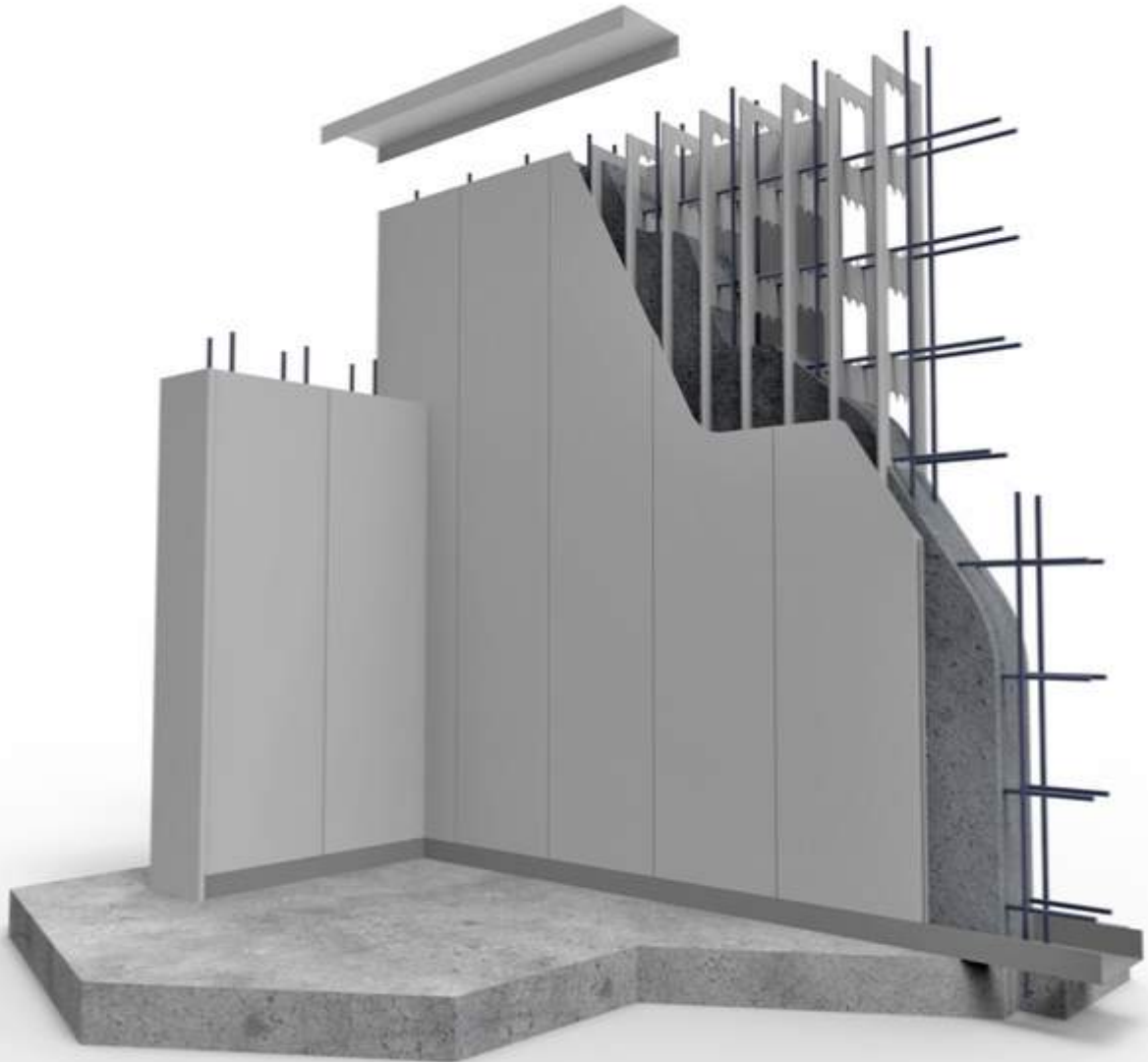




# PERMAFORM

QUICK ► STRONG ► STRAIGHT



DISTRIBUTED BY



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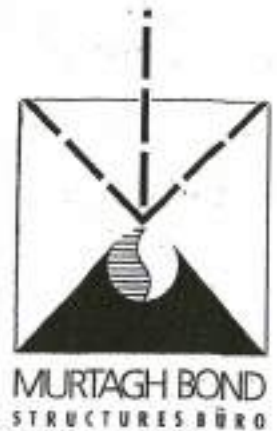
Phone No.: 02 9792 8986

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8<sup>th</sup> July 2018

Permaform Australia Pty Ltd



**Permaform Permanent Formwork System  
Engineering Certification BCA Conformity**

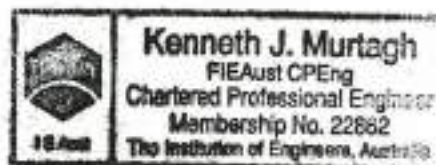
This certificate is to satisfy the suitability requirements of the Building Code of Australia (BCA) (Part A.2.2 (a) (iii)) for the inclusion of the Permaform System to generate Reinforced Concrete Wall and Blade Column elements which can form parts of compliant structures.

The system utilises extruded polymer formwork which remains as a permanent part of a "composite" Reinforced Structural section generated when filled with Structural Concrete and Steel Reinforcement, which complies with the Australian Standard AS 3600.

The system has been assessed and tested to demonstrate that it complies with the heat and smoke release requirements of the BCA.

Compliant reinforced Concrete Structures to satisfy the BCA may be designed therefore using the relevant "deemed to comply" clauses of the Australian Concrete Structures Code AS 3600, together with guidance from relevant European, British, and American Codes as necessary to support Loads prescribed by the Australian Loading Codes AS 1170.

Ken Murtagh BE, MEngSc, FIEAust, RPEQ  
Director  
Bond James x Murtagh P/L



Director: Ken Murtagh BE, M Eng Sc FIE Aust C.P. Eng RPEQ

Page 1 of 1

Bond James x Murtagh  
Pty Ltd Inc in ACT  
Consulting Engineers

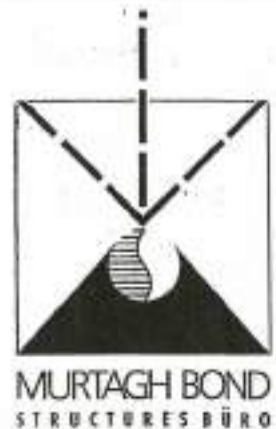
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Web: [www.murtaghbond.com.au](http://www.murtaghbond.com.au)

ABN 35 008 521 042

8th July 2018

Permaform Australia Pty Ltd

**Permaform Permanent Formwork System  
Engineering Certification of Application**



The Permaform extruded polymer shuttering system for forming reinforced concrete Walls and Blade Columns, is primarily a formwork system, suitable to construct these elements and should be regarded as such.

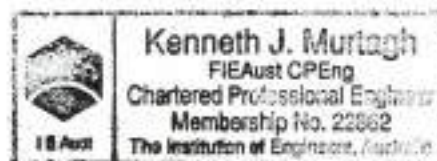
These Permaformed Reinforced Concrete elements incorporated as structural members in vertically loaded and sway restricted structures are similar in performance to those constructed by conventional forming methods, provided that steel reinforcement, if necessary, is designed and detailed to replicate the intent of the relevant clauses of Australian Standard AS 3600.

Testing of elements under load and fire situations has demonstrated that the inclusion of the polymer ribs internally has no significant effects on the performance of Elements, provided that Reinforcement Details which comply with AS 3600 are adopted. This therefore generates positive advantages over conventional formwork which is non-permanent.

I am satisfied and certify that the use of the Permaform product for reinforced Concrete Walls and Blade Columns is suitable for the realisation of fully compliant Structures to the requirements of the Building Code of Australia, provided that the structural designer replicates the Steel Reinforcement and Concrete Strength rules of AS 3600, which would be appropriate for conventional elements.

A handwritten signature in black ink, appearing to read 'Ken Murtagh'.

Ken Murtagh BE, MEngSc, FIEAust, RPEQ  
Director  
Bond James x Murtagh P/L



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Permaform International Pty Ltd

Certification Report

Product Physical Properties & Life Expectancy

Technical note – P00510-1





### **Material – PVC Physical Properties<sup>1</sup>**

Permaform is constructed from Rigid PVC type D and the materials are identical to those of PVC pipe. PVC has an amorphous structure with polar chlorine atoms in the molecular structure. Having chlorine atoms and the amorphous molecular structure are inseparably related. Although plastics seem very similar in the context of daily use, PVC has completely different features in terms of performance and functions compared with olefin plastics which have only carbon and hydrogen atoms in their molecular structures.

Chemical stability is a common feature among substances containing halogens such as chlorine and fluorine. This applies to PVC resins, which furthermore possess fire retarding properties, durability, and oil/chemical resistance.

### **Fire retarding properties**

PVC has inherently superior fire retarding properties due to its chlorine content, even in the absence of fire retardants. For example, the ignition temperature of PVC is as high as 455°C and is a material with less risk for fire incidents since it is not ignited easily.

Furthermore, the heat released in burning is considerably lower with PVC, when compared with those for PE and PP. PVC therefore contributes much less to spreading fire to nearby materials even while burning.

Therefore, PVC is very suitable for safety reasons in products close to people's daily lives.

### **Durability**

Under normal conditions of use, the factor most strongly influencing the durability of a material is resistance to oxidation by atmospheric oxygen. PVC, having the molecular structure where the chlorine atom is bound to every other carbon chain, is highly resistant to oxidative reactions, and maintains its performance for a long time. Other general-purpose plastics with structures made up only of carbon and hydrogen are more susceptible to deterioration by oxidation in extended use conditions (such as, for example, through repeated recycling). Measurements on underground 35-year-old PVC pipes taken by the Japan PVC Pipe & Fittings Association showed no deterioration and the same strength as new pipes

### **Oil/Chemical resistance**

PVC is resistant to acid, alkali and almost all inorganic chemicals. Although PVC swells or dissolves in aromatic hydrocarbons, ketones, and cyclic ethers, PVC is hard to dissolve in other organic solvents. Taking advantage of this characteristic, PVC is used in exhaust gas ducts, sheets used in construction, bottles, tubes and hoses.

### **Mechanical stability**

PVC is a chemically stable material, which shows little change in molecular structure, and also exhibits little change in its mechanical strength. However, long chain polymers are viscoelastic materials and can be deformed by continuous application of exterior force, even if the applied force is well below their yield point. This is called creep deformation. Although PVC is a viscoelastic material, its creep



deformation is very low compared with other plastics due to limited molecular motion at ordinary temperature, in contrast to PE and PP, which have greater molecular motion in their amorphous sections.

#### Reference

1. <http://www.pvc.org/en/p/pvcs-physical-properties>

#### Applicable Standards

ISO 877-1:2009      Plastics -- Methods of exposure to solar radiation

ISO 877-1:2009 provides information and general guidance on the selection and use of the methods of exposure to solar radiation described in detail in subsequent parts of ISO 877. These methods of exposure to solar radiation are applicable to plastics materials of all kinds as well as to products and portions of products.

It also specifies methods for determining radiant exposure.

It does not include direct weathering using black-box test fixtures, which simulate higher end-use temperatures in some applications

#### Statement of Certification

Permaform International Pty Ltd certifies that the PVC items that make up the Permaform panels and accessories have been tested to ISO 877-1:2009 and achieves a durability rating of greater or equal to 80 years.

Robert Rech  
Director  
Permaform International Pty Ltd

# Permaform Walling System

## BCA Compliance – Fire and Combustibility Report

### Prepared for:

**Brad Vine**  
Permaform International  
Pty Ltd

### Prepared by:

**Ettienne Jordaan**  
Project No. 41935

\\WGE-SYD-FS-01\PROJECTS\41935\PROJECT DOCUMENTATION\FIRE ENGINEERING\FIRE ENGINEERING REPORTS

**Date:**  
29<sup>th</sup> May 2019

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# Revision

REVISION	DATE	COMMENT	APPROVED BY
01	29/05/2019	Fire and Combustibility Report	Ettienne Jordaan

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3.	PERFORMANCE SOLUTIONS	3
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APPENDIX 2	AS1530.4-2014 SGS FIRE TESTING REPORTS	6
APPENDIX 3	AS1530.3-1999 CSIRO FIRE TESTING REPORT AND CERTIFICATE	7

# 1. Introduction

Permaform wall system consist of reinforced concrete infill and cast in situ formwork. The formwork, being the Permaform material, is constructed from Polyvinyl Chloride (PVC). The figure below details a typical Permaform constructed wall.

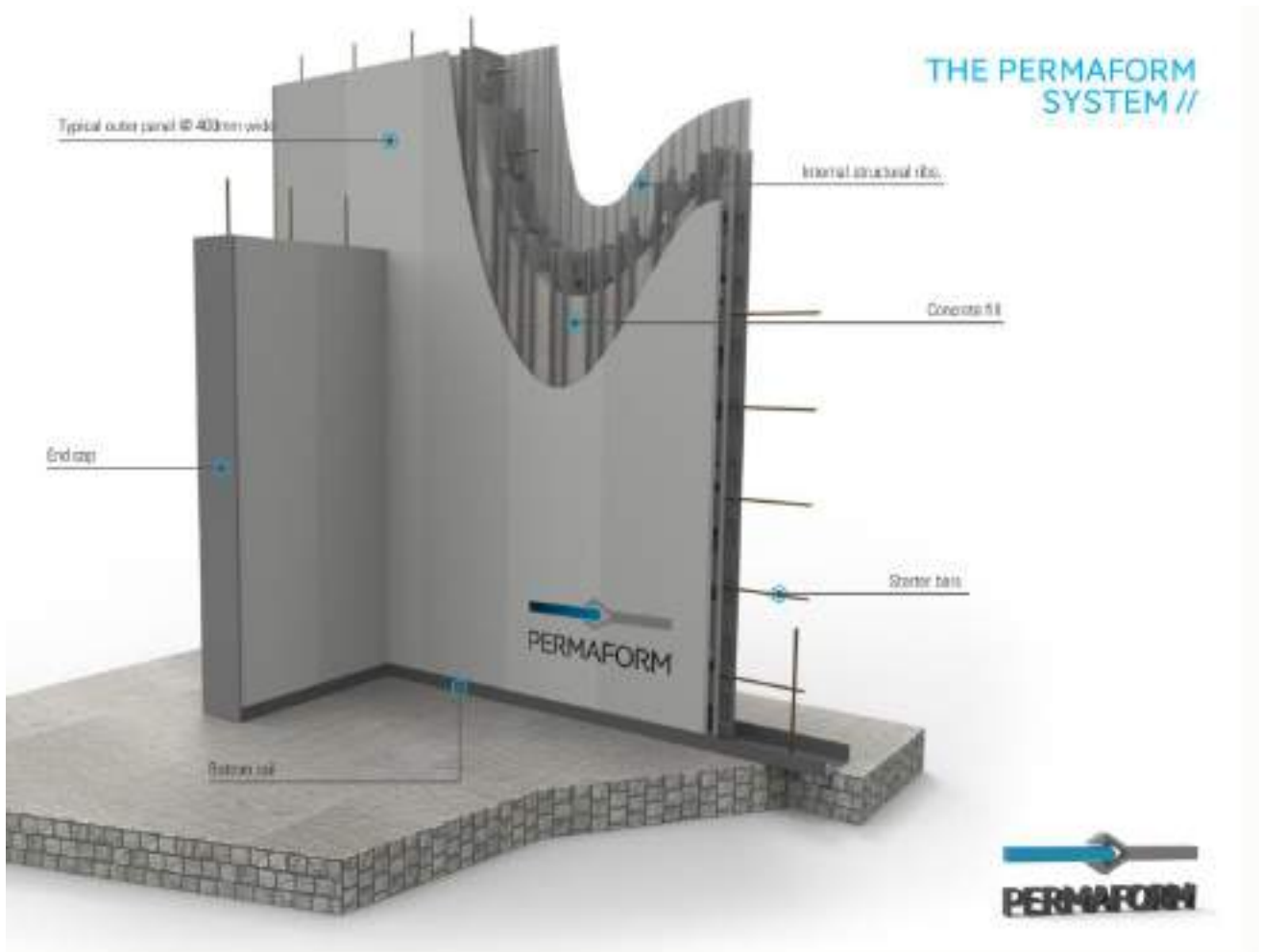


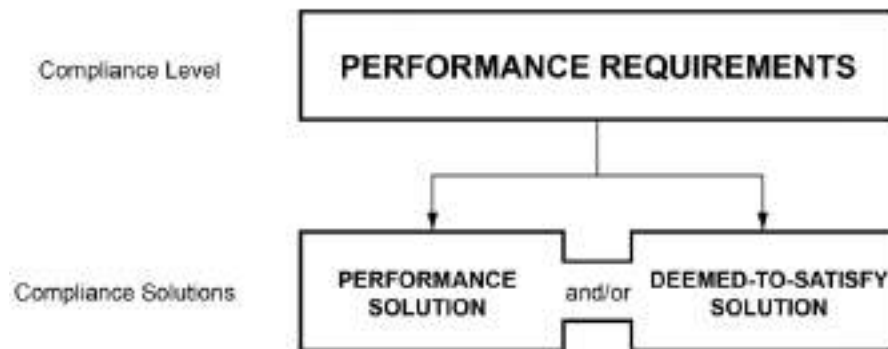
Figure 1: Typical Permaform wall [25]

Permaform consists of two PVC outer layers joined together by PVC ribs. The outer layers of the PVC are designed to be exposed while the PVC ribs are to be embedded into the concrete. It is considered that if the outer layers were removed from the wall assembly then the wall and its components would be non-combustible despite the PVC ribs remaining embedded in the concrete. The ribs which are designed to be encased in concrete do not reduce the fire resistance of the wall. This is demonstrated as Permaform walls achieve an FRL of 95 minutes and 120 minutes for wall thicknesses of 110mm and 150mm respectively.

This document provides guidance on how the use of Permaform on projects, will achieve compliance with the Building Code of Australia (BCA).

## 2. BCA Compliance

To achieve compliance with the BCA, the Performance Requirements of the BCA must be met. There are two ways to satisfy the Performance Requirements, a Deemed-to-Satisfy (DtS) Solution or a Performance Solution (Alternative Solution). To achieve a DtS solution, the prescriptive requirements of the BCA must be followed. Whereas a Performance Solution is any alternative solution that has been demonstrated to comply with the Performance Requirements of the BCA by a Fire Engineer.



The requirements vary depending on the particular application of the material (i.e. external wall, internal wall, shafts etc.). To address BCA compliance regarding the use of Permaform, the following methods of compliance could be adopted for each application.

Table 1: Permaform Applications and DtS Requirements

Application	BCA DtS Requirements	DtS Solution or Performance Solution	Evidence of Suitability
External Walls	<b>Clause C1.9(a)</b> – External walls and common walls including any covering in Type A and B buildings must be non-combustible.	Performance Solution	Fire Engineering Report specific to the building which demonstrates compliance with the BCA.
Common Walls			
Internal Walls	<b>Clause C1.10, Clause 4 of Specification C1.10</b> – Internal wall linings must comply with the group numbers specified in Table 3 of Specification C1.10 and achieve an average specific extinction area less than 250 m <sup>2</sup> /kg.	DtS Solution	CSIRO Fire Testing Report and Certificate of Assessment for test carried out in accordance with AS/NZS 3837-1998. Permaform achieved a group number 1 and an average specific extinction area of 236.8 m <sup>2</sup> /kg which achieves DtS compliance. Refer to the appended testing report.
Fire-isolated stairs and fire control rooms			
Other materials (i.e. shafts and other elements not listed above)	<b>Clause C1.10, Clause 7 of Specification C1.10</b> – Other materials and assemblies must achieve a Spread-of-Flame Index of 9 and a Smoke-Developed Index of 8 or less.	DtS Solution	CSIRO Fire Testing Report and Certificate of Assessment for test carried out in accordance with AS1530.3-1999. Permaform achieved a Spread of Flame Index and Smoke Developed Index of 0 and 4 respectively, which achieves DtS compliance for the applications relevant to Permaform. Refer to the appended testing report.

Application	BCA DtS Requirements	DtS Solution or Performance Solution	Evidence of Suitability
<b>FRL of -/60/60 (non-load-bearing)</b>	<b>Clause A2.3, Specification A2.3</b> – The FRL of a wall is required to be tested in accordance with AS 1530.4 by an Accredited Testing Laboratory.	DtS Solution	SGS Fire Testing Report for test carried out in accordance with AS 1530.4:2014. A Permaform wall with a thickness of 110mm achieved an FRL of -/60/60. Refer to the appended testing report.
<b>FRL of -/120/120 (non-load-bearing)</b>	<b>Clause A2.3, Specification A2.3</b> – The FRL of a wall is required to be tested in accordance with AS 1530.4 by an Accredited Testing Laboratory.	DtS Solution	SGS Fire Testing Report for test carried out in accordance with AS 1530.4:2014. A Permaform wall with a thickness of 150mm achieved an FRL of -/120/120. Refer to the appended testing report.

### 3. Performance Solutions

The BCA DtS requirements permits combustible materials to be applied as internal wall linings if the material achieves the required Group rating. Permaform has been fire tested and achieves a Group 1 material rating and an ASEA of 236.8m<sup>2</sup>/kg, meaning that Permaform will comply with the BCA DtS provisions for internal wall applications.

The BCA also permits combustible materials and assemblies in other locations internally such as the construction of a shaft as well as other elements not mentioned in the table above, provided they achieve a Spread-of-Flame Index of 9 or less and a Smoke-Developed Index of 8 or less. Permaform was fire tested and achieved Spread-of-Flame Index of 0 and a Smoke-Developed Index of 4, therefore will also comply with the DtS Provisions of the BCA in these other locations.

Permaform applied as an external wall or a common wall between buildings does not satisfy the BCA DtS provisions. Rather BCA compliance will be demonstrated by providing a Performance Solution which aims to satisfy the BCA Performance Requirements.

The Performance Solution strategy includes:

- Demonstrating the outer PVC layers do not pose undue risk of fire spread via the wall/façade/shaft (refer to fire behaviour of PVC)
- While Permaform is combustible, the BCA permits combustible material such as plasterboard to be used where non-combustible materials are required. The fire performance of Plasterboard will be compared to Permaform, the comparison aims to demonstrate a similar level of fire safety to determine BCA compliance using an equivalence approach.
- Fire testing was conducted in accordance with AS 1530.3:1999. The test confirmed a Spread-of-Flame Index of 0 and a Smoke-Developed Index of 4 for Permaform and as a result is better than or comparable to materials such as Plasterboard, which is considered a DtS compliant solution.

#### 3.1 Fire Behaviour of PVC

When PVC is exposed to high temperatures it will decompose to provide an insulating layer of char that retards further degradation of the virgin PVC material below. The insulating properties of this char layer can provide built-in fire resistance. The rate of char is initially fast but as the char increases it slows as this insulating layer grows.

PVC will combust when exposed to a heat source, but when the source of heat is removed, PVC will typically char and self-extinguish. This makes it difficult to burn and to sustain a fire without another source of heat and therefore would not support rapid fire spread along the façade in which Permaform is present.

PVC is made from a mixture of carbon, hydrogen and chlorine. The chlorine not only gives PVC useful durability properties, but also improves the materials resistance to fire. As mentioned, PVC will not typically burn when a flame or heat is removed. This is due to the chlorine atoms in the polymer, as chlorine improves the fire resistance of plastic polymers. [26]

While PVC is combustible by nature, it is considered to not be a highly flammable material. Flammability of a material can be characterised by the ignition temperature and ability to sustain flame. Materials with a higher ignition temperature are considered to have lower hazard to combustibility. Typically, PVC will ignite when temperatures exceed 435°C [27], in comparison, paper made from cellulose typically has an ignition temperature of 233°C [28]. Furthermore, even though PVC is combustible, its high ignition temperature coupled with its capacity to char translates to a material that is not highly flammable; materials such as paper are considered to be more flammable and more readily facilitate spread of fire faster than PVC.

It should also be noted, the BCA provides a concession for combustible materials to be used where non-combustible materials are required; BCA clause C1.9 states that plasterboard can be used where non-combustible materials are required. Plasterboard contains a plaster core with two outer layers of paper, and as discussed, paper will ignite at lower temperatures than PVC.

Plasterboard when tested in accordance with ASTM E84, has a Flame Spread Index (FSI) of 10-20, while 3mm thick PVC sheet has a FSI of 5-10. [26] The ASTM E84 test method measures flame growth across material, the result, measured as a Flame Spread Index (FSI), which is a scale from 0 to 100; asbestos board has a FSI of 0 and red oak wood has a maximum value of 100. Considering this, it is apparent that even though PVC is combustible, its ability to spread flames via the façade or internally would be limited. This is demonstrated by the AS1530.3-1999 fire test, where Permaform achieved a Spread-of-Flame Index of 0, with 0 being the best and 10 being the worst.

There is a strong indication from the information presented above, that the Permaform outer layers would not support significant flame spread and will likely self-extinguish when the source of heat is removed. The PVC ignition temperature suggests that the Permaform outer layers (PVC) could ignite when an external source of heat is applied (i.e. flames from a window impinging onto the facade), however, with PVC's ability to char coupled with a low Flame Spread Index it suggests that the material away from the original flame source would unlikely be able to sustain flaming combustion that would result in significant fire spread

## 4. Conclusion

Based on the supporting test data and the inherent performance of PVC lined concrete, Permaform is considered to be capable of complying with the BCA via a combination of DTS Solutions and Performance Solutions as discussed within this document.



Etienne Jordaan

NSW – C10 Accredited Fire Engineer

VIC – Registered Building Practitioner (Fire Safety Engineer)

For **Wood & Grieve Engineers**

Date: 29/05/2019



## 5 Assessment Certificate

Figure 3 Certificate of Assessment 1950

Certificate of Assessment	
Quote No.: NK7079	No. 1950
"Copyright CSIRO 2014" Copying or alteration of this report without written authorisation from CSIRO is forbidden.	
This is to certify that the specimen described below was tested by the CSIRO Division of Materials Science and Engineering in accordance with Australian/ New Zealand Standard 3837, Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter, 1998, at 50 kW/m <sup>2</sup> , on behalf of:	
Permaform Australia Pty Ltd 6A Barrow Pl QUEANBEYAN NSW 2620 AUSTRALIA	
A full description of the test specimen and the complete test results are detailed in the Division's sponsored investigation report numbered FNK 11034.	
SAMPLE IDENTIFICATION:	Permaform
DESCRIPTION OF SAMPLE:	The sponsor described the tested specimen as a rigid PVC-based, hollow-type rib-reinforced plastic material comprising of two PVC panel facings with internal reinforced PVC ribs, used as permanent formwork for concrete walls. The rigid PVC profile formed the exposed face of the tested specimen. The specimen contained flame-retardant additives.
	Nominal thickness of PVC: 2.50 mm Nominal thickness of concrete block: 47 mm Nominal total thickness: 50 mm Nominal density of PVC: 1300 kg/m <sup>3</sup> Nominal total mass: 97.13 kg/m <sup>2</sup> Colour: beige (PVC)
SAMPLE CLASSIFICATION:	Group Number: Group 1 (In accordance with Specification A2.4 of the Building Code of Australia.)  Average specific extinction area: 236.8 m <sup>2</sup> /kg (Refer to Specification C1.10 section 4(c) of the Building Code of Australia.)
Testing Officer:	Heherson Alarde
Date of Test:	21 January 2014
Issued on the 4 <sup>th</sup> day of February 2014 without alterations or additions.	
 Brett Roddy Team Leader, Fire Testing and Assessments	
CSIRO INFRASTRUCTURE TECHNOLOGIES	
14 Julius Avenue, Riverside Corporate Park, North Ryde NSW 2113 AUSTRALIA Telephone: 61 2 9490 5444 Facsimile: 61 2 9490 5555 www.csiro.au	
	

## Test Report

No. AJHG1511009998FB

Date: NOV.23, 2015

Page 1 of 12

PERMAFORM AUSTRALIA LTD

219-18# XINFENG (S) ROAD SHANGHAI CHINA

The following sample(s) was / were submitted and identified on behalf of the client as:

### Sample Description:

PERMAFORM PVC WALL - Extruded rigid polyvinyl chloride (PVC)-based, hollow type rib reinforced plastic material comprising of two PVC panel facings with internal reinforced PVC ribs, used as permanent formwork for concrete walls; 110mm in thickness overall. The nominal thickness of the PVC on the face panels are 2.8mm up to 5mm at the anchor points.

### Test Requested:

AS 1530.4-2014 Method for fire tests on building materials, components and structures Part 4:

Fire-resistance test of elements of construction

**Test Results:** -- See attached sheet --

### Test Period:

Sample Receiving Date : NOV.18, 2015

Test Performing Date : NOV.18, 2015 TO NOV.20, 2015

SGS is recognised by the National Association of Testing Authorities Australia (NATA) through a mutual recognition agreement as defined by the Building Code of Australia (BCA) A1.1 as a Registered Testing Authority (RTA).

Signed for and on behalf of  
SGS-CSTC Co., Ltd. Anji Branch



Allen Zou  
Technical Manager



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Attention: To check the authenticity of testing / inspection report & certificate, please contact us at telephone: (86-755) 8327-9443, or email: [CN.doccheck@sgs.com](mailto:CN.doccheck@sgs.com)

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## Test Report

No. AJHG1511009998FB

Date: NOV.23, 2015

Page 2 of 12

### 1. Introduction

Determine the fire resistance of the non-load bearing vertical separating elements in accordance with section 3 of AS 1530.4-2014: Method for fire tests on building materials, components and structures part 4: Fire-resistance test of elements of construction.

The sample with 3000 mm width by 2750mm height by 110 mm thickness was symmetrical separating element, and one side was exposed to a time-temperature curve as dictated by the Clause 2.10 of AS 1530.4 for a period of 95 minutes under Non-loaded conditions.

### 2. Test Specimen

2.1 The direction of specimen tested was a random surface

Because of the specimen is a vertical symmetrical separating element

2.2 Description of specimen :

Total nominal installation dimensions of the specimen are 2750 mm length by 3000 mm width by 110 mm thickness.

The tested specimen was assembled by two panels with normal size 1550 mm width by 2750 height and another 1450 mm width by 2750 height. Installation detail, see Figure 1. The tested specimen was symmetrical and the specimen was mounted one side of specimen towards to the heating conditions of the test.

The specimen was installed into a prepared masonry wall with an opening size 3050mm width by 2800mm height and fixed by expansible bolt. Between all around of the sample and between two panels were filled with rock wool by laboratory. Installation was conducted by a representative of Lab on 19 NOV, 2015.

