Technical Manual

australprecast

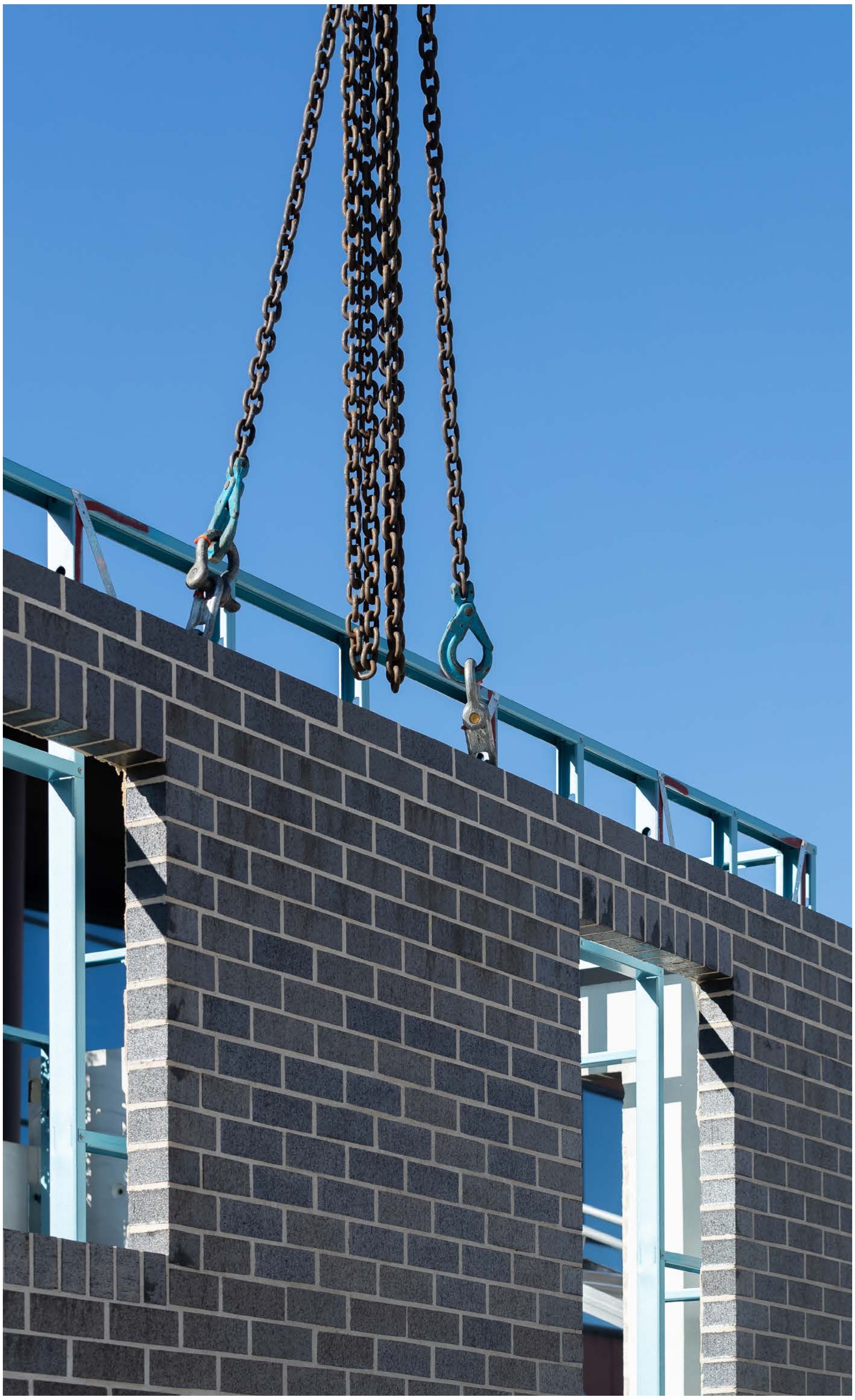
Panel Brick

What's inside

A BRAND OF
BRICKWORKS

Panel Brick is a revolutionary product that combines the simplicity and ease of precast concrete with the timeless beauty and style of brick. Elevating brick to new heights, Panel Brick allows brick to go where it has never gone before.

Using the material synergy of Austral Bricks' patented Dovetail brick and Austral Precast's precast concrete panels, Panel Brick is a cost effective and highly durable product that brings many construction advantages to a building. Austral Bricks, Australia's leading brick manufacturer has revolutionised brick slip technology with their Registered Dovetail brick design. Experience and innovation in brick manufacturing has allowed for a wide selection of bricks to be offered from the Austral Bricks range in the Dovetail form.

