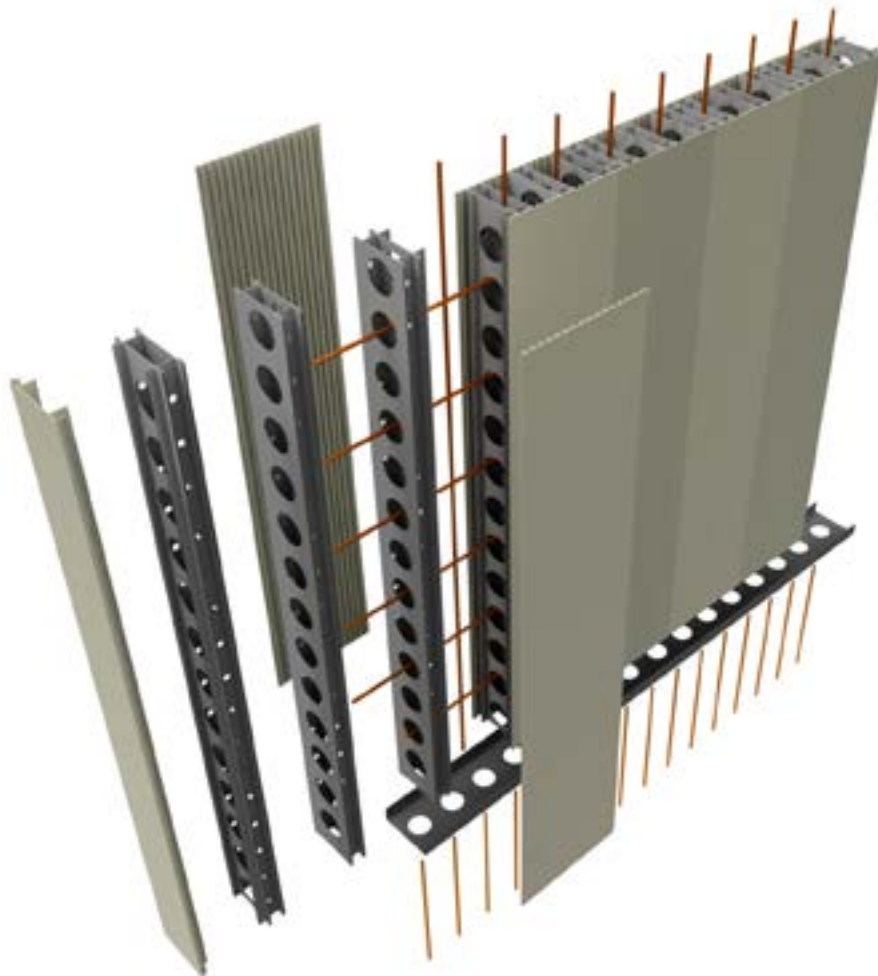




# PERMAFORM HANDBOOK

V2 - 2014



PERMAFORM IS A PERMANENT PVC FORMWORK SYSTEM WHICH REMAINS IN PLACE FOR THE LIFE OF THE STRUCTURE. AS SUCH IT DOES NOT PLAY ANY SIGNIFICANT PART IN THE STRUCTURAL INTEGRITY OF THE CONCRETE ELEMENT.

HOWEVER THE PVC PERMAFORM FINISH HAS MANY APPLICATIONS AS A FINISHED SURFACE SUCH AS BASEMENT CAR PARKS AND STAIR WELLS. ALTERNATIVELY PAINT, RENDER OR OTHER MATERIALS CAN BE APPLIED TO VERY EASILY ACHIEVE DECORATIVE AND ARCHITECTURAL FINISHES.

#### **KEY ATTRIBUTES OF CONCRETE WALL & COLUMN FORMWORK**

- + Compliant with BCA and AS 3600
- + Structurally safe
- + Practical for reinforcement and concrete placement
- + Leak resistant
- + Easy Integration with other walls, slab, columns, footings
- + Achieves an integral finish
- + Quick Installation
- + Economical

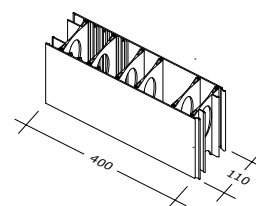
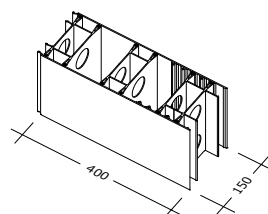
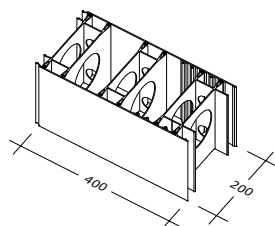
# SYSTEM COMPONENT CATALOGUE

200

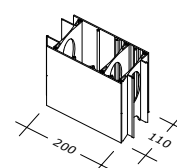
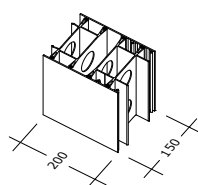
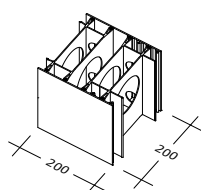
150

110

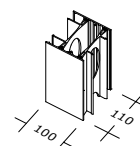
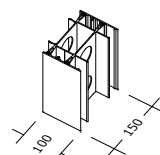
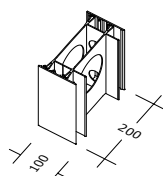
**AP** - Adjustable Standard  
Wall Panel 400 wide



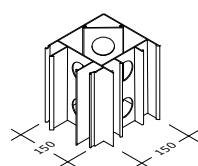
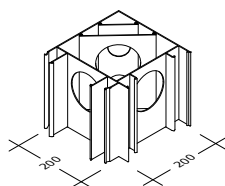
**HP** - Half Wall Panel  
200 wide



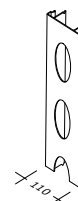
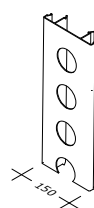
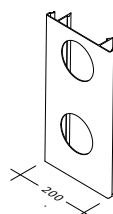
**QP** - Quarter Wall Panel  
100 wide



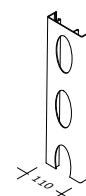
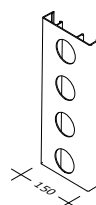
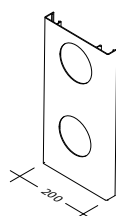
**CP** - Corner Panel