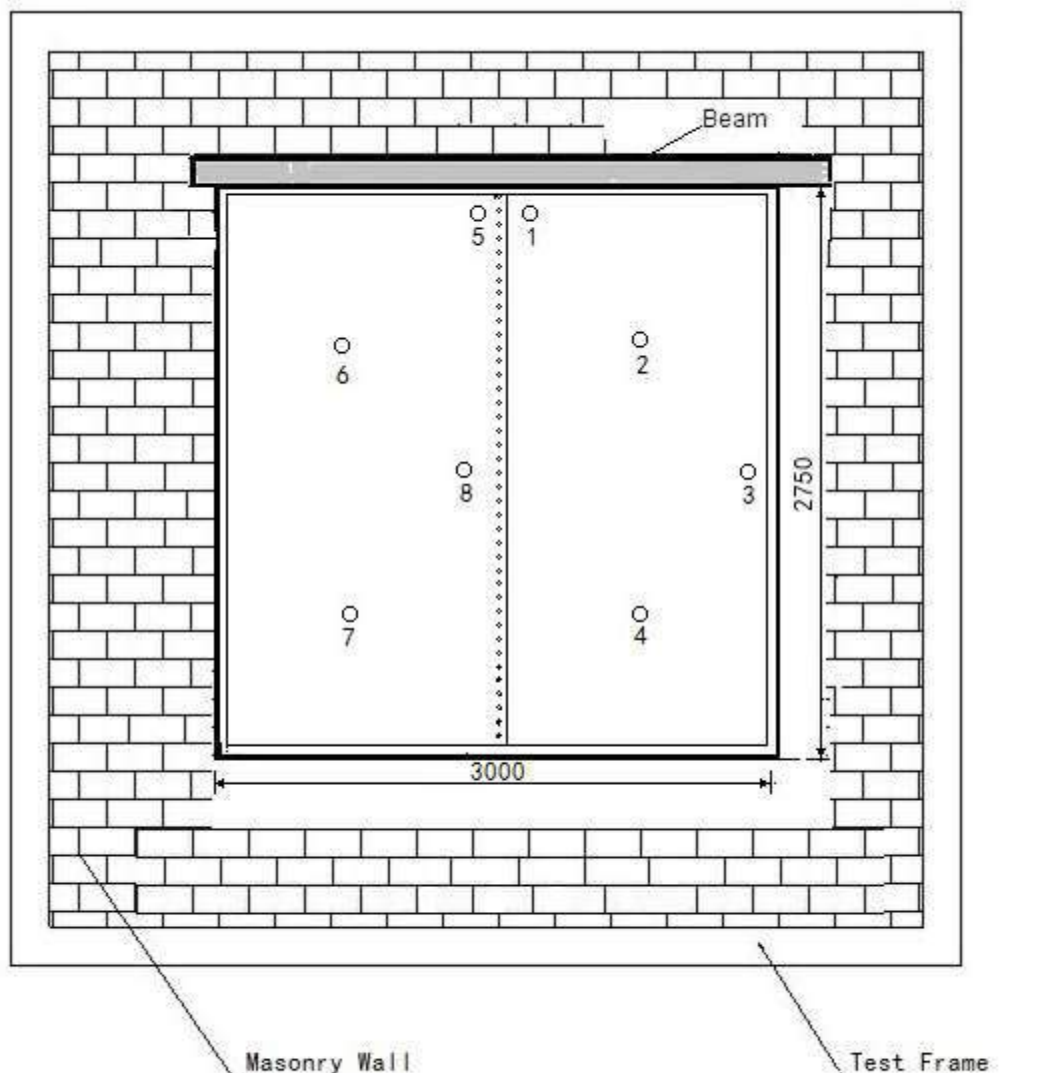
To be continued....



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Unit: mm



○ Position for thermocouples ( point 2、4、6、7、8 for average temperature )

Front View (Unexposed face)

Figure 1 - Elevation drawing of installation (Provided by client)

To be continued....

## Test Report

No. AJHG1511009998FB

Date: NOV.23, 2015

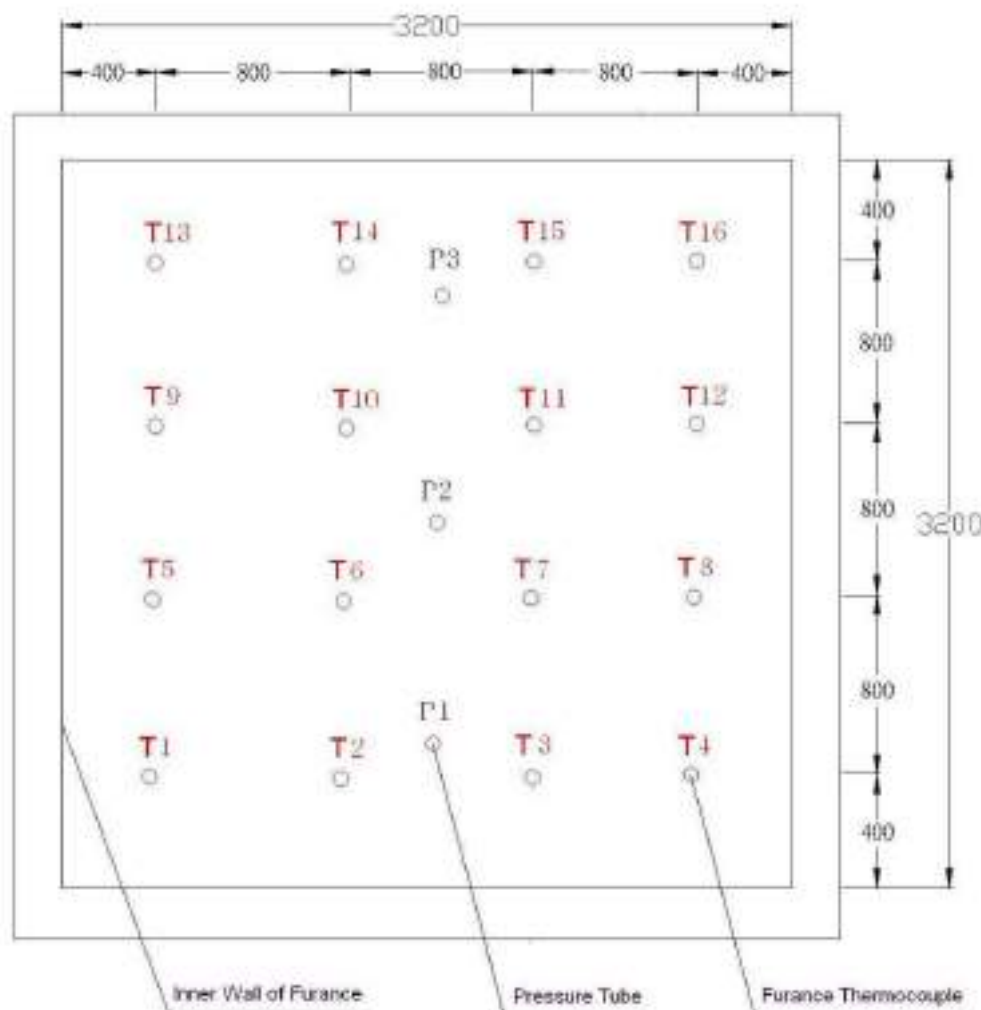
Page 4 of 12

### 3. Equipment

Sixteen mineral insulated thermocouples were kept at 100 mm away from the surface of the specimen, and were provided to monitor the temperature of the furnace. The locations and reference numbers of the furnace thermocouples are shown in Figure 2.

A pressure sensor was provided to monitor the furnace pressure.

Cotton pads and gap gauges were available to evaluate the impermeability of the specimen to hot gases.



All dimensions are in mm

Figure 2 - Plan of Furnace Thermocouples

To be continued....



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### 4. Test procedure

The test was conducted in accordance with the procedure specified in AS 1530.4-2014, section 3.

The ambient temperature of test area was 19°C at commencement of test with variation of 0°C during the test.

The furnace was controlled so that the mean furnace temperature, deviation from the mean furnace temperature and uniformity of temperature distribution complied with the requirement of AS 1530.4-2014.

Sixteen furnace thermocouples were used to determine the mean furnace temperature.

The furnace pressure was controlled to comply with the requirements of AS 1530.4-2014, Clause 2.10.3.

The furnace pressure was monitored and controlled. 5 min after the commencement of the test the furnace pressure was  $0 \pm 5$  Pa of the nominal pressure specified for the wall under test; from 10 min onwards it was  $0 \pm 3$  Pa of the nominal pressure specified for the particular element under test at a height of approximately 500 mm above the notional floor level.

Cotton pads and gap gauges were used to determine the integrity. The presence of sustained flaming on the unexposed surface was also checked to determine the integrity. The thermocouples specified in clause 2.2.3.1 were used to determine the insulation of specimen.

### 5. Test Results

The following data were recorded during the test:

- The actual mean furnace temperature/ time curve and the standard furnace temperature/ time curve, which were shown in Figure 3.
- The furnace pressures relative to laboratory atmosphere, at a height of approximately 500 mm above the notional floor level, which were shown in Figure 4.
- The mean and maximum temperature raises of the unexposed surface of were shown in Figure 5. The individual temperatures recorded on the unexposed surface of the specimen were shown in Table 1.

A summary of the observations made on the general behaviour of the specimen was given in Table 2.

To be continued....



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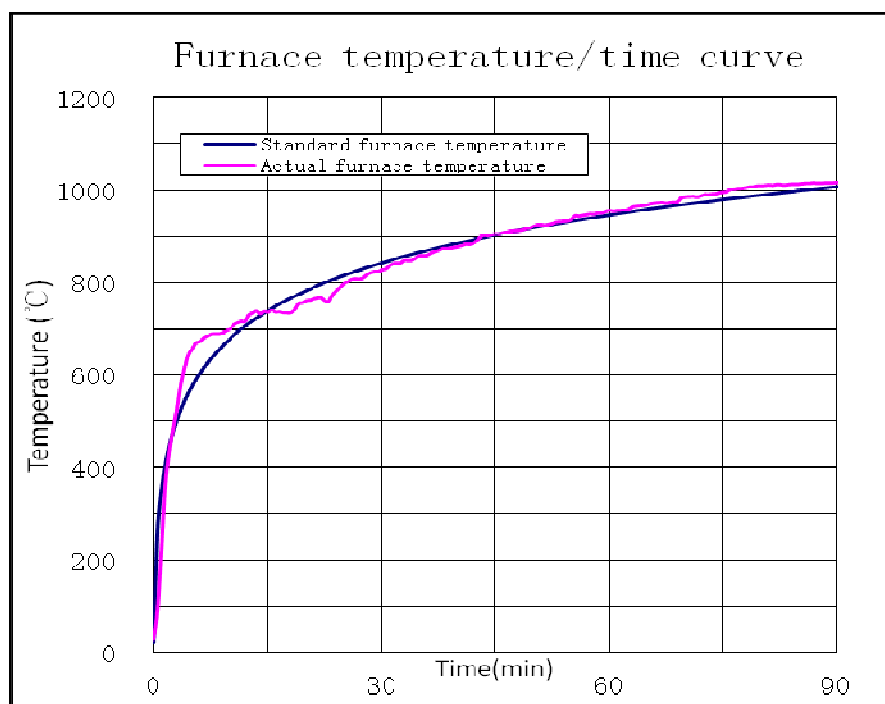


Figure 3 - Actual Mean and Standard Furnace Temperature/Time Curve

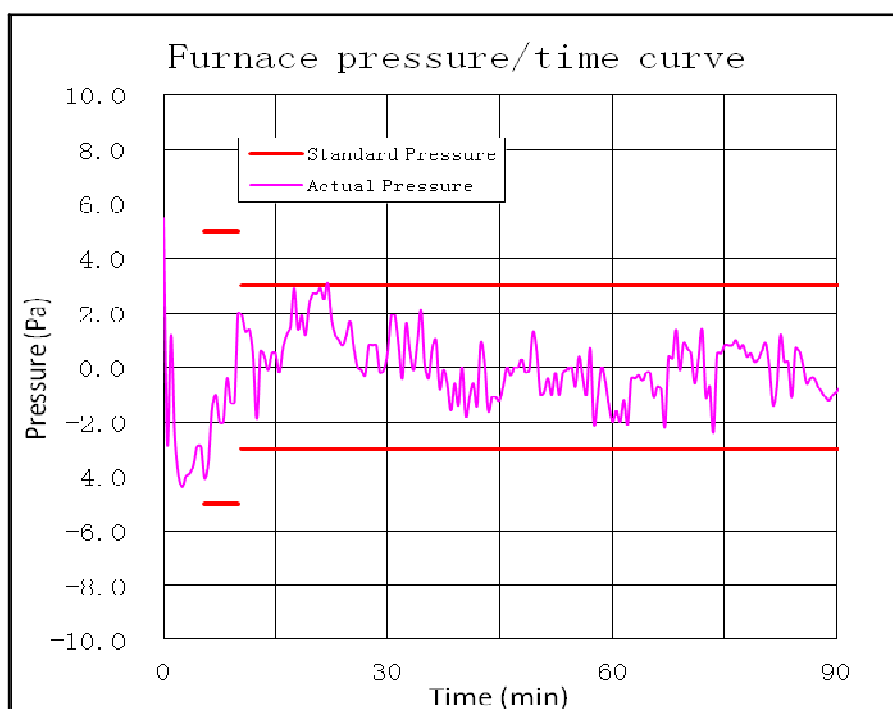


Figure 4 - Furnace Pressures Relative to Laboratory Atmosphere  
( 500 mm above the notional floor level )

To be continued....

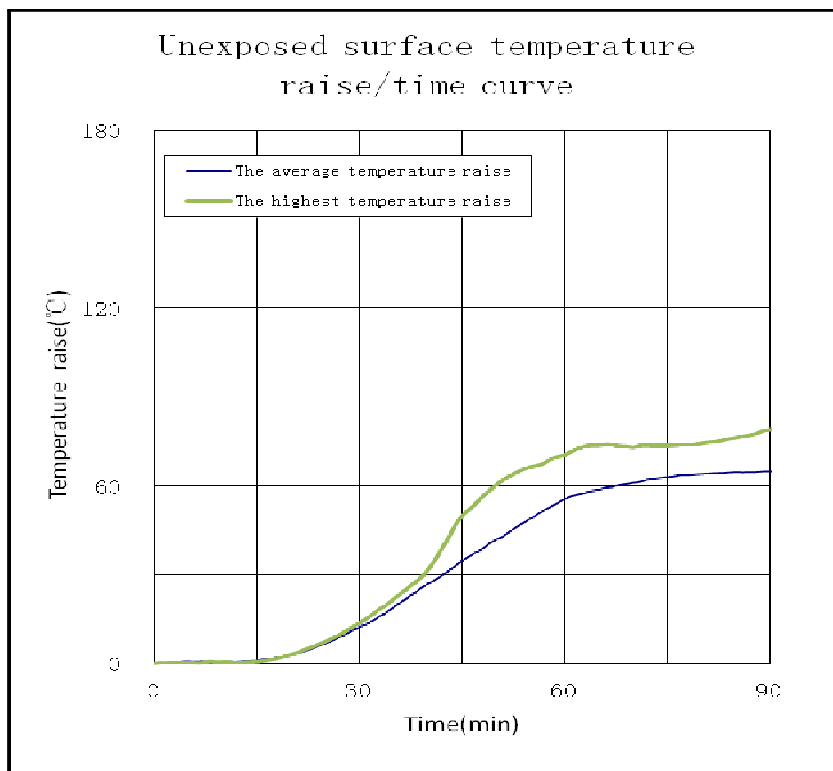


Figure 5 - Temperature raise/time curve

Table 1 Individual Temperatures Recorded on the Unexposed Surface of the Specimen (unit:°C)

Time (min)	1	2	3	4	5	6	7	8
0	18	18	17	17	20	18	18	19
5	19	18	19	17	20	18	19	19
10	19	18	19	17	20	18	19	19
15	20	18	19	18	20	18	20	20
20	21	20	21	20	23	20	22	22
21	22	21	22	21	23	20	23	23
22	23	21	22	21	24	21	23	23
23	23	22	23	22	25	21	24	24
24	24	23	24	23	26	22	26	25
25	25	24	25	24	27	23	26	26
26	25	24	26	25	28	24	28	27
27	26	26	27	26	29	25	29	28
28	27	26	28	27	31	26	30	29
29	28	28	29	28	32	27	32	31

To be continued....

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Time (min)	1	2	3	4	5	6	7	8
30	30	29	31	29	33	28	33	32
31	31	30	32	30	35	29	34	34
32	32	31	33	32	36	30	36	35
33	34	32	35	33	38	31	37	37
34	35	33	36	34	40	32	39	38
35	37	34	38	36	42	34	41	40
36	39	36	40	37	43	35	43	42
37	40	37	42	39	45	37	45	43
38	42	38	43	40	47	38	46	45
39	44	40	46	42	49	40	48	46
40	46	41	48	43	51	41	50	48
41	47	42	49	45	54	41	52	50
42	49	43	50	46	58	43	53	52
43	51	45	52	48	62	44	55	54
44	53	46	54	49	66	46	57	56
45	55	47	56	51	69	48	59	58
46	57	49	58	53	72	49	60	60
47	59	50	60	54	74	50	62	62
48	60	51	61	56	76	50	64	64
49	63	52	63	57	78	52	65	66
50	64	54	65	59	80	53	67	68
51	66	54	66	60	82	53	68	70
52	67	56	68	61	83	55	70	72
53	70	57	70	63	84	57	71	74
54	71	58	72	64	85	58	73	76
55	73	60	74	66	86	59	74	79
56	74	61	76	67	87	60	76	82
57	76	61	78	69	87	62	77	84
58	78	61	80	70	89	63	79	86
59	79	61	81	72	90	65	80	88
60	80	62	83	73	90	67	80	90
61	81	63	85	75	90	69	80	91

To be continued....



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Time (min)	1	2	3	4	5	6	7	8
62	82	64	86	75	90	69	80	92
63	84	64	86	75	90	70	80	93
64	85	65	86	76	91	71	80	93
65	85	68	86	76	91	71	80	93
66	86	70	86	77	91	71	81	94
67	86	71	86	77	92	71	81	94
68	86	73	86	78	91	71	81	93
69	86	74	87	79	91	71	81	93
70	87	75	87	79	91	72	81	93
71	86	76	86	80	91	72	81	93
72	87	77	86	81	91	72	82	93
73	87	78	86	82	91	72	81	93
74	87	79	87	83	91	72	81	93
75	87	80	87	83	91	72	81	93
76	87	81	87	83	91	72	81	93
77	87	81	86	84	92	72	82	94
78	87	82	86	84	92	72	82	94
79	86	82	86	84	92	72	82	94
80	86	83	86	84	92	73	83	94
81	86	83	86	84	92	72	83	94
82	87	84	86	84	92	72	83	95
83	87	84	86	84	92	72	83	95
84	87	85	86	84	92	73	83	96
85	87	85	86	84	92	73	83	96
86	87	85	86	84	92	73	82	96
87	87	85	86	85	92	73	83	97
88	87	85	86	84	92	73	83	97
89	87	85	86	84	92	73	83	98
90	87	85	86	84	92	73	83	99
91	87	85	86	84	92	73	84	99
92	87	85	86	85	92	74	84	100
93	87	85	87	85	92	74	84	100
94	88	85	87	85	92	74	84	101
95	88	85	87	85	92	74	84	101

To be continued....



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Table 2 Observations during the Test

Time (min:sec)	Observations
00:00	Furnace fired.
01:00	Smoke start to release from between the panels.
45:00	Slight deformation towards the furnace.
95:30	The deformation been larger than before, The sample keeps fire-resistance performance.test ended as client's requirement was achieved.

### 6. Performance Criteria (AS 1530.4-2014, Clause 2.12.2 and 2.12.3)

#### 6.1 Integrity

Failure in relation to integrity shall be deemed to have occurred when evaluated as follows:

##### 6.1.1 Cotton pad

The cotton pad in its frame shall be applied against the surface of the test specimen over the crack, fissure or flaming under examination, until ignition of the cotton pad (defined as glowing or flaming) or for a maximum of 30 seconds.

##### 6.1.2 Gap gauges

Gap gauges are used to evaluate the size of any opening in the surface of the test specimen at time intervals that will be determined by the apparent rate of the specimen deterioration.

a) a 6 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace and the gauge can be moved a distance of 150 mm along the gap; or

b) a 25 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace.

##### 6.1.3 Flaming

Sustained flaming on the surface of the unexposed surface for 10 seconds or longer constitutes integrity failure.

#### 6.2 Insulation

Failure in relation to insulation shall be deemed to have occurred when measured by thermocouples on the unexposed surface, the specimen is deemed to have failed when---

a) the mean temperature of the unexposed surface of the test specimen exceeds the initial temperature by more than 140 °C; or

b) the temperature at any location on the unexposed surface of the test specimen exceeds the initial temperature by more than 180 °C

To be continued....



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### 7. Conclusion

The tested specimen has been subjected to a fire resistance test in accordance with AS 1530.4-2014.

The fire resistance of the specimen was judged against the criteria for insulation and integrity as specified clause 6 of this report, and the specimen satisfied the performance requirements for the following period:

Insulation	Integrity
95min	95min

The test was terminated after a period of 95minutes.

None of the above criteria was observed or times exceeded in determination of periods of installation and integrity in excess of 120 minutes.  
No surface spalling was detected.

### STATEMENT:

The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions.

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not covered by this report.

Because of the nature of fire resistant and the consequent difficulty in quantifying the uncertainty of measurement of fire resistant, it is not possible to provide a stated degree of accuracy of the result.

Based on test performance of the full scale fire resistance test it is the opinion of the testing laboratory that temperature endured by a concrete filled Permaform wall would not burn or melt away the polymer webs to create holes under fire conditions.

Therefore the presence of web diaphragms will not affect the FRI capacity and smoke generation for the Permaform product tested in accordance with AS 1530.4-2014.

To be continued....



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### Appendix A Test photographs:



SGS authenticate the photo on original report only

\*\*\*End of report\*\*\*

## Test Report

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Date: JAN.13, 2016

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PERMAFORM AUSTRALIA LTD

219-18# XINFENG (S) ROAD SHANGHAI CHINA

The following sample(s) was / were submitted and identified on behalf of the client as:

### Sample Description:

PERMAFORM PVC WALL - Extruded rigid polyvinyl chloride (PVC)-based, hollow type rib reinforced plastic material comprising of two PVC panel facings with internal reinforced PVC ribs, used as permanent formwork for concrete walls; 150mm in thickness overall. The nominal thickness of the PVC on the face panels are 2.8mm up to 5mm at the anchor points.

### Test Requested:

AS 1530.4-2014 Method for fire tests on building materials, components and structures Part 4:  
Fire-resistance test of elements of construction

**Test Results:** -- See attached sheet --

### Test Period:

Sample Receiving Date : DEC.29, 2015

Test Performing Date : DEC.29, 2015 TO DEC.30, 2015

SGS is recognised by the National Association of Testing Authorities Australia (NATA) through a mutual recognition agreement as defined by the Building Code of Australia (BCA) A1.1 as a Registered Testing Authority (RTA).

Signed for and on behalf of  
SGS-CSTC Co., Ltd. Anji Branch



Allen Zou  
Technical Manager



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### 1. Introduction

Determine the fire resistance of the non-load bearing vertical separating elements in accordance with section 3 of AS 1530.4-2014: Method for fire tests on building materials, components and structures part 4: Fire-resistance test of elements of construction.

The sample with 3000 mm width by 2750mm height by 150 mm thickness was symmetrical separating element, and one side was exposed to a time-temperature curve as dictated by the Clause 2.10 of AS 1530.4 for a period of 95 minutes under Non-loaded conditions.

### 2. Test Specimen

2.1 The direction of specimen tested was a random surface

Because of the specimen is a vertical symmetrical separating element

2.2 Description of specimen :

Total nominal installation dimensions of the specimen are 2750 mm height by 3000 mm width by 150 mm thickness.

The tested specimen was assembled by two panels with normal size 1550 mm width by 2750 height and another 1450 mm width by 2750 height. Installation detail, see Figure 1. The tested specimen was symmetrical and the specimen was mounted one side of specimen towards to the heating conditions of the test.

The specimen was installed into a prepared masonry wall with an opening size 3050mm width by 2800mm height and fixed by expansible bolt. Between all around of the sample and between two panels were filled with rock wool by laboratory. Installation was conducted by a representative of Lab on 29 DEC, 2015.

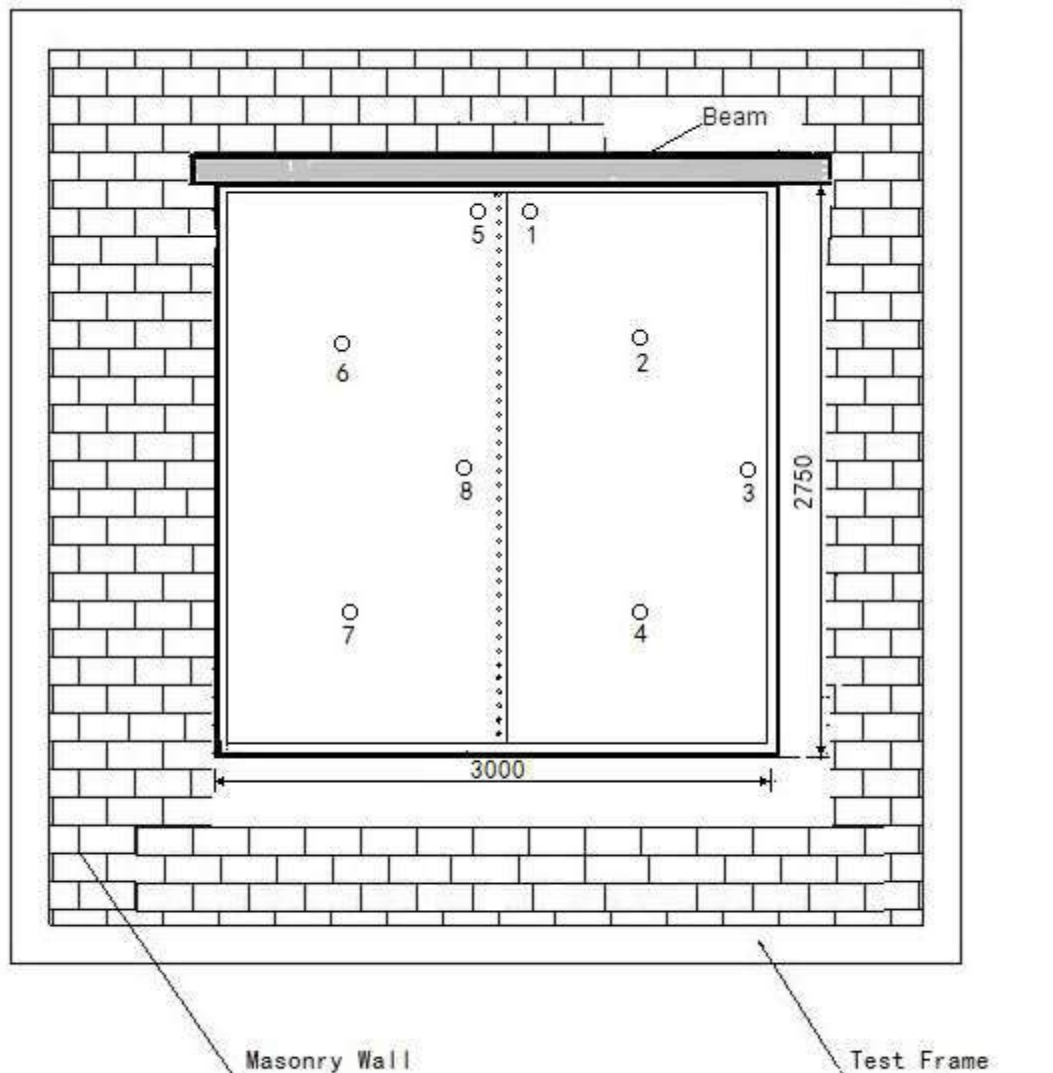
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Unit: mm



○Position for thermocouples ( point 2、4、6、7、8 for average temperature )

Front View(Unexposed face)

Figure 1 - The drawing of installation

To be continued....



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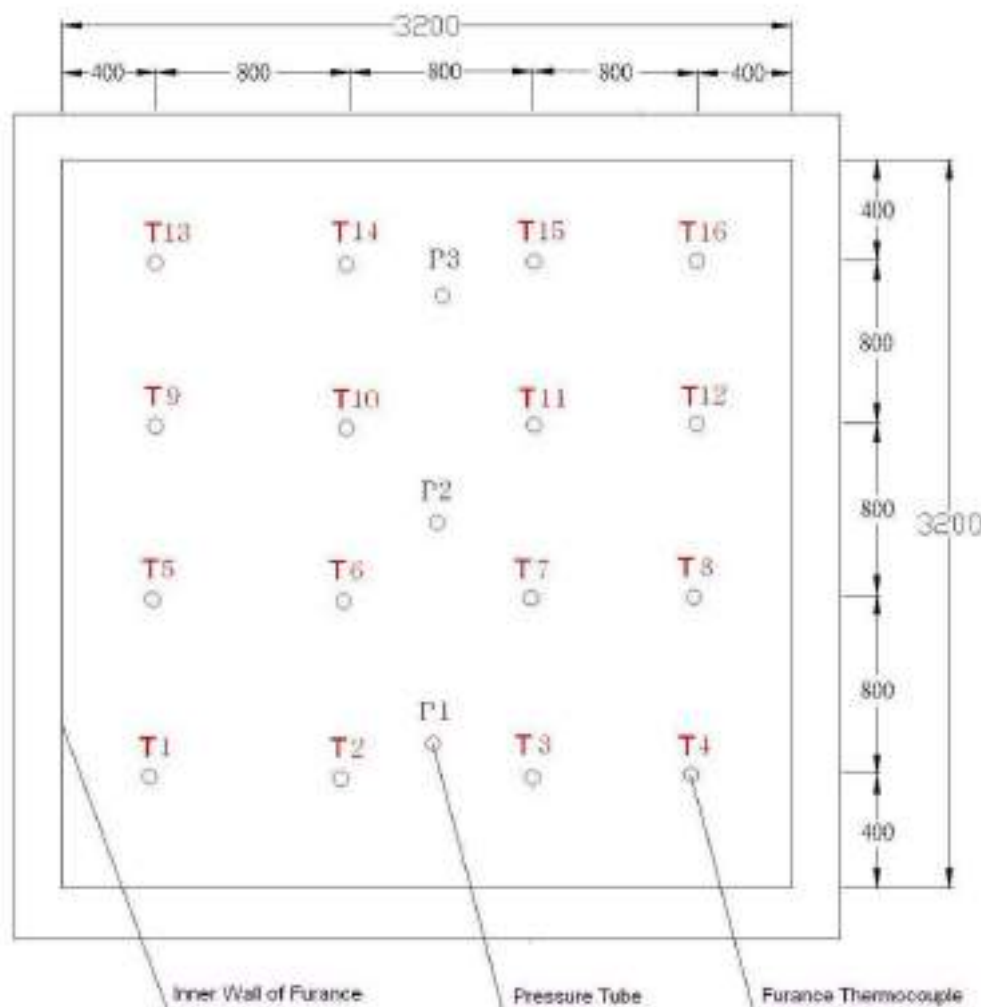
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### 3. Equipment

Sixteen mineral insulated thermocouples were kept at 100 mm away from the surface of the specimen, and were provided to monitor the temperature of the furnace. The locations and reference numbers of the furnace thermocouples are shown in Figure 2.

A pressure sensor was provided to monitor the furnace pressure.

Cotton pads and gap gauges were available to evaluate the impermeability of the specimen to hot gases.



All dimensions are in mm

Figure 2 - Elevation of Furnace Thermocouples

To be continued....

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### 4. Test procedure

The test was conducted in accordance with the procedure specified in AS 1530.4-2014, section 3.

The ambient temperature of test area was 15°C at commencement of test with variation of 0°C during the test.

The furnace was controlled so that the mean furnace temperature, deviation from the mean furnace temperature and uniformity of temperature distribution complied with the requirement of AS 1530.4-2014.

Sixteen furnace thermocouples were used to determine the mean furnace temperature.

The furnace pressure was controlled to comply with the requirements of AS 1530.4-2014, Clause 2.10.3.