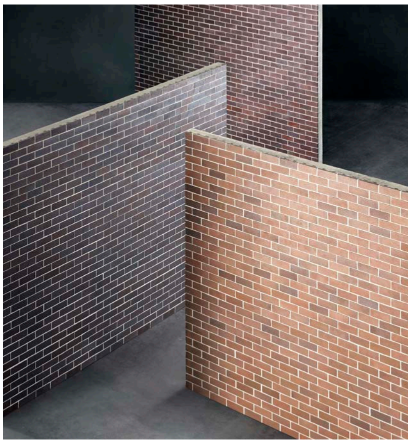


Panel Brick
Overview

1

Overview

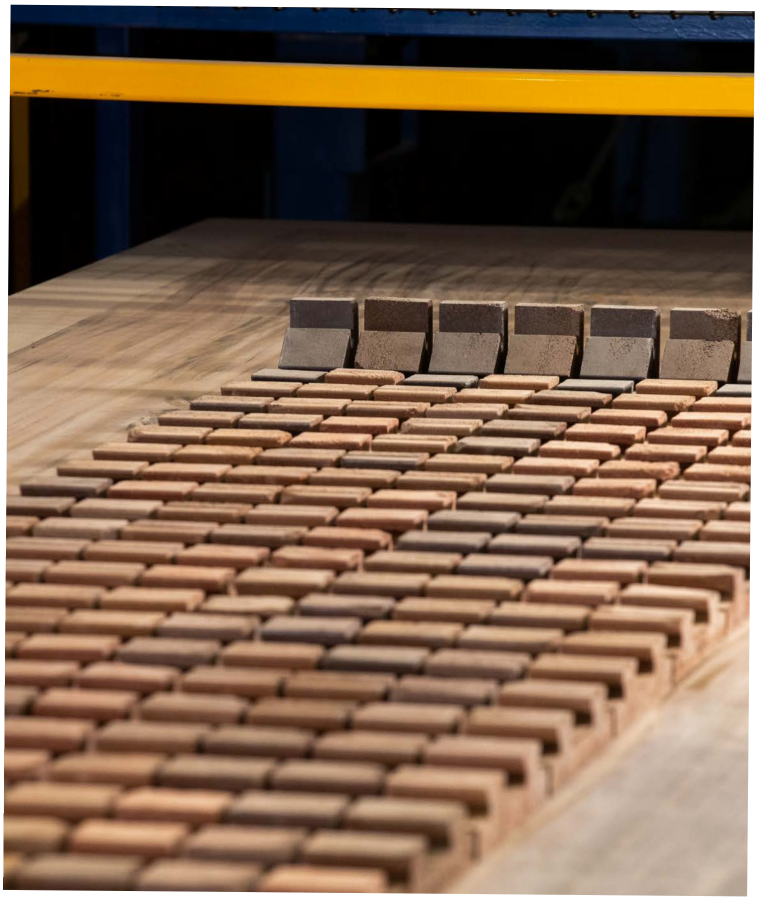
Austral Precast are the leaders in high quality and innovative, customisable precast concrete panel solutions. Using state of the art technology, production techniques and systems, Austral Precast produces a diversified range of customised walling, flooring, framework, stair, balcony, and client specific precast solutions.



The best results are achieved with the latest technology. Brickworks invests in refining and upgrading their infrastructure to ensure customers receive quality product through the relentless focus on optimising the use of advanced technology, in the pursuit of manufacturing precision.

Panel Brick combines the timeless beauty and durability of fired clay bricks from the Austral Bricks range with the design flexibility and manufacturing precision of Austral Precast's concrete panels. In the pursuit of maximising the manufacturing precision and efficiency of Panel Brick, Austral Precast have invested heavily in robotics technology. Panel Brick manufacturer Austral Precast boasts the first ever Brick Setting Robot (Australian Patent Application 2020201935, UK Patent Application 2004072.1, NZ Patent Application 762735, US Patent Application US16/825,120), capable of laying bricks in various shapes and patterns to suit your Panel Brick design needs.

This patented technology allows Austral Precast to manufacture Panel Brick without the use of traditional liner systems and introduces the possibility of designing with a wide range of brick patterns throughout each job, or even each panel.

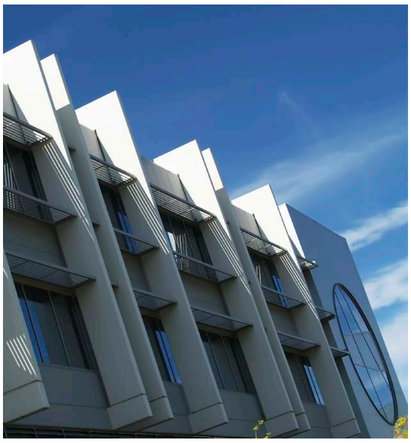


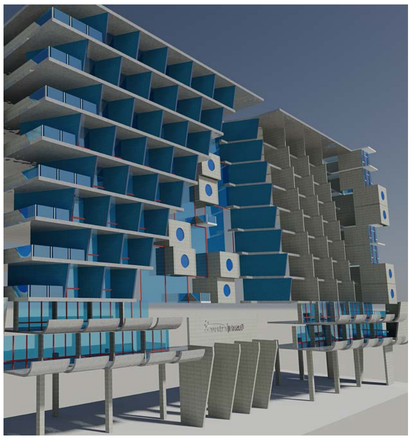
Austral Precast

Austral Precast is Australia's leading provider of high quality and innovative, customisable precast concrete solutions. Using state of the art technology, production techniques and systems, Austral Precast produces a diversified range of customised walling, flooring, framework, stair, balcony, and client specific precast solutions. The Austral Precast team take pride in their ability to exceed the expectations of customers and partner with them to find solutions to meet all their Precast needs.

Austral Precast service a range of markets including; multi residential, commercial, industrial, community and civil sectors. We offer a full product and service package with the ability to design, detail and manufacture a diverse range of precast products and provide industry leading installation services.

Our in-house detailing team is composed of industry experts with qualifications in engineering, architecture, detailing and design. Advanced 3D modelling technology is used to build projects in 3 dimensions with startling accuracy enabling any potential construction issues that may occur in the design phase to be identified and quickly overcome to ensure a seamless construction process.





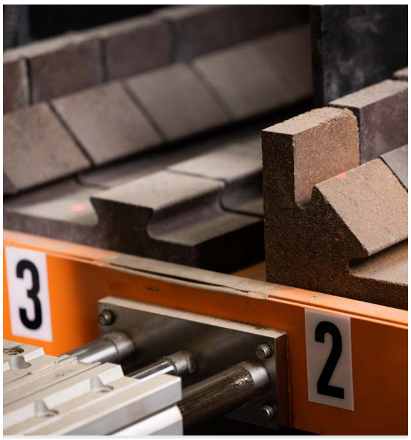
Our state-of-the-art carousel style manufacturing facility capitalises on the advantages of automated construction technology throughout the entire panel manufacturing process.

The Austral Precast shutter placement robot allows panels to be boxed up faster and more precisely.

The Austral Precast mesh machine welds up bar mat at the perfect size for each panel, maximising time and steel usage.

The in-house batch plant mixes the perfect mix for each panel every time. No mix is ever left sitting in a truck or has to be watered down before pouring.

The advanced curing system allows for the precise control of the curing environment for panels regardless of the weather or season. With elevated humidity and temperature panels can cure to lifting strength in a fraction of the time required under ambient conditions.



We also go the extra mile by offering Panel Brick in Custom Architectural and Standard Panel Brick design options.

Features and Benefits

Panel Brick offers Architects, Engineers and Builders alike the opportunity to receive the benefits new and emerging technology. Panel Brick offers benefits in speed, cost, risk and design flexibility. Austral Precast's continual drive towards innovation means we are always looking for new ways to improve construction methods and product quality in the market.

1.