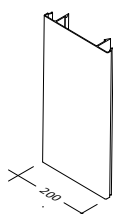
**JTM** - Junction Track  
Male

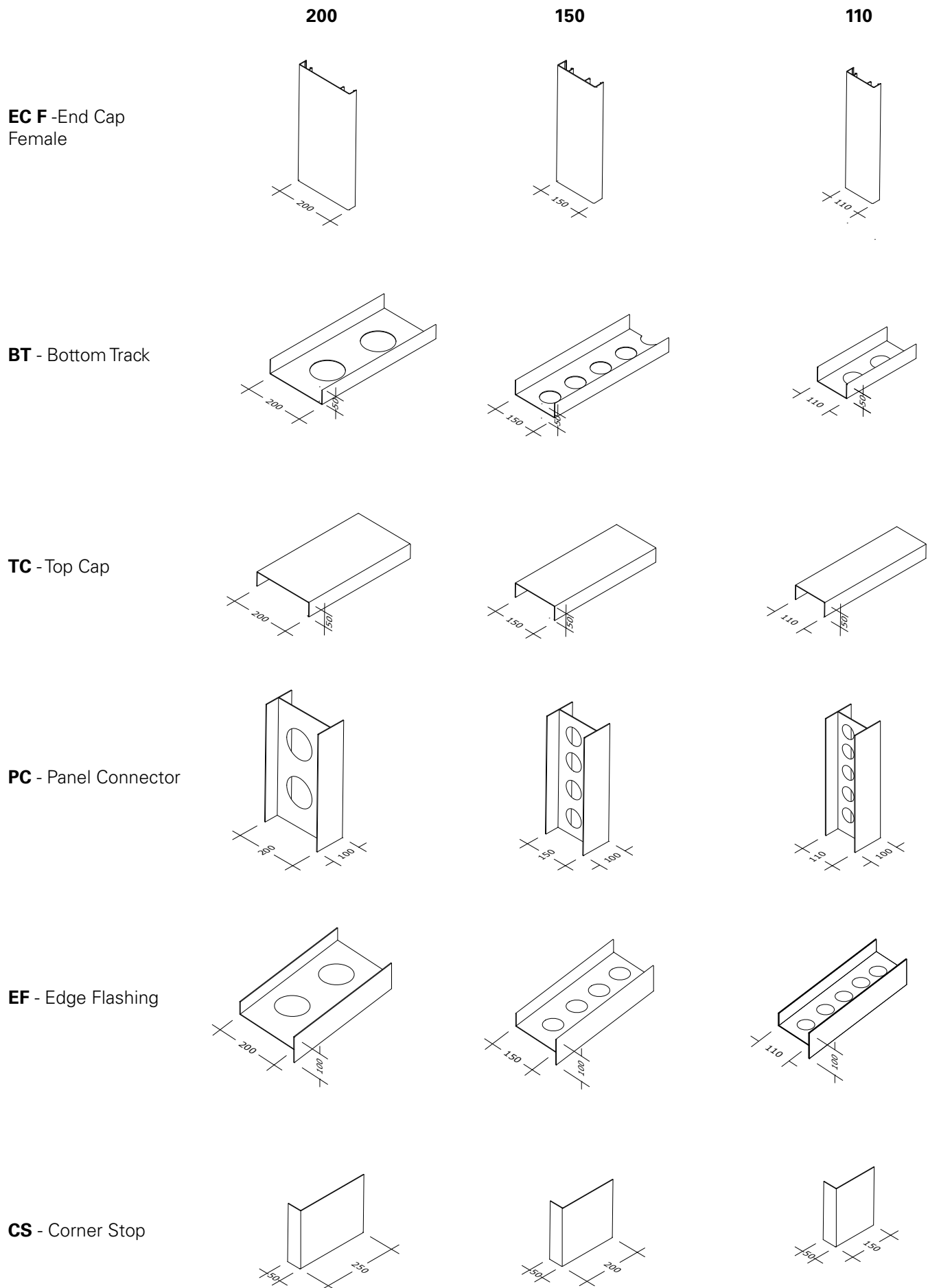


**JTF** - Junction Track  
Female

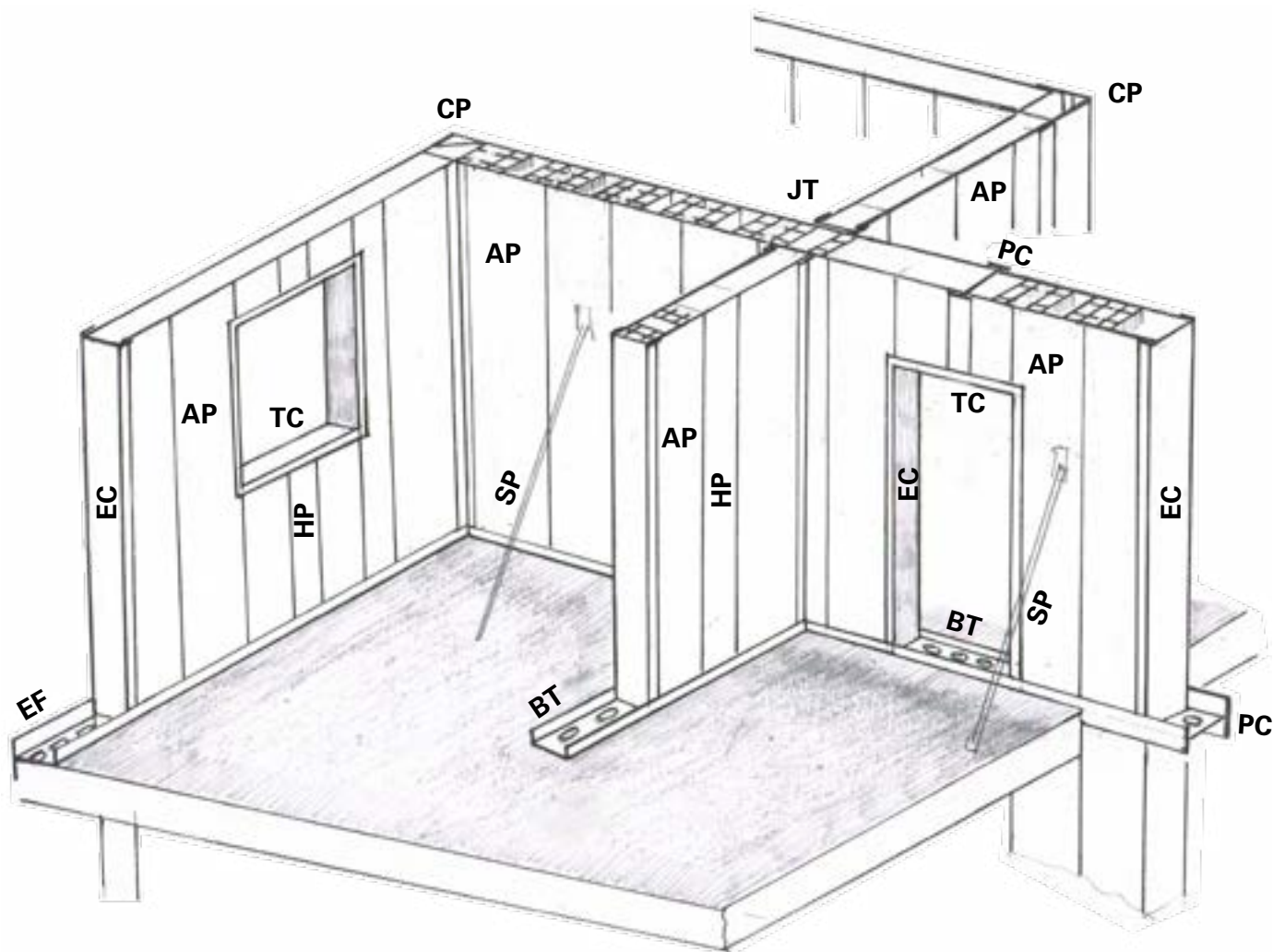


**EC M** - End Cap  
Male

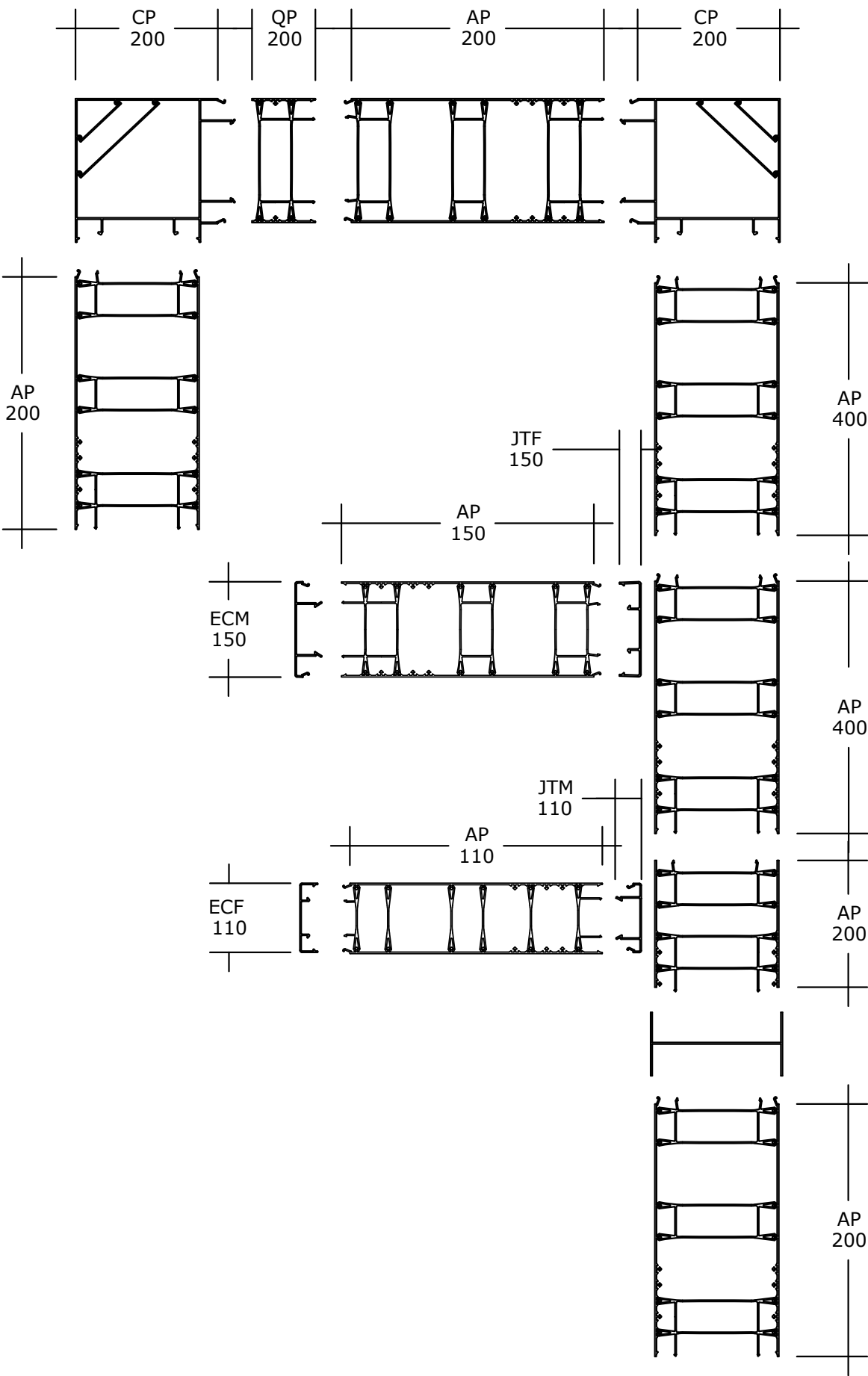




# TYPICAL COMPONENT ARRANGEMENT

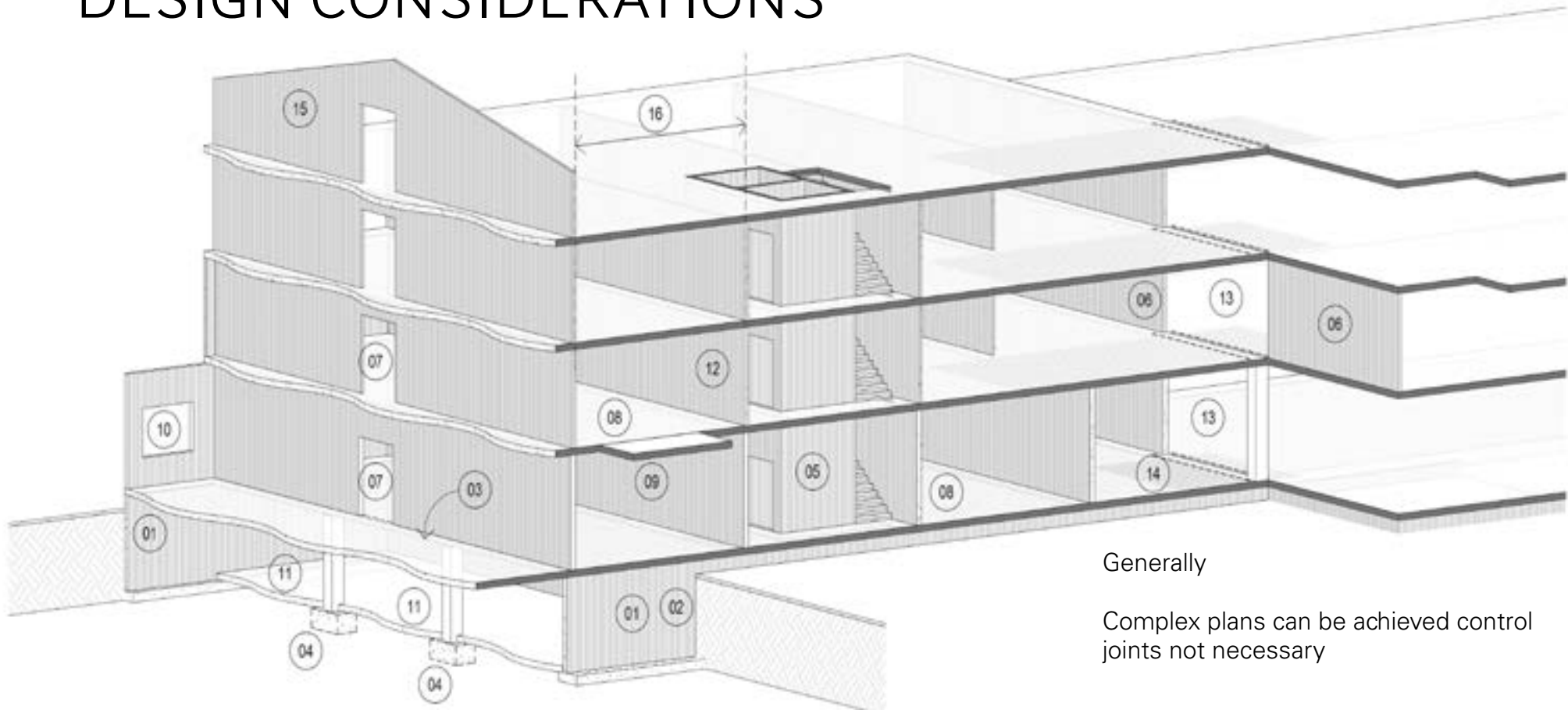


# TYPICAL PANEL ARRANGEMENT



# DESIGN CONSIDERATIONS

## (A) PERMAFORM SYSTEM



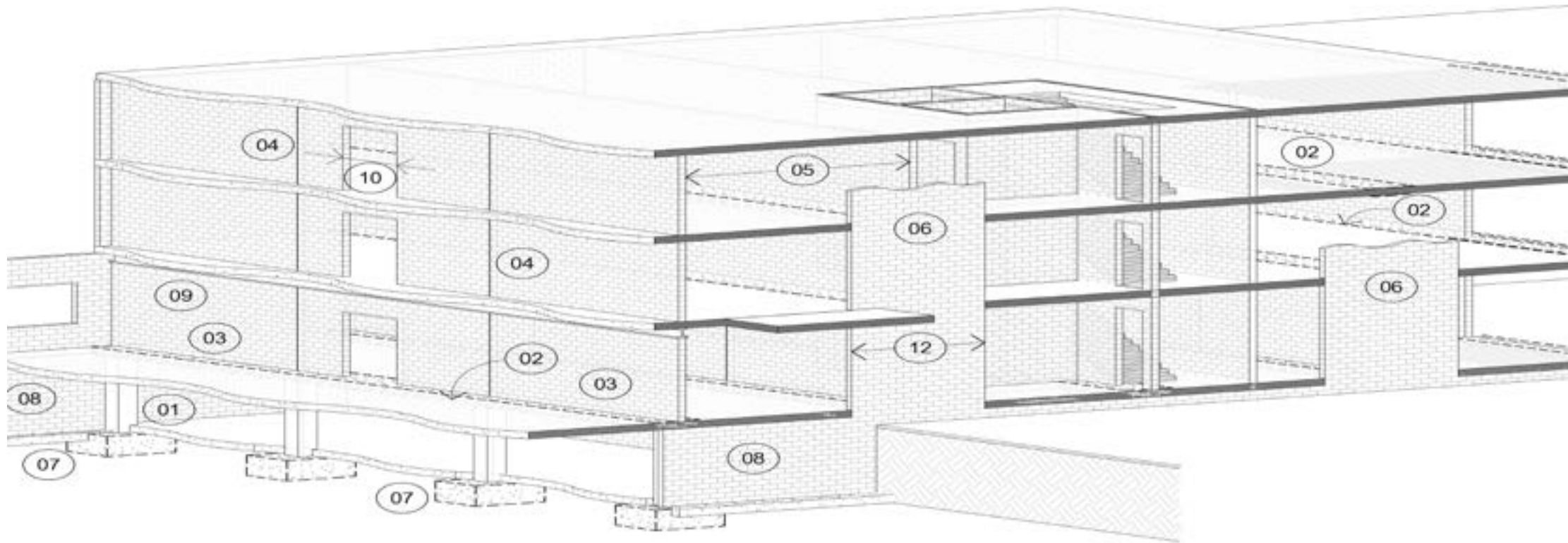
Generally

Complex plans can be achieved control joints not necessary

- |   |   |  |
|---|---|--|
| 01 Water tight retaining walls at basement capable of resisting high point loads        | 06 Bracket action of walls enhances flexibility in planning | 11 Permaform columns possible  |
| 02 Horizontal reinforcement can be eliminated/ reduced as shrinkage effects not visible | 07 Walls easy to penetrate for doorways, windows, etc       | 12 Upper floors can utilize thinner walls                                |
| 03 Transfer walls eliminate need for transfer beams                                     | 08 Low construction loads on slabs at early stage           | 13 Embedded beams can be incorporated in floor depth                     |
| 04 Dead load reductions reduce footings   | 09 Ease of resisting balcony point loads at extremities     | 14 Need for transfer beams reduced                                       |
| 05 Wall strength allows greater spans between load bearing elements                     | 10 Precast type facade possible without heavy lifts         | 15 Upper floor party walls can be used to support and stabilize the roof |