The furnace pressure shall be monitored and controlled. 5 min after the commencement of the test the furnace pressure shall be  $0 \pm 5$  Pa of the nominal pressure specified for the particular element under test; from 10 min onwards it shall be  $0 \pm 3$  Pa of the nominal pressure specified for the particular element under test at a height of approximately 500 mm above the notional floor level.

Cotton pads and gap gauges were used to determine the integrity. The sustained flaming on the unexposed surface was also checked to determine the integrity. The thermocouples specified in clause 2.2.3.1 were used to determine the insulation of specimen.

### 5. Test Results

The following data were recorded during the test:

- The actual mean furnace temperature/ time curve and the standard furnace temperature/ time curve, which were shown in Figure 3.
- The furnace pressures relative to laboratory atmosphere, at a height of approximately 500 mm above the notional floor level, which were shown in Figure 4.
- The mean and maximum temperature raises of the unexposed surface of were shown in Figure 5. The individual temperatures recorded on the unexposed surface of the specimen were shown in Table 1.

A summary of the observations made on the general behaviour of the specimen was given in Table 2.

To be continued....



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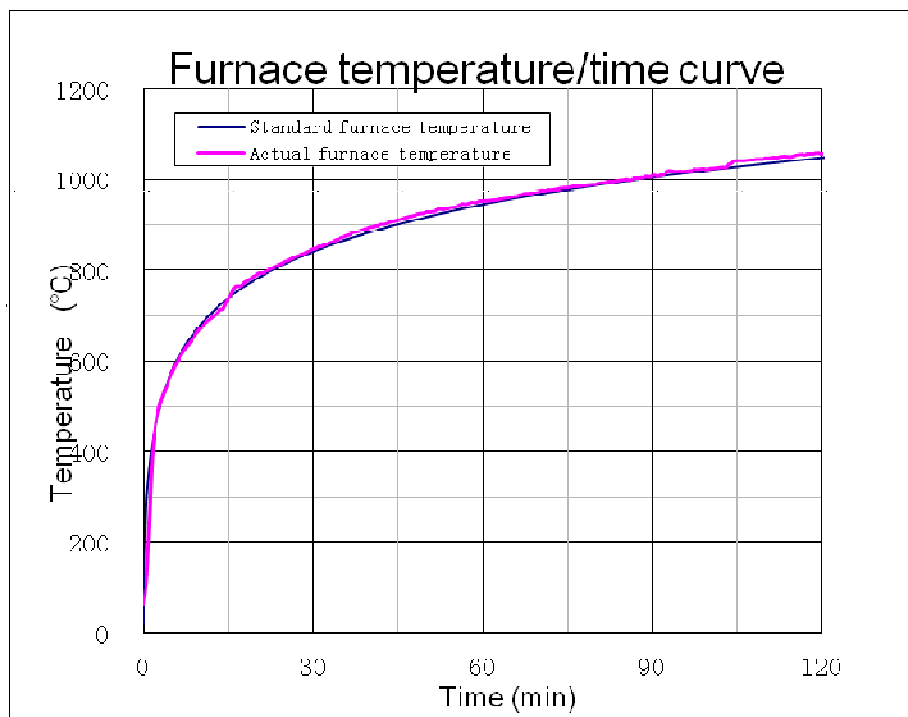


Figure 3 - Actual Mean and Standard Furnace Temperature/Time Curve

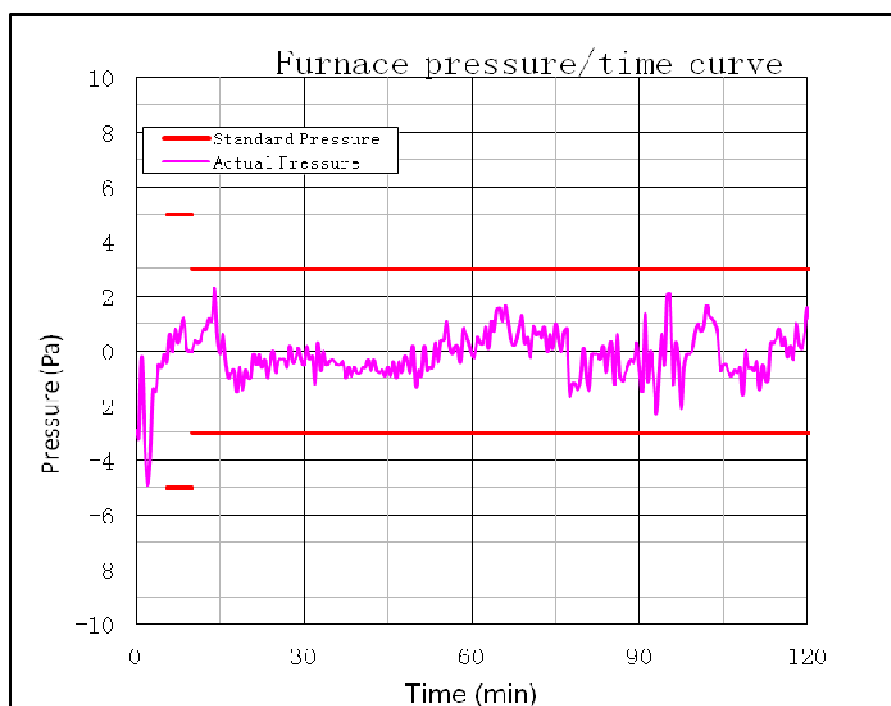


Figure 4 - Furnace Pressures Relative to Laboratory Atmosphere  
( 500 mm above the notional floor level )

To be continued....

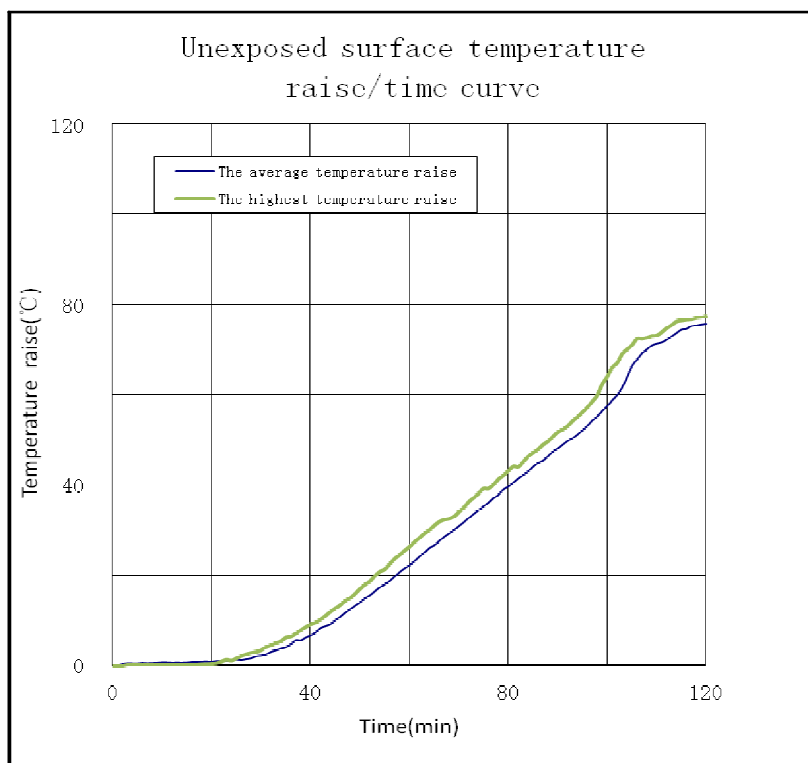


Figure 5 - Temperature raise/time curve

Table 1 Individual Temperatures Recorded on the Unexposed Surface of the Specimen (unit:°C)

Time (min)	Position of Thermocouples							
	1	2	3	4	5	6	7	8
0	15	14	15	14	14	14	14	15
1	15	14	15	14	14	14	14	15
2	15	15	15	14	14	15	14	15
3	15	15	15	14	14	15	14	15
4	15	15	15	14	14	15	14	15
5	15	15	15	14	14	15	14	15
6	15	15	15	14	14	15	14	15
7	15	15	15	14	14	15	14	15
8	15	15	15	14	14	15	14	15
9	15	15	15	14	14	15	14	15
10	15	15	15	14	14	15	14	15
11	15	15	15	14	14	15	14	15

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Time (min)	Position of Thermocouples							
	1	2	3	4	5	6	7	8
12	15	15	15	14	14	15	14	15
13	15	15	15	14	14	15	14	15
14	15	15	15	14	14	15	14	15
15	15	15	15	14	14	15	14	15
16	15	15	15	15	14	15	15	15
17	15	15	15	15	14	15	15	15
18	15	15	15	15	14	15	15	15
19	15	15	15	15	14	15	15	15
20	15	15	15	15	15	15	15	15
21	16	15	16	15	15	15	15	15
22	16	15	16	15	15	15	15	16
23	16	15	16	15	15	15	15	16
24	16	15	16	15	15	15	15	16
25	17	15	17	16	15	15	16	16
26	17	15	17	16	16	15	16	16
27	18	15	18	16	16	15	16	16
28	18	15	18	16	17	15	16	16
29	18	15	18	17	17	15	16	16
30	18	16	18	17	17	16	17	17
31	19	16	19	17	18	16	17	17
32	20	16	20	18	18	17	17	17
33	20	17	20	18	18	17	18	18
34	20	17	20	18	19	18	18	18
35	21	18	21	19	19	18	19	18
36	21	19	21	19	20	19	19	19
37	22	19	22	20	20	19	20	21
38	23	20	23	20	21	19	20	19
39	24	20	24	21	22	20	20	20
40	24	21	24	21	22	20	21	20
41	25	21	25	22	23	21	22	21
42	25	22	25	22	24	22	22	23
43	26	23	26	23	24	23	23	23
44	27	23	27	23	25	23	24	23
45	28	24	28	24	26	24	24	24
46	28	25	28	25	27	24	25	25
47	29	25	29	26	28	25	26	26

To be continued....



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Time (min)	Position of Thermocouples							
	1	2	3	4	5	6	7	8
48	30	26	30	27	28	26	27	27
49	31	27	31	27	29	27	27	28
50	32	28	32	28	30	28	28	29
51	33	29	33	29	31	29	29	30
52	34	29	34	29	32	30	30	30
53	35	30	35	31	33	30	31	31
54	36	31	36	32	34	31	32	32
55	36	32	36	32	34	31	32	33
56	38	32	38	33	36	32	33	33
57	39	34	39	34	36	33	34	34
58	40	34	40	35	37	34	35	35
59	41	35	41	36	38	35	36	35
60	41	36	41	37	39	35	37	36
61	42	37	42	38	40	36	38	37
62	43	38	43	39	41	37	39	38
63	44	39	44	40	42	38	40	39
64	45	40	45	41	42	39	40	40
65	46	41	46	42	44	40	42	40
66	47	42	47	42	44	41	42	41
67	47	42	47	43	45	42	43	42
68	48	43	48	44	45	43	44	43
69	48	44	48	45	46	43	45	44
70	49	45	49	46	47	44	46	45
71	50	46	50	47	48	46	47	45
72	51	47	51	47	49	47	47	46
73	52	48	51	48	50	47	48	47
74	53	49	53	49	50	48	49	47
75	54	49	54	50	51	49	50	48
76	54	50	54	51	52	50	51	49
77	55	51	55	52	53	51	52	50
78	56	52	56	53	54	52	53	51
79	57	53	57	54	54	53	54	52
80	58	53	57	54	56	54	54	52
81	59	55	59	55	56	55	55	53
82	59	55	59	56	57	55	56	54
83	60	56	60	57	58	56	57	55

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Time (min)	Position of Thermocouples							
	1	2	3	4	5	6	7	8
84	61	57	61	58	59	57	58	56
85	62	58	62	59	60	58	59	57
86	63	59	63	59	61	59	59	58
87	64	60	64	60	62	59	60	58
88	65	60	65	61	63	60	61	59
89	66	62	66	62	64	62	62	60
90	67	62	67	63	65	62	63	61
91	67	64	67	63	66	64	63	61
92	68	64	68	64	67	64	64	62
93	69	65	69	64	68	65	65	63
94	70	66	70	65	70	65	66	64
95	71	67	71	66	71	67	66	65
96	72	68	72	67	72	68	67	66
97	73	69	73	68	74	69	69	66
98	74	70	74	69	75	70	70	67
99	75	71	75	70	77	71	72	68
100	76	73	76	71	79	73	73	69
101	77	74	77	72	81	74	74	71
102	79	75	79	73	82	75	75	71
103	80	78	80	75	84	77	76	72
104	81	81	82	77	85	81	77	74
105	82	83	83	80	86	84	78	77
106	83	85	84	81	87	86	79	78
107	84	87	85	83	87	87	80	79
108	85	88	86	85	88	88	80	80
109	85	88	87	86	88	88	81	82
110	86	88	88	86	88	88	81	83
111	86	89	88	86	88	89	81	83
112	87	90	89	87	89	90	82	83
113	87	90	89	88	89	90	82	84
114	87	91	90	88	89	91	83	85
115	88	91	90	89	89	91	84	86
116	87	92	90	89	90	92	85	86
117	88	92	91	90	90	92	85	87
118	88	92	91	90	90	92	85	87
119	88	92	91	90	90	92	85	88
120	89	92	92	91	91	92	86	88

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Table 2 Observations during the Test

Time (min:sec)	Observations
00:00	Furnace fired.
01:00	Smoke start to release from between panels .
120:00	Slight deformation towards the furnace. The sample keeps fire-resistance performance end test as client's requirement.

### 6. Performance Criteria (AS 1530.4-2014, Clause 2.12.2 and 2.12.3)

#### 6.1 Integrity

Failure in relation to integrity shall be deemed to have occurred when evaluated as follows:

##### 6.1.1 Cotton pad

The cotton pad in its frame shall be applied against the surface of the test specimen over the crack, fissure or flaming under examination, until ignition of the cotton pad (defined as glowing or flaming) or for a maximum of 30s.

##### 6.1.2 Gap gauges

Gap gauges are used to evaluate the size of any opening in the surface of the test specimen at time intervals that will be determined by the apparent rate of the specimen deterioration.

- a) a 6 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace and the gauge can be moved a distance of 150 mm along the gap; or
- b) a 25 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace.

##### 6.1.3 Flaming

Sustained flaming on the surface of the unexposed surface for 10s or longer constitutes integrity failure.

#### 6.2 Insulation

Failure in relation to insulation shall be deemed to have occurred when measured by thermocouples on the unexposed surface, the specimen is deemed to have failed when---

- a) the mean temperature of the unexposed surface of the test specimen exceeds the initial temperature by more than 140 °C; or
- b) the temperature at any location on the unexposed surface of the test specimen exceeds the initial temperature by more than 180 °C

To be continued....



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### 7. Conclusion

The tested specimen has been subjected to a fire resistance test in accordance with AS 1530.4-2014.

The fire resistance of the specimen was judged against the criteria for insulation and integrity as specified clause 6 of this report, and the specimen satisfied the performance requirements for the following period:

Insulation	Integrity
≥120 mins	≥120 mins

The test was terminated after a period of 121minutes.

None of the above criteria was observed or times exceeded in determination of periods of installation and integrity in excess of 120 minutes.

No surface spalling was detected.

### STATEMENT:

The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions.

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not covered by this report.

Because of the nature of fire resistant and the consequent difficulty in quantifying the uncertainty of measurement of fire resistant, it is not possible to provide a stated degree of accuracy of the result.

Based on test performance of the full scale fire resistance test it is the opinion of the testing laboratory that temperature endured by a concrete filled Permaform wall would not burn or melt away the polymer webs to create holes under fire conditions.

Therefore the presence of web diaphragms will not affect the FRI capacity and smoke generation for the Permaform product tested in accordance with AS 1530.4-2014

To be continued....



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### Appendix A Test photographs:



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# Emission Test Certificate

Tuesday, February 26, 2013

Supplier: Permaform Australia (66 Hawdon St, Ainslee, ACT, 2620)

Sample Description: Permaform

Date Tested: February 2013

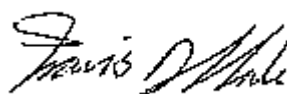
Test Method: ASTM D5116 "Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Material/Products".

Emission Data:

Specification	
<b>Green Building Council of Australia Green Star Office Design V1.1 IEQ-11</b>	<b>Permaform</b>
Total Volatile Organic Compound emission rate <0.5 mg/m <sup>2</sup> /hr	Total Volatile Organic Compound emission rate 0.225 mg/m <sup>2</sup> /hr



Dr. Vyt Garnys  
PhD, BSc(Hons) AIMM, ARACI, ISIAQ  
ACA, AIRAH, FMA  
Managing Director and Principal Consultant



Travis Hale  
BSc  
Consultant

**CV130219**



## Permaform Acoustic Assessment

For: Permaform

Report Number: R146207AC R1 14-05-22



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00	For Information	Jerremy Lofts	5 November 2013	Jerremy Lofts	5 November 2013
01	For Information	Jerremy Lofts	22 May 2014	Jerremy Lofts	23 May 2014

This report has been prepared in accordance with the scope of services described in the contract or agreement between Rudds Consulting Engineers Pty Ltd ABN 16 054 221 162 (Rudds) or Rudds Acoustics Pty Ltd ABN 41 147 203 610 and the client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the client. Furthermore, the report has been prepared solely for use by the client and Rudds accepts no responsibility for its use by other parties.

No acoustic test results have been provided in order to undertake these predictions. This being the case, Rudds recommends that prototype testing of the chosen wall system be undertaken prior to committing to large scale construction.

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## Section 1 - Introduction

Rudds Acoustics Pty Ltd. (Rudds) is pleased to provide a desktop assessment to determine configurations of two Permaform wall systems that will comply with Part F5 of the Building Code of Australia for acoustic performance.

These predictions are based upon a visual inspection of the product only. No test results, predictions or detailed acoustic data is currently available on the product. This being the case, Rudds recommends that prototype testing of the chosen wall system be undertaken prior to committing to large scale construction.

The product is a PVC system that acts as sacrificial formwork for concrete walls. It consists of a number of outer sides and edges with interlocking central link panels that join the faces prior to concrete core filling.

The sample provided to Rudds is the 110 mm wide product, consisting of 400 mm wide face panels linked at various intervals by 100 mm wide centre link panels. The link panels are 2 mm thick in the centre and have 60 mm diameter holes at 150 mm centres to allow for structural steel and will aid in even spreading of concrete. Rudds also expects these could be used for conduit reticulation where necessary.

The overall design creates a cavity of between 100 mm and 104 mm which is to be filled with concrete. It is understood that the concrete can be vibrated down if necessary by using a concrete vibrator.

Figure 1 shows a photograph of the sample provided.

**FIGURE 1 PERMAFORM PHOTOGRAPHS**



Permaform also provides 150 mm and 200 mm thick systems. Information is available in the brochures and on the website, but Rudds has not been provided with a sample of the 150 mm or 200 mm wide system. On the understanding that the face panels are the same as for the 110 mm system and the link panels are the only change, Rudds expects a total concrete thickness of not less than 140 mm for the 150 mm system and 190 mm for the 200 mm system when the panels are filled.

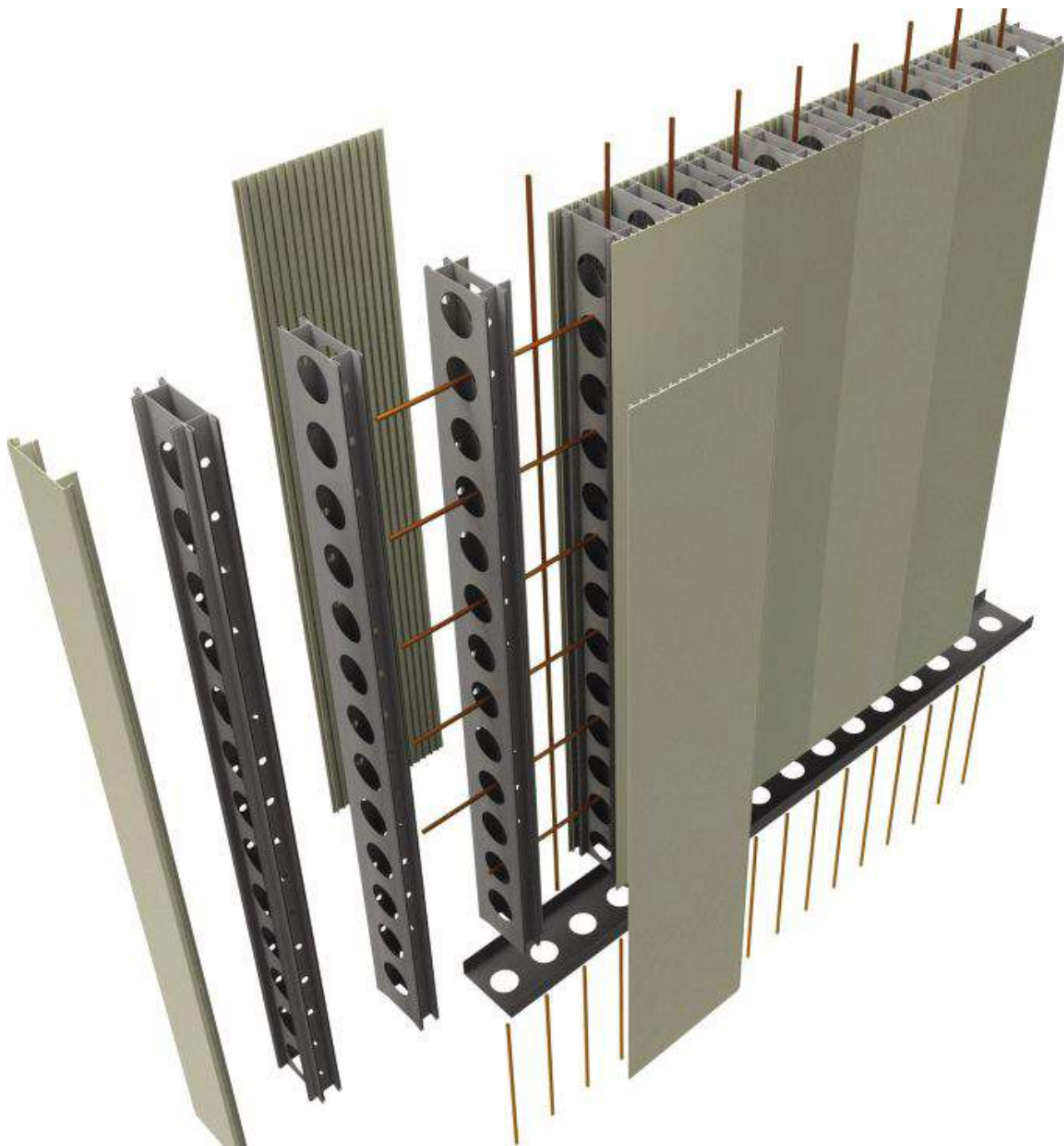
Figure 2 contains a picture from the Permaform website and brochure detailing the construction of the 200 mm thick system. It shows double bracing panels between the faces.

Actual link panel spacing is variable and will depend upon the final system requirements for each particular project. Rudds has assumed typical link panel spacing of 100 mm.

Rudds has undertaken this assessment assuming that the concrete will bond to the PVC structure and will not shrink away from the plastic. Rudds has also assumed that the final system, when constructed, will contain no substantial air voids or the like. Acceptable air voids include the small V shaped section behind the linking clips.



**FIGURE 2 PERMAFORM CONSTRUCTION**



Source: [www.permaform.com.au](http://www.permaform.com.au)

## Section 2 - BCA Requirements for Party Wall Systems

Acoustic design and construction requirements are prescribed in the Building Code of Australia (BCA).

In each case, the goal of the BCA is to protect the acoustic amenity of the occupants of the building through appropriate design and construction materials and methods. Building elements must provide insulation against the transmission of airborne and impact generated sound sufficient to prevent illness or loss of amenity to the occupants.

There are similar airborne and impact noise requirements depending upon the classification of the buildings, with the following being the relevant sections of the BCA 2014 for particular building classifications:

1. Part F5 of Volume 1 details requirements for Class 2 and Class 3 residential buildings and Class 9c aged care buildings.
2. Part 3.8.6 of Volume 2 details requirements for Class 1 residential buildings.

In each case, the requirements include acoustic requirements for the interface between the appropriate classification and parts of a different classification.

Table 1 contains the airborne and impact noise requirements for a party wall in a Class 2 or Class 3 residential development.

**TABLE 1 BCA 2014 REQUIREMENTS FOR CLASS 2 AND CLASS 3 BUILDINGS**

Item	Airborne Noise Requirement	Impact Noise Requirement
<b>Walls</b>		
Separating sole occupancy units	<b>Design Rating</b> Not less than $R_w + C_{tr}$ 50  <b>Field Rating</b> Not less than $D_{nT, w} + C_{tr}$ 45	Discontinuous construction is required if the wall is separating a bathroom, sanitary compartment, laundry or kitchen in one sole occupancy unit from a habitable room (other than a kitchen) in an adjoining unit.
Separating sole occupancy units from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	<b>Design Rating</b> Not less than $R_w$ 50  <b>Field Rating</b> Not less than $D_{nT, w}$ 45	Discontinuous construction is required if the wall is separating a sole occupancy unit from a plant room or lift shaft.

Discontinuous construction is defined by the BCA as a wall having a minimum 20 mm cavity between 2 separate leaves and:

1. For masonry, where wall ties are required to connect the leaves, the ties are of the resilient type
2. For other than masonry, there is no mechanical linkage between leaves except at the periphery.

In addition to the requirements contained in Table 1, the BCA 2014 sets minimum construction and detailing standards for acoustically rated partitions so as to minimise any weaknesses or degradation of the partitions during construction. Refer to the BCA for these requirements.

## Section 3 - BCA Compliant Permaform Wall Systems

Rudds has undertaken a desktop assessment of the Permaform wall systems at 110 mm, 150 mm and 200 mm thickness. The following wall systems are predicted to comply with the minimum requirements under the Building Code of Australia 2014 for acoustic performance. Three options for each wall system have been provided and are shown in Table 2, Table 3 and Table 4. These include:

1. Wall achieving minimum  $R_w$  50 (Suitable for use as a wall between a sole occupancy unit and a public corridor).
2. Wall achieving minimum  $R_w + C_{tr}$  50.
3. Wall achieving minimum  $R_w + C_{tr}$  50 and discontinuous construction.

It is important to understand that triple wall systems (systems containing a central element with linings either side) are particularly vulnerable to minor changes in design and construction. Under no circumstances should it be assumed that adding or changing a lining where it is not shown is acceptable. In many cases, changing the lining will reduce the acoustic performance of the wall and can have a detrimental effect on the  $C_{tr}$  value. Put simply, the  $C_{tr}$  value is a negative number that is applied to show the low frequency performance of the wall. The more negative the number, the poorer the acoustic performance in the low frequency range.

Rudds has also found that 51 mm steel studs may require bracing where walls are high. With modern apartment construction, it is not uncommon to have ceiling heights exceeding 2.4 metres. If the stud is braced back to the Permaform, this means the wall is no longer of discontinuous construction, and acoustic performance will be reduced. Therefore, we recommend using 64 mm steel studs for discontinuous wall systems.

**TABLE 2 110 MM PERMAFORM CORE WALL SYSTEMS**

One Side	Other Side	$R_w$ 50	$R_w + C_{tr}$ 50	Discontinuous
Paint, render or 13 mm thick direct stick plasterboard.	13 mm thick plasterboard on 16 mm furring channel mounted on furring channel clips to create a minimum cavity of 25 mm. Minimum 25 mm thick, 24kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✗	✗
Paint or render.	13 mm thick plasterboard on 16 mm furring channels mounted using resilient mounts to create a cavity not less than 45 mm. Minimum 50 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✗
13 mm plasterboard on 64 mm steel stud spaced minimum 20 mm clear of Permaform. No connection to the Permaform at any point. Minimum 75 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity.	13 mm thick plasterboard on 16 mm furring channel mounted on furring channel clips to create a minimum cavity of 25 mm. Minimum 25 mm thick, 24kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✓

**TABLE 3 150 MM PERMAFORM CORE WALL SYSTEMS**

One Side	Other Side	Rw 50	Rw+Ctr 50	Discontinuous
Paint or render.	Paint or render.	✓	✗	✗
Paint or render.	13 mm thick plasterboard on 16 mm furring channels mounted using resilient mounts to create a cavity not less than 45 mm. Minimum 50 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✗
13 mm plasterboard on 64 mm steel stud spaced minimum 20 mm clear of Permaform. No connection to the Permaform at any point. Minimum 75 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity.	13 mm thick plasterboard on 16 mm furring channel mounted on furring channel clips to create a minimum cavity of 25 mm. Minimum 25 mm thick, 24kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✓

**TABLE 4 200 MM CORE PERMAFORM WALL SYSTEMS**

One Side	Other Side	Rw 50	Rw+Ctr 50	Discontinuous
Paint or render.	Paint, render or 13 mm thick direct stick plasterboard	✓	✗	✗
Paint or render.	Paint or render or 13 mm thick plasterboard on 16 mm furring channels mounted using resilient mounts to create a cavity not less than 45 mm. Minimum 50 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✗
13 mm plasterboard on 64 mm steel stud spaced minimum 20 mm clear of Permaform. No connection to the Permaform at any point. Minimum 75 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity.	13 mm thick plasterboard on 16 mm furring channel mounted on furring channel clips to create a minimum cavity of 25 mm. Minimum 25 mm thick, 24kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity <sup>4</sup> .	✓	✓	✓

## Notes:

1. Green tick (✓) means the proposed construction is predicted to comply with the prescribed acoustic rating in the relevant column. The red cross (✗) means that it does not comply with the prescribed acoustic rating in the relevant column.
2. In all cases the 13 mm plasterboard can be substituted for 9 mm FC sheet, 10 mm CSR Soundchek plasterboard, 13 mm CSR Aquachek plasterboard or 16 mm thick fire rated plasterboard.
3. All furring channels and framing are 0.55 BMT steel.
4. The 25 mm insulation specified herein is suitable for a 25 mm cavity. For different cavity depths, consult your acoustic engineer for suitable construction.
5. Where polyester insulation is to be used it must be a high quality acoustic polyester insulation with acoustic absorption properties equal to the equivalent thickness of glasswool insulation.

## Section 4 - Glossary of Terms

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dB	Decibel. This is the unit measurement of sound.
dBA	A weighted decibel is the most commonly used descriptor. The A weighting is an adjustment to the raw sound level to approximate what the average human ear can hear, which is less sensitive at very low and very high frequencies.
Lw or SWL	Sound power level. This is the total radiated sound energy.
Lp or SPL	Sound pressure level. This is the measurable sound level at a given distance from an item.
$L_{\max}$	The RMS maximum noise level of a measurement
$L_{10}$	90 <sup>th</sup> percentile sound level of a measurement. Often called the average maximum noise level
$L_{eq}$	The energy average noise level of a measurement.
$L_{90}$	10 <sup>th</sup> percentile sound level of a measurement. Often called the average background noise level
$L_{\min}$	The minimum noise level of a measurement
$L_{eq(T)}$	The time (T) equivalent energy noise level. The time interval is often in blocks of 10 or 15 minutes for short term measurements, or hours for long-term measurements. Common increments for long term measurements are 1 hour, day, night, 18 hours and 24 hours.
$L_{eq(8h)}$	The 8 hour equivalent energy noise level. Primarily used for occupational noise assessments
$LC_{peak}$	The C weighted peak noise level. Primarily used for occupational noise assessments
Dw	The Weighted Level Difference as defined in AS/NZS ISO 717.1:2004. This is the single number rating describing the ability of a partition to reduce noise as measured in the field with no standardisation or normalisation.
Rw	The Weighted Sound Reduction Index. This is the single number rating describing the ability of a building element to reduce noise as measured in a laboratory. Assessed in accordance with AS/NZS ISO 717.1:2004.
NRC	Noise Reduction Coefficient. The NRC defines how much sound is absorbed by a surface. An NRC of 0 means it absorbs no sound while an NRC of 1 means it will absorb most sound.
CAC	Ceiling Attenuation Class. The CAC determines how much cross-talk will occur between one room and another through the ceiling cavity where both rooms have the tested ceiling tile. This is an ideal situation, with no wall head leaks and no services penetrations in the ceiling. Therefore, it defines the ideal, best possible result as tested in a laboratory.