Speed of construction

- Less susceptible to inclement weather delays.
- Seal up building days after slab is poured.
- Panel Brick allows brick construction to go higher and faster than traditional brick methods.

2.

Cost

- Improved quality from a factory-made product.
- Outsourcing quality control.
- Eliminates need for expensive scaffolding.
- Panel Brick removes the need for on-site brick cleaning, as all panels are washed prior to delivery.
- No waste on site.

3.

Risk

- Increased scheduling ability.
- Allows for precise and controlled off-site manufacture.
- Minimises loose materials on site.
- Minimises site storage.
- Improved safety on site.
- Leaner and safer work-site.

4.

Design

- Panel Brick can be used higher than traditional brick.
- A wide selection of clay bricks from the Austral Bricks range are available options for Panel Brick..
- Panel Brick construction allows engineers and architects to integrate bricks into loadbearing structural units.
- Panel Brick has strong thermal insulating and fire resisting properties.
- Allows for construction on boundaries with limited external access.

Austral Precast offers Panel Brick in two distinct ranges; Standard robot laid panels and Custom hand-laid panels.

The Standard Panel Brick range has been designed specifically to maximise the efficiencies of automated manufacturing within the Austral Precast factory. Panel sizes and brick options are limited by robotic capabilities, allowing for significant savings in manufacturing costs and time.

The Custom Panel Brick range offers a wider variety of panel design and brick options to choose from. Panels are hand-laid with the bricks of your choice, in the shape and pattern you desire.

Designing
with Panel Brick

2

Designing with Panel Brick

Panel Brick has been developed to provide external walls of buildings with an attractive, traditional and low maintenance finish, with high resistance to wind and earthquake loads. It can deliver a high quality, thermally efficient and cost effective structural wall system to any project. Panel Brick can provide solutions for loadbearing and non-loadbearing external walls for a range of building applications.

Panel Brick can be used in a variety of applications tailored to suit a wide variety of design and architectural needs. By combining Standard and Custom Panel Brick options, designers will experience the full benefits of building with Panel Brick, and the unique methods of precast construction allow for extremely high levels of planning and precision to be integrated into the construction process.

Panel Brick connections are the same as traditional precast panels, with a variety of fixing methods available to suit your design.

Panel Brick is ideally suited for:

- Medium Density Multi-Residential
- High-Rise Buildings
- Industrial Buildings and Warehouses
- Commercial Buildings
- Schools
- Hospitals

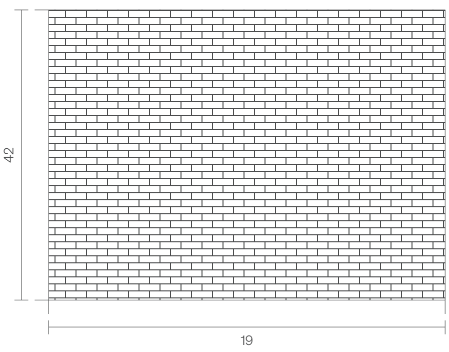
Standard Panel Brick

Fabrication	Laid by robot
Colour Range	Bowral 76 Burlesque Metallix
Panel Size (m)	Maximum Length: 4.5 Maximum Height: 3.6
Form	Flat
Thickness (mm)	110, 125, 150, 200
Double Wall Panels	Maximum Length: 4.5m Maximum Height: 3.6m External Skin: 110mm Internal Skin: 70mm Minimum Cavity: 60mm

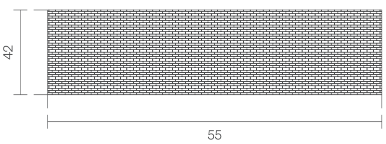
Custom Panel Brick

Fabrication	Laid by hand
Colour Range	San Selmo La Paloma Bowral 50
Panel Size (m)	Maximum Length: 12 Maximum Height: 3.6
Form	Custom
Thickness (mm)	Minimum: 110
Double Wall Panels	Maximum Length: 12m Maximum Height: 3.6m Maximum Panel Size: 26m² External Skin: 110mm Internal Skin: 70mm Minimum Cavity: 60mm

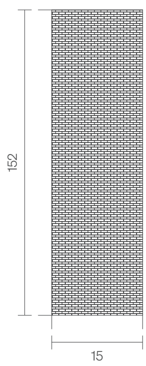
Maximum Standard Panel Brick*
Horizontal only



Maximum Custom Panel Brick*
Horizontal



Vertical



Designing with Panel Brick

Panel Brick Standard Range

The Panel Brick Standard range offers panels of up to 3600mm in height, 4500mm in width and from 110mm to 200mm in overall thickness in the Bowral 76, Metallix and Burlesque ranges. The manufacture of these panels is highly automated through the Austral Precast Carousel Plant 1 factory.

Panel Brick Custom Range

The Panel Brick Custom range offers panels of up to 3600mm by 13000mm in vertical or horizontal orientation. Panel weights are limited to 13 tonnes for transport, or the maximum capacity of the on-site crane. A collection of brick ranges including San Selmo, Bowral 50 and La Paloma can be chosen for Custom panels. Panels can incorporate a wide variety of design options, including custom moulds and liners to help bring your project to life.

For design and architectural purposes both Standard and Custom Panel Brick can be treated as a regular precast panel. Panel Brick can be self-supported, supported on slab edges or structurally integrated into a building. Panel Brick can be used as a cladding, façade or structural element in a building.

Cladding Panels

Panel Brick cladding panels are designed as a non-loadbearing brick external walling system.

Cladding panels utilise a purely mechanical bracket fixing system engineered specifically for Panel Brick. Panels are typically 110mm or 125mm thick and are ideal for buildings where external access is limited.

Façade Panels

Panel Brick façade panels are designed as a loadbearing brick external wall system.

Panels are typically 150mm to 250mm thick depending on service load requirements. Panel Brick façades panels can be created with openings such as windows and doors. These panels do not contribute to the structural frame of the building.

Structural Panels

Panel Brick structural panels are ideal for integrating external column sections into the building with no interruption to the external brick facade.

Structural panels utilise traditional precast connection methods of grout tubes, starter bars, slab rebates and key boxes for connecting to the building structure. Panels are typically 250mm thick or greater.

