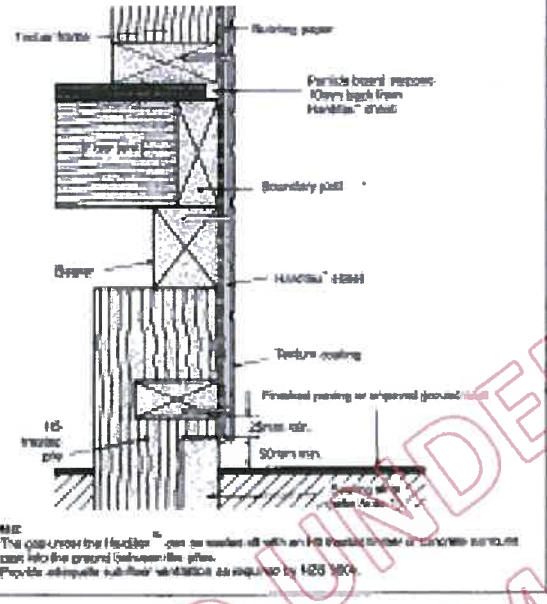
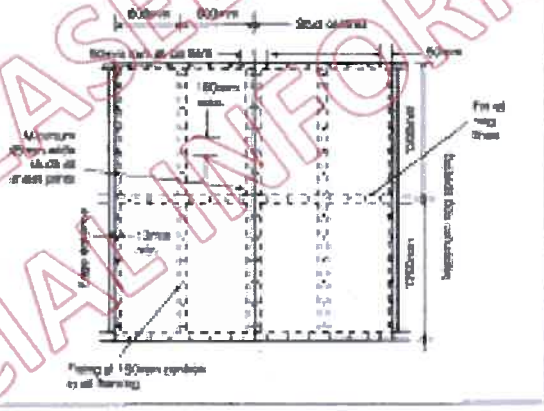


Fig. 21 BASE DETAIL FOR HARDITEX™ ON TIMBER PILE



NOTES:
1. The gap under the Hardiflex™ can be sealed off with an H5 treated timber or concrete surround and into the ground between the piles.
2. Provide adequate sub-floor ventilation as required by NZS 3604.

Fig. 22 STANDARD VERTICAL SHEET FIXING



Section 4: Control, expansion and corner joints

Control Joints

Control joints are provided to take up the normal movement when sheets are flush jointed together.

Vertical and horizontal control joints must be provided to limit the unsupported cladding area.

Vertical and horizontal control joints must be provided at 5.4 metre maximum centres.

Horizontal control joints must be provided at the inter-storey floor joint level (refer page 8).

Provide a maximum 6mm gap between the sheets.

Control joints must be located at 5.4 metre centres from corners. When an opening is in the vicinity of a control joint, then the edge of the opening is an ideal location for it. A good location for control joints is behind downpipes.

For details of alternative vertical control joints refer Fig. 23 and 24.

Fig. 23 VERTICAL BUTTNOK INSEAL CONTROL JOINT (ALTERNATIVE 1)

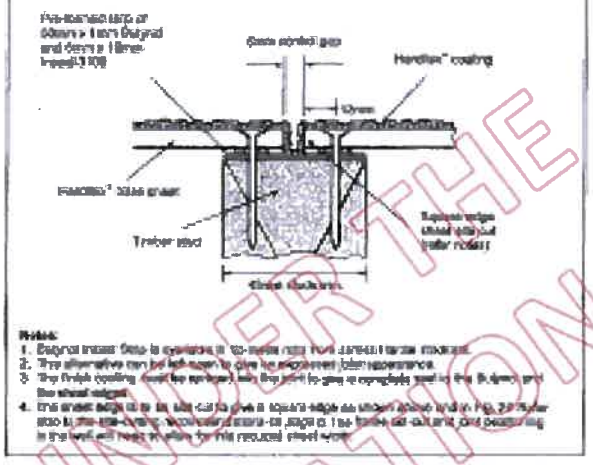


Fig. 24 VERTICAL SEALANT CONTROL JOINT (ALTERNATIVE 2)