# PERMAFORM ACOUSTIC OPINIONS

**Prepared for:**

Permaform International Pty Ltd  
6A Barrow Place  
Queanbeyan East NSW 2620

SLR Ref: 640.11733-R01  
Version No: -v0.1  
July 2018





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## BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Permaform International Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

## DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
640.11733-R01-v0.1	23 July 2018	Jim Antonopoulos	Dianne Williams	Jim Antonopoulos

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## 1 Introduction

SLR Consulting Australia Pty Ltd (SLR) were retained by Permaform International Pty Ltd (Permaform) to provide sound insulation ratings for their 250 mm thick concrete panel system. The sound insulation ratings are compared to the National Construction Code (NCC) acoustical provisions.

## 2 National Construction Code Acoustical Provisions

Part F5 of the National Construction Code 2016 (NCC 2016) issued by the Building Code of Australia (BCA) provides the requirements for the sound insulation performance of walls in Class 2 and 3 buildings. These are summarised in **Table 1**.

**Table 1 NCC / BCA Acoustical Provisions for Walls – Class 2 and 3 Building**

Construction Location	Required Acoustical Requirements
Walls between sole occupancy units	$R_w + C_{tr}$ not less than 50 dB
Walls between a bathroom, sanitary compartment, laundry or kitchen in one sole occupancy unit and a habitable room (other than a kitchen) in an adjoining unit	$R_w + C_{tr}$ not less than 50 dB AND Discontinuous Construction
Walls between sole occupancy units and a plant room or lift shaft	$R_w$ not less than 50 dB AND Discontinuous Construction
Walls between sole occupancy units and a stairway, public corridor, public lobby or the like, or parts of a different classification	$R_w$ not less than 50 dB

Discontinuous construction is defined as a wall having a minimum 20 mm cavity between two separate leaves with no mechanical linkage except at the periphery (Clause F5.3(c)).

Note that the NCC / BCA acoustical ratings include two different parameters; the  $R_w + C_{tr}$  which is used between sole occupancy units, and the  $R_w$  which is used between sole occupancy units and other uses.

## 3 Permaform Panel and Acoustical Ratings

The Permaform panels comprise a PVC formwork with poured concrete infill. The panels include central connecting ribs with large diameter holes to allow for concrete mixing and steel reinforcement as necessary. Our assumptions in relation to the provision of the acoustical ratings are as follows:

- The PVC formwork is typically 2 mm thick
- Ribs are provided at no closer than 100 mm within the panel
- Concrete is appropriately poured and vibrated / agitated such that there are no significant voids, and the concrete does not shrink away from the PVC facings forming small gaps.
- Concrete of density not less than 2300 kg/m<sup>3</sup>

### 3.1 Acoustical Tests

There are no laboratory tests of the system available.

SLR undertook field sound insulation testing of two different wall configurations utilising the Permaform 150 mm thick panels. The testing was undertaken on 12 July 2018 at 197-199 Lyons Road Drummoyne NSW, generally in accordance with the requirements of ISO 140-4 'Acoustics – Measurement of sound insulation in buildings and of building elements – Part 4:

The results of these tests, together with acoustical analysis and wall prediction theory, provide the basis of the acoustic opinions provided below.

### 3.2 Acoustical Ratings

Acoustical compliance ratings for a range of wall configurations are provided in **Table 2**.

Note that the lining configurations are consistent with those prepared by Rudds Consulting Engineers for 110 mm, 150 mm and 200 mm thick panels (refer to Rudds report dated 23 May 2014).

**Table 2 Acoustical Performance – 250 mm thick Permaform with various facings**

Wall Facing Side 1	Wall Facing Side 2	Rw 50 dB	Rw + Ctr 50 dB	Discontinuous Construction
Paint or render	Paint or render or 13mm thick direct fixed plasterboard (glue fixed / daubs)	✓	✓	✗
Paint or render	Paint or render or 13mm thick plasterboard on 16mm furring channels mounted using resilient mounts or clip system to create a cavity not less than 45mm. Minimum 50mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity	✓	✓	✗
13mm plasterboard on 64mm steel stud spaced minimum 20mm clear of Permaform. No connection to the Permaform at any point. Minimum 75 mm thick, 14kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity.	13mm thick plasterboard on 16mm or 28mm furring channel mounted on furring channel clips to create a minimum cavity of 25 mm. Minimum 25 mm thick, 24kg/m <sup>3</sup> polyester or glasswool acoustic insulation in cavity	✓	✓	✓

1. In all cases the 13 mm plasterboard can be substituted for 9 mm FC sheet, 10 mm sound-rated plasterboard (CSR Soundchek or USG Boral Soundstop), 13 mm wet area plasterboard or 16 mm thick fire rated plasterboard or other plasterboard type products with a surface density not less than 8.5 kg/m<sup>2</sup>.
2. The 25 mm insulation specified herein is suitable for a 25 mm cavity. For different cavity depths, consult acoustical engineer for suitable construction.
3. Where polyester insulation is to be used it must be a high quality acoustic grade polyester insulation with acoustic absorption properties equal to the equivalent thickness of glasswool insulation.

## ADDITIONAL NOTES

1. The  $R_w$  (Weighted Sound Reduction Index) is a single number index used to rate the sound insulation of a partition, against noises such as speech, which do not have significant low frequency components. The index given is the expected performance in a laboratory which tests to AS1191 "Acoustics – Method for Laboratory Measurement of the Airborne Sound Transmission Loss of Building Partitions", and determined according to the procedure in AS/NZS ISO 717.1 "Acoustics - Rating of Sound Insulation Buildings and of Building Elements – Airborne Sound Insulation". The rating obtained on a building site, called the Weighted Apparent Sound Reduction Index ( $R'_w$ ) may differ from the laboratory results.
2. The  $C_{tr}$  is an adaptation term which when applied to the  $R_w$  value results in a single number index which provides a more reliable indicator of the ability of the partition to isolate against certain types of noise. In particular, the  $R_w$  combined with the  $C_{tr}$  value gives a more reliable indicator of the ability of the partition to isolate against traffic noise, or noise containing some low frequency components. Refer also to AS/NZS ISO 717.1 "Acoustics - Rating of Sound Insulation Buildings and of Building Elements – Airborne Sound Insulation".
3. The expected tolerance is  $\pm 2\text{dB}$  for  $R_w$  and  $\pm 3\text{dB}$  for  $R_w + C_{tr}$ . This allows for variations in the test method, the difference between laboratories and the accuracy of the estimating techniques.
4. The opinions are based on the wall being of good construction and assume the face joints finished, the perimeters acoustically caulked and that there are no acoustical weaknesses in the wall etc.

Prepared by:



Jim Antonopoulos BAppSc MAAS  
Principal – Acoustics, SLR Consulting Australia Pty Ltd

## **REPORT No R-0111**

**Attention:** Robert Rech

**Client:** Permaform

**Re:** Permaform Wall Thermal performance calculations "Total R"

**Report Date:** 21/10/2019

**Compliance to:** AS/NZS 4859.2:2018 Thermal insulation materials for buildings - Design

The following calculations PF01-CALC01-01 to 04 were carried out by Andres Romero based on the following literature.

- 1) AS/NZS 4859.2:2018 Thermal insulation materials for buildings – Design
- 2) The Australian Institute of Refrigeration Air-Conditioning & Heating (AIRAH) handbook 2013, 5<sup>th</sup> edition.

Also, the following assumptions and/or procedures were used for the calculations

- Results are for the insulation path only and no thermal short circuiting by frames were considered.
- R-values for the air cavities were calculated based on AS/NZS 4859.2:2018 section 6 and only the converged result from the iterations are shown.
- Emittance value adjustments were done as per AS/NZS 4859.2:2018 section 5.3.2. which depending on the conditions of installation factors for deteriorations such as dust were added.

If any of the materials, thicknesses or conditions change from the ones in this report new calculations might be required in order to capture those modifications.



If you require any additional information or clarification, please don't hesitate to contact me.



## THERMAL PERFORMANCE CALCULATIONS

**Client:** Permaform

**Report Date:** 21/10/19

**Calculation No:** PF01-CALC01-01

**Calculations By:** Andres Romero - BE (Mech), MIEAust, CPEng, NER, RPEQ, M. AIRAH

**Product Name:** Permaform Wall System

Permaform G4AP110 wall (Bare)													
WALL ELEMENT	THK (mm)	k (W/m·K)	WINTER (6K)					SUMMER (12K)					NOTES
			R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	
Outside air film			0.040	12.00	12.92	12.46	0.92	0.040	36.00	34.15	35.08	1.85	1
PVC	2.0	0.159	0.013	12.92	13.21	13.07	0.29	0.013	34.15	33.57	33.86	0.58	4
32-40MPa concrete	106.7	1.43	0.075	13.21	14.94	14.08	1.72	0.075	33.57	30.12	31.85	3.45	3
PVC	2.0	0.159	0.013	14.94	15.23	15.08	0.29	0.013	30.12	29.54	29.83	0.58	4
Indoor air film			0.120	15.23	18.00	16.61	2.77	0.120	29.54	24.00	26.77	5.54	2
Total Thermal Resistance R <sub>Ti</sub> (m <sup>2</sup> ·K/W):			<b>0.26</b>					<b>0.26</b>					
Total Conductance U (W/m <sup>2</sup> ·K):			<b>3.85</b>					<b>3.85</b>					
C <sub>t</sub> (W/m <sup>2</sup> ):			<b>23.1</b>					<b>46.2</b>					
ΣΔt			6.0					12.0					

Summary table for Permaform Wall standard thicknesses (Bare)				
Permaform Wall Panel Type	TOTAL THK (mm)	Concrete THK (mm)	Winter TOTAL R	Summer TOTAL R
G4AP110	110.7	106.7	<b>0.26</b>	<b>0.26</b>
G4AP155	156.7	152.7	<b>0.29</b>	<b>0.29</b>
G4AP200	200.0	196.0	<b>0.32</b>	<b>0.32</b>
G4AP250	250.0	246.0	<b>0.36</b>	<b>0.36</b>

### NOTES:

- As per AS/NZS 4859.2:2018 section 8.a.
- As per AS/NZS 4859.2:2018 section 8 Table 15
- As per AIRAH Technical Handbook 2013 (pages 62-73)
- ASHRAE Handbook p.22.18 and Rochling technical data sheet tested to DIN 52612-1.
- Indoor and outdoor temperatures per AS/NZS 4859.2:2018 section 5.
- Thermal short circuiting by frames was not considered here as evaluation is for the insulation path only.
- These results are not compliant for labeling of insulation products to AS/NZS 4859.1:2018 section 3 without an independent endorsement from a recognised laboratory.



## THERMAL PERFORMANCE CALCULATIONS

**Client:** Permaform

**Report Date:** 21/10/19

**Calculation No:** PF01-CALC01-02

**Calculations By:** Andres Romero - BE (Mech), MIEAust, CPEng, NER, RPEQ, M. AIRAH

**Product Name:** Permaform Wall System

Permaform G4AP110 wall + 50mm H grade EPS + 8mm render + 2mm texture coat													
WALL ELEMENT	THK (mm)	k (W/m·K)	WINTER (6K)					SUMMER (12K)					NOTES
			R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	
Outside air film			0.040	12.00	12.14	12.07	0.14	0.040	36.00	35.70	35.85	0.3	1
Texture coat	2.0	0.4	0.005	12.14	12.16	12.15	0.02	0.005	35.70	35.66	35.68	0.0	3
Render	8.0	0.4	0.020	12.16	12.23	12.20	0.07	0.020	35.66	35.51	35.59	0.1	3
EPS grade H	50.0	0.037	1.390	12.23	17.21	14.72	4.98	1.317	35.51	25.65	30.58	9.9	3, 8
PVC	2.0	0.159	0.013	17.21	17.26	17.24	0.05	0.013	25.65	25.55	25.60	0.1	4
32-40MPa concrete	106.7	1.43	0.075	17.26	17.53	17.39	0.27	0.075	25.55	24.99	25.27	0.6	3
PVC	2.0	0.159	0.013	17.53	17.57	17.55	0.05	0.013	24.99	24.90	24.95	0.1	4
Indoor air film			0.120	17.57	18.00	17.79	0.43	0.120	24.90	24.00	24.45	0.9	2
Total Thermal Resistance R <sub>T</sub> (m <sup>2</sup> ·K/W):			1.67					1.60					
Total Conductance U (W/m <sup>2</sup> ·K):			0.60					0.62					
C <sub>t</sub> (W/m <sup>2</sup> ):			3.6					7.5					
ΣΔt			6.0					12.0					

## THERMAL PERFORMANCE CALCULATIONS

**Client:** Permaform

**Report Date:** 21/10/19

**Calculation No:** PF01-CALC01-03

**Calculations By:** Andres Romero - BE (Mech), MIEAust, CPEng, NER, RPEQ, M. AIRAH

**Product Name:** Permaform Wall System

Permaform G4AP110 wall + 50mm 32kg/m <sup>3</sup> XPS + 8mm render + 2mm texture coat													
WALL ELEMENT	THK (mm)	k (W/m·K)	WINTER (6K)					SUMMER (12K)					NOTES
			R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	R (m <sup>2</sup> ·K/W)	°C OUT	°C IN	°C AVG	Δt	
Outside air film			0.040	12.00	12.11	12.06	0.11	0.040	36.00	35.76	35.88	0.2	1
Texture coat	2.0	0.40	0.005	12.11	12.13	12.12	0.01	0.005	35.76	35.73	35.75	0.0	3
Render	8.0	0.40	0.020	12.13	12.18	12.15	0.06	0.020	35.73	35.61	35.67	0.1	3
Extruded Polystyrene (32kg/m <sup>2</sup> )	50.0	0.028	1.854	12.18	17.38	14.78	5.20	1.726	35.61	25.31	30.46	10.3	3, 8
PVC	2.0	0.159	0.013	17.38	17.42	17.40	0.04	0.013	25.31	25.24	25.27	0.1	4
32-40MPa concrete	106.7	1.43	0.075	17.42	17.63	17.52	0.21	0.075	25.24	24.79	25.01	0.4	3
PVC	2.0	0.159	0.013	17.63	17.66	17.65	0.04	0.013	24.79	24.72	24.75	0.1	4
Indoor air film			0.120	17.66	18.00	17.83	0.34	0.120	24.72	24.00	24.36	0.7	2
Total Thermal Resistance R <sub>T</sub> (m <sup>2</sup> ·K/W):			2.14					2.01					
Total Conductance U (W/m <sup>2</sup> ·K):			0.47					0.50					
C <sub>t</sub> (W/m <sup>2</sup> ):			2.8					6.0					
ΣΔt													12.0

Summary table for Permaform Wall standard thicknesses plus 50mm 32kg/m <sup>3</sup> XPS + 8mm render + 2mm texture coat				
Permaform Wall Panel Type	TOTAL THK (mm)	Concrete THK (mm)	Winter TOTAL R	Summer TOTAL R
G4AP110	110.7	106.7	2.14	2.01
G4AP155	156.7	152.7	2.17	2.04
G4AP200	200.0	196.0	2.20	2.07
G4AP250	250.0	246.0	2.24	2.11

### NOTES:

- As per AS/NZS 4859.2:2018 section 8.a.
- As per AS/NZS 4859.2:2018 section 8 Table 15
- As per AIRAH Technical Handbook 2013 (pages 62-73)
- ASHRAE Handbook p.22.18 and Rochling technical data sheet tested to DIN 52612-1.
- Indoor and outdoor temperatures per AS/NZS 4859.2:2018 section 5.
- Thermal short circuiting by frames was not considered here as evaluation is for the insulation path only.
- These results are not compliant for labeling of insulation products to AS/NZS 4859.1:2018 section 3 without an independent endorsement from a recognised laboratory.
- 32kg/m<sup>2</sup> extruded polystyrene k= 0.028W/m·K @ 23°C. R adjusted as per AS/NZS 4859.2:2018 section 5.2.



## THERMAL PERFORMANCE CALCULATIONS

**Client:** Permaform

**Report Date:** 21/10/19

**Calculation No:** PF01-CALC01-04

**Calculations By:** Andres Romero - BE (Mech), MIEAust, CPEng, NER, RPEQ, M. AIRAH

**Product Name:** Permaform Wall System

Permaform G4AP110 wall + 28mm air space + 10mm plasterboard													
WALL ELEMENT	THK (mm)	k (W/m·K)	WINTER (6K)					SUMMER (12K)					NOTES
			R (m²·K/W)	°C OUT	°C IN	°C AVG	Δt	R (m²·K/W)	°C OUT	°C IN	°C AVG	Δt	
Outside air film			0.040	12.00	12.15	12.08	0.15	0.040	36.00	35.68	35.84	0.3	1
PVC	2.0	0.159	0.013	12.15	12.20	12.18	0.05	0.013	35.68	35.58	35.63	0.1	4
32-40MPa concrete	106.7	1.430	0.075	12.20	12.48	12.34	0.28	0.075	35.58	34.98	35.28	0.6	3
PVC	2.0	0.159	0.013	12.48	12.53	12.51	0.05	0.013	34.98	34.88	34.93	0.1	4
Foilboard SL grade polystyrene	15.0	0.034	0.456	12.53	14.27	13.40	1.74	0.428	34.88	31.46	33.17	3.4	8
Unventilated reflective air space	28.0	0.035	0.800	14.27	17.32	15.79	3.05	0.753	31.46	25.43	28.45	6.0	
Plasterboard	10.0	0.169	0.059	17.32	17.54	17.43	0.23	0.059	25.43	24.96	25.20	0.5	3
Indoor air film			0.120	17.54	18.00	17.77	0.46	0.120	24.96	24.00	24.48	1.0	2
Total Thermal Resistance $R_T$ (m²·K/W):			1.57					1.50					
Total Conductance U (W/m²·K):			0.63					0.67					
$C_t$ (W/m²):			3.8					8.0					
$\Sigma \Delta t$													
			6.0					12.0					

Summary table for Permaform Wall standard thicknesses plus 28mm air space + 10mm plasterboard				
Permaform Wall Panel Type	TOTAL THK (mm)	Concrete THK (mm)	Winter TOTAL R	Summer TOTAL R
G4AP110	110.7	106.7	1.57	1.50
G4AP155	156.7	152.7	1.61	1.54
G4AP200	200.0	196.0	1.64	1.57
G4AP250	250.0	246.0	1.67	1.61

### NOTES:

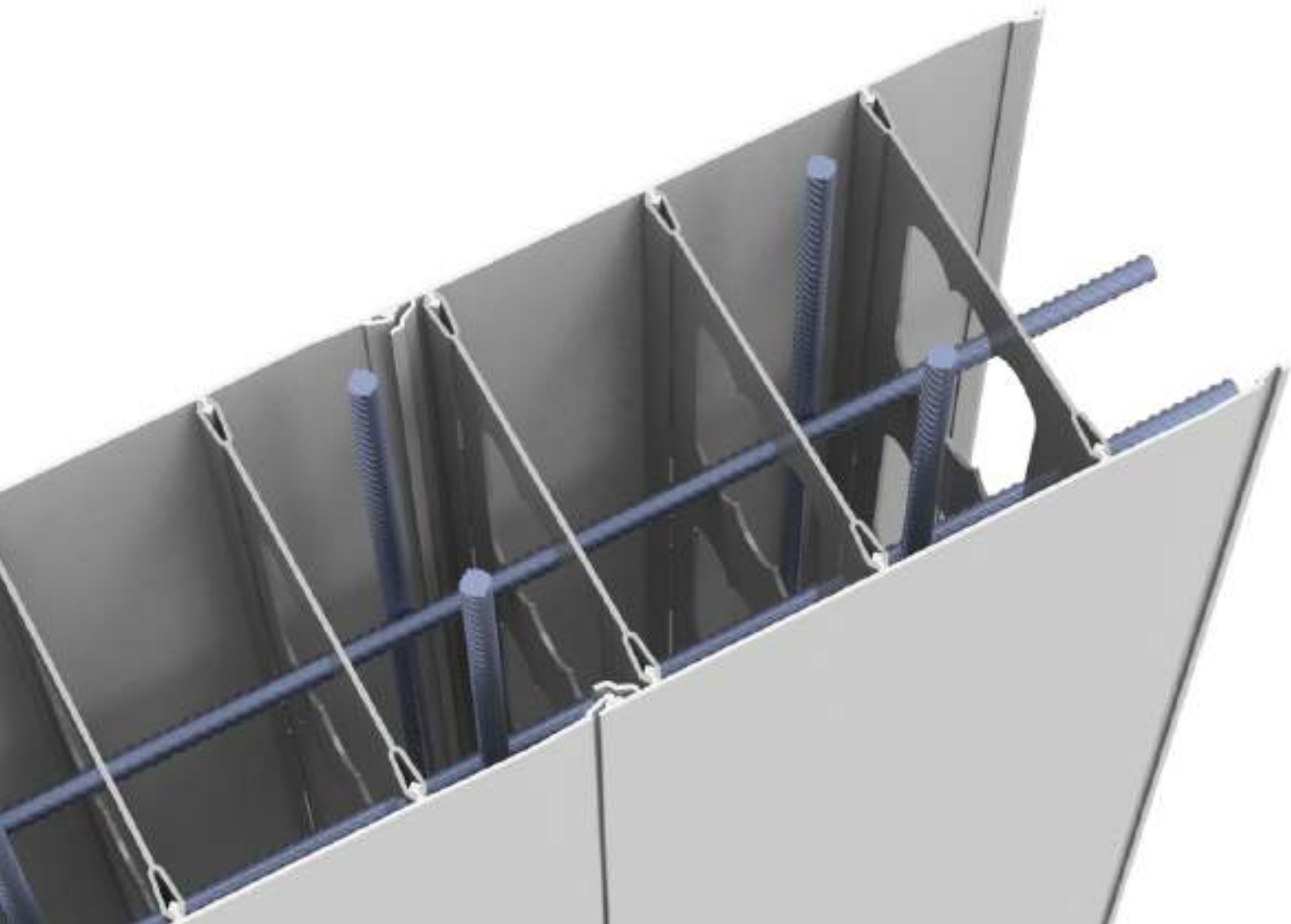
- As per AS/NZS 4859.2:2018 section 8.a.
  - As per AS/NZS 4859.2:2018 section 8 Table 15
  - As per AIRAH Technical Handbook 2013 (pages 62-73)
  - ASHRAE Handbook p.22.18 and Rochling technical data sheet tested to DIN 52612-1.
  - Indoor and outdoor temperatures per AS/NZS 4859.2:2018 section 5.
  - Thermal short circuiting by frames was not considered here as evaluation is for the insulation path only.
  - These results are not compliant for labeling of insulation products to AS/NZS 4859.1:2018 section 3 without an independent endorsement from a recognised laboratory.
  - Foilboard 15mm foil based SL grade polystyrene  $k = 0.034 \text{ W/m·K}$  @ 23°C. R adjusted as per AS/NZS 4859.2:2018 section 5.2.
  - Unventilated air space with uniform parallel surfaces was calculated based on AS/NZS 4859.2:2018 section 6 and incorporating emittance value adjustments as per AS/NZS 4859.2:2018 section 5.3.2.
- Cavity properties were assumed as,  $e_1 = 0.03$  and  $e_2 = 0.87$ .





# PERMAFORM

QUICK ► STRONG ► STRAIGHT



## INSTALLATION MANUAL

V2.0 AUGUST 2019

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(1800 737 623)  
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## APPENDICES

• TECH-SPECS DATASHEET
• MSDS SAFETY DATA SHEET
• TERMS AND CONDITIONS OF SALE
• PRODUCT CATALOGUE
• PRE-POUR CHECKLIST

**Date:** August 2019

**Version:** 2.0

**Revisions:**

Void rectification process; Tech-specs datasheet; pre-pour checklist; formatting and images

**Disclaimer:** To be read in conjunction with PERMAFORM INTERNATIONAL P/L TERMS AND CONDITIONS (found in appendices) and 1. Installers' liability. The detailing in this document are to be treated as general guidance and not project specific.

# INTRODUCTION AND INSTALLERS' LIABILITY

PERMAFORM is a Polyvinyl Chloride (PVC) permanent formwork wall system for structural elements which is concrete filled.

The installation of PERMAFORM should only be undertaken by persons with building industry knowledge and who have a trade background.

While every effort has been taken to make this guide as comprehensive as possible, it is not feasible to produce a document that pre-empts every detail and circumstance that could arise in the process of installing PERMAFORM. This document is produced solely as a guide. It is the responsibility of the installer to read and understand this manual thoroughly.

To ensure successful installation of PERMAFORM, it is critical that builders and trades people follow the recommended practises within. Installers of PERMAFORM should either be - or be supervised by – those with at least conventional form-working, carpentry or foreman qualifications to adhere to safe construction practices.

These include the requirements of the applicable local authority's Occupational Health and Safety rules and building codes of practice for form-working and concrete steel placement.

As the manufacturer, PERMAFORM International accepts no liability for any consequences whatsoever that arise as a result of the use of PERMAFORM on any site or in any application. By undertaking to install PERMAFORM, the persons doing so acknowledge they have the skills, knowledge, experience and ability to safely, efficiently and professionally install PERMAFORM; thereby indemnifying PERMAFORM International from any claim that arises from such installation except to make good or replace (at their discretion) any product that has failed as a result of defective materials or manufacture.

## 1A. BULGING AND BLOW-OUTS

During and after pouring concrete, bulging or 'blow-outs' can occur at panel joints if the ribs within the panels have been damaged.

It is the responsibility of the installer to ensure no PERMAFORM ribs or panels are damaged prior to pouring. This manual includes a pre-pour checklist for installers to help mitigate this risk. As the manufacturer, PERMAFORM International accepts no responsibility for installation issues that may occur on the construction site after acceptance of the product. (Refer Terms and Conditions of Sale – in the appendices.)

## 2 SAFETY

Installers of PERMAFORM must adhere to all safety standards normally required of formworking and concreting trades.

If the product needs to be cut or drilled on-site, installers must wear appropriate PPE (Personal Protective Equipment) including dust-proof respirators and protective eyewear. Appropriate, safety-tagged cutting tools – drills, grinders with steel blades and circular saws – must be used.

Depending on profile width and length, panels typically weigh between 15kgs and 18kgs per square metre.

Panels up to 20kgs can be safely handled by one person, 20kgs – 40kgs should be handled by two people.

Always follow safe manual handling practices.

TYPICAL WEIGHTS FOR HANDLING	
Profile	Weight per square metre
110mm	14.7 kg
150mm	15.8 kg
200mm	16.8 kg
250mm	17.8 kg

PERMAFORM panels do not require any specific PPE. Gloves are not essential, however on sites where mandatory, gloves with rubber fingers and palm infills will reduce the risk of slipping.

PERMAFORM should not be installed in high-wind conditions.

Please refer to PERMAFORM's MSDS in the appendices.



PERMAFORM'S MSDS

# 3

## DELIVERY AND UNLOADING

### 3A. PACKAGING

PERMAFORM is typically delivered to site in packs – by either a rigid or semi - packaged in timber frames, nailed together and secured by steel strapping.

Depending on profile widths ordered, packs may contain from 12 to 27 panels.

Accessories are packed carefully on an order-by-order basis and will typically arrive with timber spacings to best fit the configuration of the rest of the order.

The number of panels and configuration in each pack – and on each truck - will vary depending on the profile width and length and accompanying accessories.

### 3B. ACCEPTANCE

Particular care must be taken by the client (or representative) to ensure the unloading and storage of the product on site does not incur damage to the product. Clients are required to sign a Proof of Delivery Docket upon receipt of their order confirming the order has been received in good condition.

Once products are inspected, signed for and accepted on-site – PERMAFORM International is indemnified from any claim that arises. This is particularly important as installing damaged products can lead to blow-outs, bulging and other defects which PERMAFORM cannot accept liability for once acceptance of the product is signed for.

EXAMPLE: 200MM PROFILE AT 3M LENGTHS:

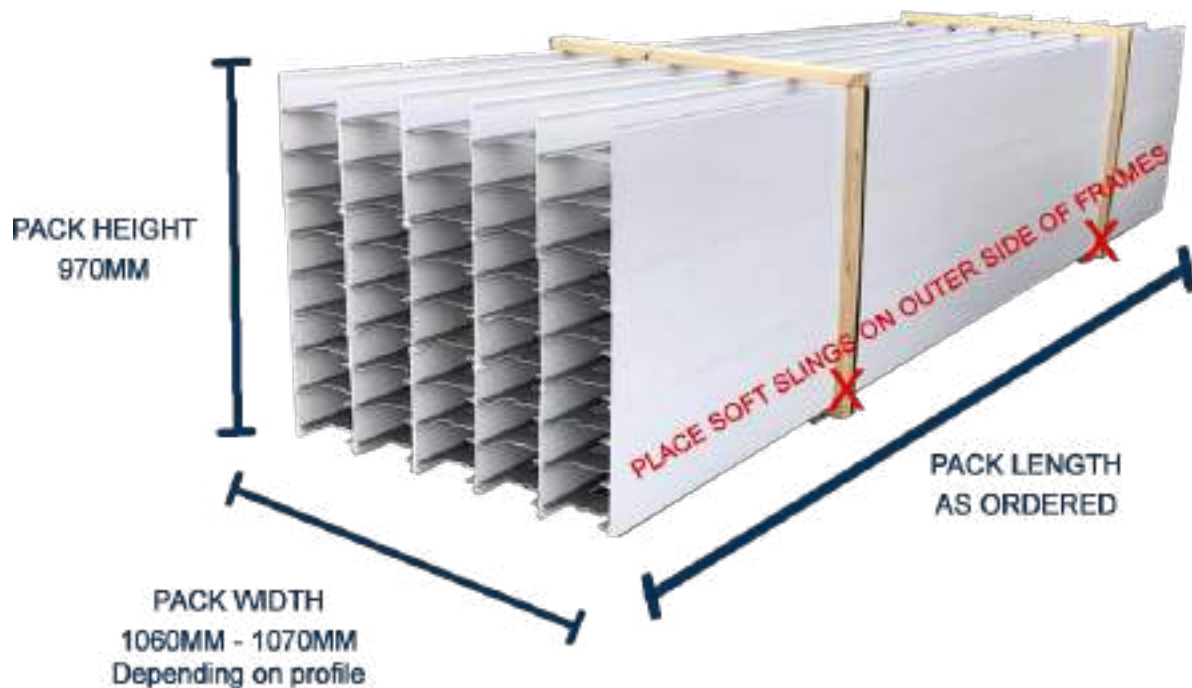


Truck	Packs	Panels (up to)	M <sup>2</sup> of product
Rigid	8	120 panels	108
Semi	16	240 panels	216



### 3C. UNLOADING

Prepare an appropriately sized space onsite for bundles to be unloaded to (refer to dimensions guide below). The space should be a level surface, clear of debris and hazards.