Double Wall

Panel Brick can be incorporated into the Austral Precast Double Wall system for structural panels up to 400mm thick. Panels are delivered as two separate skins of precast with trusses spanning between the cavity. Panels are core-filled on site, creating insitu connections with permanent formwork.

Full Brick Facing
–
The standard brick facing used for Panel Brick.

Front

Back

Full Brick Corner
–
Applied at corners and panel edges.

Front

Back

Half Brick Facing
–
Used at panel edges or in the body of the wall to create an interesting bond pattern.

Front

Back

Half Brick Corner
–
Applied at corner or panel edges.

Front

Back

Design Registrations
Australia: 201911536, 201911537, 201911538, 201911539
New Zealand: 425978, 425979, 425980, 425981 **US:** 29700880, 29700881, 29700882, 29700883

Designing with Panel Brick

Brick Options

Austral Brick's registered Dovetail brick design maximises the mechanical bond between the brick and the precast panel. The Dovetail design allows you to build higher with confidence. Extensive testing of the brick's pull-out strength has been performed under arduous freeze-thaw conditions to ensure compliance with Australian and international building standards. When it comes to brick-in-concrete construction, there is no better option than the Austral Bricks Dovetail Brick.

Brick Ranges

Brick facing sizes are 230mm x 76mm or; 230mm x 50mm for Bowral 50

Panel Brick Standard and Custom range

Bowral 76
Metallix
Symmetry

Custom Range only

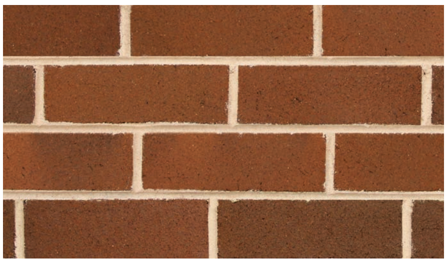
La Paloma
Bowral 50
Bowral 76
Metallix

Bowral Bricks Colours


Chillingham White


Simmental Silver


Bowral Brown


Gertrudis Brown


Bowral Blue

La Paloma Colours



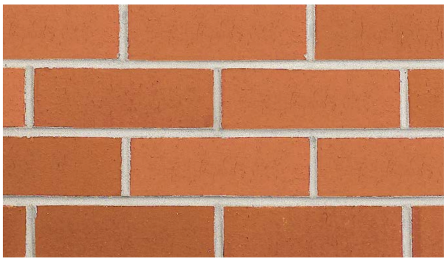
Metallix Colours

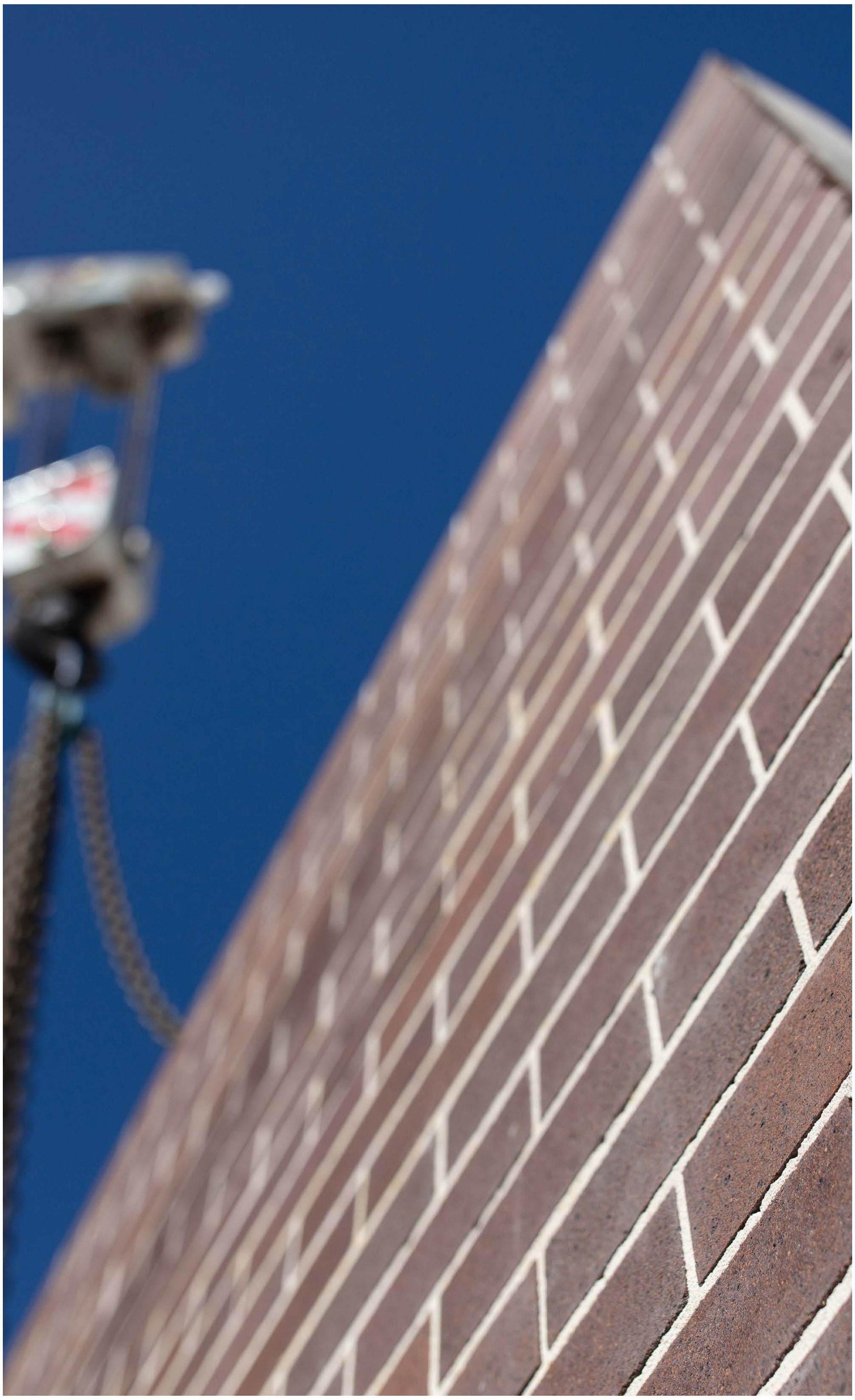

Quartz


Platinum


Blackstone

Symmetry Colours


Terracotta



Design Considerations

3

Design Considerations

When designing with Panel Brick, there is a range of considerations that must be factored in to maximise the benefits of the product in a building.