## (B) BLOCKWORK SYSTEM



01 Pilasters / columns necessary to carry transfer beam reactions

02 Transfer beams required to carry wall loads

03 Blockwork insufficient to distribute loads adequately due to low wall strength requiring stiffer transfer beams

04 Control joints require acoustic/ fire treatment

05 Spans between load bearing wall are restricted by wall capacity

06 Cross walls may be necessary at wall extremities reducing windows to support balconies, etc.

07 High dead load maximizes footings

08 Waterproofing of basement walls rely on membrane

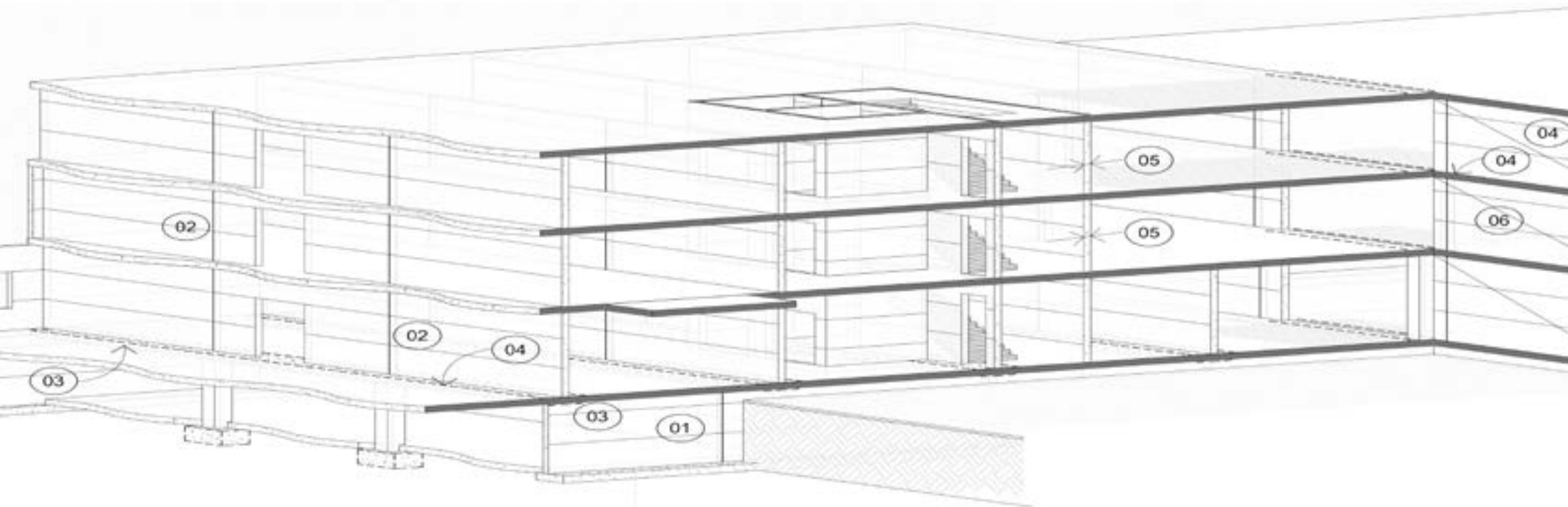
09 Difficult to place blockwork filling for high reinforcement percentages

10 Wall penetrations limited by wall capacity

11 Block cantilevers very restricted without extra columns

12 Edge balcony support loads restricted

### (C) FRAMED SYSTEM

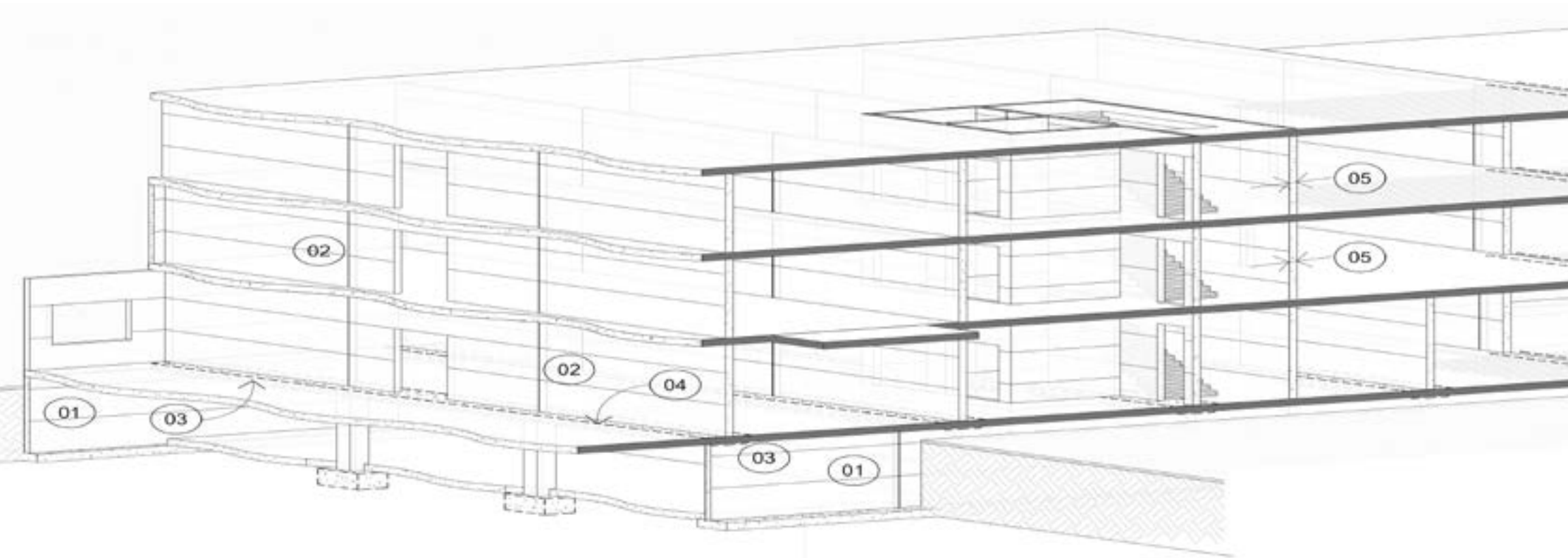


- 01 Infill retaining walls difficult to seal/ waterproof
- 02 Heavy Transfer beams support upper columns
- 03 Band beams required to support infill party walls

- 04 Columns intrude in apartment plans
- 05 Relatively high structural dead load not compatible with low apartment live loads producing heavy footings
- 06 One Way slabs require beam support

- 07 Perimeter columns restrict garage and wall waterproofing
- 08 Support footing/ column required

## (D) FULL PRECAST SYSTEM



- 01 Precast retaining walls - critical to water proof joints
- 02 Panel joints require treatment and are difficult to include structural action
- 03 Transfer beams generally necessary
- 04 Full structural integrity difficult at slab/ wall joints
- 05 Wall thickness determined by handling
- 06 Brackets overhanging require complex slab/ wall joints to achieve cantilevers

# PERMAFORM APPLICATIONS

## LOAD TRANSFER STRUCTURE

PERMAFORM system can be used to replicate all the features of a poured concrete wall assembly. Such walls have inherent rigidity within the wall plane and detailed correctly can replace transfer beams to distribute and resist concentrated and distributed loads to achieve larger grid spacing with economy.

Deep wall/beams demonstrate strut-tie properties normally associated with arches where vertical shear forces do not occur. The compressive properties of concrete can then be utilised.

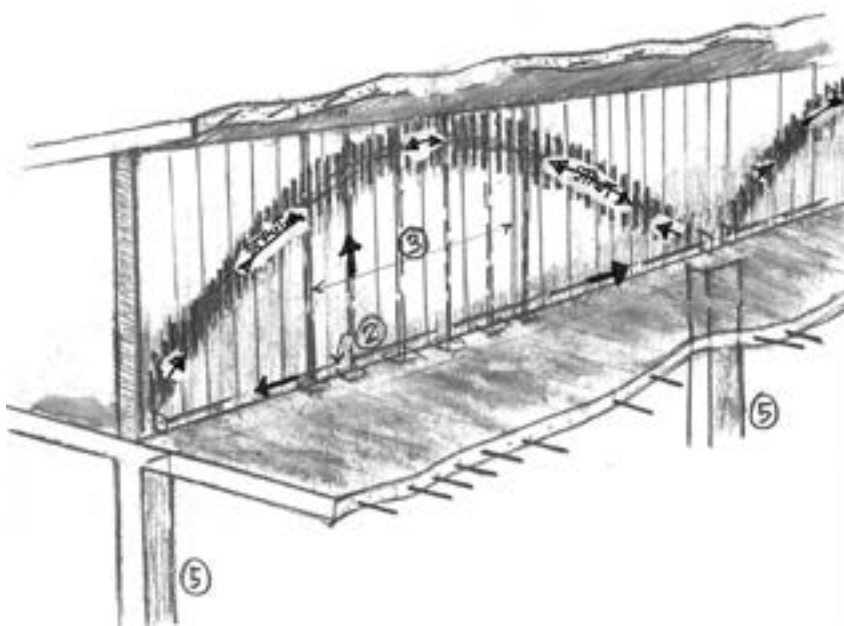
Vertical shear forces are a concept related to beam flexure which is not present in wall/beams. Where in the unusual circumstance that arch action is not developed, shear friction principles can be adopted using aggregate interlock at the internal diaphragm penetrations, to transfer loads.

Typical transfer wall/beam actions can be confirmed using finite element software.

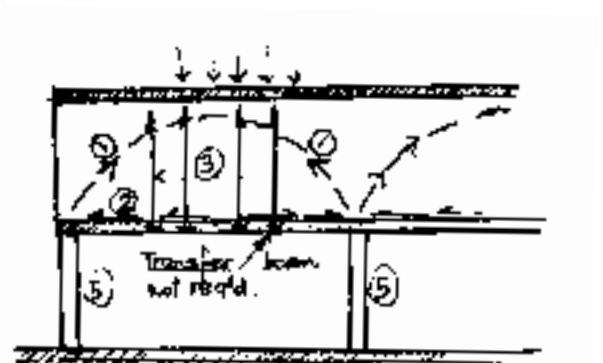
Typical cases are illustrated in the following diagrams, which can be utilised to drive economies in structures.

### A - TRANSFER WALLS

Distributed loads use of wall arch action eliminates need for beams and reduced head room and cost.