Packs can be unloaded by Hiab, forklift or crane. Lift no more than two bundles at a time. If lifting by Hiab or crane, strap crange soft slings to the bottom outside faces of timber frames to minimise risk of damaging panels.

Packs should be stacked no greater than two packs high with spacers. Spacers should be at four (4) points for even distribution of dead weight, particularly to prevent distortion in extreme heat.

Packs with stock measuring greater than 5m in length should be lifted one pack at a time.

The licensed forklift driver/crane operator must ensure packs are placed carefully on the ground and not dropped from a height.

### 3E. IDENTIFYING PACKS

The contents of each pack delivered is clearly labelled on the pack.

 <b>PERMAFORM</b>	
DESCRIPTION	QTY
QA CHECK <input type="checkbox"/> Date: .....	

# 4 SET OUT

Using the pins and markings provided by the surveyor, ensure the walls are clearly and accurately set out. The builder should be responsible for this – and should sign-off on the set out.



It is important to consider the wall layout and to establish the best starting point and sequence in which to proceed with installation of panels, to ensure that the most working space possible is kept clear.

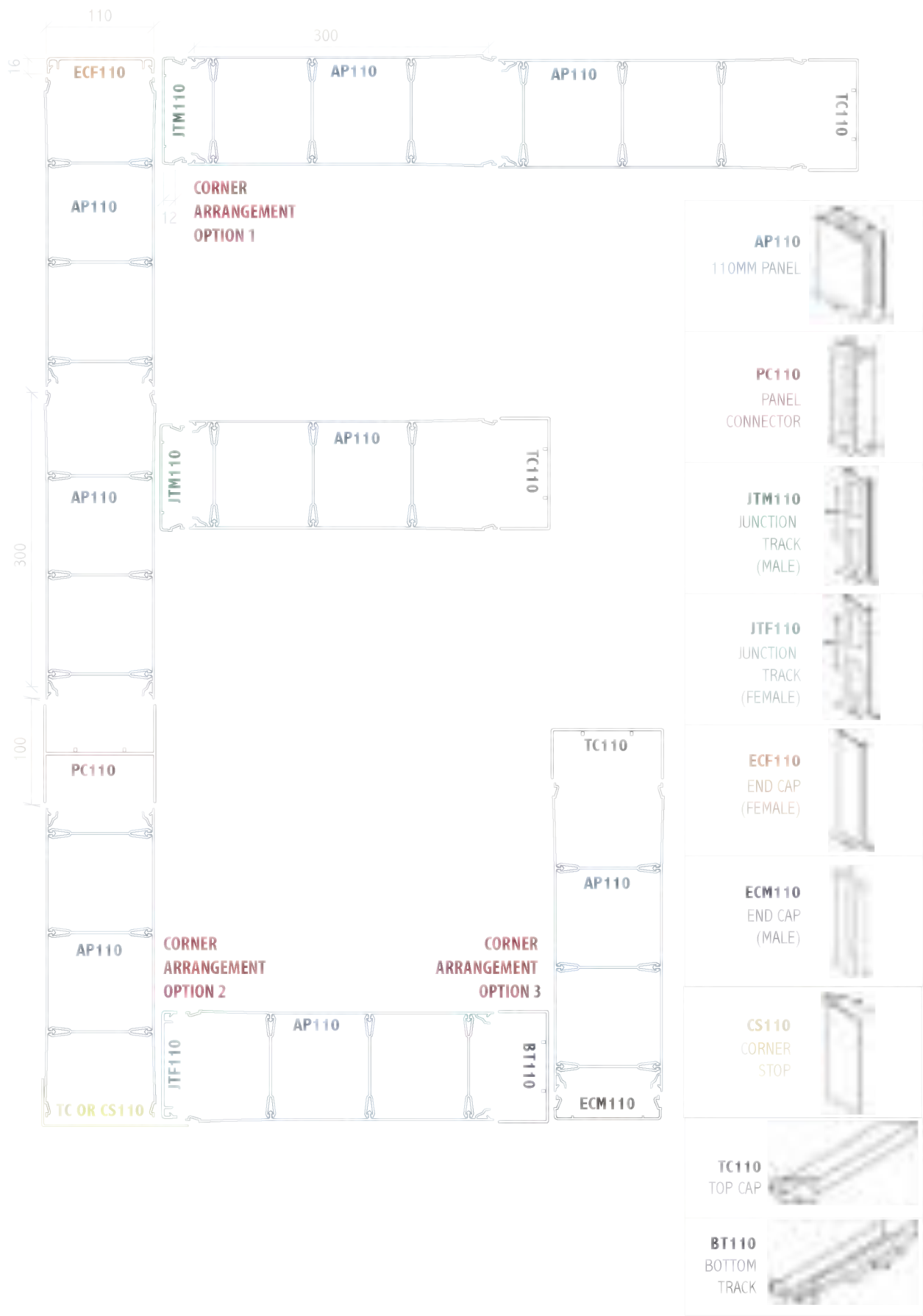
Consideration should also be given to the positioning of braces to provide the best results and also to minimise the restriction of free movement of trades around the site.

If walls are to be filled from a mobile scaffold, run the braces in a logical way that leaves one face of each wall clear.

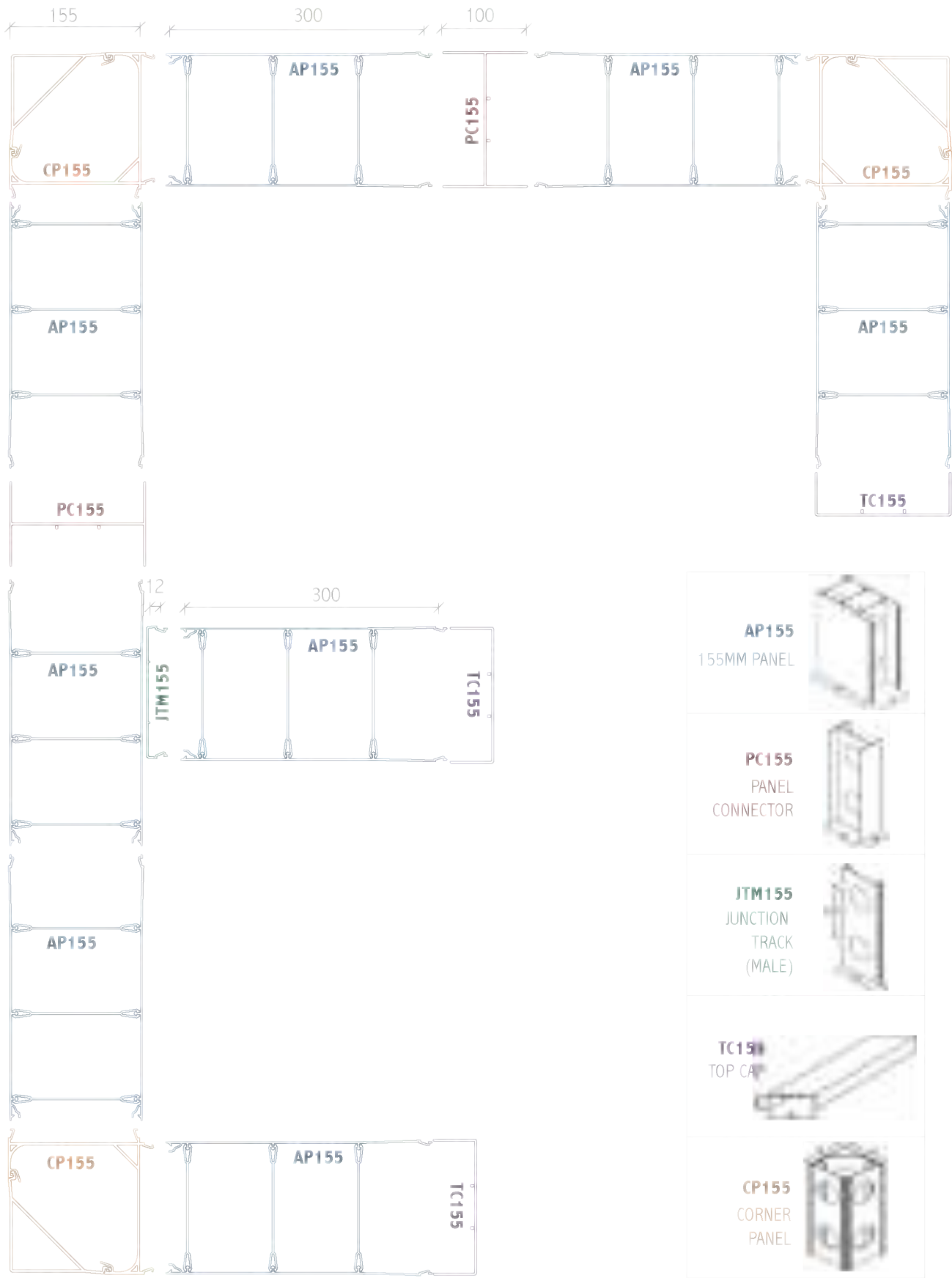
Refer to the 'Example panel arrangement' guides in this chapter to assist in planning your site set-out and forming elements like corners.



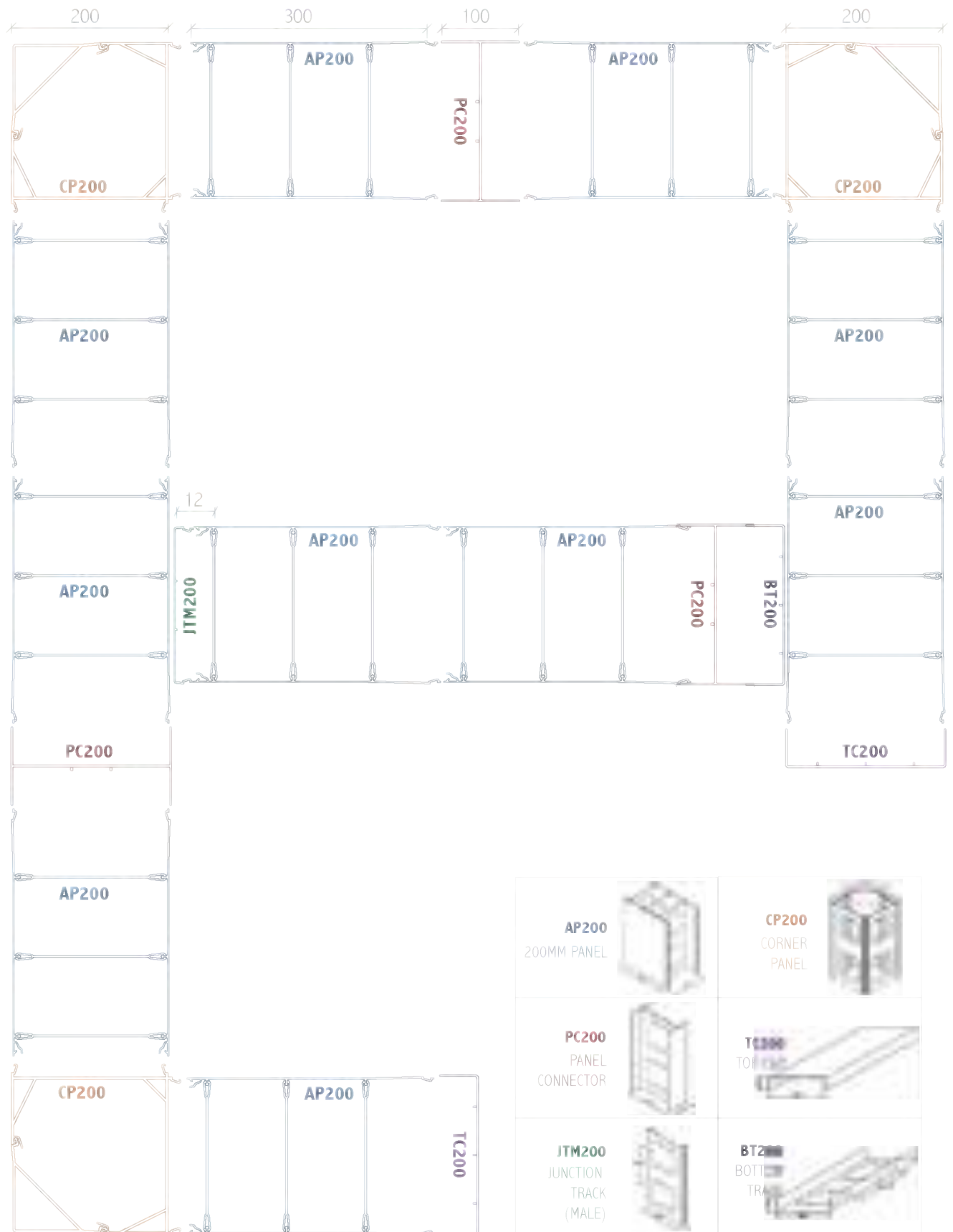
110MM EXAMPLE PANEL ARRANGEMENT



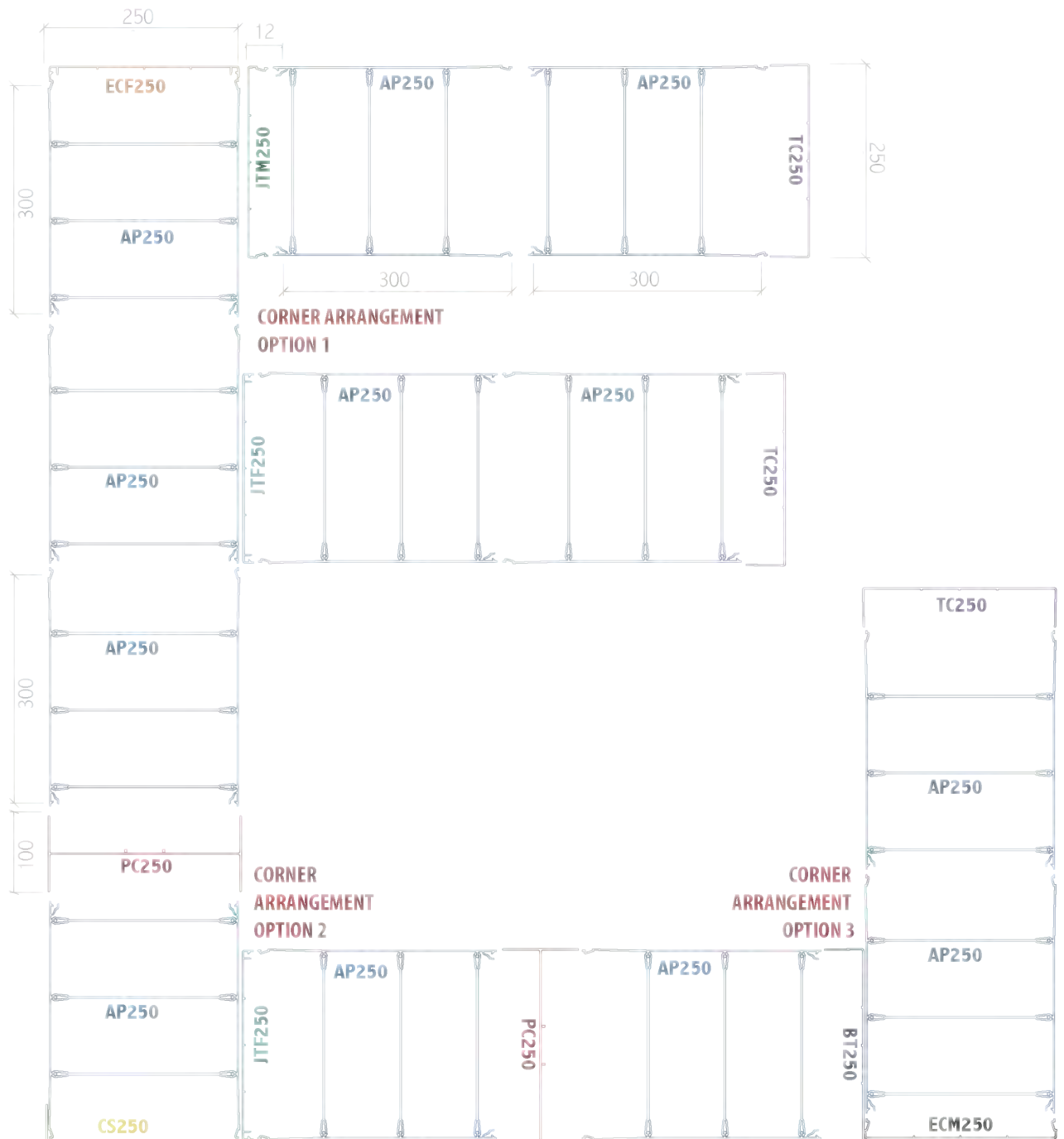
# 155MM EXAMPLE PANEL ARRANGEMENT



## 200MM EXAMPLE PANEL ARRANGEMENT



## 250MM EXAMPLE PANEL ARRANGEMENT



<b>AP250</b> 250MM PANEL	<b>ECF250</b> END CAP (FEMALE)	<b>JTM250</b> JUNCTION TRACK (MALE)	<b>BT250</b> BOTTOM TRACK	<b>CS250</b> CORNER STOP
<b>PC250</b> PANEL CONNECTOR	<b>ECM250</b> END CAP (MALE)	<b>JTF250</b> JUNCTION TRACK (FEMALE)	<b>TC250</b> TOP TRACK	



# 5 INSTALLATION

## 5A. BOTTOM TRACKS AND STARTER BARS

Before beginning the installation of Bottom Tracks, ensure the concrete footing/slab is clear, flat and free of debris.

Using pins/markings provided by the surveyor, ensure that the walls are clearly and accurately set out.



If specified, waterproofing detail must be applied in conjunction with the Bottom Track on all external walls and any portion of the wall that separates or adjoins wet areas.

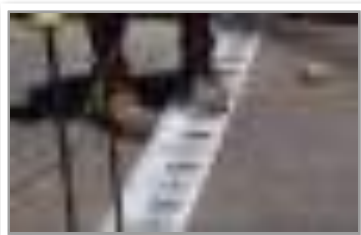
Place each starter bar as specified by structural engineer's design. See overleaf for example starter bar positions.



*Angles or lengths of timber can be used in place of Bottom Tracks to guide the wall panels.*

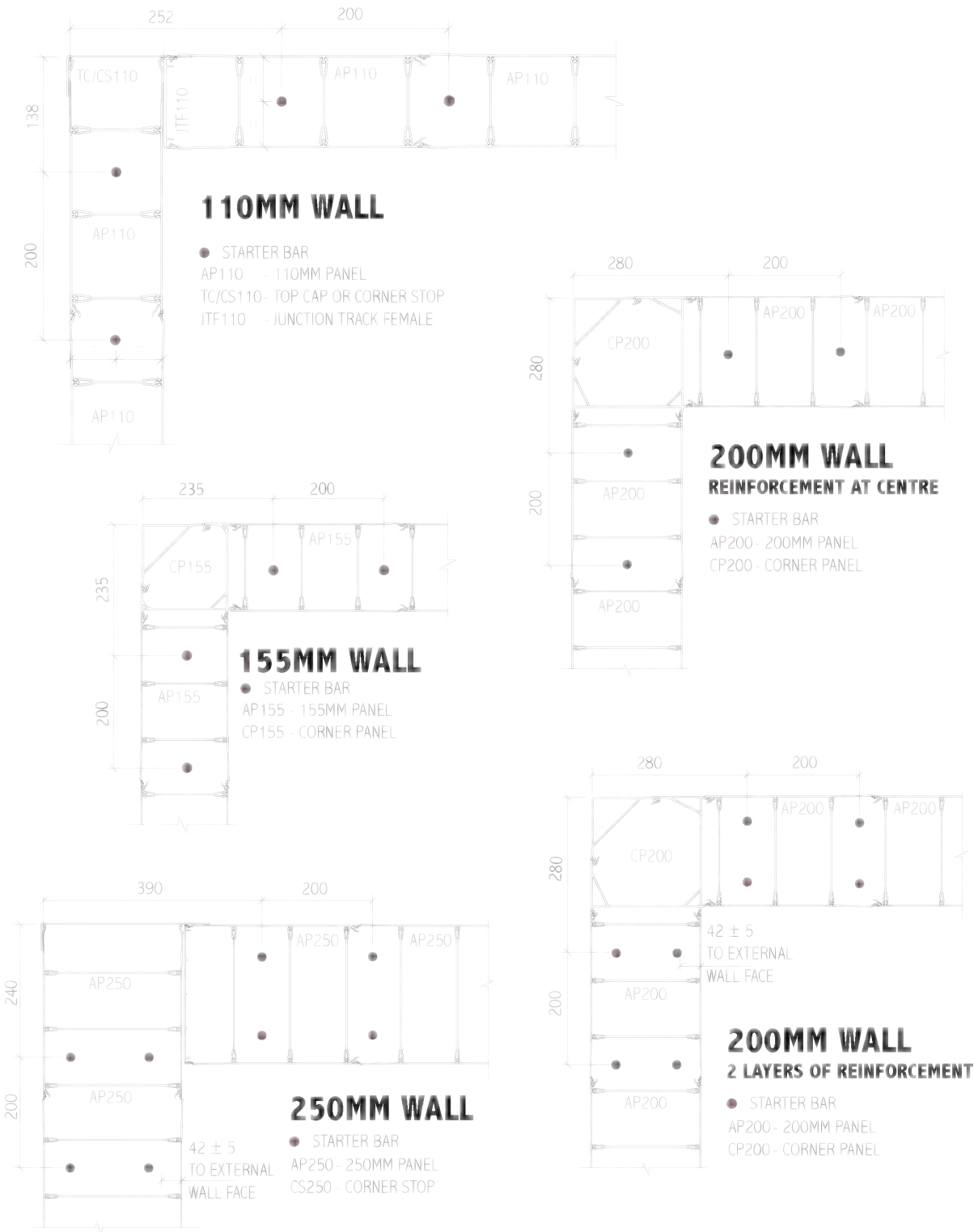
Fix Bottom Track in place using concrete nails. Apply enough nails to ensure the Bottom Track is securely fastened into the slab.

Cut the Bottom Track to accommodate fouling starter bars if required.



# EXAMPLE STARTER BAR PLACEMENT

NOTE: THESE DETAILS ARE SUGGESTIONS ONLY.  
STARTER BAR PLACEMENT SHOULD BE SPECIFIED BY THE STRUCTURAL ENGINEER.



## 5B. FIRST PANEL

It's recommended to start with a corner panel and plumb this from adjacent faces.

Working in a two-man team, adhering to safe manual handling procedures, lift the panel clear of the starter bars, align with the Bottom Track and lower into position within the track's upturned edges.

Should any of the starter bars foul on the ribs within the panel, the bars can normally be pushed/pulled clear of the rib and the panel successfully lowered as normal. Occasionally it may be necessary to lift the panel completely clear and bend the starter bar that is fouling to re-align them sufficiently for the panel to be easily lowered into position.

Brace the first panel using one screw per brace. The base of the brace is then fixed to the slab using an anchor style bolt.

The first panel is then plumbed with a spirit level or similar before the brace is fixed.

In some instances, there may be no slab to affix the brace base by bolt. In this case, it is recommended to use a steel peg driven through the brace base plate into the ground.

## 5C. BRACING AND PROPPING

Adjustable braces are recommended to be able to push/pull the top of the wall into alignment.

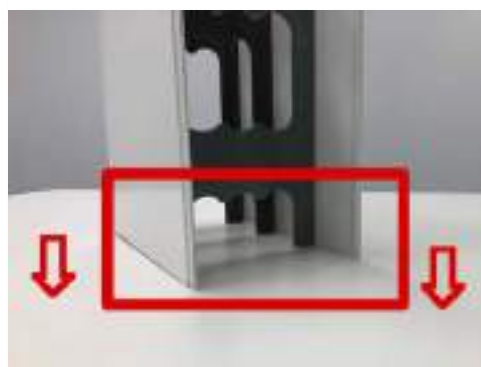
In situations where panels higher than 3.3m are being installed, or on sites known to be subject to wild wind conditions, it is the responsibility of the builder and the installers to ensure that the PERMAFORM panels are adequately braced to maintain their integrity until filled with concrete.

Along with the bracing, the top of the panels must also be secured with a timber strong back or steel angle (see diagram). These are to be screwed to the panel. One screw per panel is recommended.

Once the first panel is securely in place and plumbed, screw along the bottom track at 300mm centres. (Do not screw within 10mm of a panel joint).



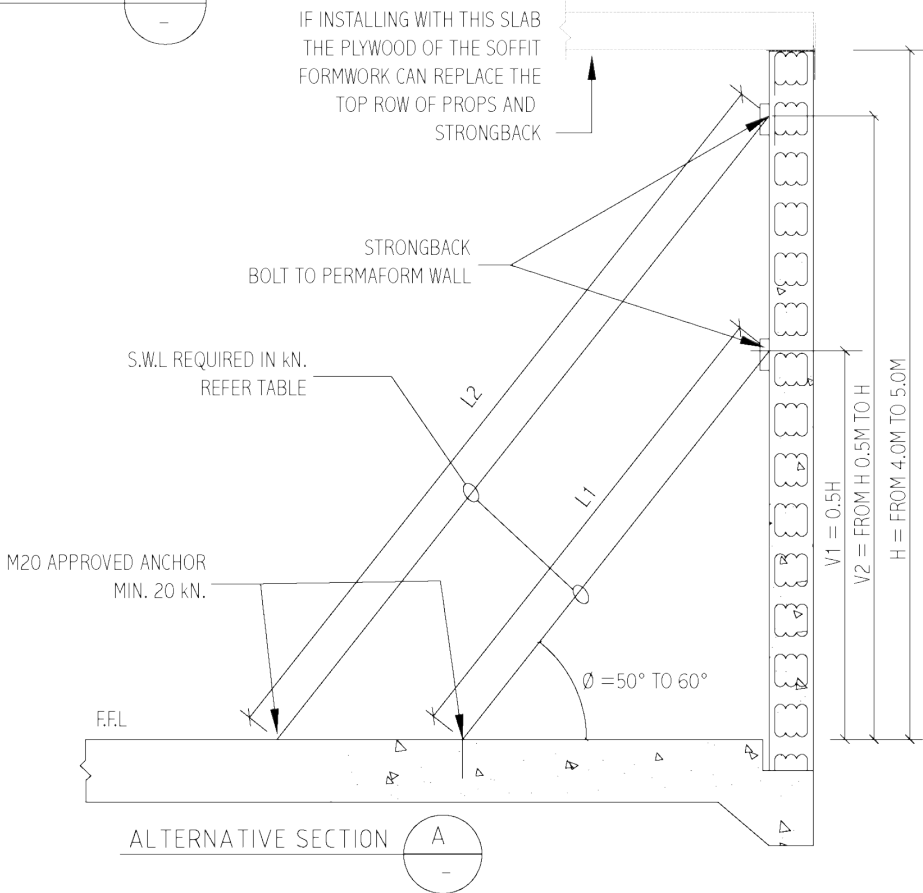
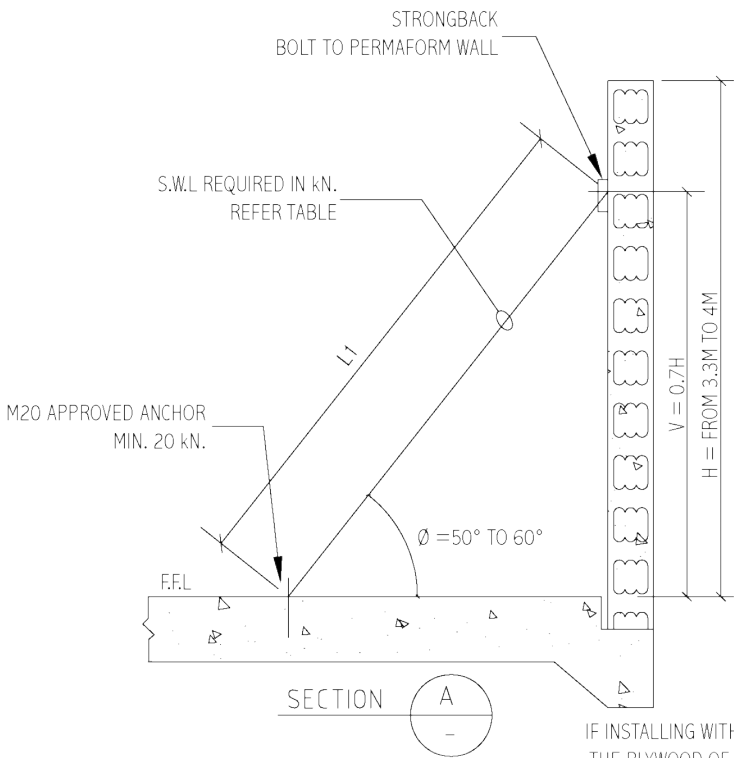
ALWAYS INSTALL PANELS WITH THE HALF RIB HOLE TO THE BOTTOM. THIS IS NECESSARY FOR CORRECT ALIGNMENT OF ALL RIBS, PLACING HORIZONTAL REINFORCEMENT AND CONCRETE FLOW.



ONCE THE FIRST PANEL OF THE WALL IS IN PLACE, IT IS ESSENTIAL THAT THE PANEL IS SQUARE, STRAIGHT, PLUMB AND TRUE BEFORE FURTHER PANELS ARE INSTALLED.