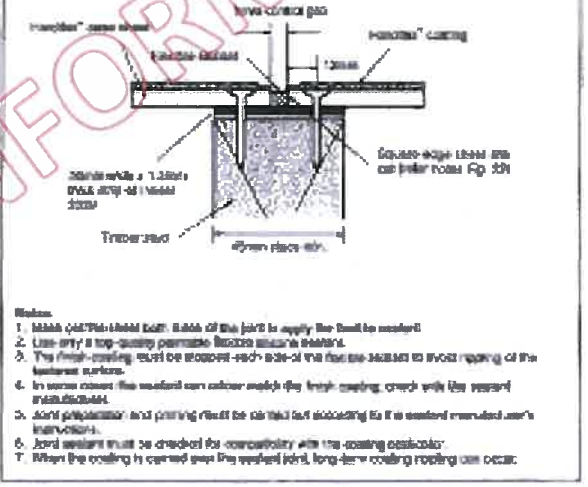


Fig. 29 HORIZONTAL FLASHING CONTROL JOINT (ALTERNATIVE 1)

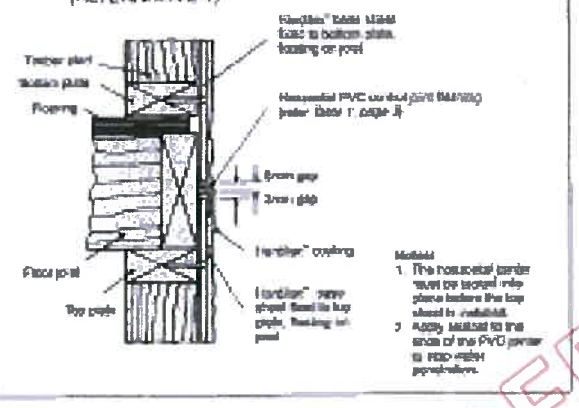


Fig. 27 HORIZONTAL OVERLAP CONTROL JOINT DETAIL (ALTERNATIVE 3)

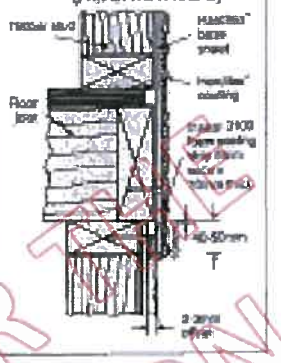
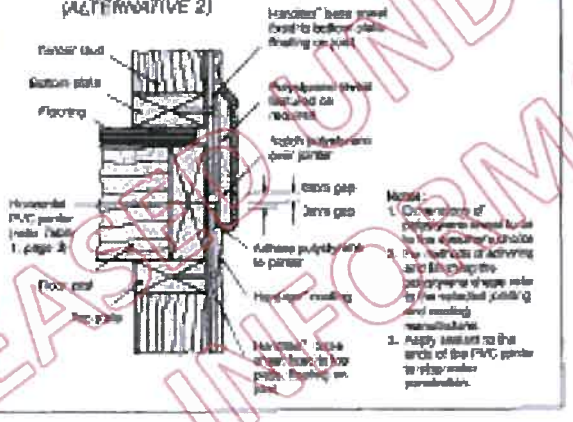


Fig. 28 HORIZONTAL REVEAL CONTROL JOINT (ALTERNATIVE 2)



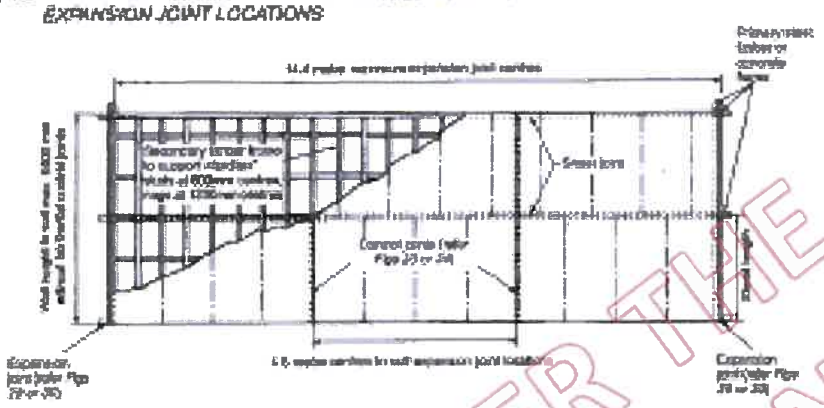
For details of alternative horizontal control joints refer Figs 25, 26 and 27.

Expansion joints

Expansion joints are provided to provide clearance to allow for long-term linear movement that occurs because of component shrinkage and temperature related expansion and contraction.

Vertical structural expansion joints must be provided where walls exceed 14.4 metres in length. These expansion joints must be correctly designed structural joints. They must flow to all framing, including top and bottom plate, lining and cladding required on to allow for the structural framing expansion and contraction that can occur.