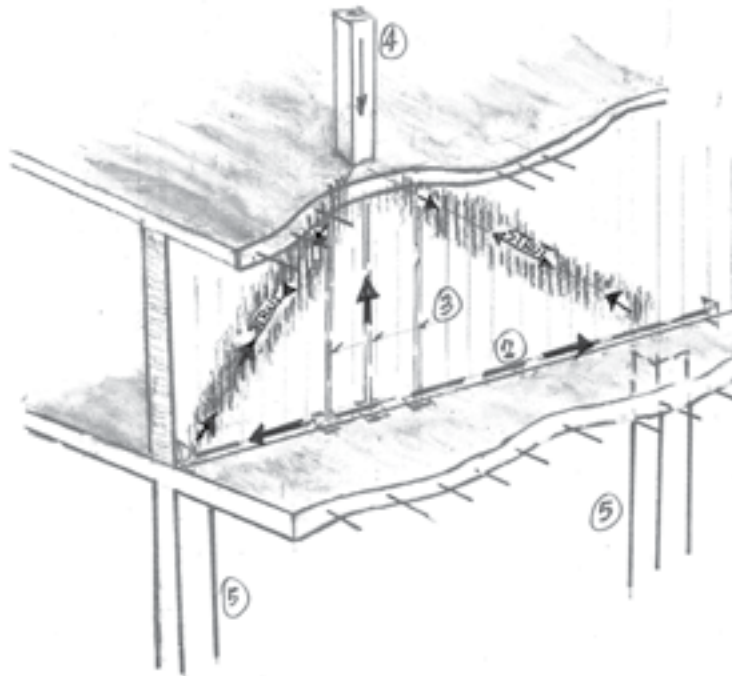


- (1) Compressive thrust
- (2) Tension tie
- (3) Hanger rods
- (4) Col loads
- (5) Support wall/column

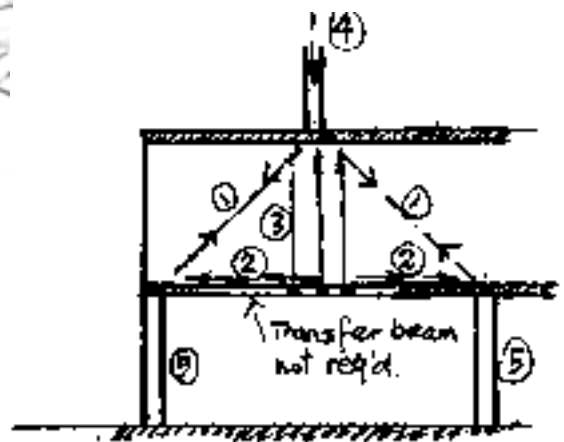


## B - TRANSFER WALLS - COLUMN LOADS

Concentrated loads can be redistributed without recourse to beams

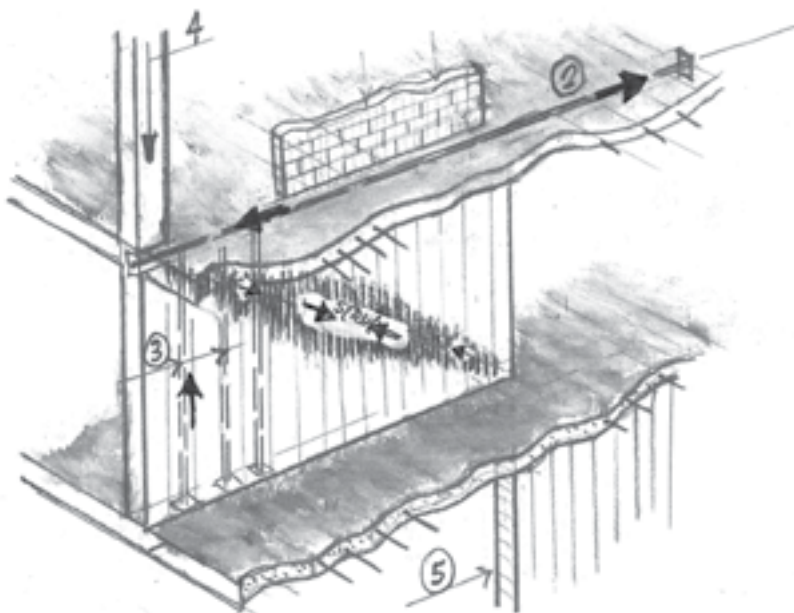


- (1) Compressive thrust
- (2) Tension tie
- (3) Hanger rods
- (4) Col loads
- (5) Support wall/column

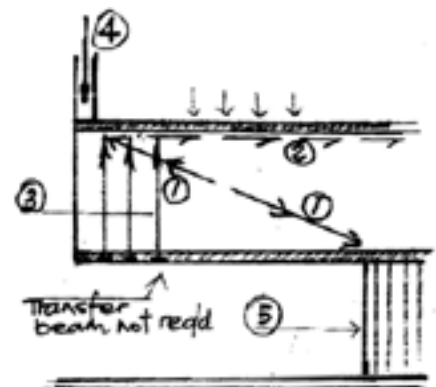


## C - WALL BRACKETS

Used to support massive cantilevers with relative ease and stiffness to eliminate beam elements



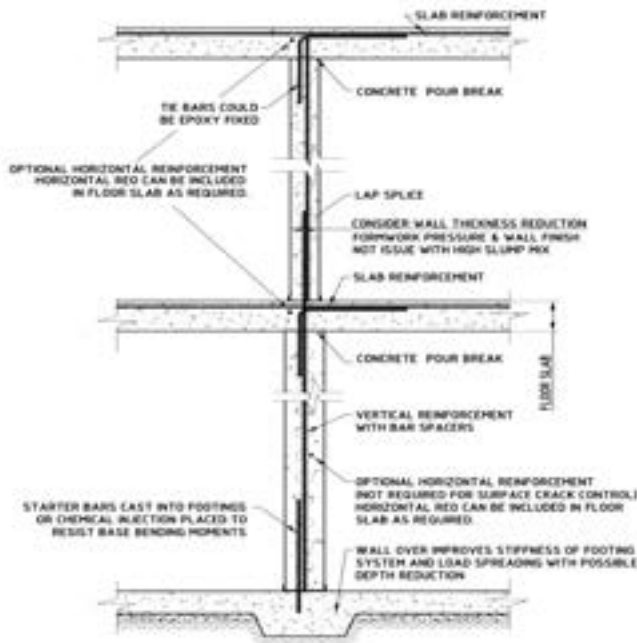
- (1) Compressive thrust
- (2) Tension tie
- (3) Hanger rods
- (4) Col loads
- (5) Support wall/column





# STRUCTURAL APPLICATIONS

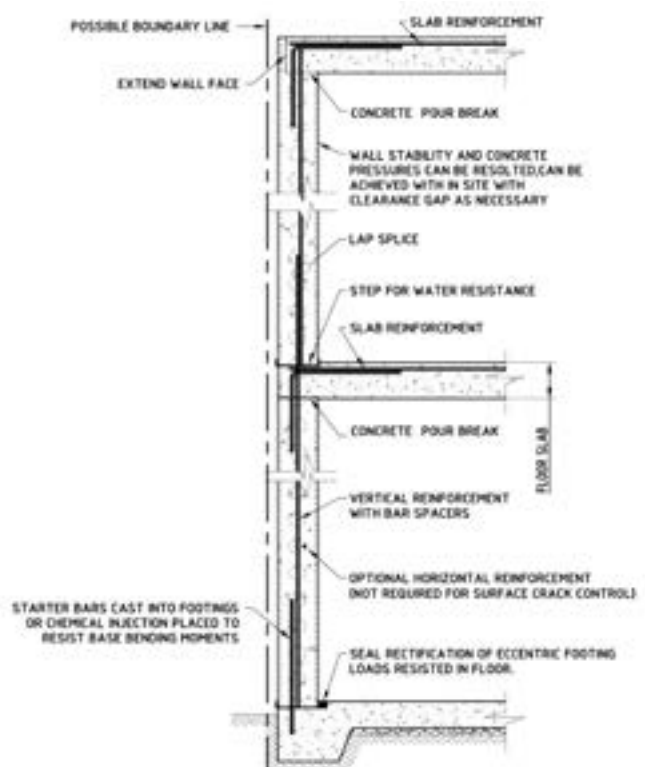
## INTERNAL WALL - UPPER STOREY LOAD BEARING CONSTRUCTION



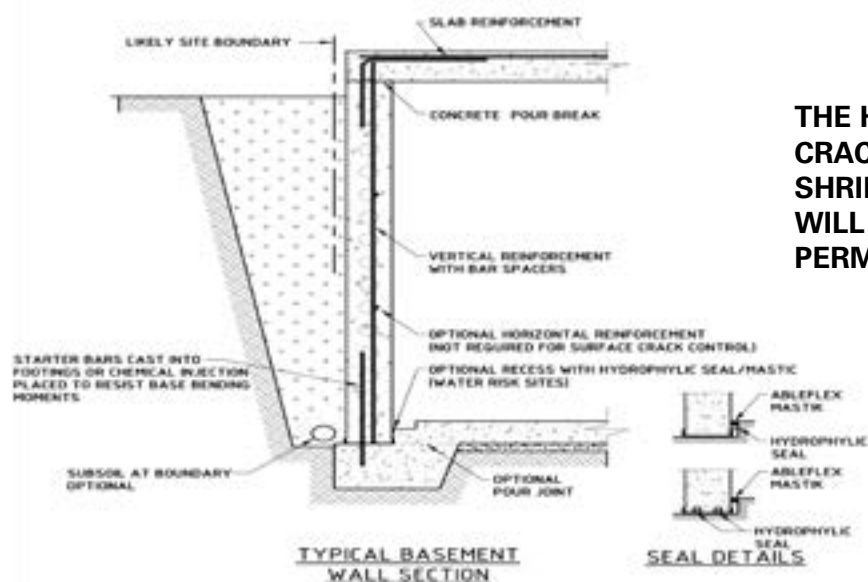
**WALL SLAB REINFORCEMENT & THICKNESS TO BE DETERMINED BY ENGINEER. PERMAFORM RECOMMENDED PLACEMENT OF SINGLE PANELS BETWEEN FLOOR HEIGHTS NOT TO EXCEED 6 METRES.**

## EXTERNAL WALL - UPPER STOREY LOAD BEARING CONSTRUCTION

**WALL SLAB REINFORCEMENT & THICKNESS TO BE DETERMINED BY ENGINEER. PERMAFORM CUT BACK AT TOP TO ACCOMMODATE SLAB. LAP SPLICES NORMALLY 40D.**

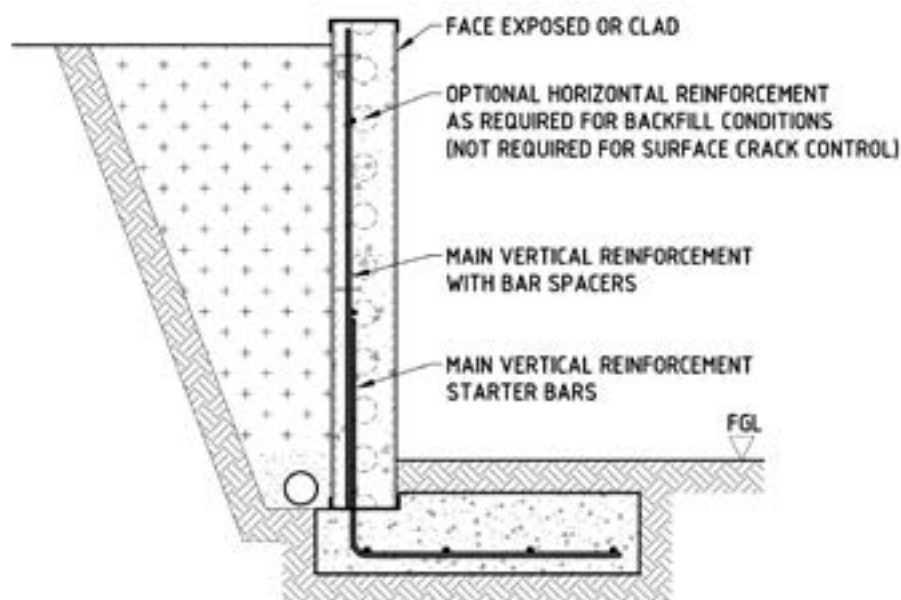


## TYPICAL BASEMENT WALL SECTION



**THE HORIZONTAL REINFORCEMENT FOR CRACK CONTROL IS OPTIONAL. VERTICAL SHRINKAGE CRACKS IF FORMED, WILL BE FULLY ENCAPSULATED IN THE PERMAFORM ENVELOPE.**