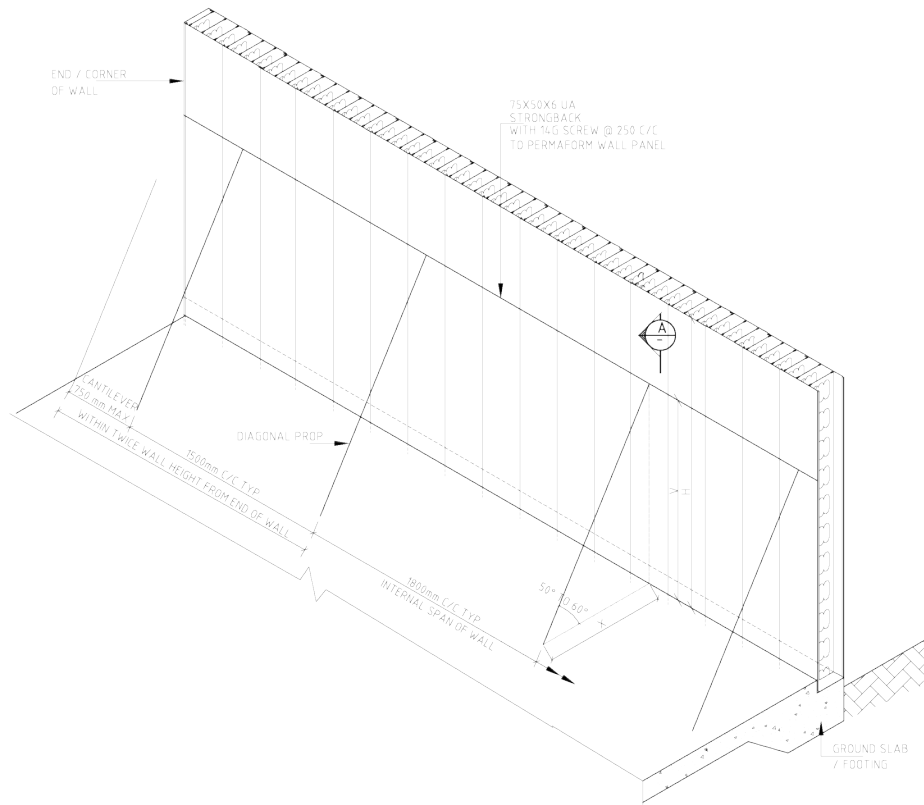
BRACE TYPE	L1/L2 (M)	DESIGN CAPACITY
MINI	4.4 MAX	kN 15
STANDARD	6.8 MAX	kN 25

- THE PROPS WITH DESIGN CAPACITY NOTED ARE TO COMPLY WITH AUSTRALIAN STANDARDS
- DIMENSIONS QUOTED ARE BASED ON FULL EXTENSION OF BRACES
- LONG BRACES MAY REQUIRE KNEE BRACING - REFER TO SUPPLIER



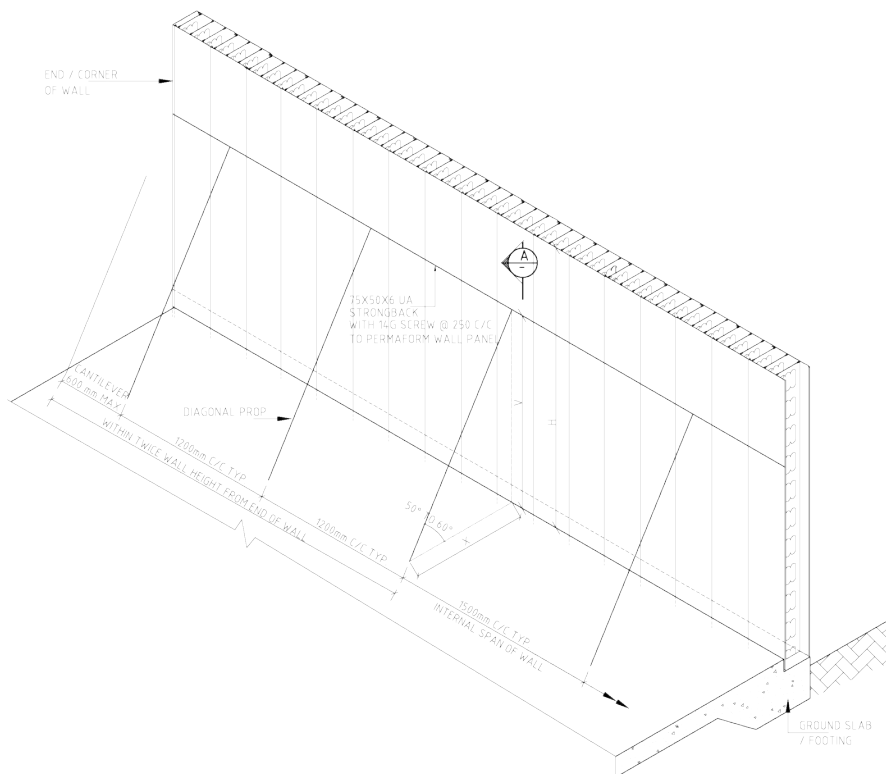
### SUGGESTED PROPPING FOR LOW WIND / SUBURBAN / SHELTERED AREAS

PLEASE NOTE: DETAILS ARE FOR GUIDANCE PURPOSES ONLY. PROPPING SHOULD BE SPECIFIED BY ENGINEER AND SHOULD BE CALCULATED FOR SPECIFIC SITE CONDITIONS.



### SUGGESTED PROPPING FOR OPEN RURAL AREAS AND SUBURBAN EXPOSED AREAS

PLEASE NOTE: DETAILS ARE FOR GUIDANCE PURPOSES ONLY. PROPPING SHOULD BE SPECIFIED BY ENGINEER AND SHOULD BE CALCULATED FOR SPECIFIC SITE CONDITIONS.







## 5D. PANEL-TO-PANEL

The next panel is now brought alongside the Bottom Track and lifted clear of the starter bars.

Place panels carefully to accommodate starter bars and other detail. Panels clip and slide into place and lock together with ease. Use a rubber mallet or similar for adjustment and persuasion to height and line.

Should any of the starter bars foul on the panels internal ribs, the bar can be adjusted by being pulled or pushed clear of the rib.

### Repeat the process

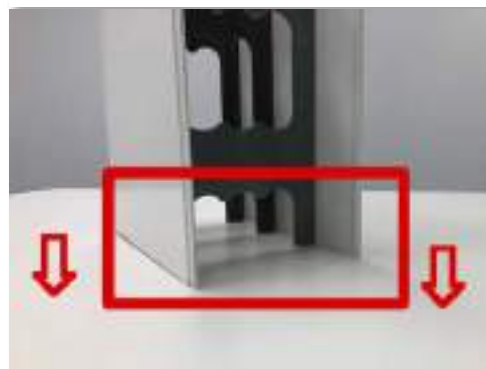


Continue to place panel-to-panel, repeating the process of bracing and propping to ensure plumb – and screwing off at bottom tracks.

Ensure all internal rib holes are aligned with each other to ensure correct placement of horizontal reinforcing bars and free flow of concrete.



ALWAYS INSTALL PANELS WITH THE HALF RIB HOLE TO THE BOTTOM. THIS IS NECESSARY FOR CORRECT ALIGNMENT OF ALL RIBS, PLACING HORIZONTAL REINFORCEMENT AND CONCRETE FLOW.



## 6

# SETDOWNS AND PLACING HORIZONTAL REINFORCING BARS

All steps in footings and walls must be in suitable increments to align with the rib holes of adjacent panels to ensure correct lapping of reinforcing (as specified by the engineer) and the free flow of concrete.

Horizontal reinforcing is installed as the panels are erected and in strict accordance with the structural engineers' design.

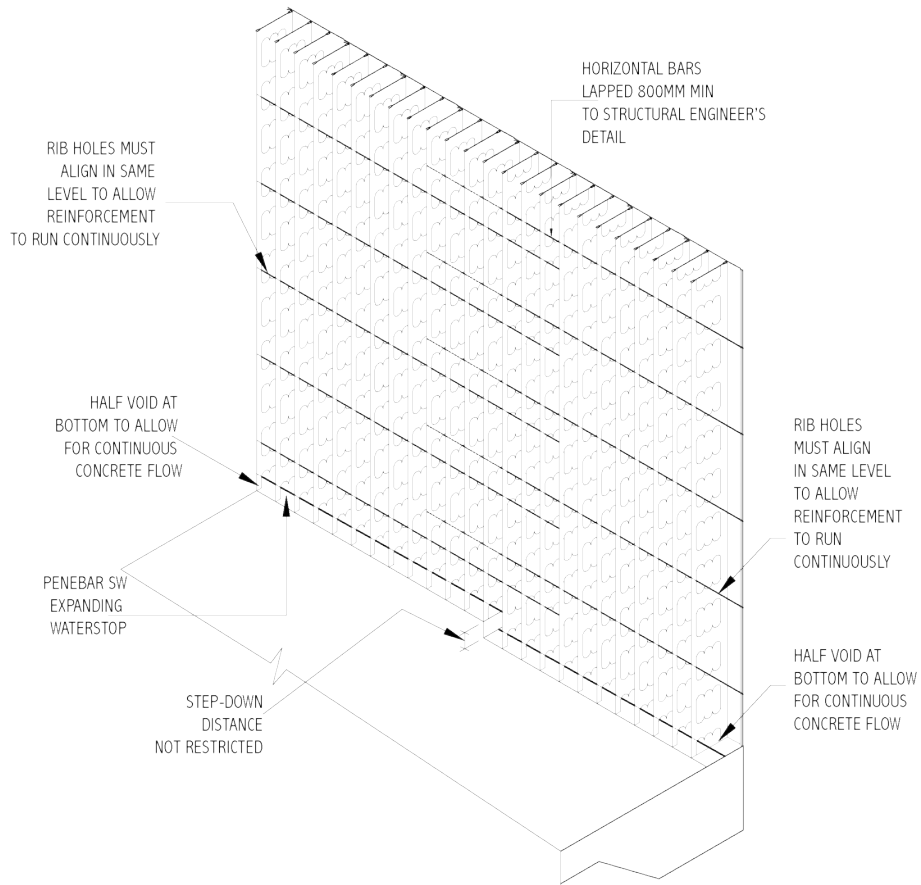
Typically, 15 panels are erected and braced 6m lengths of reinforcement bars are placed at the centres specified. Another 20 panels are then erected and braced, and another 6m long bars are placed to provide lap as specified by the engineer.

In short run lengths of wall, the reinforcement needs to be cut to the appropriate length and, in the case of a blade wall, placed prior to the end of the wall being capped.

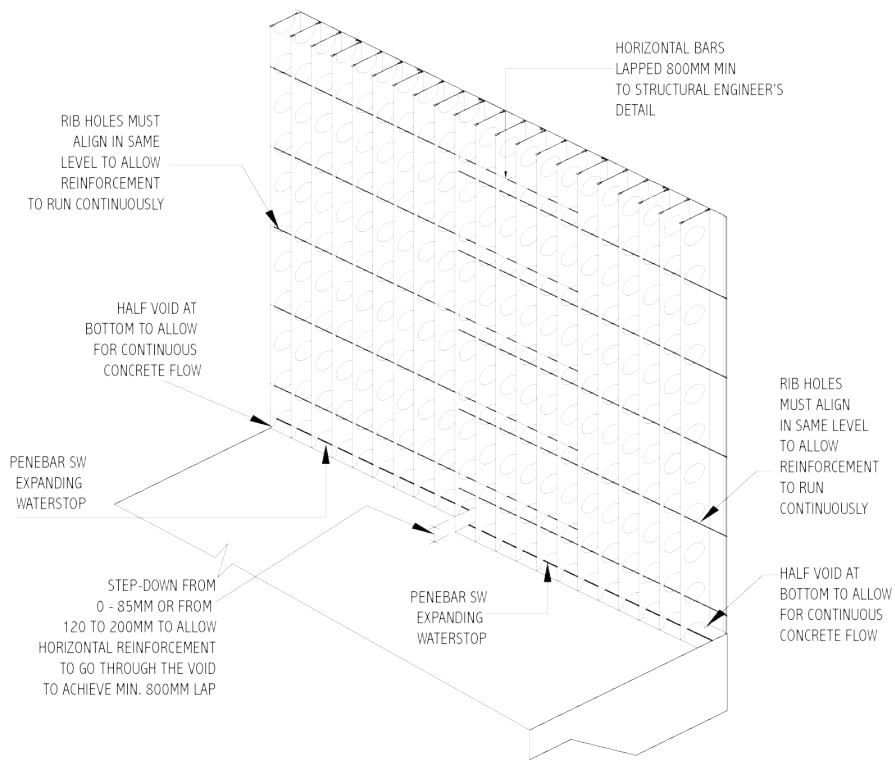


PARTICULAR CARE MUST BE TAKEN WHEN FEEDING HORIZONTAL REINFORCEMENT THROUGH INTERNAL RIBS SO THAT RIBS ARE NOT DAMAGED. DAMAGED RIBS INCREASE THE RISK OF BULGING AND BLOW-OUTS WHEN THE WALL IS POURED.

**SECTION THROUGH 110MM, 200MM, 250MM PERMAFORM WALL**  
(NEAR FACE PANEL NOT SHOWN FOR CLARITY)



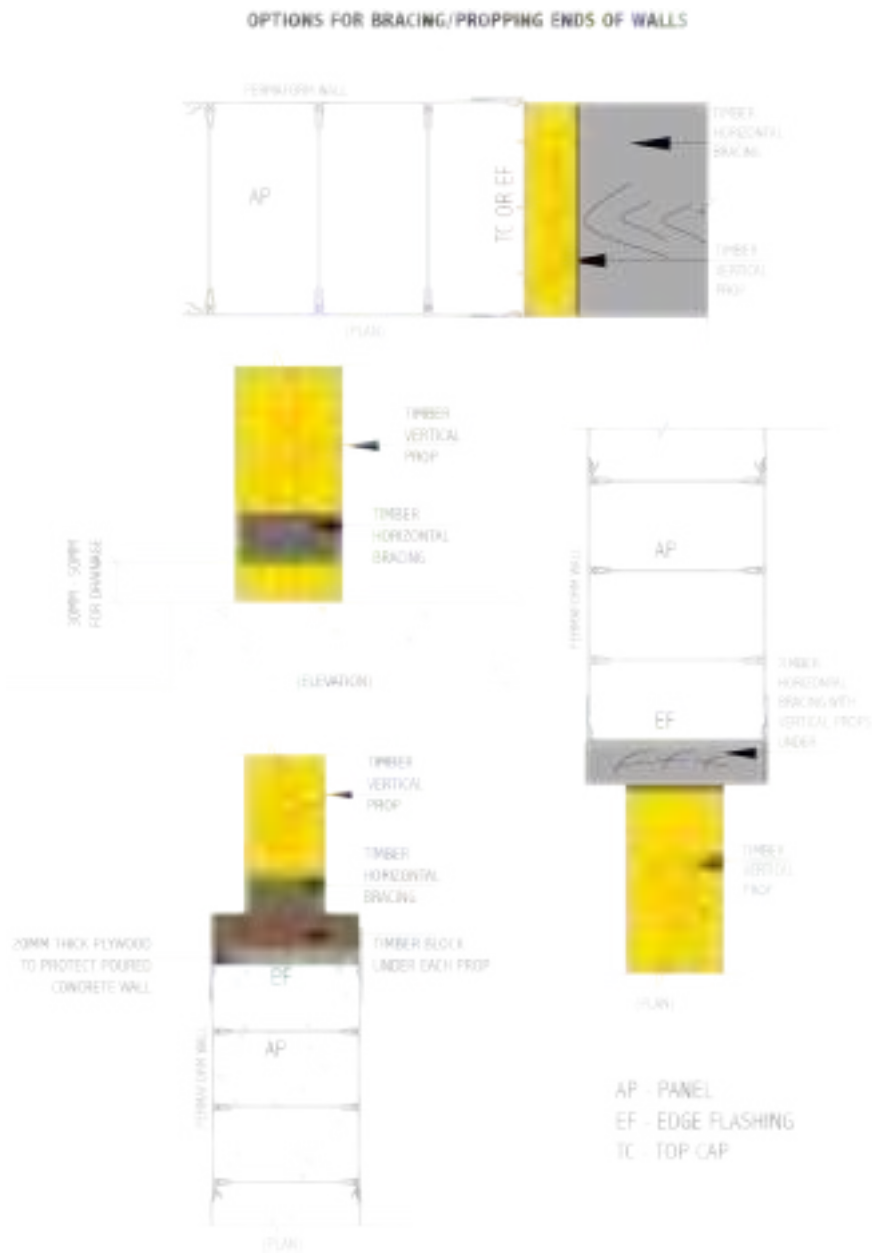
**SECTION THROUGH 155MM PERMAFORM WALL**  
(NEAR FACE PANEL NOT SHOWN FOR CLARITY)



# 7 ENDING A WALL

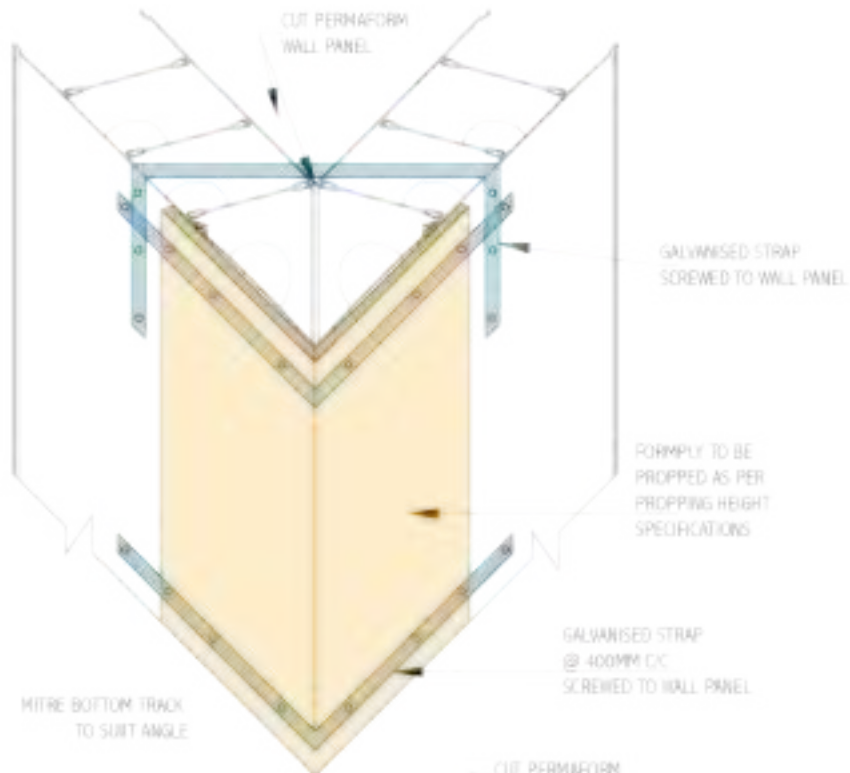
As PERMAFORM panels come in 300mm wide sections, you may need to cut down a section in order to finish within the desired wall dimension. The PERMAFORM panel lock design offers the installer two options of ending a wall – either using an end cap (male or female) or a top cap installed vertically at the end of the wall with screws to its adjoining wall.

All end caps must be braced. Corners should be braced if not locked into an adjacent panel. Not doing so can result in bulging or blow-outs of end caps or unbraced corners.

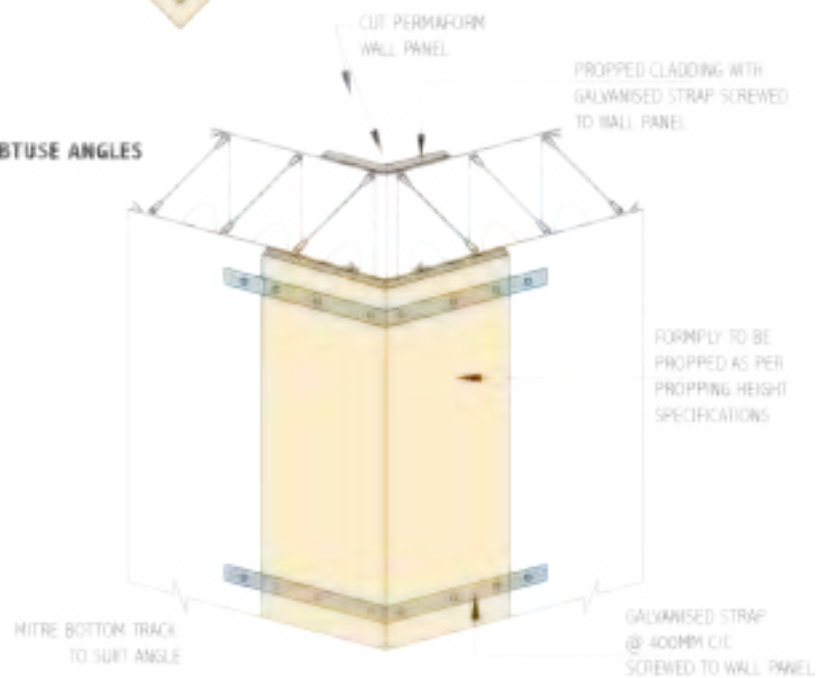


# 8 IRREGULAR CORNERS

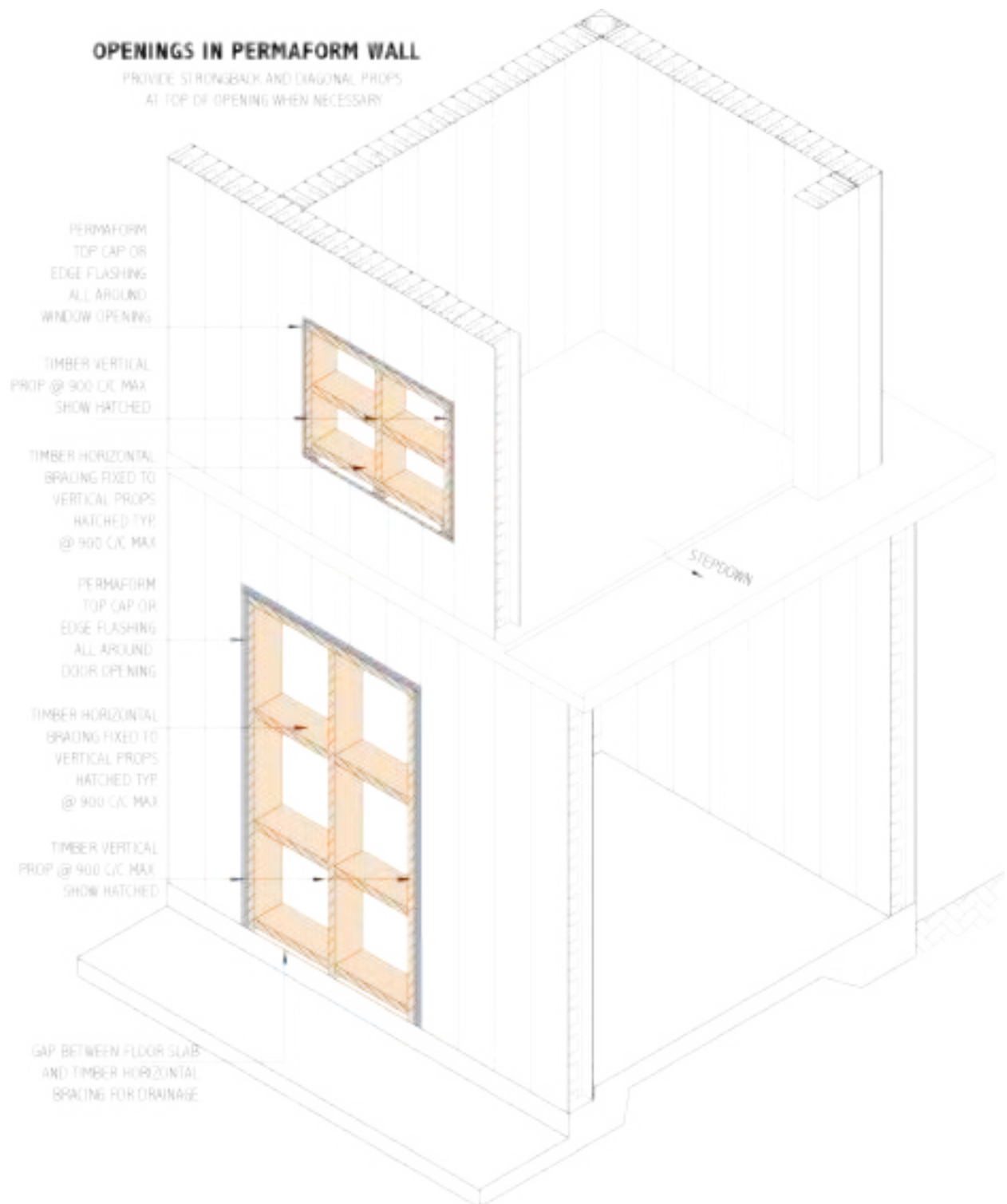
## FORMING ACUTE ANGLES



## FORMING OBTUSE ANGLES



# OPENINGS – WINDOWS, DOORS AND PENETRATIONS



Erect full length PERMAFORM panels sequentially until arriving to the first jamb. You may have to cut into the first jamb panel – this should be done prior to installation.

If a metal door frame is being fitted, the frame is slid into position with the throat of the frame over or into the last panel. The next full-sized panel is then placed in position having been engaged into the throat of the doorframe.

Alternatively, the panels either side of the door frame are fixed into position and plumbed (ensuring the opening between them is accurate). The frame can then be lowered into position, engaging into the

panels on both sides and dropping down into the head of the door frame.

Metal door frames require sufficient bracing to prevent distortion during pouring. This can be achieved by timber bracing.

For Fire doors, obtain certificates from the manufacturers for metal frames and doors for the required fire resistance level (FRL).

If metal frames (door, window penetrations) are built within the PERMAFORM panels and are to receive direct contact with wet concrete or moisture conditions, protect appropriately against corrosion (eg galvanising).





For windows, install sill panels, screw a top cap into place on the sill and the first jamb.

Install formwork timber framing to the internal measurements of the opening.

Place Top Cap on top of the timber framing for the head panels and the second jamb by screwing into the timber frame.

Install head panels.

Install full length PERMAFORM panel (the second jamb) and engage sill and header panels.

Screw the Top Cap into place by using screws on each face of the PERMAFORM panel at 200mm centres.

The vertical sides of the opening and the window head are capped using Top Caps cut to appropriate lengths and is fitted into the panels using adhesive and screws.

Large span lintels will need temporary propping during and after pour until adequately cured.

Refer to project structural engineer for advice



# 10 VERTICAL REINFORCING BARS

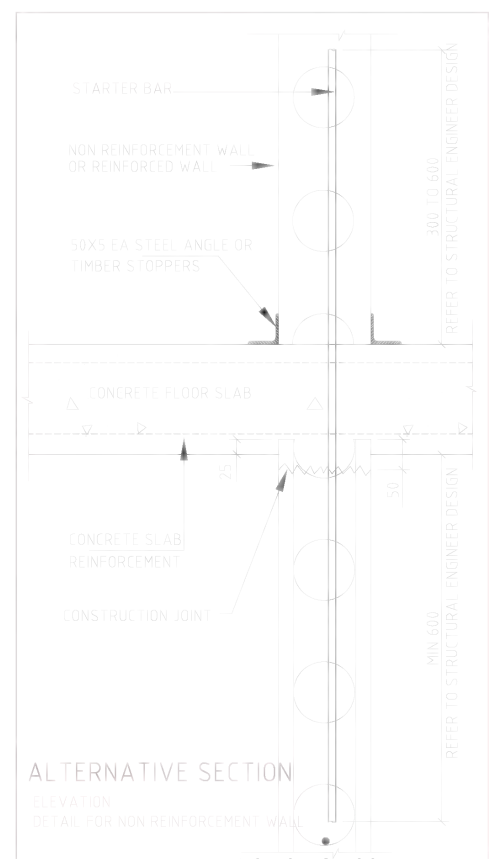
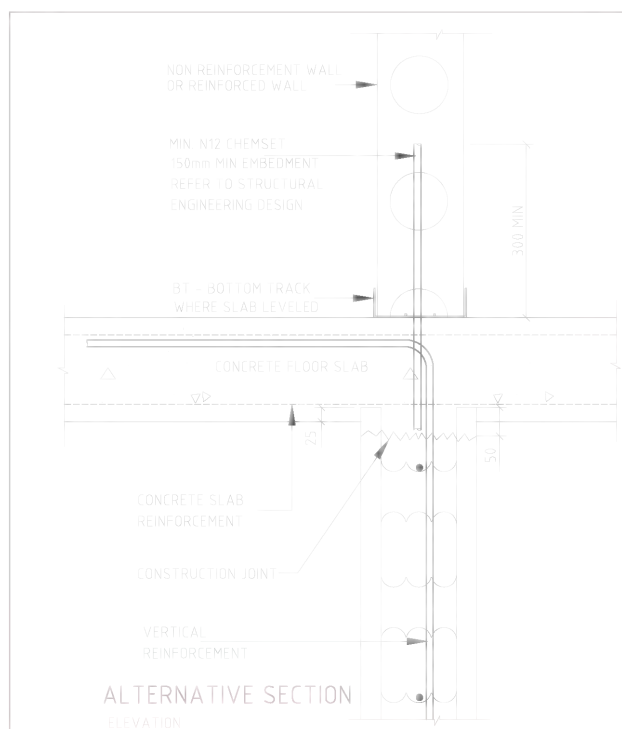
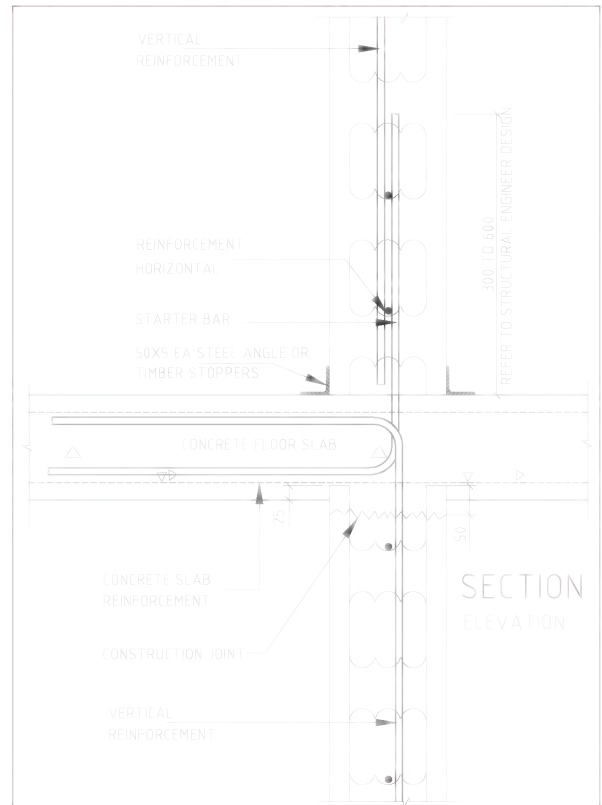
If a normal formwork deck is being erected, once the deck is in and it is safe to do so, the vertical reinforcing bars are lifted onto the deck. Slide the vertical bars from the top of the PERMAFORM panels at centres prescribed by the structural engineer.

Where the walls continue through to the next floor, the vertical bars are left longer by the amount required to clear the slab and act as the starter bar for the next floor.

Prior to placing each vertical bar, ensure it has a slight curve on the top end. This offset makes it easy when lowering the bar into the wall to guide it either side of the horizontal bars.