Design to Brick Sizes

Careful consideration must be made when designing in Panel Brick to integrate brick sizes and mortar joints into the details of each building.

Wall lengths, window and other panel void sizes, wall heights and panel joints must be designed to suit the brick size and mortar joints. Cost, manufacturing, installation time and aesthetic can all be greatly affected by the integration of brick unit sizing into the building design.

Please work with the Austral Precast team who can assist to ensure the panel sizes, design and manufacturing efficiencies are optimised.

	Brick Courses	1	2	3	4	5	6	7	8	9	10
	Height (mm)	76	162	248	334	420	506	592	678	764	850
	Width (mm)	230	470	710	950	1190	1430	1670	1910	2150	2390
Panel Size	Bricks	11	12	13	14	15	16	17	18	19	20
	Height	936	1022	1108	1194	1280	1366	1452	1538	1624	1710
	Width	2630	2870	3110	3350	3590	3830	4070	4310	4550	4790
Panel Size	Bricks	21	22	23	24	25	26	27	28	29	30
	Height	1796	1882	1968	2054	2140	2226	2312	2398	2484	2570
	Width	5030	5270	5510	5750	5990	6230	6470	6710	6950	7190
Panel Size	Bricks	31	32	33	34	35	36	37	38	39	40
	Height	2656	2742	2828	2914	3000	3086	3172	3258	3344	3430
	Width	7430	7670	7910	8150	8390	8630	8870	9110	9350	9590

This table gives an indication of panel dimensions at brick unit increments.

Please note the following;

- Panel dimensions in grey are offered in the Custom Architectural range only
- Panel width can also include half bricks (add 120mm to width for extra half brick)

Design for Precast Panels

Designing in precast requires special care around panel sizes and shapes to maximise efficiencies in cost, manufacturing and construction.

Smaller panels increase manufacturing and installation cost relative to area. Avoid unnecessarily small panel sections where possible.

Slender sections of panel around voids are difficult and expensive to reinforce. Panel voids should be located close to the centre of the panel where possible.

The panel support mechanism needs to be considered in the initial design as it may rely on a cantilevered or footing slab for support.

Consider Transport

Panels being transported to site will need to meet the size and weight requirements of the truck and trailer carrying the panels and any height limitations en-route. Panels arriving promptly to site rely on unpredictable factors such as weather and traffic. Proper traffic control is the responsibility of the receiving party in instances where trucks must wait on public roads prior to or during the unloading process.

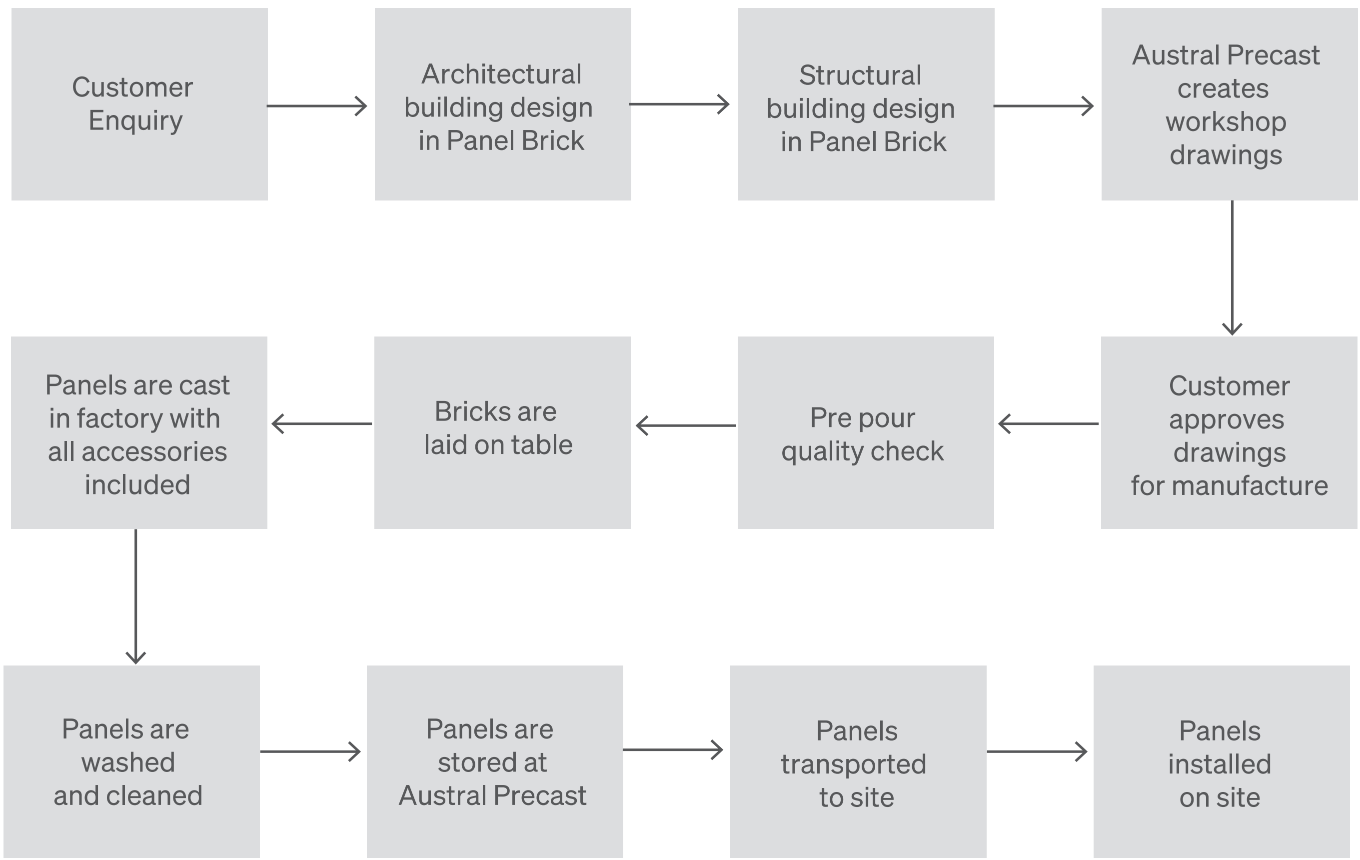
Consider Installation

Installation of Panel Brick requires a crane to hoist panels into place and a rigging team to install and access to the panels. Panels should be designed to accommodate the lifting capacity of the crane at the radius required.