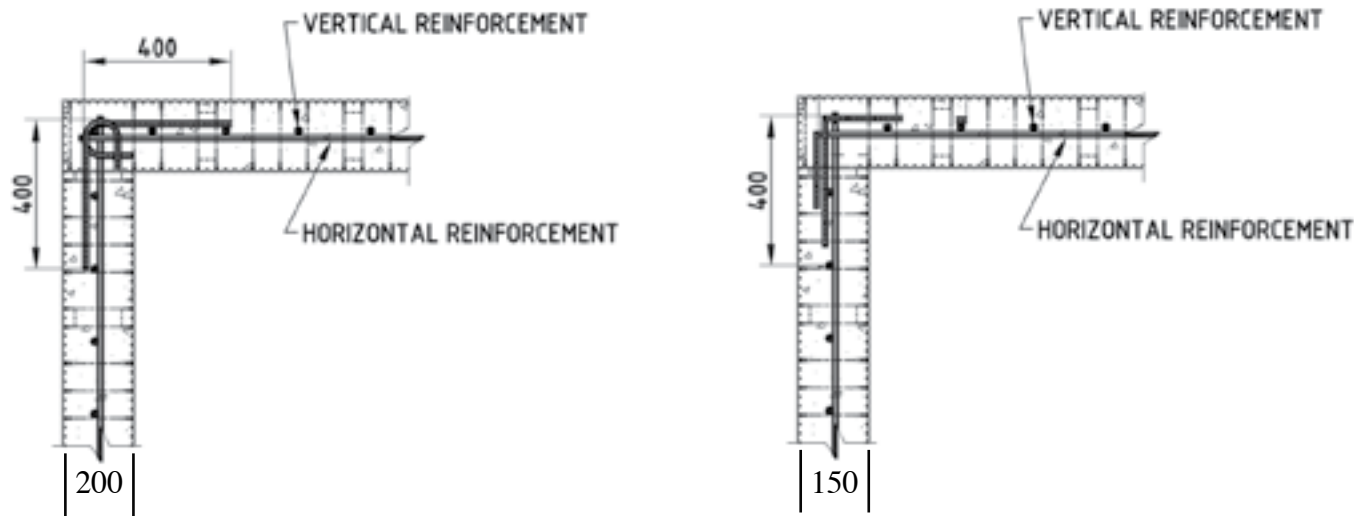
## TYPICAL CANTILEVER RETAINING WALL



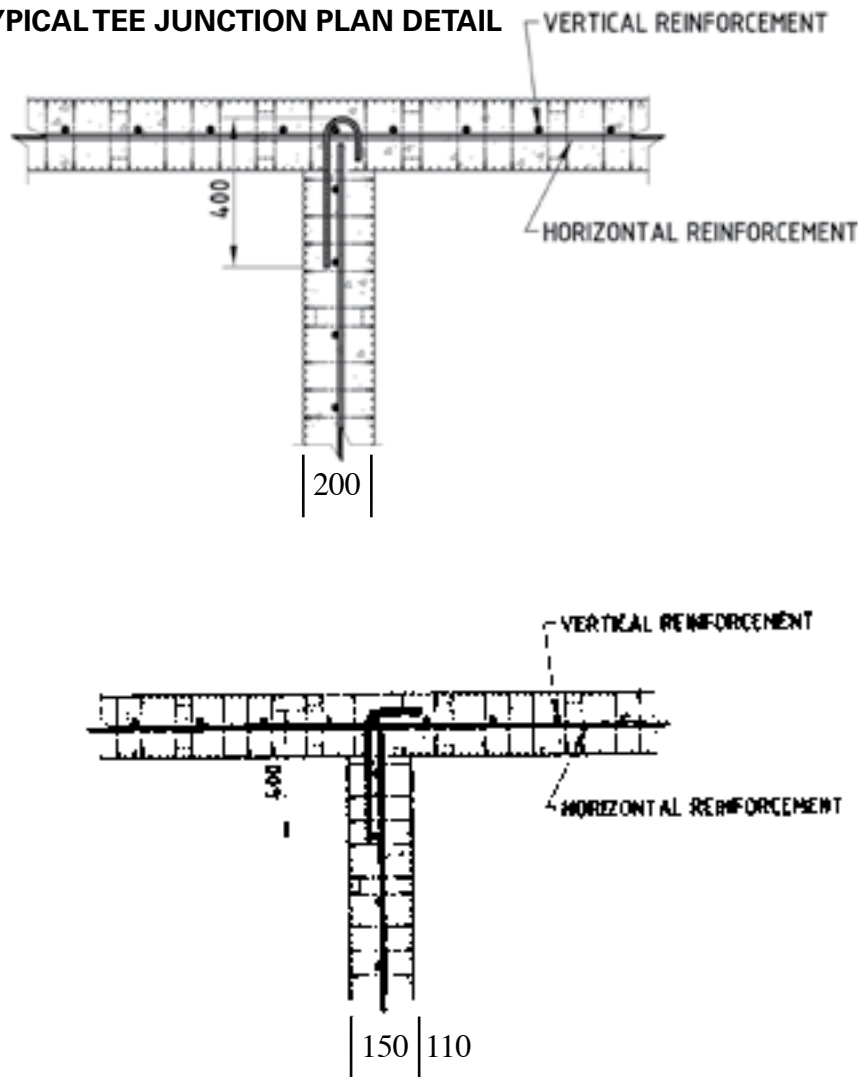
**PERMAFORM WILL ACT AS AN EFFECTIVE WATERPROOFING MEMBRANE FOR MOST SITUATIONS.**

**IF FULL WATER PROOF INTEGRITY IS REQUIRED, PROPRIETARY WATER PROOFING AGENT SHOULD BE APPLIED. MOST BRANDS OF SHEET MEMBRANES ARE SUITABLE, CHECK WITH MANUFACTURER FOR ADHESION QUALITY TO PVC IF IN DOUBT. IN CASES WHERE WATERPROOFING IS NOT IMPERATIVE, PERMAFORM WILL PROVIDE A BARRIER TO WATER PENETRATION AND SUBSEQUENT REINFORCING DEGRADATION.**

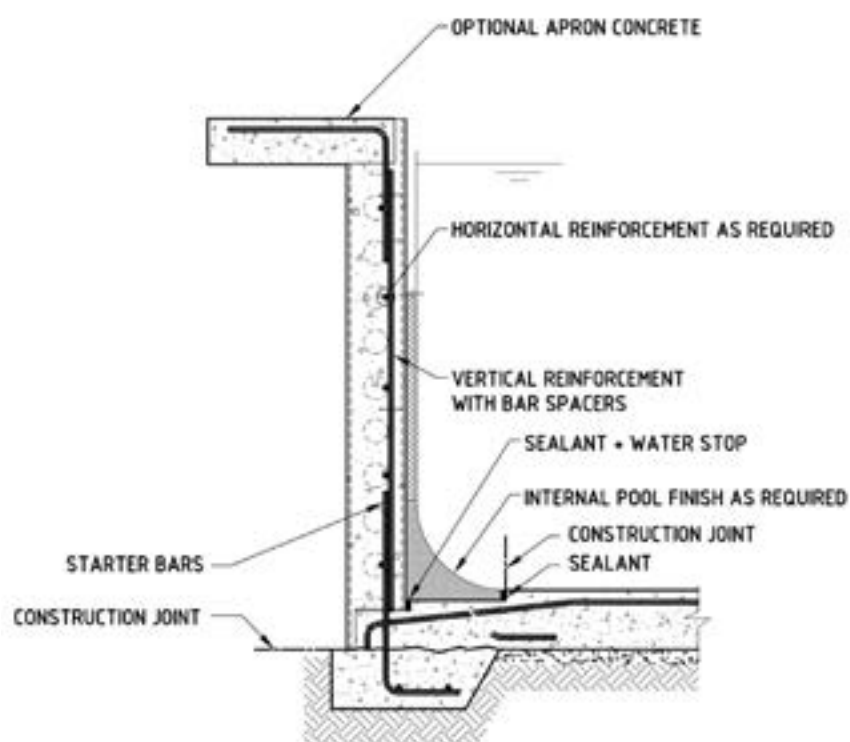
TYPICAL CORNER PLAN DETAIL



TYPICAL TEE JUNCTION PLAN DETAIL

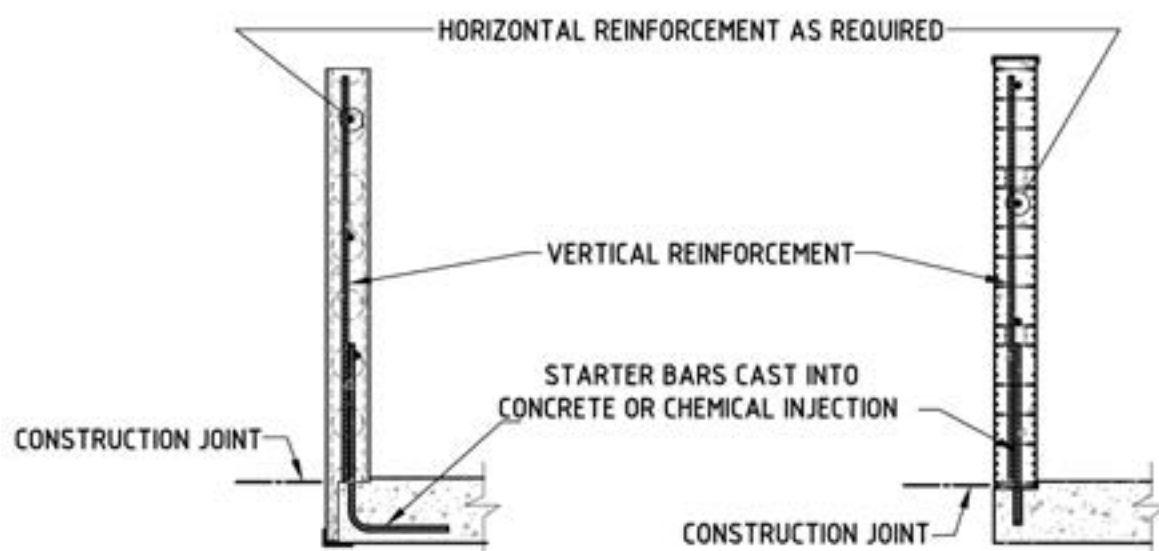






TYPICAL POOL SECTION

**CUT AWAY SECTION AT TOP. THIS IS FACILITATED WITH HAND OR POWER SAW, OSCILLATING SAW OR GRINDER. PERMAFORM IS EASILY DRILLED OR CUT OUT FOR PENETRATIONS, BOLTS AND OTHER DETAILING.**



TYPICAL BALUSTRADE  
VERTICAL PANELS

TYPICAL BALUSTRADE  
HORIZONTAL PANELS

**THE VERSATILITY OF PERMAFORM IS EVIDENT WITH PRODUCT ADAPTABLE IN BOTH DIRECTIONS. ON SLOPING WALKWAYS FOR DISABLED ACCESS, PERMAFORM CAN BE USED VERY EFFECTIVELY FOR QUICK, SMART APPEARANCE AND FUNCTIONAL USE.**

# AS 3600 COMPLIANCE

<b>SECTION 1 SCOPE AND GENERAL</b>			
1	SCOPE AND APPLICATION 1.1.1 SCOPE	This Standard sets out minimum requirements for the design and construction of concrete structures and members that contain reinforcing steel, or tendons, or both. It also sets out minimum requirements for plain concrete members.	Noted. PERMAFORM is modelled on this criteria
	DESIGN 1.4.2 DESIGN DETAILS	The drawings or specification for concrete members and structures shall include, as appropriate, the following:  (c) Class of formwork in accordance with AS 3610 for the surface finish specified.	Noted for cross reference to AS 3610
<b>SECTION 2 DESIGN REQUIREMENTS AND PROCEDURES</b>			
2	DESIGN REQUIREMENTS 2.1.1.AIM	The aim of structural design is to provide a structure that is durable, serviceable and has adequate strength while serving its intended function and that satisfies other relevant requirements such as robustness, ease of construction and economy.  A structure is durable if it withstands expected wear and deterioration throughout its intended life without the need for undue maintenance.	As a permanent formwork material, PERMAFORM satisfies the intended function as a temporary component and in use a long term durable finished surface.  However, with PERMAFORM acting integrally with other building elements providing very deep beams and arching design principles, the designer can take advantage of these attributes to:  + Reduce slab depths + Optimise vertical components + Minimise or eliminate slab/beam requirements + Consider options for sway resistance
	2.6 DESIGN FOR DURABILITY	The structure and its component members shall be designed for durability in accordance with the requirements of Section 4	
	2.7 DESIGN FOR FIRE RESISTANCE	The structure and its component members shall be designed for the appropriate fire resistance in accordance with Section 5.	See Later Section & Review BCA

<b>SECTION 3 LOADS AND LOAD COMBINATIONS FOR STABILITY STRENGTH AND SERVICEABILITY</b>			
3	Section 3 Loads & Load Combinations For Stability Strength & Serviceability		Can be accommodated by PERMAFORM
<b>SECTION 4 DESIGN FOR DURABILITY</b>			
4	4.1.3 COVER FOR CORROSION PROTECTION	Code requirements for cover relate to standard formed elements rather than permanent formwork.	Whilst the presence PERMAFORM does not relax this code requirement an added benefit of the product is to provide an additional measure to combat the effect of water permeating into concrete below ground. PERMAFORM recommends that cover requirements are not relaxed with its use generally.
<b>SECTION 5 DESIGN FOR FIRE RESISTANCE</b>			
5	5.7.4 STRUCTURAL ADEQUACY FOR WALLS	<p>A laterally supported wall has the required fire-resistance period for structural adequacy if the following are satisfied:</p> <ul style="list-style-type: none"> <li>(a) The wall complies with the requirements of Clause 11.2.</li> <li>(b) Its effective thickness is not less than the thickness required by Clause 5.7.2 for that period.</li> <li>(c) If <math>N^* \leq 0.03f'_c A_g</math> and <math>H_{we}/t_w</math> is not greater than 50.</li> <li>(d) If <math>N^* \leq 0.03f'_c A_g</math>—</li> <li>(i) <math>H_{we}/t_w</math> is not greater than 20; and</li> <li>(ii) The cover from the fire-exposed face to the vertical reinforcement or tendons is not less than the corresponding cover given in Table 5.7.4 for that period.</li> </ul>	<p>PERMAFORM does not prejudice the performance of a concrete element under fire conditions and does not affect the cover criteria as detailed in this section of AS 3600.</p> <p>The effect of smoke generated from the effect of fire is dealt with elsewhere in this document under the BCA provisions, noting that PERMAFORM does comply with the relevant section of the subject Code.</p>
<b>SECTION 6 DESIGN PROPERTIES OF MATERIALS</b>			
6	Section 6 Design Properties Of Materials		Applicable to elements formed in PERMAFORM.