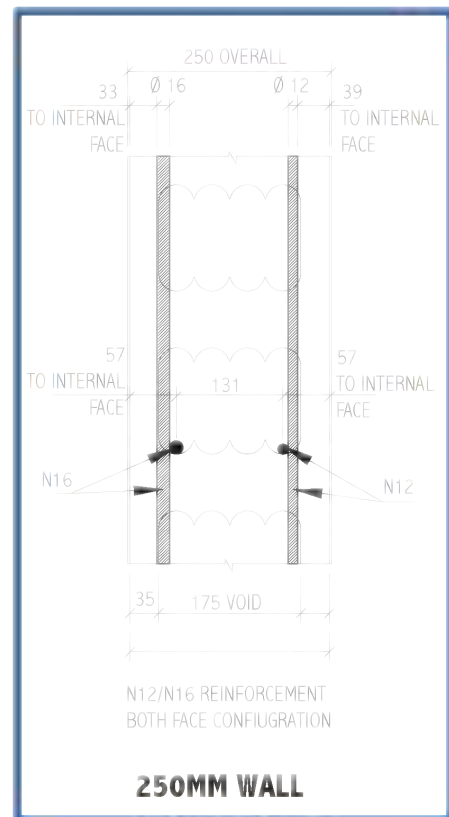
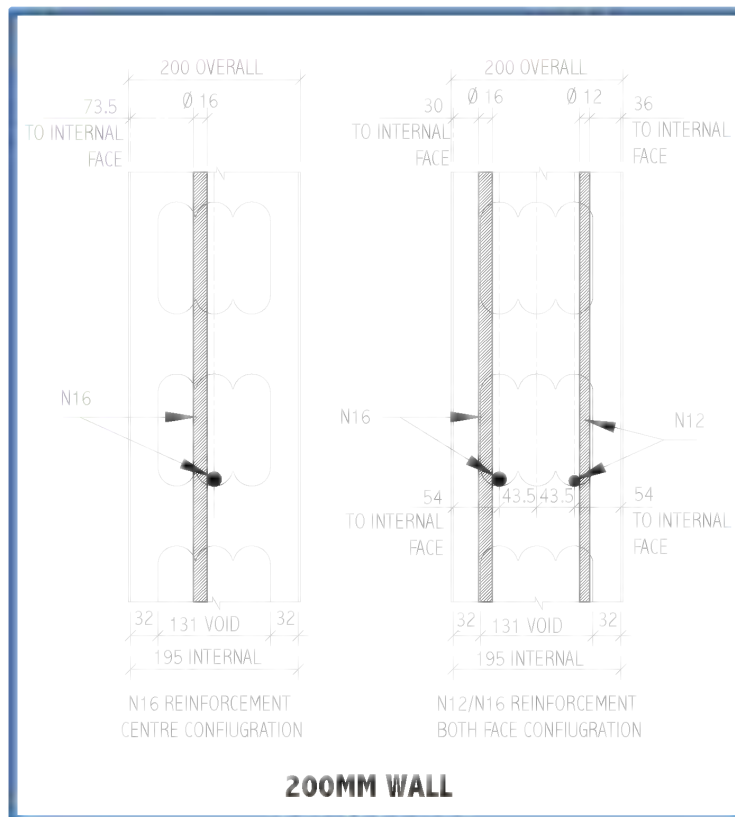
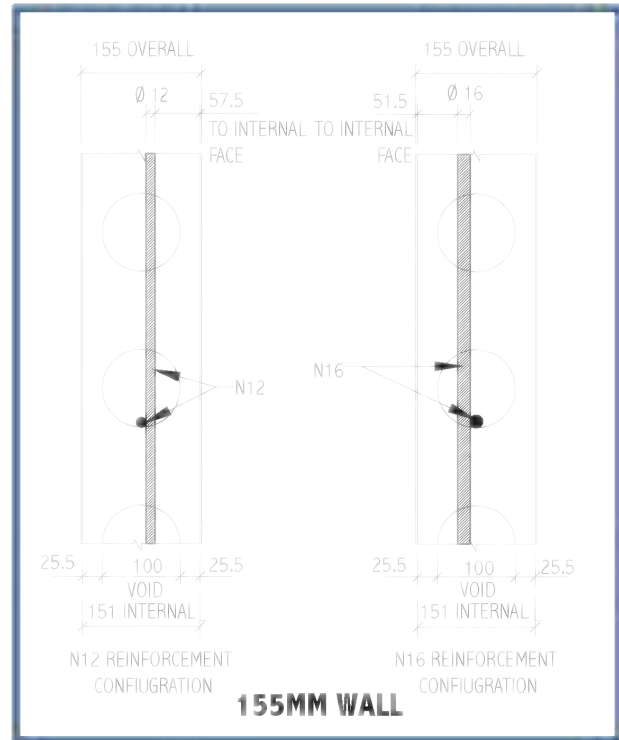
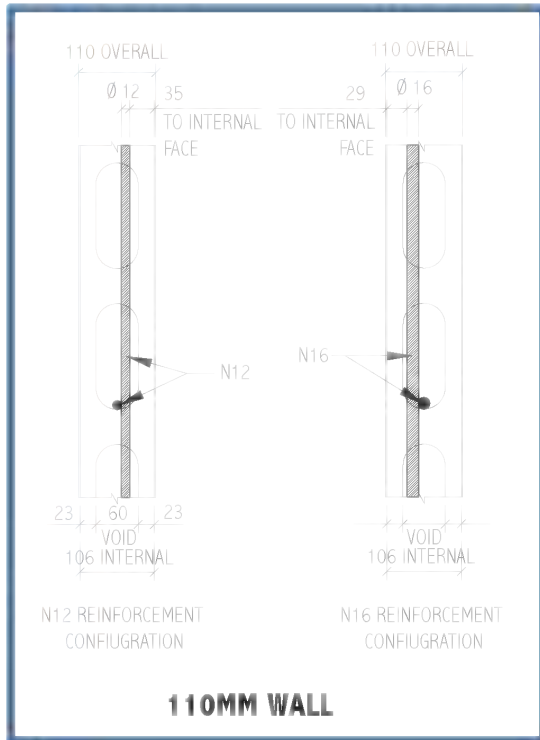
On projects where it is necessary to pour walls prior to the deck going in (for example, pre-cast slab systems) place the vertical reinforcement from either a mobile or temporary scaffold.

When the vertical bars are in place, tie the top of each vertical bar to a horizontal length of reinforcement (lacer bar) using normal reinforcement tie wire as specified. This holds the bars in the correct place during the concrete pour.



## EXAMPLE OF REINFORCEMENT CONFIGURATION

ELEVATION



# 11

## PRE-POUR

### 11A. PRE-POUR CHECKS

Prior to pouring the PERMAFORM wall, the installer, engineer and builder should perform a check of all walls ensuring they are straight, plumb square and true, and that reinforcing (both horizontal and vertical) has been placed as per the structural drawings and specifications.

Make sure all openings are the correct size. Ensure that all electrical and data conduits are in and according to the plan. Ensure all end caps and corners are correctly braced to prevent any bulging or blow-outs.

Perform the following checks:

- Concrete footing flat and free of debris
- Bottom track installed correctly
- Water proofing/hydrophilic sealant installed correctly
- All walls installed in correct locations as per drawings and survey
- All penetrations locations provided and installed in accordance with site mark-out
- All walls have been installed straight and plumb
- No ribs/diaphragms are damaged, split or cracked
- All wall panels have been clipped in correctly with no visible gaps
- All finish wall heights have been installed as per drawings and specifications
- All corners and stop ends are adequately braced
- All window/door openings have been formed and braced correctly
- All walls checked for areas of minor damage and patched appropriately
- For walls above 4m: midway horizontal strongback to be screwed to panels and propped
- Props installed at a maximum spacing of 1.8m

A complete pre-pour checklist can be found in the appendices.

### 11B. TEMPORARY PATCHING

When installation of panels is complete, and before the pour, all walls need to be checked for areas of minor damage. They must be temporarily patched to ensure they don't become weak points and blow-out during the concrete pour.

Complete any patching using appropriate sized pieces of form-ply tek-screwed over the area. After the pour, these patches are simply removed by reversing out the tek-screws.

## 11C. RECOMMENDED CONCRETE QUANTITY

### Net concrete quantity

Excluding wastage for pump/hose hopper

Concrete must be placed using a suitable boom pump via a delivery hose.

	110mm	155mm	200mm
Per cubic metre of concrete	9.5m <sup>2</sup> of wall area	6.67m <sup>2</sup> of wall area	5.5m <sup>2</sup> of wall area
Per square metre of wall area	0.105m <sup>3</sup> of concrete	0.15m <sup>3</sup> of concrete	0.182m <sup>3</sup> of concrete

## 11D. SUGGESTED CONCRETE MIX

The concrete supplier is responsible for providing a mix design that is suitable for filling PERMAFORM.

The mix must be designed with enhanced flow characteristics and should be minimum 150 slump.

The following is a guide only:

Cement type	Type GP in accordance to AS3972. Fly ash in accordance with AS3582.1 may be used as cement replacement.
Characteristic 28 days compressive strength	20MPa to 60MPa as specified by design engineer
Concrete pump nozzle size	Internal diameter of 75mm-100mm provided the concrete flow pressure is controlled.

# 12

## POUR SEQUENCE

Below sets out the recommended number of concrete passes required. Higher MPa mixes will gel faster than low strength mix designs. These guidelines will vary according to site conditions, extra passes and extra gelling time may be required in wet or cold weather. In cases of extreme weather, the concrete pour should be postponed.

- Flowing slump concrete: 150mm to 180mm slump.
- Concrete can be mechanically vibrated during placing by using concrete vibrator 20mm to 25mm diameter head to the depth of 500mm within the final layer to assist flow under low pressure.
- After first pour layer, check wall straightness, integrity of ribs. (ribs can be easily damaged from in-situ starter bars)
- Pouring wall same day with the suspended slab: Pour wall concrete first and allow it to set prior to pouring of the slab.

Wall Ht(m)	110MM WALL			155MM WALL			
	1 <sup>st</sup> pour	2 <sup>nd</sup> pour	3 <sup>rd</sup> pour	1st pour	2nd pour	3rd pour	4th pour
2.8	1.2	1.6		1.2	1.6		
3.0	1.2	1.8		1.2	1.8		
3.3	1.2	2.1		1.2	2.1		
3.6	1.2	1.2	1.2	1.2	1.2	1.2	
4.0	1.2	1.2	1.6	1.2	1.2	1.6	
5.0				1.2	1.8	2.0	
5.6				1.2	1.2	1.4	1.8
6.0				1.2	1.2	1.6	2.0
6.6				1.2	1.4	1.8	2.2

Wall Ht(m)	200MM WALL				250MM WALL			
	1st pour	2nd pour	3rd pour	4th pour	1st pour	2nd pour	3rd pour	4th pour
2.8	1.2	1.6			1.2	1.6		
3.0	1.2	1.8			1.2	1.8		
3.3	1.2	2.1			1.2	2.1		
3.6	1.2	1.2	1.2		1.2	1.2	1.2	
4.0	1.2	1.2	1.6		1.2	1.2	1.6	
5.0	1.2	1.8	2.0		1.2	1.8	2.0	
5.6	1.2	1.2	1.4	1.8	1.2	1.2	1.4	1.8
6.0	1.2	1.2	1.6	2.0	1.2	1.2	1.6	2.0
6.6	1.2	1.4	1.8	2.2	1.2	1.4	1.8	2.2

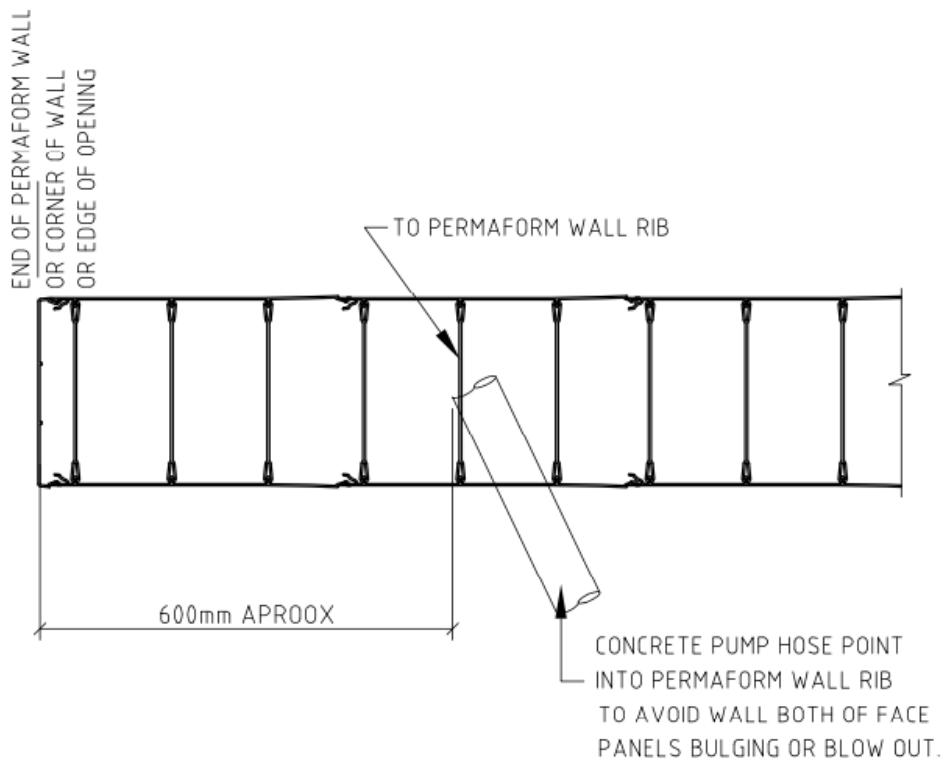
USE FLOWING SLUMP CONCRETE. ALLOW A MINIMUM OF **45 MINUTES** BETWEEN POURS. FOR WALLS GREATER THAN 6.6M AND UP TO 8.0M THE FIRST 3 LAYERS FROM THE 6.6M SCHEDULE TO BE ADOPTED



# 13

## POUR PROCEDURE

When pouring, do not aim the pump directly at corners or wall ends. Always point the pump nozzle towards a rib/diaphragm. The pump nozzle should remain at least 500mm away from wall/column ends.



### CONCRETE PUMP HOSE LOCATION PLAN AT END OF WALL / CORNER OF WALL / EDGE OPENING

When moving around the walls filling them, remember that the shorter or thinner a section of wall is, the faster it will fill.

Do not leave finished concrete surface uneven at the top of forms. Following compaction at the top of the walls, screed the concrete to achieve a smooth and even surface.

When slab and walls are poured at the same time, finish the concreting for the walls first. This should provide enough time for wall concrete to settle before the slab concreting takes place over the particular wall.

While pouring, be sure to visually inspect walls regularly to ensure vertical alignment and plumb of the panels is maintained. Stop the pour, or proceed at reduced speed if any areas start to move. Keep props, timbers or plywood readily available to provide temporary bracing if required.

# 14

## VIBRATING

Proper compacting of concrete is essential to prevent voids in the finished walls.

Pay particular attention to the sides of all openings, bulkheads and any areas that have a high concentration of steel.

Use a 25mm pocket vibrator. Vibrating helps ensure the concrete mix slurry fills all voids, particularly at joints. When vibrating, take care not to damage ribs or the external face of the panels. Place the vibrator in the upper 300mm of the wall panel.

PERMAFORM is made from PVC and is non-porous. This means it does not absorb water like masonry, fibre-cement or plywood. This increases the flowability of concrete and reduces honeycombing.

# 15

## POST-POUR

### 15A. CLEAN UP

Any household detergent can be used for general cleaning purposes.

Any concrete slurry that has spilt onto the PERMAFORM panels can be easily removed if it is washed with high pressure water within 30 minutes before the slurry hardens.

If concrete slurry has hardened, removing it may damage the walls' surface. If this occurs, make sure the slurry is at least two weeks old before attempting to remove it. Apply hydrochloric-acid diluted 1/10 or less onto the slurry with a brush and clean with a soft brush.

Apply high water pressure to remove the solution and slurry within 10 minutes.

### 15B. PATCHING

If surface damage has occurred, it can be patched with a two-part polyester resin (for example Bostik Bog).

The damaged part of the surface can be cut and removed.

If repairing damaged concrete, complete concrete patching by conventional means. Fill the surface of the patched concrete with resin of not less than 2mm in thickness to match the adjacent panel surface.

Sand and level the dried resin surface and apply etching primer to the damaged area only.

## **15C. REMOVING PROPS AND BRACING**

Braces and props should be removed once the slab over is poured or the roof is attached.

If it's necessary to remove braces earlier, approval must be obtained from the project engineer, especially when the wall is being used as a retaining wall and will be back-filled against.

Removing braces should always be done in accordance with the engineer's specifications.

## **15D. CHECK FOR VOIDS**

After the PERMAFORM panels have been core filled, they should each be checked by tapping gently with hammer on both sides to check compaction (with caution not to damage the surface). Should a hollow in the wall be identified, the location should be marked. A high strength grout should then be injected into the panel to fill the hollow.

This process should be done in conjunction with specification from the grout supplier and the methodology approved by the project engineer.

## **15E. VOID RECTIFICATION PROCESS**

### **IDENTIFICATION**

Tap panels in a 100mm x 100mm grid with the end of a hammer stick, screwdriver or chisel. If "hollow" or "drummy" noise is heard mark the area. If necessary, confirm by driving a 50mm nail or drilling a 5mm drill bit into the top of the marked panel area (the hole will be removed by a larger hole if a void is present). If nail or drill bit penetrates more than 10mm then a void is present.

### **RECTIFICATION PROCESS**

1. Drill a 40mm hole into the panel at the very top of the void area (if possible the hole should extend just above void). Align and attach a 40mm PVC pipe fitting 450 or 900 to the wall and secure accordingly so as to stay in place through the filling process.
2. Fill void with non-shrinking grout of an equivalent or higher strength material than was used to fill the walls, i.e. if walls have been filled with 32 MPA concrete typically 40 MPA non-shrinking grout is used.
3. Fill the void by pouring in liquid non-shrinking grout mixed to manufacturers specification into attached pipe fitting (this can be done via a funnel or similar), tap void with rubber mallet to aid in movement, continue to fill until the top of pipe fitting is full.
4. Allow non-shrinking grout to harden.
5. Next day the fitting can be removed with a hammer or grinder

### **CONFIRMATION**

Confirmation that the void has been filled is typically done by repeating the tapping process or ground penetrating radar or "x-ray" concrete scanning can be used to ensure no voids are left present in the walls.

# TECH SPECS DATASHEET

AS AT AUGUST 2019



PRODUCT SPECIFICATIONS			
PROFILES	110MM, 150MM, 200MM AND 150MM	PANEL WIDTH	300 MM
PVC THICKNESS	2.6 MM	PVC DENSITY	1,300 KG/ M <sup>3</sup>
LIFE EXPECTANCY	MINIMUM 50 YEARS	FINISH	GLOSS WHITE, WATER RESISTANT
HEIGHT	ALL PANELS CAN BE ORDERED TO CUSTOM HEIGHTS MINIMUM 1.0M – MAXIMUM 8.0M STOCK HEIGHTS: 2.8M, 3M, 3.3M, 3.6M, 3.8M, 4.0M, 4.6M, 5M, 6M.	UV STABILITY	NOT AFFECTED BY EXPOSURE TO SUNLIGHT EITHER IN STORAGE OR AS FINISHED PRODUCT
		SPECIFIC PPE	NONE REQUIRED. GLOVES ARE NOT ESSENTIAL, BUT ON SITES WHERE MANDATORY, GLOVES WITH RUBBER FINGERS AND PALM INFILL WILL REMOVE RISK OF SLIPPING.
		MSDS	READILY AVAILABLE
		ORDERING LEAD TIME	STOCK HEIGHTS DELIVERED TO MAJOR CAPITAL CITIES WITHIN SEVEN DAYS FROM ORDER. CUSTOM HEIGHT PANELS WITHIN FIVE WEEKS.
		SHIPPING AND FREIGHT	WE OFFER DELIVERY AT COST, OR YOU CAN ARRANGE YOUR OWN
		PAYMENT TERMS	COD OR 30-DAY ACCOUNT UPON APPLICATION

CERTIFICATIONS AND COMPLIANCE	
CODE, SPECIFICATION OR STANDARD	CERTIFIED BY
AS1530.3 - IGNITABILITY, FLAME PROPAGATION, HEAT RELEASE AND SMOKE RELEASE	CSIRO
AS/NZ3837:1998 - HEAT & SMOKE RELEASE RATES	CSIRO
BCA PARTS A2 & C1 - HEAT & SMOKE RELEASE REQUIREMENTS	CSIRO; SGS-CSTC; MURTAGH BOND STRUCTURAL ENGINEERS
BCA PART F5 – ACOUSTIC PERFORMANCE, SOUND TRANSMISSION AND INSULATION	RUDDS CONSULTING ENGINEERS
GREEN BUILDING COUNCIL OF AUSTRALIA – GREEN STAR OFFICE DESIGN	CETEC

## ABBREVIATIONS AND ACRONYMS

- + BCA – Building Code of Australia
- + PPE – Personal Protective Equipment
- + MSDS – Material Safety Data Sheet
- + CSIRO – Commonwealth Scientific and Industrial Research Organisation
- + SGS-CSTC - the world's leading inspection, verification, testing and certification company. [www.sgs.com](http://www.sgs.com)
- + CETEC Pty Ltd - a professional and independent consultancy delivering scientific and technical based solutions.
- + CETEC focuses on providing Environmental, Sustainability and OH&S services and solutions for buildings and the built environment [www.cetec.com.au](http://www.cetec.com.au)

# PERMAFORM APPLICATION SAFETY DATA SHEET



*PERMAFORM IS A PERMANENT PVC CONCRETE WALL FORMWORK SYSTEM DESIGNED AND PRODUCED FOR AUSTRALIAN CONDITIONS*

PERMAFORM is a permanent PVC wall formwork system for concrete retention which remains in place for the life of the structure, designed and produced for Australian conditions. As such it does not affect the structural integrity of the concrete element.

## 1- PRODUCT IDENTIFIER AND CHEMICAL IDENTITY

### *PRODUCT NAME: PERMAFORM*

Recommended Use of the Chemical and Restriction on Use: Formwork system - extruded rigid polymer material used for permanent formwork for retaining concrete when pouring and subsequently as permanent wall cladding.

### *DETAILS OF MANUFACTURER/IMPORTER:*

Permaform International Pty Ltd  
PO Box 490  
Fyshwick ACT 2609

PH: 1800 737 623  
Emergency: 0488 040 603

## 2- HAZARDS IDENTIFICATION

### *PRECAUTIONARY STATEMENTS*

- + P272 Contaminated work clothing should not be allowed out of the workplace.
- + P201 Obtain special instructions before use.
- + P202 Do not handle until all safety precautions have been read and understood.
- + P321 Specific treatment (see on this label).
- + P308+P313 If exposed or concerned: Get medical advice/attention.
- + P333+P313 If skin irritation or rash occurs: Get medical advice/attention.
- + P302+P352 If on skin Wash with plenty of soap and water.
- + P362+P364 Take off contaminated clothing and wash it before reuse.
- + P405 Store locked up.
- + P501 Dispose of contents/container in accordance with local/regional/national regulations.

## 3- COMPOSITION AND INFORMATION ON INGREDIENTS

### *CHEMICAL CHARACTERIZATION: MIXTURES*

Description: Mixture of substances listed below with nonhazardous additions.

### *ACCORDING TO SAFE WORK AUSTRALIA*

Printing date 11.04.2013; Revision: 11.04.2013;  
Product Name: PERMAFORM 36.0.9

### *HAZARDOUS COMPONENTS:*

471-34-1 calcium carbonate 4%; 12202-17-4 Lead oxide sulphate; Repr. 1B, H360; STOT RE 2, H373; Aquatic Acute 1, H400; Aquatic Chronic 1, H410; Acute Tox. 4, H302; Acute Tox. 4, H332 1% 8013-07-8 Soybean oil, epoxidized Skin Sens. 1, H317 1%

PERMAFORM INTERNATIONAL PTY LTD  
ABN 70 609 958 527

PO BOX 490  
Fyshick ACT 2609

PH **1800 PERMAFORM**  
(1800 737 623)

**permaform.com.au**  
info@permaform.com.au

# PERMAFORM APPLICATION SAFETY DATA SHEET



## 4- FIRST AID MEASURES

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**INHALATION:** If inhaled, remove to fresh air. Seek medical attention if breathing problems develop.

**SKIN CONTACT:** In case of skin contact, immediately remove contaminated clothing and wash affected areas with water and soap. Seek medical attention if symptoms occur.

**EYE CONTACT:** In case of eye contact, rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Seek medical attention.

**INGESTION:** If swallowed, do not induce vomiting. Do not give anything by mouth to an unconscious person. Seek immediate medical attention.

## 5- FIRE FIGHTING MEASURES

---

### **SUITABLE EXTINGUISHING MEDIA**

Use fire-extinguishing methods suitable to surrounding conditions.

### **SPECIFIC HAZARDS ARISING FROM THE CHEMICAL**

No further relevant information available.

### **SPECIAL PROTECTIVE EQUIPMENT AND PRECAUTIONS FOR FIRE FIGHTERS**

Wear Safe Work Australia approved self-contained breathing apparatus and full protective clothing.

## 6- ACCIDENTAL RELEASE MEASURES

---

### **PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY**

**PROCEDURES:** Wear Safe Work Australia full protective clothing. Evacuate all non-essential personnel from affected area. Do not breathe vapours/dusts. Ensure adequate ventilation.

**ENVIRONMENTAL PRECAUTIONS:** In the event of a major spill, prevent spillage from entering drains or watercourses.

### **METHODS AND MATERIALS FOR CONTAINMENT AND CLEANING UP:**

Collect the pieces and place into a suitable container for disposal. Avoid generating dusts. Provide adequate ventilation.

# PERMAFORM APPLICATION SAFETY DATA SHEET



## 7- HANDLING AND STORAGE

---

**PRECAUTIONS FOR SAFE HANDLING:** Use of safe work practices are recommended to avoid eye or skin contact and inhalation of dusts. Use only outdoors or in a well-ventilated area.

Food, beverages and tobacco products should not be stored or consumed where this material is in use. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

Provide eyewash fountains and safety showers in close proximity to points of potential exposure.

**CONDITIONS FOR SAFE STORAGE:** Store in a cool, dry and well-ventilated area. Avoid accumulation of dust.

## 8- EXPOSURE CONTROLS AND PERSONAL PROTECTION

---

**EXPOSURE STANDARDS (SAFE WORK AUSTRALIA):** 471-34-1 calcium carbonate NES 10 mg/m<sup>3</sup>

**ENGINEERING CONTROLS:** Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapour below occupational exposure standards.

**PERSONAL PROTECTIVE EQUIPMENT (PPE):** Wear Safe Work Australia full protective clothing.

**RESPIRATORY PROTECTION:** Use dust mask when cutting product. See Australian Standards AS/NZS 1715 and 1716 for more information.

**SKIN PROTECTION:** Impermeable gloves and protective clothing. See Australian Standards AS/NZS 2161, 2210.1 and 2210.2 for more information.

**EYE AND FACE PROTECTION:** Safety glasses with top and side shields or goggles. See Australian Standards AS/NZS 1336 and 1337 for more information.

## 9- PHYSICAL AND CHEMICAL PROPERTIES

---

**APPEARANCE:** Form: Solid - hollow-type rib reinforced plastic material comprising of two PVC panel facings adhered onto a concrete block with three internal reinforcing PVC ribs.

Colour: Off white

Odour: None

**MELTING POINT/MELTING RANGE:** No information available

**FLAMMABILITY:** Non-flammable

**RELATIVE DENSITY AT 20 °C:** 1300 kg/m<sup>3</sup>



# PERMAFORM APPLICATION SAFETY DATA SHEET



## 10- STABILITY AND REACTIVITY

---

### **POSSIBILITY OF HAZARDOUS REACTIONS:**

Hazardous polymerisation will not occur.

**CHEMICAL STABILITY:** Stable at ambient temperature and under normal conditions of use.

**CONDITIONS TO AVOID:** No further relevant information available.

**INCOMPATIBLE MATERIALS:** No further relevant information available.

**HAZARDOUS DECOMPOSITION PRODUCTS:** No dangerous decomposition products known.

## 11- TOXICOLOGICAL INFORMATION

---

### **TOXICITY: LD50/LC50 VALUES RELEVANT FOR CLASSIFICATION**

471-34-1 calcium carbonate

Oral LD50 6450 mg/kg (rat)

8013-07-8 Soybean oil, epoxidized Oral LD50

21000-40000 mg/kg (rat)

Dermal LD50 >2000 mg/kg (rabbit)

### **ACCORDING TO SAFE WORK AUSTRALIA**

Printing date 11.04.2013 Revision: 11.04.2013

**ACUTE HEALTH EFFECTS:** Skin Corrosion / Irritation: No information available

**SERIOUS EYE DAMAGE / IRRITATION:** No information available

**RESPIRATORY OR SKIN SENSITISATION:** Sensitization possible through skin contact.

**GERM CELL MUTAGENICITY:** No information available

**CARCINOGENICITY:** Polyvinyl chloride is classified by IARC as a Group 3 - Not classifiable as to its carcinogenicity to humans.

**SPECIFIC TARGET ORGAN TOXICITY (STOT) - SINGLE EXPOSURE:** No information available

**SPECIFIC TARGET ORGAN TOXICITY (STOT) - REPEATED EXPOSURE:** No information available

**CHRONIC HEALTH EFFECTS:** No information available

**EXISTING CONDITIONS AGGRAVATED BY EXPOSURE:** No information available

## 12- ECOLOGICAL INFORMATION

---

### **ECOTOXICITY AQUATIC TOXICITY**

8013-07-8 Soybean oil, epoxidized EC50 / 24 hours > 100 mg/l (daphnia)

Inhalation LC50 900 mg/m<sup>3</sup> (fathead minnows)

### **PERSISTENCE AND DEGRADABILITY**

No further relevant information available.

**BIOACCUMULATIVE:** Potential: No further relevant information available.

**MOBILITY IN SOIL:** No further relevant information available.

# PERMAFORM APPLICATION SAFETY DATA SHEET



## 13- DISPOSAL CONSIDERATIONS

### **DISPOSAL METHODS AND CONTAINERS:**

Dispose according to applicable local and state government regulations.

### **SPECIAL PRECAUTIONS FOR LANDFILL OR**

**INCINERATION:** Please consult your state Land Waste Management Authority for more information.

**UN NUMBER:** ADG, IMDG, IATA: Not applicable

**PROPER SHIPPING NAME:** ADG, IMDG, IATA: Not applicable

**DANGEROUS GOODS CLASS:** ADG CLASS: Not applicable

**PACKING GROUP:** ADG, IMDG, IATA Not applicable

## 14- TRANSPORT INFORMATION

**UN NUMBER:** ADG, IMDG, IATA Not applicable

**PROPER SHIPPING NAME:** ADG, IMDG, IATA Not applicable

**DANGEROUS GOODS CLASS:** ADG Class: Not applicable

**PACKING GROUP:** ADG, IMDG, IATA Not applicable

## 15- REGULATORY INFORMATION

### **AUSTRALIAN INVENTORY OF CHEMICAL**

**SUBSTANCES:** All ingredients are listed.

## 16- OTHER INFORMATION

**CREATION DATE:** 11 April 2013

**PREPARED BY:** MSDS.COM.AU Pty Ltd

[www.msds.com.au](http://www.msds.com.au)

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PERMAFORM INTERNATIONAL Pty Ltd

## TERMS & CONDITIONS OF TRADE

### 1. Definitions

- 1.1 "Permaform" means Permaform International P/L ABN: 70 609 958 527.
- 1.2 "Customer" means the person/s buying the Goods as specified in any invoice, document or order, and if there is more than one Customer is a reference to each Customer jointly and severally.
- 1.3 "Agreement" refers to any agreement between Permaform and the customer whereby Permaform supplies the goods and services to the customer.
- 1.4 "Goods" means all Goods or Services supplied by Permaform to the Customer at the Customer's request from time to time (where the context so permits the terms 'Goods' or 'Services' shall be interchangeable for the other).
- 1.5 "Price" means the Price payable for the Goods as agreed between Permaform and the Customer in accordance with clause 5 below.
- 1.6 "GST" means Goods and Services Tax as defined within the "A New Tax System (Goods and Services Tax) Act 1999" (Cth).
- 1.7 "Default" means an invoice not paid by the due date on the Permaform invoice to the Customer.
- 1.8 "Deposit Payment" refers to the payments following the orders to confirm Permaform's product supply in cleared funds for each order or project or customer.

### 2. Acceptance

- 2.1 The Customer is taken to have exclusively accepted and is immediately bound, jointly and severally, by these terms and conditions if the Customer places an order for or accepts delivery of the Goods.
- 2.2 These terms and conditions may only be amended with the consent of both parties in writing and shall prevail to the extent of any inconsistency with any other document or agreement between the Customer and Permaform.

### 3. Electronic Transactions Act 2001

- 3.1 Electronic signatures shall be deemed to be accepted by either party providing that the parties have complied with Section 9 of the Electronic Transactions Act 2001 or any other applicable provisions of that Act or any Regulations referred to in that Act.

### 4. Change in Control

- 4.1 The Customer shall give Permaform not less than fourteen (14) days prior written notice of any proposed change of ownership of the Customer and/or any other change in the Customer's details (including but not limited to, changes in the Customer's name, address, contact phone or fax number/s, or business practice). The Customer shall be liable for any loss incurred by Permaform as a result of the Customer's failure to comply with this clause.