Panels higher than 3.6m will need to be spun 90 degrees to be unloaded and installed. This process requires a second crane and additional installation time. Spinning panels also introduces additional risk of damaging the product during install.

Design Considerations

Building with Precast



Structural Considerations

Architects, designers, engineers and project managers should ensure that the planning, design and detailing of projects, incorporating Panel Brick, is such that their manufacture, transport and construction complies with AS 3600 Concrete Structures, AS 3700 Masonry Structures and AS 3850 Prefabricated Concrete Elements.

The design capacity for Panel Brick can be calculated using a combination of methods from AS 3600 Concrete Structures and AS 3700 Masonry Structures. To understand which standard is applicable for each design requirement, please refer to the Building with Panel Brick section of this manual.

Design Loads

The structural requirements of Panel Brick, and any other building element, must be calculated on a case-by-case basis using the specific details of each element, it's location within the building and the buildings location with respect to its surroundings.

Design Loads from AS/NZS 1170.0 Structural design actions (Part 0: General principles) and AS/NZS 1170.1 Structural design actions (Part 1: Permanent, imposed and other actions) combined with Design Capacities calculated from AS3600 and AS3700 must be used to determine panel size and thickness requirements for each distinct situation within a building.

Cladding Panels

The chart on the following page shows an approximation of the maximum panel size achievable, while resisting the ultimate wind pressure for different building heights and wind categories. Many assumptions have been made about building location and proximity to both natural and man-made surroundings in the calculations for this table, and no considerations have been made for elevated wind pressures at building corners or for voids in panels. As such, this chart should be used as an indication only for the maximum panel sizes for a building.

Design Considerations

The below is a generic approximation of the dimensional capabilities for Panel Brick panels in a variety of situations.

110mm Panel - 3.2mm High

Wind Region	Region A						Region B					
Terrain Category	TC3			TC1			TC3			TC1		
Building Height	10m	20m	50m	10m	20m	50m	10m	20m	50m	10m	20m	50m
Panel Mesh	SL82			SL82			SL82			SL82		
Panel Thickness (mm)	110			110			110			110		
Panel Height (m)	3.2			3.2			3.2			3.2		
Panel Width (m)	8.7	8.7	8.7	8.7	8.6	7.8	8.7	8.6	6.6	6	5.3	4.8

125mm Panel - 3.2mm High

Wind Region	Region A						Region B					
Terrain Category	TC3			TC1			TC3			TC1		
Building Height	10m	20m	50m	10m	20m	50m	10m	20m	50m	10m	20m	50m
Panel Mesh	SL92			SL92			SL92			SL92		
Panel Thickness (mm)	125			125			125			125		
Panel Height (m)	3.2			3.2			3.2			3.2		
Panel Width (m)	10.9	10.9	10.9	10.9	10.9	10.4	10.9	10.9	8.8	8	7.1	6.4

Please note, panels wider than 19 bricks (4550mm) are only offered in the Custom range.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PHOENIX

Engineering with Panel Brick

4

Engineering with Panel Brick

Building with Panel Brick is regulated by the National Construction Code. The NCC provides deemed-to-satisfy solutions for precast reinforced concrete panels via AS 3600 Concrete Structures. However, the deemed-to satisfy solution for precast concrete panels does not make allowance for the contribution of embedded brick units to the performance of the panel. Therefore AS 3700 Masonry Structures can be used to provide design solutions for Panel Brick in situations where the embedded brick unit forms part or all of the area of panel under stress.

Panel Brick must also be designed to withstand the manufacturing, transport and construction loads of each panel, in addition to the in-service loads as set out in the following Australian Standards:

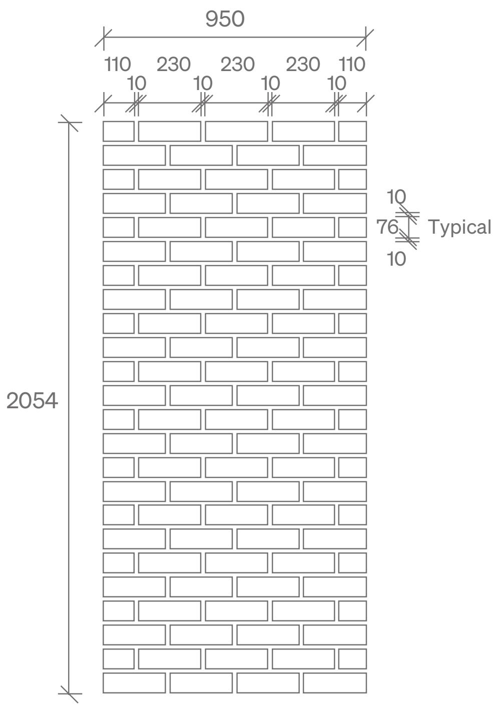
- AS/NZS 1170.0 Structural design actions, Part 0: General principles
- AS/NZS 1170.1 Structural design actions, Part 1: Permanent, imposed and other actions
- AS/NZS 1170.2 Structural design actions, Part 2: Wind actions
- AS/NZS 1170.4 Structural design actions, Part 4: Earthquake actions in Australia
- AS 3850 Tilt-up concrete construction
- AS 3850 Clause 3.5 specifies that the design shall be carried out in accordance with AS 3600 and the following factors to be applied to the panel weight for the nominated situations.

The below section outlines clearly the recommended method for calculating the design capacity of Panel Brick in a variety of situations. The full worked examples for each of these calculations can be found in Appendix A.