<b>SECTION 7 METHODS OF STRUCTURAL ANALYSIS</b>			
7	Methods of Structural Analysis		Applicable to elements formed with PERMAFORM.
<b>SECTION 8 BEAMS FOR STRENGTH AND SERVICEABILITY</b>			
8	Beams for Strength and Serviceability		Applicable to PERMAFORM formed elements.
<b>SECTION 9 DESIGN OF SLABS FOR STRENGTH AND SERVICEABILITY</b>			
9	Beams for Strength and Serviceability		Applicable to PERMAFORM formed elements.
<b>SECTION 10 DESIGN OF COLUMNS FOR STRENGTH AND SERVICEABILITY</b>			
10	Design of Columns for Strength and Serviceability		Applicable to PERMAFORM formed elements.
<b>SECTION 11 DESIGN OF WALLS</b>			
11	Reinforcement requirements for walls 11.6.1 Minimum reinforcement	<p>Walls shall have a reinforcement ratio (<math>\rho_w</math>)—</p> <p>(a) in the vertical direction of not less than the larger of either 0.0015 or the value required by structural analysis; and</p> <p>(b) as horizontal reinforcement is necessary to control cracking where conventional formwork is used with PERMAFORM permanent panels, this requirement is not relevant as multiple cracks are generated by the internal ribs. In some circumstances therefore, the minimum ratio of 0.0025 may be reconsidered as necessary by the designer for the actual wall reinforcement and relocated to floor slabs where more convenient and effective in overall structural stability.</p>	<p>It should be noted that compressive axial strength of walls by the code is based on unreinforced section properties.</p> <p>The internal configuration of PERMAFORM allows any array of either horizontal or vertical reinforcement (or equivalent thereto by adjustment if necessary).</p> <p>Horizontal reinforcement which is normally placed as shrinkage distribution, steel is discretionary in the hands of the Engineer with permanent formwork.</p>
	Horizontal reinforcement for crack control 11.6.2 Horizontal reinforcement for crack control	Where a wall is restrained horizontally against shrinkage and temperature effects, then in some crack control situations a reinforcement ratio of 0.0025 may be desirable for a PERMAFORM installation. Such reinforcement may however be more effective if placed in floor slabs.	<p>Keeping in mind that the acceptance of cracking or otherwise is partly for cosmetic reasons and also to minimise the ingress of moisture, technically horizontal rebar is not required as PERMAFORM will hide the vertical cracks and provide a near 100% barrier for the ingress of water/moisture into the concrete substrate and subsequent attack on reinforcement.</p> <p>To sum up, horizontal reinforcement is a choice and for expediency and cost saving deletion is a positive option. However as mentioned above the final choice should be up to the designer.</p>

**SECTION 12 DESIGN OF NON-FLEXURAL MEMBERS, END ZONES AND BEARING SURFACES**

12	Design of Non-Flexural Members, End Zones and Bearing Surfaces		Applicable to PERMAFORM in deep beam configuration.
	Horizontal reinforcement for crack control  11.6.2 Horizontal reinforcement for crack control	Where a wall is restrained horizontally against shrinkage and temperature effects, then in some crack control situations a reinforcement ratio of 0.0025 may be desirable for a PERMAFORM installation. Such reinforcement may however be more effective if placed in floor slabs.	<p>Keeping in mind that the acceptance of cracking or otherwise is partly for cosmetic reasons and also to minimise the ingress of moisture technically horizontal rebar is not required as PERMAFORM will hide the vertical cracks and provide a near 100% barrier for the ingress of water/moisture into the concrete substrate and subsequent attack on reinforcement.</p> <p>To sum up horizontal reinforcement is a choice and for expediency and cost saving deletion is a positive option. However as mentioned above the final choice should be up to the designer.</p>

**SECTION 13 STRESS DEVELOPMENT IN REINFORCEMENT AND TENDONS**

13	Stress development in reinforcement and tendons	13.2.2 Lapped splices for bars in tension	Applies to reinforcement embedded in the PERMAFORM element.
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**SECTION 14 JOINTS, EMBEDDED ITEMS, FIXINGS AND CONNECTIONS**

14	14.2 Joints, embedded items, fixings and connections	<p>Embedded items and penetrations can be included in PERMAFORM elements provided that necessary external support to the shutter is provided.</p> <p>Joints can be generated similar to conventional methods but in many cases can be eliminated by use of PERMAFORM and its ability to mask shrinkage effects.</p>	Notwithstanding the fact that PERMAFORM is an engineered and robust system drilling and cutting through the PVC is relatively easy with drill and hole saw or cutting blade. Furthermore compared to conventional timber formwork which is effectively sterilised once cut in this way PERMAFORM being a permanent system does not suffer from this downside.
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SECTION 15 PLAIN CONCRETE MEMBERS			
15	Plain Concrete Members		Not applicable to PERMAFORM.
SECTION 16 CONCRETE PAVEMENTS, FLOORS AND RESIDENTIAL FOOTINGS			
16	Concrete Pavements, Floors And Residential Footings		Not applicable to PERMAFORM.
SECTION 17 LIQUID RETAINING STRUCTURES—DESIGN REQUIREMENTS			
17	Note	Reinforced or pre-stressed concrete structures, which are intended for the retention of aqueous liquids at ambient temperatures, shall be designed and detailed in accordance with AS 3735 or AS 2783 as appropriate.	Reference to other codes tabled for convenience of reader. Such elements can be formed using the PERMAFORM system.
SECTION 18 MARINE STRUCTURES			
18	18.3.1 ADDITIONAL DURABILITY AND DESIGN REQUIREMENTS  Abrasive tidal or wave action	Structures exposed to abrasive tidal or wave action shall be specifically designed for such cases and suitable provisions to ensure durability shall be specified.	The use of PERMAFORM in marine environments is likely to assist in the long life integrity of concrete elements subjected to marine exposure.
	18.3.3 Marine growth	Allowance shall be made for the increase in sectional area and alteration of surface characteristics due to extensive marine growth, on fully or partially submerged member's characteristics due to extensive marine growth, on fully or partially submerged members that are sensitive to such changes.	The product will protect the surface and substrate of the concrete and also discourage attachment of marine growth. When this may occur and removal/cleaning are an issue this will be much easier to remove from the PERMAFORM surface than concrete.

# AS 3610 - CONCRETE COMPLIANCE FORMWORK DOCUMENTATION

## 4.71 GENERAL

All formwork shall have documentation which shall include the following information as appropriate:

- a. Plans, elevations and sections sufficient to depict the general arrangement of the formwork and to identify and locate all members and components, including bracing.
- b. Details sufficient to fully describe important or unusual features of the design.
- c. Reference to documentation for proprietary items.
- d. The areas of the forms designed to carry stacked loads.
- e. Requirements of the project documentation which relate to formwork.
- f. Method of provision for field adjustment of the forms prior to and during placement of the concrete.
- g. Where required, location of weep holes, vibrator holes, clean-out holes and inspection openings.
- h. Sequence of concrete placement and minimum elapsed time between adjacent placements.

PERMAFORM is just one of the tools to achieve a high quality and efficient formwork system. PERMAFORM can be integrated with other forms of proprietary or conventional formwork methods.

PERMAFORM does not replace the need for sound structural analysis and conformance with all live, dead and other loadings.

Designers should adopt (a) to (h) all of which can and should be part of the design criteria for all formwork including PERMAFORM.

When the above procedures are adopted using PERMAFORM as part or all of the formwork system, PERMAFORM will satisfy these requirements of AS 3610.

<b>2.3 INFORMATION TO BE PROVIDED IN THE PROJECT DOCUMENTATION</b>  Project documentation shall cover any matters associated with the formwork construction, concrete placement or formwork removal, and which are critical to the serviceability of the permanent structure. In addition to the description of the concrete element, the following shall be specified or indicated in the project documentation, where applicable:	<b>COMPLIANCE AND NOTES</b>
a) Minimum formwork stripping times and stripping procedures.	Not applicable.
(b) Any limitations on the magnitude and locations of stacked materials and minimum concrete strength to be achieved prior to the stacking of materials.	Not applicable.
(c) Requirements for the minimum number of levels of supports relative to the type of formwork, timing and sequence of its use, the anticipated time between construction of subsequent floors and the expected ambient temperature for multi-storey structures.	Generally not relevant.
(d) Limitations on the use of the permanent structure for the restraint of formwork.	Should be considered if applicable.
(e) Details of and information on the effect of the post-tensioning procedures on the formwork and any special procedures to be adopted in the stripping of formwork is not applicable.	Not applicable.
(f) Location of any mandatory joints and any special procedures for locating other joints.	To be considered as for conventional formwork.
(g) Sequence of placement of the concrete if this is critical.	Yes. Concrete should be placed in layers no greater than 2 metres in height in concurrent pours.
(h) Requirements for propping of any composite construction	See manual.
(i) Details of the cambering of any slabs of beams.	Not applicable for PERMAFORM element.
(j) Design loads for the permanent structure.	Applicable.
(k) Details of any inserts, waters tops, specially formed shapes or penetrations to be constructed, the location and details of which are critical to the serviceability of the permanent structure.	To be considered as for conventional formwork.
(l) Any known information about the foundation which is relevant to the design of the footings for the formwork assembly.	As with any wall PERMAFORM requires a stable & sound footing.
m) Information about any permanent formwork systems, together with any limitations on deflections and any special requirements for their erection and concreting Information on the critical face of elements (see Clause 3.4.3.3), any special measuring points and more stringent tolerances for any small areas (see Table 3.4.2).	See Manual. Refer to Clauses (3) not relevant.
(o) The details set out in Table 3.4.1 relating to surface finish, colour control, surface treatment, critical elements, tolerances and repairs where relevant for all surfaces of the permanent structure.	Not applicable.



(p) Details of any special-class concrete required under Clause 3.5.2 with the tonal scale to be used	Not applicable.
(q) Where an 'X' suffix is used as defined in Clause 3.3.2, all relevant information relating to Tables 3.4.1 and 3.4.2.	Not applicable.
(r) Details of test panels. (See Clause 3.6 and Clause 5.6.2.1(c))	Not applicable.
(s) Information on any architectural details to be cast into the structural concrete.	To be considered as for conventional formwork.
(g) Sequence of placement of the concrete if this is critical.	To be considered as for conventional formwork.
<b>SECTION 5 CONSTRUCTION</b> <b>5.3 GENERAL FORMWORK REQUIREMENTS—IN SITU CONCRETE</b>	<b>COMPLIANCE AND NOTES</b>
5.3.1 General	The unique interlocking system of PERMAFORM ensures that the formwork is safe & secure.
The formwork shall be erected, used and maintained in a manner that will ensure—	
a) a stable formwork assembly throughout all stages of construction;.	
(b) compliance with the formwork documentation and project documentation; and	Refer elsewhere in this manual.
(c) that these formwork operations are not detrimental to the permanent structure	In many cases the permanent formwork system of PERMAFORM will add to the intrinsic value of the finished structure.
The various stages of construction are as follows:	PERMAFORM comfortably satisfies these criteria.
(a) Stage I - prior to placement of concrete. Includes the time...	
(i) during handling and erection of the formwork structure; and	
(ii) when the formwork structure is erected, but prior to the placement of concrete.	
(b) Stage II—during placement of concrete.	
(c) Stage III—after placement of concrete, and until the concrete is able to support the applied loads.	
5.3.3 Safety and access	The relative lightness of the PERMAFORM element and ease of handling assists with ameliorating WH&S risk.  Continuous monitoring of the product/system during pouring is easy and in the event of a very unlikely impending mishap ample time will be available to address the event.
5.3.3.1 Safety	
A safe working environment shall be provided and maintained at all times. Precautions shall be taken to ensure that the partial or complete dislodgement or failure of any component does not lead to progressive collapse. Regular inspections of the formwork assembly shall be carried out during Stage I, and continuous observation shall take place during Stage II.	