### 5. Price and Payment

- 5.1 At Permaform's sole discretion the Price shall be either:
- (a) as indicated on any invoice provided by Permaform to the Customer; or
- (b) the Price as at the date of delivery of the Goods according to Permaform's current price list; or
- (c) Permaform's quoted price (subject to clause 5.2) which will be valid for the period stated in the quotation or otherwise for a period of thirty (30) days.
- 5.2 Permaform reserves the right to change the Price if a variation to Permaform's quotation is requested. Any variation from the plan of scheduled Services or specifications (including, but not limited to, any variation as a result of additional works required due to unforeseen circumstances such as a result of any increase to Permaform in the cost of materials and labour) will be charged for on the basis of Permaform's quotation and will be shown as variations on the invoice.
- 5.3 An invoice or Quote/Proforma Invoice for deposit purposes may be issued by Permaform to the Customer on placement of an order. Any applicable payment schedule will be duly noted on the documentation.
- 5.4 At Permaform's sole discretion a deposit may be required which:
- (a) shall be assigned to the amount of the invoice if the order proceeds; or
- (b) becomes non-refundable if the order does not proceed or is cancelled as per clause 14.2.
- 5.5 If any part of an invoice is in dispute then the Customer shall notify Permaform in writing within ten (10) business days once in receipt of the invoice, then the Customer may only withhold payment for that part of the invoice that is in dispute and shall pay the balance of the invoice when due.
- 5.6 Time for payment for the Goods being of the essence, the Price will be payable by the Customer on the date/s determined by Permaform, which may be:
- (a) available for delivery defined as available for collection or delivery ex warehouse;
- (b) by way of instalments/progress payments in accordance with Permaform's payment schedule;
- (c) the date specified on any invoice or other form as being the date for payment; or
- (d) failing any notice to the contrary, the date which is seven (7) business days following the date of any invoice given to the Customer by Permaform.

- 5.7 Payment may be made by electronic/on-line banking, or by any other method as agreed to between the Customer and Permaform.
- 5.8 Unless otherwise stated the Price does not include GST. In addition to the Price the Customer must pay to Permaform an amount equal to any GST Permaform must pay for any supply by Permaform under this or any other agreement for the sale of the Goods. The Customer must pay GST, without deduction or set off of any other amounts, at the same time and on the same basis as the Customer pays the Price. In addition the Customer must pay any other taxes and duties that may be applicable in addition to the Price except where they are expressly included in the Price.
- 5.9 The price quoted may be subject to change due to but not limited to change in supplier's costs, change in the cost of material and the currency fluctuations of the Australian Dollar. The price charged will be the price set by Permaform in accordance with Permaform's pricing policies and charges occurring prior to or at the date of collection/delivery. The project under construction may consist of a number of orders. The prices between these orders may vary.
- 5.10 Where Permaform has offered credit by way of an account with Permaform then Permaform, at its sole and absolute discretion, may alter any offered Credit Limit to any amount including zero without notice and will confirm this in writing within 5 business days of the decision. Furthermore, Permaform will be entitled to demand immediate payment in full of any unpaid monies. If any invoice remains unpaid 7 days after such demand, then the Customer is in default and Permaform is entitled to commence all legal actions required to recover unpaid amounts.
- 5.11 Permaform may extend credit, to approved Customers, on a strict thirty (30) day basis from the end of the month in which the invoice is dated. Statements may be issued on the last day of each month. The customer must pay all amounts on all of the invoices within the payment terms.
- 5.12 Should any invoice due to be paid but remaining unpaid seven (7) calendar days after due date the account may be placed on "STOP CREDIT/TRADING" without notice to the Customer until the account is paid. Future Credit may be withdrawn at Permaform's unfettered discretion. Permaform reserves the right to report any default to its Credit Reporting partners and Trade Credit partners.
- 5.13 Any account (invoice) in default (remains unpaid 7 days after due date) attracts a charge of 2.5% per month. This charge will be calculated on the full value of the invoice from due date (or part thereof being the daily rate of the month to 2 decimal places) until the invoice is paid in full. The 0.2% charge amount must be paid in full to lift a STOP CREDIT/TRADING status.
- 5.14 If Permaform's Trade Credit Insurer cancels or reduces the insurance offered on the Customer, then Permaform reserves the right to immediately terminate any Credit terms and demand immediate payment of any or all accounts (invoices) issued to the Customer.

### 6. Delivery of Goods

- 6.1 Delivery ("Delivery") of the Goods is taken to occur at the time that:
- (a) the Customer or the Customer's nominated carrier takes possession of the Goods at Permaform's address; or
- (b) Permaform (or Permaform's nominated carrier) delivers the Goods to the Customer's nominated address even if the Customer is not present at the address.
- 6.2 Where the Goods are delivered by a third party, the Customer is required to sign the delivery docket or any other form requiring acknowledgement of receipt of the Goods by the Customer immediately on delivery and these forms are to be given to the Delivery Driver for return to Permaform. If there is any dispute on the delivery quantities or condition of the goods, the Customer must state its dispute in writing with in within seven (7) days of the delivery date (see Clause 11). If the Customer fails to comply with clause 6.2 then Permaform reserves the right to deem the Goods are supplied as per the Delivery documentation and to be in satisfactory working order.
- 6.3 At Permaform's sole discretion the cost of delivery is either included in the Price or is in addition to the Price.
- 6.4 The Customer must take delivery by receipt or collection of the Goods whenever they are tendered for delivery. In the event that the Customer is unable to take delivery of the Goods as arranged then Permaform shall be entitled to charge a reasonable fee for redelivery and/or storage.
- 6.5 Any time or date given by Permaform to the Customer is an estimate only. The Customer must still accept delivery of the Goods even if late and Permaform will not be liable for any loss or damage incurred by the Customer as a result of the delivery being late.

### 7. Risk

- 7.1 Risk of damage to or loss of the Goods passes to the Customer on Delivery and the Customer must insure the Goods on or before Delivery.
- 7.2 If any of the Goods are damaged or destroyed following delivery but prior to ownership passing to the Customer, Permaform is entitled to receive all insurance proceeds payable for the Goods. The production of these terms and conditions by Permaform is sufficient evidence of Permaform's rights to receive the insurance proceeds without the need for any person dealing with Permaform to make further enquiries.
- 7.3 If the Customer requests Permaform to leave Goods outside Permaform's premises for collection or to deliver the Goods to an unattended location then such Goods shall be left at the Customer's sole risk.

### 8. Title

- 8.1 Permaform and the Customer agree that ownership of the Goods shall not pass until:
- (a) the Customer has paid Permaform all amounts owing to Permaform; and
- (b) the Customer has met all of its other obligations to Permaform.
- 8.2 Receipt by Permaform of any form of payment other than cash shall not be deemed to be payment until that form of payment has been honoured, cleared or recognised.
- 8.3 It is further agreed that:
- (a) until ownership of the Goods passes to the Customer in accordance with clause 8.1 that the Customer is only a bailee of the Goods and must return the Goods to Permaform on request.
- (b) the Customer holds the benefit of the Customer's insurance of the Goods on trust for Permaform and must pay to Permaform the proceeds of any insurance in the event of the Goods being lost, damaged or destroyed.
- (c) the Customer must not sell, dispose, or otherwise part with possession of the Goods other than in the ordinary course of business and for market value. If the Customer sells, disposes or parts with possession of the Goods then the Customer must hold the proceeds of any such act on trust for Permaform and must pay or deliver the proceeds to Permaform on demand.
- (d) the Customer should not convert or process the Goods or intermix them with other goods but if the Customer does so then the Customer holds the resulting product on trust for the benefit of Permaform and must sell, dispose of or return the resulting product to Permaform as it so directs.
- (e) the Customer irrevocably authorises Permaform to enter any premises where Permaform believes the Goods are kept and recover possession of the Goods.
- (f) Permaform may recover possession of any Goods in transit whether or not delivery has occurred.
- (g) the Customer shall not charge or grant an encumbrance over the Goods nor grant nor otherwise give away any interest in the Goods while they remain the property of Permaform.
- (h) Permaform may commence proceedings to recover the Price of the Goods sold notwithstanding that ownership of the Goods has not passed to the Customer.

### 9. Personal Property Securities Act 2009 ("PPSA")

- 9.1 In this clause financing statement, financing change statement, security agreement, and security interest has the meaning given to it by the PPSA.
- 9.2 Upon assenting to these terms and conditions in writing the Customer acknowledges and agrees that these terms and conditions constitute a security agreement for the purposes of the PPSA and creates a security interest in all Goods and/or collateral (account) – being a monetary obligation of the Customer to Permaform for Services – that have previously been supplied and that will be supplied in the future by Permaform to the Customer.
- 9.3 The Customer undertakes to:
- (a) promptly sign any further documents and/or provide any further information (such information to be complete, accurate and up-to-date in all respects) which Permaform may reasonably require to;
- (i) register a financing statement or financing change statement in relation to a security interest on the Personal Property Securities Register;
- (ii) register any other document required to be registered by the PPSA; or
- (iii) correct a defect in a statement referred to in clause 9.3(a)(i) or 9.3(a)(ii);
- (b) indemnify, and upon demand reimburse, Permaform for all expenses incurred in registering a financing statement or financing change statement on the Personal Property Securities Register established by the PPSA or releasing any Goods charged thereby;
- (c) not register a financing change statement in respect of a security interest without the prior written consent of Permaform;
- (d) not register, or permit to be registered, a financing statement or a financing change statement in relation to the Goods and/or collateral (account) in favour of a third party without the prior written consent of Permaform;
- (e) immediately advise Permaform of any material change in its business practices of selling the Goods which would result in a change in the nature of proceeds derived from such sales.
- 9.4 Permaform and the Customer agree that sections 96, 115 and 125 of the PPSA do not apply to the security agreement created by these terms and conditions.
- 9.5 The Customer waives their rights to receive notices under sections 95, 118, 121(4), 130, 132(3)(d) and 132(4) of the PPSA.
- 9.6 The Customer waives their rights as a grantor and/or a debtor under sections 142 and 143 of the PPSA.
- 9.7 Unless otherwise agreed to in writing by Permaform, the Customer waives their right to receive a verification statement in accordance with section 157 of the PPSA.
- 9.8 The Customer must unconditionally ratify any actions taken by Permaform under clauses 9.3 to 9.5.
- 9.9 Subject to any express provisions to the contrary (including those contained in clause 9), nothing in these terms and conditions is intended to have the effect of contracting out of any of the provisions of the PPSA.



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### 10. Security and Charge

- 10.1 In consideration of Permaform agreeing to supply the Goods, the Customer charges all of its rights, title and interest (whether joint or several) in any land, realty or other assets capable of being charged, owned by the Customer either now or in the future, to secure the performance by the Customer of its obligations under these terms and conditions (including, but not limited to, the payment of any money).
- 10.2 The Customer indemnifies Permaform from and against all Permaform's costs and disbursements including legal costs on a solicitor and own client basis incurred in exercising Permaform's rights under this clause.
- 10.3 The Customer irrevocably appoints Permaform and each director of Permaform as the Customer's true and lawful attorney/s to perform all necessary acts to give effect to the provisions of this clause 10 including, but not limited to, signing any document on the Customer's behalf.

### 11. Defects, Warranties and Returns, Competition and Consumer Act 2010 (CCA)

- 11.1 The Customer must inspect the Goods immediately on delivery and must within seven (7) days of delivery and prior to installation, notify Permaform in writing of any evident defect/damage, shortage in quantity, or failure to comply with the description or quote. The Customer must notify any other alleged defect in the Goods as soon as reasonably possible after any such defect becomes evident. Upon such notification the Customer must allow Permaform to inspect the Goods.
- 11.2 Under applicable State, Territory and Commonwealth Law (including, without limitation the CCA), certain statutory implied guarantees and warranties (including, without limitation the statutory guarantees under the CCA) may be implied into these terms and conditions (Non-Excluded Guarantees).
- 11.3 Permaform acknowledges that nothing in these terms and conditions purports to modify or exclude the Non-Excluded Guarantees.
- 11.4 Except as expressly set out in these terms and conditions or in respect of the Non-Excluded Guarantees, Permaform makes no warranties or other representations under these terms and conditions including but not limited to the quality or suitability of the Goods. Permaform's liability in respect of these warranties is limited to the fullest extent permitted by law.
- 11.5 If the Customer is a consumer within the meaning of the CCA, Permaform's liability is limited to the extent permitted by section 64A of Schedule 2.
- 11.6 If Permaform is required to replace the Goods under this clause or the CCA, but is unable to do so, Permaform may refund any money the Customer has paid for the Goods.
- 11.7 If the Customer is not a consumer within the meaning of the CCA, Permaform's liability for any defect or damage in the Goods is:
- (a) limited to the value of any express warranty or warranty card provided to the Customer by Permaform at Permaform's sole discretion;
  - (b) limited to any warranty to which Permaform is entitled, if Permaform did not manufacture the Goods;
  - (c) otherwise negated absolutely.
- 11.8 Subject to this clause 11, returns will only be accepted provided that:
- (a) the Customer has complied with the provisions of clause 11.1; and
  - (b) Permaform has agreed that the Goods are defective; and
  - (c) the Goods are returned within a reasonable time at the Customer's cost (if that cost is not significant); and
  - (d) the Goods are returned in as close a condition to that in which they were delivered as is possible.
- 11.9 Notwithstanding clauses 11.1 to 11.8 but subject to the CCA, Permaform shall not be liable for any defect or damage which may be caused or partly caused by or arise as a result of:
- (a) the Customer failing to properly maintain or store any Goods;
  - (b) the Customer using the Goods for any purpose other than that for which they were designed;
  - (c) the Customer continuing the use of any Goods after any defect became apparent or should have become apparent to a reasonably prudent operator or user;
  - (d) the Customer failing to follow any instructions or guidelines provided by Permaform;
  - (e) fair wear and tear, any accident, or act of God.
- 11.10 In the case of second hand Goods, unless the Customer is a consumer under the CCA, the Customer acknowledges that it has had full opportunity to inspect the second hand Goods prior to delivery and accepts them with all faults and that to the extent permitted by law no warranty is given by Permaform as to the quality or suitability for any purpose and any implied warranty, statutory or otherwise, is expressly excluded. The Customer acknowledges and agrees that Permaform has agreed to provide the Customer with the second hand Goods and calculated the Price of the second hand Goods in reliance of this clause 11.10.

### 12. Intellectual Property

- 12.1 Where Permaform has designed, drawn or developed Goods for the Customer, then the copyright in any designs and drawings and documents shall remain the property of Permaform.

- 12.2 The Customer warrants that all designs, specifications or instructions given to Permaform will not cause Permaform to infringe any patent, registered design or trademark in the execution of the Customer's order and the Customer agrees to indemnify Permaform against any action taken by a third party against Permaform in respect of any such infringement.
- 12.3 The Customer agrees that Permaform may (at no cost) use for the purposes of marketing or entry into any competition, any documents, designs, drawings or Goods which Permaform has created for the Customer.

### 13. Default and Consequences of Default (definition of Default?)

- 13.1 Interest on overdue invoices shall accrue daily from the date when payment becomes due, until the date of payment, at a rate of two and a half percent (2.5%) per calendar month (and at Permaform's sole discretion such interest shall compound monthly at such a rate) after as well as before any judgment.
- 13.2 If the Customer owes Permaform any money the Customer shall indemnify Permaform from and against all costs and disbursements incurred by Permaform in recovering the debt (including but not limited to internal administration fees, legal costs on a solicitor and own client basis, Permaform's contract default fee, and bank dishonour fees).
- 13.3 Further to any other rights or remedies Permaform may have under this contract, if a Customer has made payment to Permaform, and the transaction is subsequently reversed, the Customer shall be liable for the amount of the reversed transaction, in addition to any further costs incurred by Permaform under this clause 13 where it can be proven that such reversal is found to be illegal, fraudulent or in contravention to the Customer's obligations under this agreement.
- 13.4 Without prejudice to any other remedies Permaform may have, if at any time the Customer is in breach of any obligation (including those relating to payment) under these terms and conditions Permaform may suspend or terminate the supply of Goods to the Customer. Permaform will not be liable to the Customer for any loss or damage the Customer suffers because Permaform has exercised its rights under this clause.
- 13.5 Without prejudice to Permaform's other remedies at law Permaform shall be entitled to cancel all or any part of any order of the Customer which remains unfulfilled and all amounts owing to Permaform shall, whether or not due for payment, become immediately payable if:
- (a) any money payable to Permaform becomes overdue, or in Permaform's opinion the Customer will be unable to make a payment when it falls due;
  - (b) the Customer becomes insolvent, convenes a meeting with its creditors or proposes or enters into an arrangement with creditors, or makes an assignment for the benefit of its creditors; or
  - (c) a receiver, manager, liquidator (provisional or otherwise) or similar person is appointed in respect of the Customer or any asset of the Customer.

### 14. Cancellation

- 14.1 Permaform may cancel any contract to which these terms and conditions apply or cancel delivery of Goods at any time before the Goods are delivered by giving written notice to the Customer. On giving such notice Permaform shall repay to the Customer any money paid by the Customer for the Goods. Permaform shall not be liable for any loss or damage whatsoever arising from such cancellation.
- 14.2 In the event that the Customer cancels delivery of Goods the Customer shall be liable for any and all loss incurred (whether direct or indirect) by Permaform as a direct result of the cancellation (including, but not limited to, any loss of profits).
- 14.3 Cancellation of orders for Goods made to the Customer's specifications, or for non-stocklist items, will definitely not be accepted once production has commenced, or an order has been placed.

### 15. Privacy Act 1988

- 15.1 The Customer agrees for Permaform to obtain from a credit reporting body (CRB) a credit report containing personal credit information (e.g. name, address, D.O.B, occupation, previous credit applications, credit history) about the Customer in relation to credit provided by Permaform.
- 15.2 The Customer agrees that Permaform may exchange information about the Customer with those credit providers and with related body corporates for the following purposes:
- (a) to assess an application by the Customer; and/or
  - (b) to notify other credit providers of a default by the Customer; and/or
  - (c) to exchange information with other credit providers as to the status of this credit account, where the Customer is in default with other credit providers; and/or
  - (d) to assess the creditworthiness of the Customer including the Customer's repayment history in the preceding two years.
- 15.3 The Customer consents to Permaform being given a consumer credit report to collect overdue payment on commercial credit.
- 15.4 The Customer agrees that personal credit information provided may be used and retained by Permaform for the following purposes (and for other agreed purposes or required by):
- (a) the provision of Goods; and/or
  - (b) analysing, verifying and/or checking the Customer's credit, payment and/or status in relation to the provision of Goods; and/or
  - (c) processing of any payment instructions, direct debit facilities and/or credit facilities requested by the Customer; and/or
  - (d) enabling the collection of amounts outstanding in relation to the Goods.

- 15.5 Permaform may give information about the Customer to a CRB for the following purposes:

- (a) to obtain a consumer credit report;
  - (b) allow the CRB to create or maintain a credit information file about the Customer including credit history.
- 15.6 The information given to the CRB may include:
- (a) personal information as outlined in 15.1 above;
  - (b) name of the credit provider and that Permaform is a current credit provider to the Customer;
  - (c) whether the credit provider is a licensee;
  - (d) type of consumer credit;
  - (e) details concerning the Customer's application for credit or commercial credit (e.g. date of commencement/termination of the credit account and the amount requested);
  - (f) advice of consumer credit defaults, overdue accounts, loan repayments or outstanding monies which are overdue by more than sixty (60) days and for which written notice for request of payment has been made and debt recovery action commenced or alternatively that the Customer no longer has any overdue accounts and Permaform has been paid or otherwise discharged and all details surrounding that discharge (e.g. dates of payments);
  - (g) information that, in the opinion of Permaform, the Customer has committed a serious credit infringement;
  - (h) advice that the amount of the Customer's overdue payment is equal to or more than one hundred and fifty dollars (\$150).
- 15.7 The Customer shall have the right to request (by e-mail) from Permaform:
- (a) a copy of the information about the Customer retained by Permaform and the right to request that Permaform correct any incorrect information; and
  - (b) that Permaform does not disclose any personal information about the Customer for the purpose of direct marketing.
- 15.8 Permaform will destroy personal information upon the Customer's request (by e-mail) or if it is no longer required unless it is required in order to fulfil the obligations of this agreement or is required to be maintained and/or stored in accordance with the law.
- 15.9 The Customer can make a privacy complaint by contacting Permaform via e-mail. Permaform will respond to that complaint within seven (7) days of receipt and will take all reasonable steps to make a decision as to the complaint within thirty (30) days of receipt of the complaint. In the event that the Customer is not satisfied with the resolution provided, the Customer can make a complaint to the Information Commissioner at [www.oaic.gov.au](http://www.oaic.gov.au).

### 16. Building and Construction Industry (Security of Payment) Act 2009

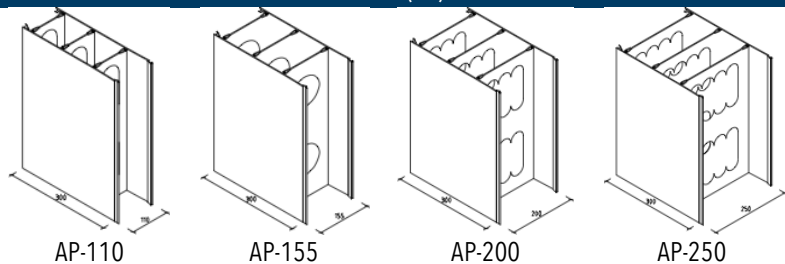
- 16.1 At Permaform's sole discretion, if there are any disputes or claims for unpaid Goods and/or Services then the provisions of the Building and Construction Industry (Security of Payment) Act 2009 may apply.
- 16.2 Nothing in this agreement is intended to have the effect of contracting out of any applicable provisions of the Building and Construction Industry (Security of Payment) Act 2009 of the Australian Capital Territory, except to the extent permitted by the Act where applicable.

### 17. General

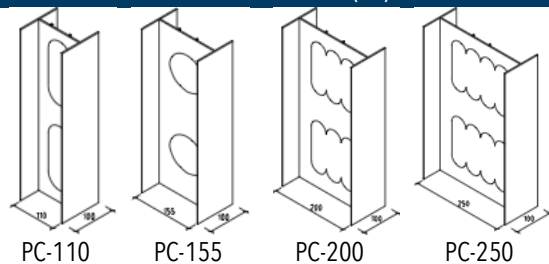
- 17.1 The failure by either party to enforce any provision of these terms and conditions shall not be treated as a waiver of that provision, nor shall it affect that party's right to subsequently enforce that provision. If any provision of these terms and conditions shall be invalid, void, illegal or unenforceable the validity, existence, legality and enforceability of the remaining provisions shall not be affected, prejudiced or impaired.
- 17.2 These terms and conditions and any contract to which they apply shall be governed by the laws of New South Wales and are subject to the jurisdiction of the courts in New South Wales.
- 17.3 Subject to clause 11, Permaform shall be under no liability whatsoever to the Customer for any indirect and/or consequential loss and/or expense (including loss of profit) suffered by the Customer arising out of a breach by Permaform of these terms and conditions (alternatively Permaform's liability shall be limited to damages which under no circumstances shall exceed the Price of the Goods).
- 17.4 The Customer shall not be entitled to set off against, or deduct from the Price, any sums owed or claimed to be owed to the Customer by Permaform nor to withhold payment of any invoice because part of that invoice is in dispute.
- 17.5 Neither party shall assign or sub-contract all or any part of their rights and obligations under this agreement without the written consent of the other party.
- 17.6 The Customer agrees that Permaform may amend these terms and conditions by notifying the Customer in writing. These changes shall be deemed to take effect from the date on which the Customer accepts such changes, or otherwise at such time as the Customer makes a further request for Permaform to provide Goods to the Customer.
- 17.7 Neither party shall be liable for any default due to any act of God, war, terrorism, strike, lock-out, industrial action, fire, flood, storm or other event beyond the reasonable control of either party.
- 17.8 Both parties warrant that they have the power to enter into this agreement and have obtained all necessary authorisations to allow them to do so, they are not insolvent and that this agreement creates binding and valid legal obligations on them.



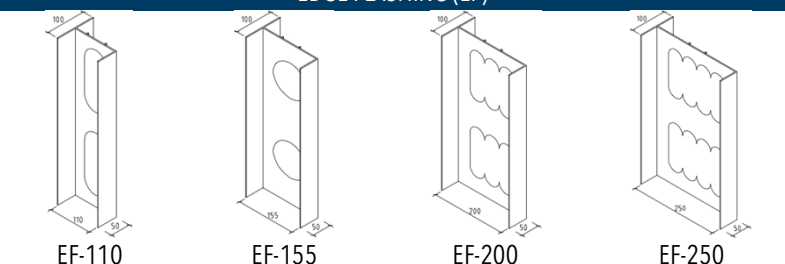
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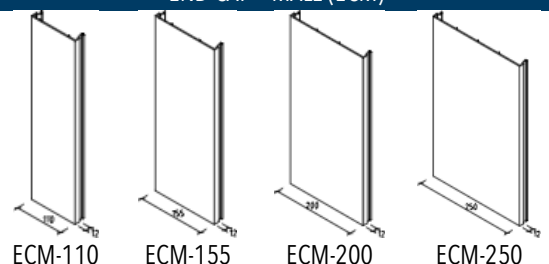
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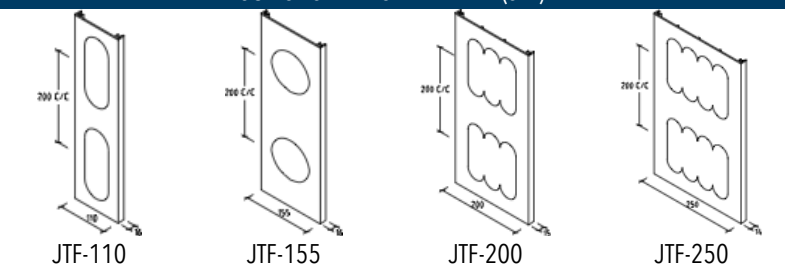
## EDGE FLASHING (EF)



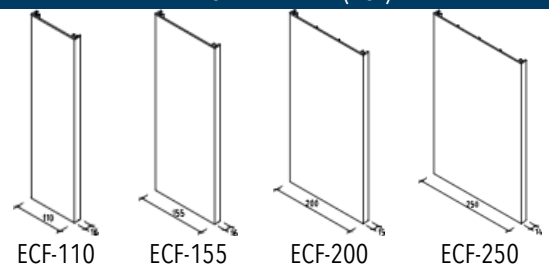
## END CAP - MALE (ECM)



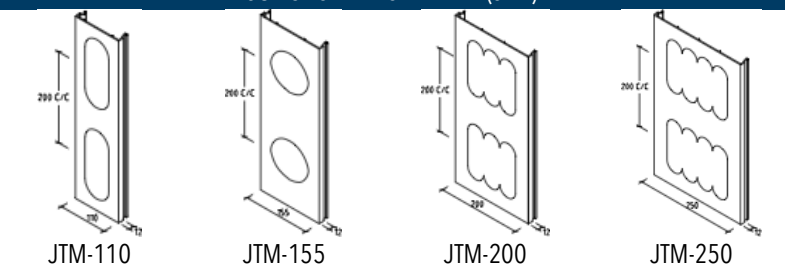
## JUNCTION TRACK - FEMALE (JTF)



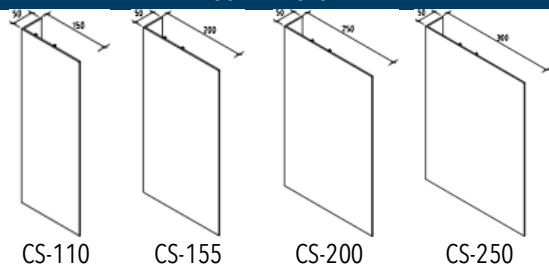
## END CAP - FEMALE (ECF)



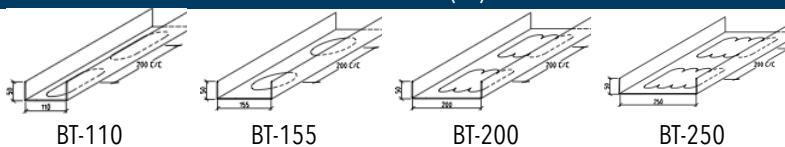
## JUNCTION TRACK - MALE (JTM)



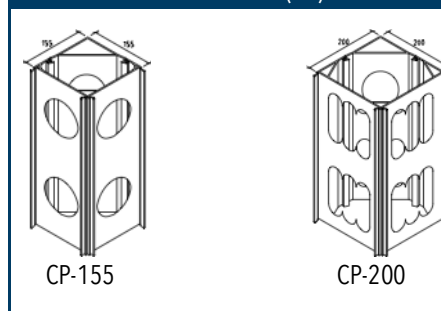
## CORNER STOP



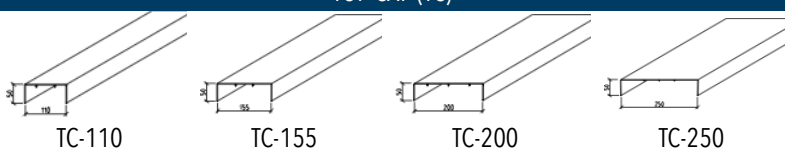
## BOTTOM TRACK (BT)



## CORNER PANEL (CP)



## TOP CAP (TC)



# WALL INSTALLATION QUALITY ASSURANCE CHECKLIST



REF	DESCRIPTION	APPROVED			COMMENTS/REFERENCE/CONTACT
		YES	NO	N/A	
<b>1</b>	<b>PRELIMINARIES</b>				
A	Drawing transmittal date (Confirm all drawing numbers and revisions are correct)				
B	Wall quantities/heights/sizes approved by client				
C	Material supplied by: (eg installer/builder)				
D	All reinforcement supplied meets all drawing and specification requirements				
E	Concrete mix designs have been submitted and approved Provide mix code/number				
F	Concrete testing number:                      Test frequency:				
G	All concrete supplied meets all drawings and specification requirements				
H	Concrete supplier				
I	Concrete pump supplied by:				
J	Concrete pump size:                      Rego:				
<b>2</b>	<b>PREPOUR CHECKLIST</b>				
A	Wall survey supplied by				
B	Concrete footing flat and free of debris				
C	Bottom track installed correctly				
D	Water proofing/hydrophilic sealant installed correctly				
E	All walls installed in correct locations as per drawings and survey				
F	All penetrations locations provided and installed in accordance with site mark-out				
G	All walls have been installed straight and plumb				
H	No ribs/diaphragms are damaged, split or cracked				
I	All wall panels have been clipped in correctly with no visible gaps				
J	All finish wall heights have been installed as per drawings and specifications				
K	All corners and stop ends are adequately braced				
L	All window/door openings have been formed and braced correctly				
M	For walls above 4m: midway horizontal strongback to be screwed to panels and propped				
N	Props installed at a maximum spacing of 1.8m				
<b>3</b>	<b>POUR CHECKLIST</b>				
A	Max fill height 1500mm adhered to				
B	Concrete leaks are cleaned from walls and door frames				
C	Door frames remain plumb during pour process				
D	Window sills topped up and steel trowled				
E	All props secure and fixed and remain in situ in readiness of concrete slab above concrete pour				

## PERMAFORM INSTALLER

NAME

SIGNATURE

DATE

## AUTHORISED CLIENT REPRESENTATIVE

NAME

SIGNATURE

DATE