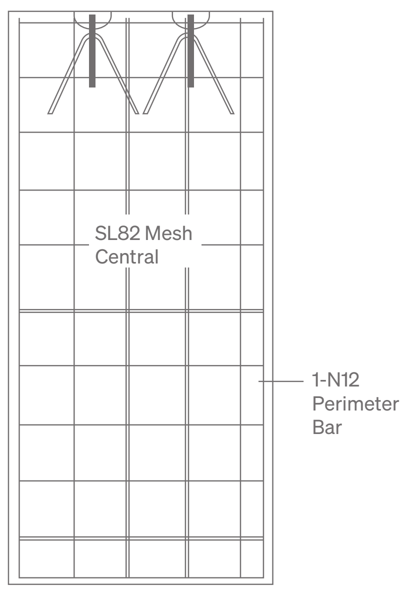
Out-of-Plane Bending

Out-of-plane bending (outwards)

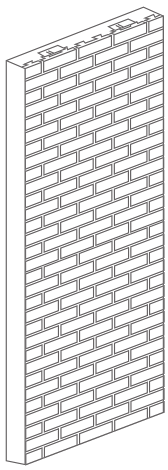
For Panel Brick fixed at the top and bottom that forms the external wall of a building, it will experience lateral out-of-plane loading from either wind or earthquake events. When the panel is bending outwards, the internal (concrete) face is stressed in compression while the external face is stressed in tension. For ultimate limit state design, the distance from the inside face to the vertical reinforcing bars is the effective thickness of the reinforced concrete section and should be designed in accordance with AS 3600:2018. The external (brickwork) face is assumed to have negligible tensile resistance and therefore ignored.



Elevation



Reinforcement



Example of a Panel Brick Precast Panel

Engineering with Panel Brick

Out-of-plane bending (inwards)

Conversely, when the panel is bending inwards, the external (brickwork) face is in compression while the internal face is in tension. For ultimate limit state design, the distance from the external face to the vertical reinforcing bars is the effective depth of the section. Since this is essentially reinforced masonry, the section is designed in accordance with AS 3700:2018. For the Dovetail (brick facing) unit, the thickness of the clay masonry section will represent the majority of the area of the section in compression and therefore using AS 3700:2018 is appropriate and recommended. However, for facing unit panels, since the thickness of clay masonry is relatively small, the panel should be designed in accordance with AS 3600:2018 by ignoring any contribution of the clay masonry units.

In-plane Bending and Shear

For panels with openings like windows or doorways, the section of panel spanning over the opening will be required to act like a lintel beam. This action is referred to as in-plane bending of the wall panel which also has associated shear.

When determining this in-plane bending and shear capacity, it is recommended that the masonry units are ignored and the remaining section of reinforced concrete is relied upon for ultimate limit state strength for in-plane bending and shear. Furthermore, the sections of concrete between the dovetails (brick facing) of the masonry unit should also be ignored. This area is identified in the adjacent diagram

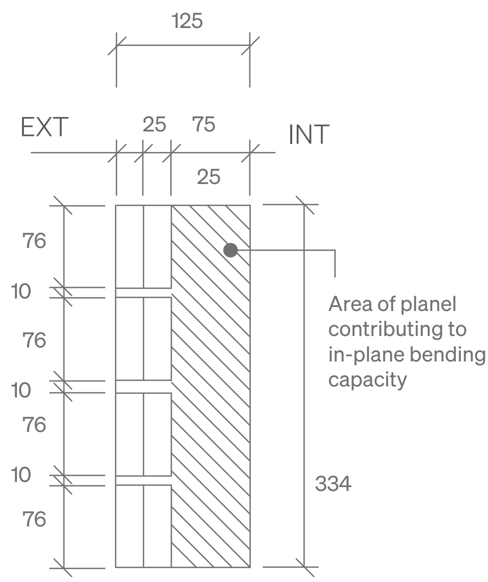


Figure 2 - Contributing Area for In-Plane Bending (Section View)

It is recommended that the section of panel over openings is designed as a reinforced concrete beam in accordance with AS 3600:2018. Due to the manufacturing methods of precast concrete panels, it is recommended that the beams are designed without transverse shear reinforcement. That is, the shear capacity of the beam relies on the

Compression

When designing a reinforced concrete wall for compression (as well as other forces), designers must carefully consider the purpose of the particular wall within the overall force resisting system of the building and ensuring that the connection of the wall to the structure is suitable for that purpose.

For Panel Brick, it is recommended that AS 3600:2018 is used to determine the capacity for compression – refer to section 11 of the Standard. However, the full cross section of the panel should not be used because of the difference between the compression strength of the brick units and the concrete. It is recommended that only the area of concrete behind the brick units should be considered to be contributing to the compression capacity. this area is identified in the adjacent diagram.