Fig. 28 PANELLISED TIMBER FRAME OVER STEEL PORTALS – EXPANSION JOINT LOCATIONS



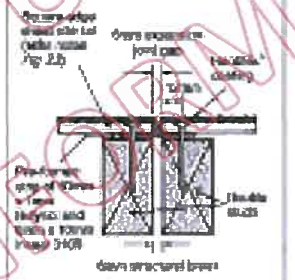
A well designed long wall will therefore have full expansion joints at 14.4 metre maximum centres with intermediate control joints at 5.4 metre centres minimum from an expansion joint. (Refer Fig 28)

Note that for minimum sheet cutting, control joints can be placed at 4.8 metre centres between expansion joints at 14.4 metre centres.

NOTE: These expansion joints must be used on commercial and industrial applications where long wall lengths are frequently required. This can be achieved by specifying the Hardiflex® support framework at the main structural frame. These details are difficult to achieve on domestic construction therefore wall areas less than 14.4 metres must be avoided.

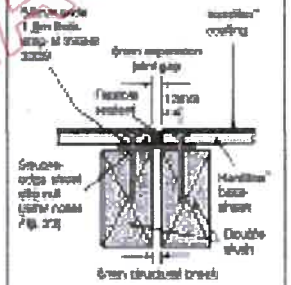
For details of alternative vertical expansion joints refer Figs 29 and 30.

Fig. 29 VERTICAL BUTYNOL CAULKED EXPANSION JOINT (ALTERNATIVE 1)



Refer Sister to Fig. 28 for general notes relating to this as the details are the same except for the double studs

Fig. 30 VERTICAL SEALANT EXPANSION JOINT (ALTERNATIVE 2)



Refer Ridge to Fig. 28 for general notes relating to this as the details are the same except for the double studs

Fig. 31 RECESSED-EDGE SHEET JOINT DETAIL

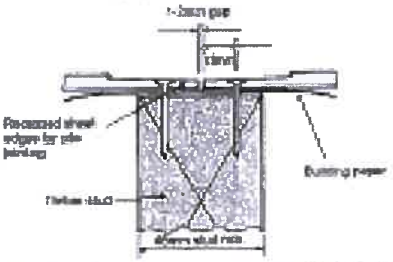


Fig. 33 PVC CORNER FINISHING

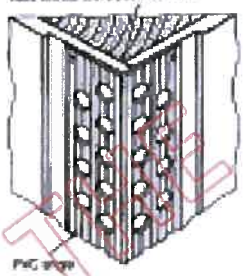


Fig. 32 RECESSED-EDGE EXTERNAL CORNER DETAIL

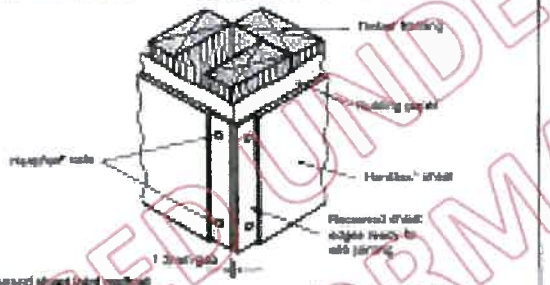
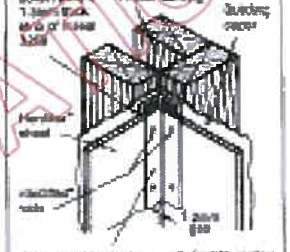


Fig. 34 RECESSED-EDGE INTERNAL CORNER DETAIL



Base sheet jointing details

The recessed edge sheet joint is formed between each edge of the Hardiflex™ sheet for both vertical and horizontal joints (refer Fig 31) and at internal and external corners.

The jointed panel areas can be limited in size by the use of vertical and horizontal control and expansion joints.

Corner joints

External and internal corners have the jointing and coving continuous around the corner or are finished with a perforated corner angle (refer Fig 33). Exposed external and internal corners can be used. Details are similar to those shown in Figs 23 and 24.

For external corners refer to Figs 32 and 33.

At internal corners allow a strip of Insect 2050 in position before fixing sheets. (Refer Fig 34.) The sheets can then be finished with the standard tape-reinforced flexible jointing system. (Refer Figs 31 and 34.)

Corner details can also be expressed or joints filled similar to the details shown in Figs 23 and 24. Refer to the notes in Figs 23 and 24.