<b>SECTION 3 SURFACE FINISH</b>	
<b>3.2 APPLICATION OF SECTION</b>	
This Section does not apply to unformed surfaces, or to the faces of concrete constructed from permanent formwork	
<p>Whatever the intent may be in use, PERMAFORM will always present the same smooth and functional finish.</p> <p>In many applications such as basements and stairwells this finish will require no further treatment.</p>	
4.3 DESIGN REQUIREMENTS	Compliance and Notes
4.3.2 Structural requirements	
(a) Stability The formwork assembly shall resist overturning, uplift, sliding and sideways under the action of all appropriate load combinations.	✓ Provided end fixings and propping are in accordance with recommendations contained in this manual. Stability of PERMAFORM elements is expected.
b) Strength The formwork assembly and its component members shall withstand the effects of all appropriate load combinations.	PERMAFORM when braced or proposed is not designed and is not intended to withstand imposed loads other than the mass and hydraulic pressure of wet concrete.
(c) Stiffness The stiffness shall be such that the deformation under the appropriate loading on the formwork assembly and its component members does not exceed the limits specified in this Standard.	✓
<b>3.3 Restraint systems</b> The members and connections of bracing systems required to reduce the effective lengths of compression members shall be designed to transfer the forces and moments specified in Clauses 4.4.6.1 and 4.4.6.2 from the points where the forces or moments arise to the foundation or to the permanent structure (where this is permitted by the project documentation (see Clause 2.3(d)).	✓ Not applicable.
<b>4.3.4 Construction</b> The detailed design of the formwork assembly shall permit the components to be erected and dismantled without conflict with other structures or the newly poured structure.	✓ This manual demonstrates the techniques required to assemble PERMAFORM. Notwithstanding the designer needs to address the practical aspects of handling and placing panels often over 3 metres in length but rarely is this a restraint to the construction process.  Stripping is not relevant as PERMAFORM is a permanent formwork system.

4.6 CONSTRUCTION CONSIDERATIONS	PERMAFORM compliance	
4.6.3 Formwork The formwork shall comply with the following requirements:	✓  ✓  ✓  ✓  ✓	Locked together, the PERMAFORM panels form a stable and well aligned element.
a) It shall be provided with adequate means to resist movement and misalignment at construction joints in the concrete.		See elsewhere in this manual.
(b) Where it is assembled from proprietary components these shall be used in accordance with the manufacturer's directions.		Although stripping is not relevant PERMAFORM can be adjusted in small increments to achieve straight and plumb finished concrete.
c) It shall be fitted with devices to facilitate adjustment of the formwork and to permit the controlled movement of formwork during stripping. The installation of all adjustment devices in the formwork framing shall be such that they are not able to be dislodged by the anticipated loads. The adjustment devices shall not be subject to uncontrolled movement under load.		
(d) Where it is possible that movement would cause the components to become unstable, dislodged or to collapse, there shall be positive means to prevent that occurrence.		Propping of PERMAFORM walls is essential See elsewhere in this manual.
(e) It shall be provided with bracing which, in addition to the requirements of Clauses 4.3 and 4.4 shall ensure that the formwork assembly can be safely erected and removed.		

5.3.3.2 Access	
5.3.4 Components	<p>This table specifies the criteria for quality and performance of props and associated items for supporting all types of formwork. Construction personnel need to be vigilant with care and use of these items for all systems including PERMAFORM.</p> <p>Key criteria for acceptance of materials for these purposes are items</p> <p>  Free from cracks, splits &amp; deformations  </p> <p>  Straightness   Clean threads   Compliance with other standards</p> <p>All systems including PERMAFORM must comply with these requirements.</p>
All components of the formwork assembly shall—	
(a) comply with the acceptance criteria of Table 5.3.1;	
(b) be of the specified type and material grade; and	
<p>(c) be assembled in accordance with the formwork documentation and the requirements of this section.</p> <p>Where components do not meet these criteria they shall be rejected, or accepted subject to satisfactory proof testing under the provisions of Appendix A to ensure that their load capacity is in accordance with Clause 4.5.6.3.</p>	
5.3.5 Materials	
5.3.5.1 General	
All materials used in formwork components shall be in accordance with the relevant Australian Standards. (See Clause 4.5.6.) Previously used materials shall have structural characteristics at least equal to those of the specified materials. Unidentified materials shall not be used.	See above
5.3.5.2 Unidentified materials	<p>PERMAFORM has been subjected to extensive laboratory and field tests to verify the ability of the product to withstand normal site conditions. See elsewhere in this document.</p>
The following requirements shall apply to the identification of materials:	
(d) Other materials appropriate means of identification, by established visual grading methods, non-destructive evaluation or laboratory tests, shall be undertaken before the material is used for formwork construction.	

SECTION 5 CONSTRUCTION	Compliance and Notes
5.3 GENERAL FORMWORK REQUIREMENTS—IN SITU CONCRETE	
5.4 FORMWORK CONSTRUCTION—IN SITU CONCRETE	The precise factory controlled tolerances and the simplicity of the patented dual interlocking system ensures that once in place and supported by recommended propping and other support methods a near perfect profile to line And level will be achieved by use of PERMAFORM.
5.4.1 Stage I of construction—Erection of forms	
5.4.1.1 General	
All formwork shall be—	
(a) in accordance with the formwork documentation; and	
(b) erected so that the finished concrete is within the required tolerances.	Essential for PERMAFORM and all formwork systems.
5.4.1.2 Foundations	
The formwork shall be founded on material that has adequate strength, stability and stiffness to comply with the formwork documentation	

# PERMAFORM APPLICATION EMBEDDED CONCRETE & REINFORCEMENT

## CONCRETE

Concrete used to fill the PERMAFORM walling system:

- + can be designed with few restrictions on mix design, placement and fluid pressure generation due to the inherent strength of the PERMAFORM enclosure
- + can utilise high slump or super plasticised mixes to completely fill the void without the usual concern for surface integrity generated by conventional formwork where the surface is exposed to view
- + can utilise high strength concrete without undue emphasis on mix proportions generated by the need for the required surface finish
- + can relax restrictions on concrete shrinkage which impact on surface cracking, the internal diaphragms act as crack inducers without effecting structural capacity.

The actual basis for slender axially loaded concrete wall design to AS3600 is unreinforced concrete sections.

## REINFORCEMENT

The requirement for horizontal reinforcement is generally related to surface crack control in conventionally formed walls where the surface is exposed. In the case of Permaform the surface is not exposed and the need for such reinforcement needs to be reviewed.

Horizontal reinforcement required to tie the building laterally may in some situations be provided at the floor slabs leaving the walls free of horizontal reinforcement.

Where horizontal reinforcement is necessary, use of larger diameter bars with greater rigidity have been found more convenient to thread through the wall at greater centres.

Vertical reinforcement where required is often more convenient and rigid, by utilisation of larger bar diameters spaced at maximum centres to resist concrete pressure deformation.

Review of successful wall solutions used in existing older structures will include plain concrete or block work and even unreinforced brickwork which should make engineers more aware of possible cost effective structural options.

# PERMAFORM APPLICATION GUIDELINES AND PROCEDURES

## UNLOADING AND STORAGE

PERMAFORM will usually arrive on site in packs of between 25 and 30 panels. Within each pack there are up to 6 bundles of up to 6 panels. Lift in bundles of 2 at 2/3 points, spreader bar useful.

Stack on level surface up to 2 packs high with spacers. In very hot conditions spacers should be at four points to ensure uniform distribution of dead weight thus preventing possible distortion of product in the heat. PERMAFORM is UV stabilised and is not affected by exposure to sunlight either in storage or as part of finished product.

## HANDLING AND PLACING

Under normal conditions PERMAFORM panels can be comfortably handled by two persons. When installation height is say one or two floors above stack location for convenience and expediency crane or fork lift is common practice.

At all times PPE protocol should be adopted. Gloves not essential but on sites where mandatory, gloves with rubber type fingers and palm infill will limit risk of slipping.

After placing the bottom track PERMAFORM panels will normally slip or clip into place and lock together with ease. Adjustment and persuasion to height and line is best facilitated with a rubber mallet. Panels are to be placed carefully to accommodate starter bars and other detail. Raking props installed as required to maintain plumb.

## POUR HEIGHT

For single pours up to 3 metres high PERMAFORM is configured to withstand the dynamic bursting pressure of fresh concrete. For pours greater than 3 metres horizontal bracing at 900 centres including slab level for the lower half of the PERMAFORM wall is recommended.

## REINFORCEMENT

Place vertical reinforcement from top locating as close as possible to starter bars, if applicable. The internal PVC dividers will usually assist to achieve desired centres.

Horizontal reinforcement (where necessary) may be threaded from the open end as wall progresses in lengths to accommodate handling and placing. In cases where a run ends up to an existing wall and horizontal bars are required; place a length of horizontal bar with an attached draw wire in the voids then ease the bar forward until it reaches its final location.

Note for designers. Vertical reinforcement can be designed placed at vertical spacing of 100, 150, 200, 300. The spacing of horizontal reinforcement are to relate to voids in the vertical diaphragms.

## PROPPING

Whilst propping is in part a function of site conditions, height of wall, wall thickness, wind exposure, top restraint and length of wall adequate propping is essential. Due to the number of variables, precise tabulation of prop configuration is not practical.

**RECOMMENDED PROPPING**

Walls up to 3000 in height

- + Fixed restraint as base
- + Centre
- + Utilise top restraint if available
- + Props 1500mm centres

Walls greater than 3000

- + Fixed restraint as base
- + At third points
- + Utilise top restraint if available
- + Props 1000mm centres

**ALIGNING AND TRIM**

Check base which should be plumb from previous set out and fixing by adjusting screw on prop.

- + Align panels and adjust with stringline or laser.
- + Simultaneously check for vertical plumb.

**POURING**

Place concrete infill with care in layers not exceeding 2 metres in height. To minimise impact of hydrostatic pressure and segregation at lower levels discharge

concrete so that it impacts on maximum number of internal webs available. Vibrate placed concrete at low frequency. The slick PVC surface will allow concrete to slide easily thus minimising air pockets and voids.

**NOTES**

Windows, doors and other openings easily placed and cut in with usual pre pour procedures.

Penetrations, services and all other in situ requirements as for conventional formwork systems.

Contraction control in walls not normally required but if wall is tied into slab above or below with expansion or construction joints complementary joints in walls recommended.

Timing. The PERMAFORM system allows installation within 24 hours (or less) of pouring slab or footing.

Concrete mix. Recommend minimum 25mpa, 10mm aggregate @ 150mm slump.



# COMPLIANCE WITH FIRE PROVISIONS

## BUILD CODE OF AUSTRALIA

### Specification C1.10

- (a) For the purposes of this Clause, the group number of a material is determined by either -
  - (i) physical testing in accordance with AS ISO 9705; or
  - (ii) prediction in accordance with Clause 3 of Specification A2.4 using data obtained by testing the material at 50 kW/m<sup>2</sup> irradiance in the horizontal orientation with edge frame in accordance with AS/NZS 3837.
- (b) The group number of a material is as follows when tested or predicted in accordance with sub-clause (a):
  - (i) A Group 1 material is one that does not reach flashover when exposed to 100 kW for 600 seconds followed by exposure to 300 kW for 600 seconds.
  - (ii) A Group 2 material is one that reaches flashover following exposure to 300 kW within 600 seconds after not reaching flashover when exposed to 100 kW for 600 seconds.
  - (iii) A Group 3 material is one that reaches flashover in more than 120 seconds but within 600 seconds when exposed to 100 kW.
  - (iv) A Group 4 material is one that reaches flashover within 120 seconds when exposed to 100 kW.
- (c) A material used as a finish, surface, lining or attachment to a wall or ceiling must be a Group 1, Group 2 or Group 3 material used in accordance with Table 3 and for buildings not fitted with a sprinkler system complying with Specification E1.5, have—
  - (i) a smoke growth rate index not more than 100; or
  - (ii) an average specific extinction area less than 250 m<sup>2</sup>/kg.

Refer to the CSIRO fire test report certifying PERMAFORM as a group 1 rated material product having no restrictions in all areas of application.

Table 3 WALL AND CEILING LINING MATERIALS (Material Groups permitted)						
Class of Building	Fire-isolated exits + fire control rooms	Public Corridors		Specific Areas		Other Areas
	Wall/Ceiling	Wall	Ceiling	Wall	Ceiling	Wall/Ceiling
Class 2 or 3 Excluding accommodation for the aged, people with disabilities, and children						
Unsprinklered	1	1, 2	1, 2	1, 2, 3	1, 2, 3	1, 2, 3
Sprinklered	1	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
Class 3 or 9a Accommodation for the aged, people with disabilities, children and health-care buildings						
Unsprinklered	1	1	1	1, 2	1, 2	1, 2, 3
Sprinklered	1	1, 2	1, 2	1, 2, 3	1, 2, 3	1, 2, 3
Class 5, 6, 7, 8 or 9b Schools						
Unsprinklered	1	1, 2	1, 2	1, 2, 3	1, 2	1, 2, 3
Sprinklered	1	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
Class 9b other than schools						
Unsprinklered	1	1	1	1, 2	1, 2	1, 2, 3
Sprinklered	1	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
Class 9c						
Sprinklered	1	1, 2	1, 2	1, 2, 3	1, 2, 3	1, 2, 3
<p>For the purpose of this Table—</p> <p>1. "Sprinklered" means a building fitted with a sprinkler system complying with Specification E1.5.</p> <p>2. "Specific areas" means within—</p> <p>(a) for Class 2 and 3 buildings, a sole-occupancy unit; and</p> <p>(b) for Class 5 buildings, open plan offices with a minimum floor dimension/floor to ceiling height ratio &gt; 5; and</p> <p>(c) for Class 6 buildings, shops or other building with a minimum floor dimension/floor to ceiling height ratio &gt; 5; and</p> <p>(d) for Class 9a health-care buildings, patient care areas; and</p> <p>(e) for Class 9b theatres and halls, etc, an auditorium; and</p> <p>(f) for Class 9b schools, a classroom; and</p> <p>(g) for Class 9c aged care buildings, resident use areas.</p>						

# ACOUSTIC PERFORMANCE REPORT



## PERMAFORM ACOUSTIC ASSESSMENT

**FOR - PERMAFORM**

**REPORT NUMBER - R146207AC R1 14-05-22**

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Rev No	Reason for Issue	Author		Approver for Issue	
		Name	Date	Name	Date
00	For Information	Jerremy Lofts	5 November 2013	Jerremy Lofts	5 November 2013

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.

## Section 1 - Introduction

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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.

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.

Permaform also provides a 200 mm system. Information is available in the brochures and on the website, but Rudds has not been provided with a sample of the 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 190 mm 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.

## Section 2 - BCA Requirements for Party Wall Systems

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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 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. This is followed by a section relating to specific mandatory detailing and construction requirements contained in the BCA.

**TABLE 1 BCA 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 sets the following minimum construction requirements regarding acoustically rated partitions:

1. The required sound insulation of a floor or wall must not be compromised by the incorporation or penetration of a pipe or other service element or a door assembly.
2. Masonry units must be laid with all joints filled solid, including those between the masonry and adjoining construction.
3. Joints between concrete slabs or panels and any adjoining construction must be filled solid.
4. Sheeting materials
  - a. If one layer is required on both sides of the wall it must be fastened to the studs with joints staggered on opposite sides.
  - b. If two layers are required, the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer.
  - c. Joints between sheets or between sheets and any adjoining construction must be taped and filled solid.
5. Timber or steel-framed construction – perimeter framing members must be securely fixed to the adjoining structure and
  - a. Bedded in resilient compound, or
  - b. The joints must be caulked so that there are no voids between the framing members and the adjoining structure.
6. Services must not be chased into concrete or masonry elements.

7. A door or panel required to have a certain  $R_w + C_{tr}$  that provides access to a duct, pipe or other service must
  - a. Not open into any habitable room (other than a kitchen)
  - b. Be firmly fixed so as to overlap the frame or rebate of the frame by not less than 10 mm
  - c. Be fitted with a sealing gasket along all edges
  - d. Be constructed of one of the following:
    - i. Wood, particle board or blockboard not less than 33 mm thick.
    - ii. Compressed fibre reinforced cement sheeting not less than 9 mm thick.
    - iii. Other suitable material with a mass per unit area not less than  $24.4 \text{ kg/m}^2$ .
8. A water supply pipe must:
  - a. Only be installed in the cavity of discontinuous construction.
  - b. In the case of a pipe that services only one sole occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole occupancy unit and have a clearance not less than 10 mm to the other wall leaf.
9. Electrical outlets must be offset from each other by not less than 100 mm in masonry walling and not less than 300 mm in steel framed walling.

### Section 3 - BCA Compliant Permaform Wall Systems

---

Rudds has undertaken a desktop assessment of the Permaform wall systems at 110 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 on the following page. 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 a lining where it is not shown is acceptable. In many cases, adding the lining will reduce the acoustic performance of the wall and can have a detrimental affect 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.

**TABLE 2 WALL SYSTEMS COMPLYING WITH BCA REQUIREMENTS**

One Side	Core	Other Side	Rw 50	Rw+Ctr 50	Discontinuous
Paint, render or 13 mm thick direct stick plasterboard.	110 mm Permaform	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.	✓	✗	✗
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.	✓	✓	✗
13 mm plasterboard on 51 mm steel stud spaced minimum 20 mm clear of Permaform. Minimum 50 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.	✓	✓	✓
Paint or render.	200 mm Permaform	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.	✓	✓	✗
13 mm plasterboard on 51 mm steel stud spaced minimum 20 mm clear of Permaform. Minimum 50 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.	✓	✓	✓

**Notes:**

1. Green tick (✓) means the proposed construction complies 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.

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## 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 <sub>max</sub>	The RMS maximum noise level of a measurement
L <sub>10</sub>	90 <sup>th</sup> percentile sound level of a measurement. Often called the average maximum noise level
L <sub>eq</sub>	The energy average noise level of a measurement.
L <sub>90</sub>	10 <sup>th</sup> percentile sound level of a measurement. Often called the average background noise level
L <sub>min</sub>	The minimum noise level of a measurement
L <sub>eq(T)</sub>	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 <sub>eq(8h)</sub>	The 8 hour equivalent energy noise level. Primarily used for occupational noise assessments
LC <sub>peak</sub>	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 APPLICATIONS HEALTH & SAFETY 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 reduce the structural integrity of the structural integrity of the concrete element.

This manual is a guide for the designer and installer and covers PERMAFORM compliance with the Building Code of Australia, Australian Standards AS 3600 Concrete & AS 3610 Formwork. Other criteria embracing fire provisions, acoustic, WH&S and structural integrity are addressed. PERMAFORM satisfies all relevant aspects of these requirements.

Construction methodology for the PERMAFORM system is summarised in this publication. Full details are in the companion document PERMAFORM Installation Manual.

PERMAFORM can be used for:

- + Concrete walls 110 & 200 thickness
- + Retaining walls shear walls
- + Party walls
- + Lift shaft and stair wells
- + Basements
- + Civil
- + Marine

The PVC PERMAFORM exterior has many applications as a finished surface such as basement car parks and stair wells. Alternatively acrylic render or other finishes can be applied to achieve decorative and architectural finishes.

PERMAFORM introduces a new standard of formwork for concrete in terms of:

- + A quality water proof finish often requiring no further treatment
- + Cost and value for money
- + Easy inclusion for penetrations, openings & other integrated requirements
- + Optimum design for walls and integrated structural elements
- + Rapid and efficient placement of reinforcing with option to minimise horizontal bar requirements
- + Reduction in cycle time
- + Satisfying all relevant Codes and other functional criteria

The information provided in this Manual is correct to the best available knowledge and information at the date of its publication.

This manual is a guide only and it is the responsibility of the Engineer or other accredited professionals to determine all design parameters where PERMAFORM has an application.

## 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 Australia Pty Ltd  
6 Barrow Pl, Queanbeyan  
NSW

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.  
(Contd. on page 2) Page 2/5

### ACCORDING TO SAFE WORK AUSTRALIA

Printing date 11.04.2013 Revision: 11.04.2013  
Product Name: PERMAFORM  
(Contd. of page 1) 36.0.9

### HAZARDOUS COMPONENTS:

471-34-1 calcium carbonate 4%  
12202-17-4 Lead oxide sulfate  
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%

## 4 - FIRST AID MEASURES

---

### 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 water courses.

### **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.

## **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>

## 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

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### 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)

(Contd. on page 4) Page 4/5

### 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> (flathead minnows)

### **PERSISTENCE AND DEGRADABILITY**

No further relevant information available.

### **BIOACCUMULATIVE**

Potential: No further relevant information available.

### **MOBILITY IN SOIL**

No further relevant information available.

## 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

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**CREATION DATE:**

11 April 2013

**PREPARED BY:**

MSDS.COM.AU Pty Ltd

www.msds.com.au

**ABBREVIATIONS AND ACRONYMS:**

- + ADG: Australian Dangerous Goods
- + IMDG: International Maritime Code for Dangerous Goods
- + IATA: International Air Transport Association
- + GHS: Globally Harmonized System of Classification and Labelling of Chemicals
- + LC50: Lethal concentration, 50 percent
- + LD50: Lethal dose, 50 percent
- + IARC: International Agency for Research on Cancer
- + STEL: Short Term Exposure Limit
- + TWA: Time Weighted Average

## DISCLAIMER

---

This MSDS is prepared in accord with the Safe Work Australia document "Code of Practice for the

Preparation of Safety Data Sheets for Hazardous Chemicals - December 2011 "

The information contained in this material safety data sheet is provided in good faith and is believed to be accurate at the date of issuance. Permaform Australia Pty Ltd makes no representation of the accuracy or comprehensiveness of the information and to the full extent allowed by law excludes all liability for any loss or damage related to the supply or use of the information in this material safety data sheet. MSDS.COM.AU Pty Ltd is not in a position to warrant the accuracy of the data herein. The user is cautioned to make their own determinations as to the suitability of the information provided to the particular circumstances in which the product is used.

# Certificate of Assessment

Quote No.: NK7079

No. 1950

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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





# Emission Test Certificate

Tuesday, February 26, 2013

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

Sample Description: Permaform

Date Tested: February 2013

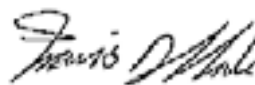
Test Method: ASTM D5116 "Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Material/Products".

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

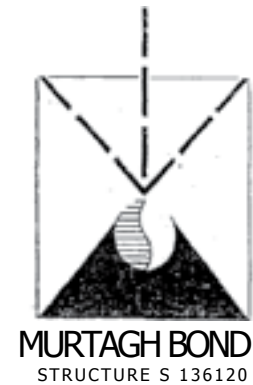


Travis Hale  
BSc  
Consultant

**CV130219**

5<sup>th</sup> August 2013

Permaform Australia Pty Ltd



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

This certificate refers to the "PERMAFORM" rigid polymer permanent formwork concrete containment profile to generate wall and strut elements which conform to the Building Code of Australia suitability requirements.

The Structural members produced are similar to those generated by conventional concrete formwork systems with the exception that the concrete surface is not exposed and embedded polymer is included in the cross section.

The formwork system has been assessed by SGS-CSTC (Standards Technical Services Co Ltd) and the CSIRO to comply with heat and smoke release requirements of the Building Code of Australia.

Compliant concrete structures to satisfy the Building Code of Australia may be designed therefore, using the relevant "deemed" to comply clauses of the Australian Code AS 3600-2009, Concrete Structures, together with guidance from relevant overseas standards as necessary to support loads prescribed by Australian Standard Code AS1170.

Note that the concealed concrete surface may in some circumstances reduce the need for surface cracking control reinforcement.

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

Bond James x Murtagh  
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