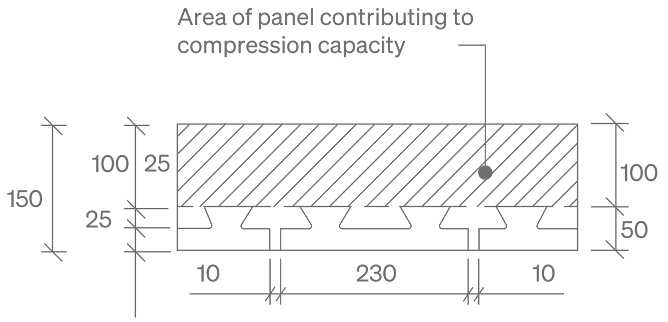
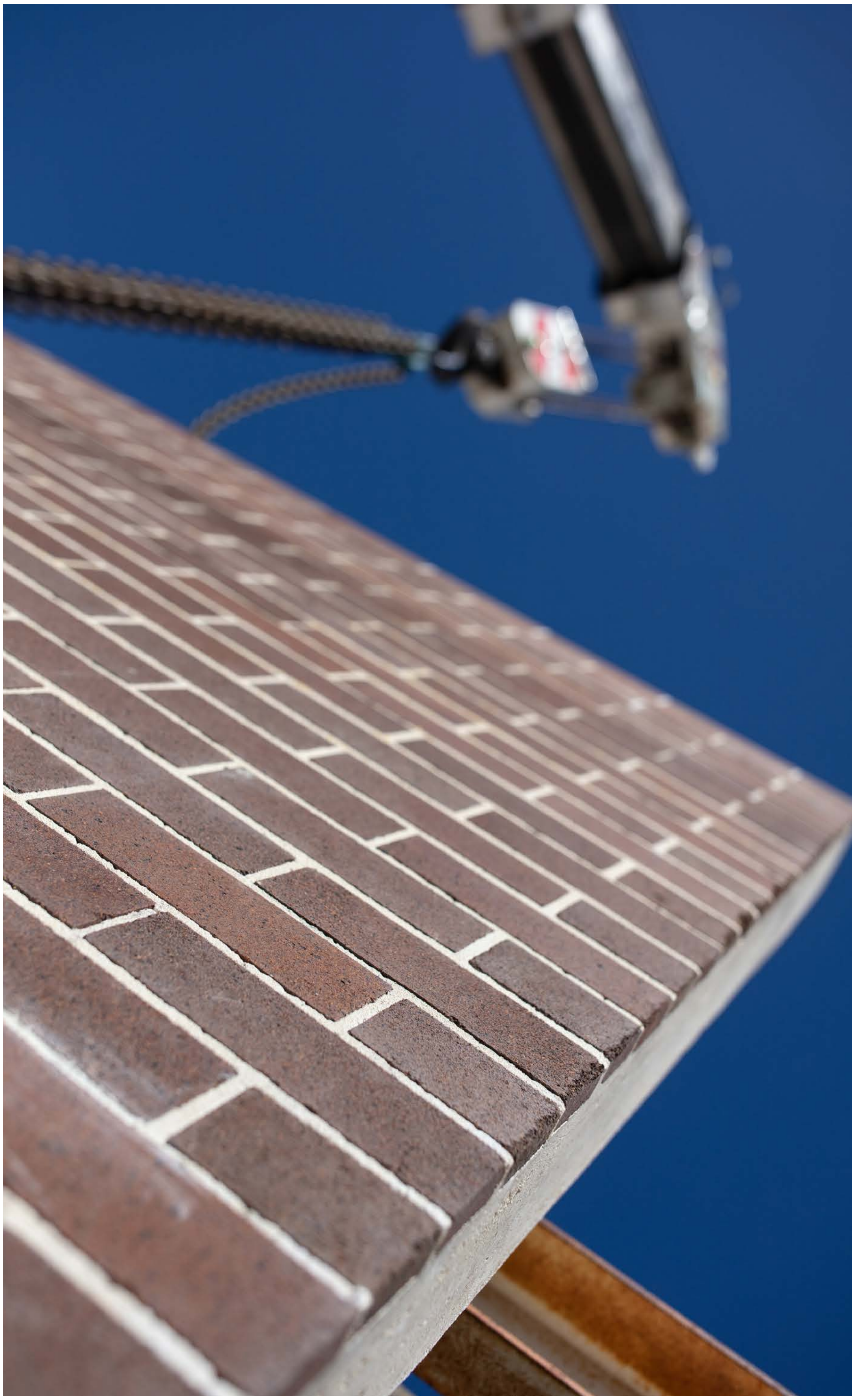


Figure 3 - Panel Compression Section (Top-View)



Panel Brick
Performance

5

Panel Brick Performance

Durability

The durability of Panel Brick must be considered from both sides of the panel. For the external side (brick side), the reinforcement in the panel is protected by the brickwork units and the concrete between the back of the brickwork units and the reinforcement. In this instance it is recommended that AS 3700:2018 is used to determine the durability requirements for specific exposure environment – refer to section 5 of AS 3700:2018. This applies to the requirements of the bricks as well as the cover to the reinforcement.

For the internal side, the reinforcement is protected by the concrete cover on the inside face. For this side it is recommended that AS 3600:2018 is used to determine the durability requirements for the specific exposure environment – refer to section 4 of AS 3600:2018. (Refer to Appendix A).

Fire rating

Non-combustibility

The components Panel Brick consist of clay masonry, concrete and steel reinforcement. These materials are widely accepted as being non-combustible materials. Therefore, Panel Brick is considered as a non-combustible building product.

Fire Resistance Level

Panel Brick has been tested to AS 1530.4 to determine the Fire Resistance Level (FRL) of the of the composite product (CSIRO Report 2086FSV). FRL is the measure of a building elements capacity to resist the spread of fire within a building and between buildings. This is quantified in the measurement of three distinct criteria; Structural Adequacy, Insulation and Integrity.

Structural Adequacy is the measure of an elements capacity to maintain its loadbearing capacity in a fire event. The time at which the element fails under the weight of its load due to fire (rounded down to the nearest 30 minutes) is taken as the value for Structural Adequacy.

Integrity is the measure of an elements capacity to impede the spread of flame through the specimen. The time at which sufficient heat or flames breach the specimen barrier (rounded down to the nearest 30 minutes) is taken as the value for Integrity

Insulation is the measure of an elements capacity to resist the transfer of heat energy through the specimen. The time at which the unexposed side of the specimen reaches a certain temperature barrier (rounded down to the nearest 30 minutes) is taken to be the value for Insulation

The FRL of Panel Brick at various thicknesses can be determined using a combination of data from the CSIRO AS 1530.4 test and standard calculation factors found in AS 3600. Please contact Austral Precast for more information regarding fire ratings of Panel Brick.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Panel Brick Performance

Accoustic Performance

Panel Brick acoustic insulation ratings have been calculated by PKA Acoustic Consultants.

The below table shows values for R_w (Weighted Sound Reduction Index) which describes an expected decibel reduction factor based on the density and thickness of the panel section and for C_{tr} (Low Frequency Adjustment Factor) which describes an expected decibel reduction correction factor low frequency noise.

Panel Brick alone provides exceptional acoustic insulation properties for external walls. Acoustic ratings combining Panel Brick with an internal insulated stud section have also been calculated.

The National Construction Code has no acoustic performance requirements for external walls, however some local jurisdiction may have acoustic insulation requirements where external noise is an issue.

Panel Brick Accoustic Performance - Single Skin Panel Brick

Total Thickness	Minimum Surface Density	Airborne Sound Insulation		
		R_w	C_{tr}	$R_w + C_{tr}$
110mm	280 kg/m2	51	-3	48
125mm	320kg/m2	53	-4	49
150mm	380kg/m2	55	-4	51
175mm	440kg/m2	57	-5	52
180mm	455kg/m2	58	-5	53
200mm	505kg/m2	59	-5	54

Accoustic Performance

Panel Brick Accoustic Performance - Panel Brick External System[1]

Panel Thickness	Minimum Total Thickness	Airborne Sound Insulation		
		R_w	C_{tr}	$R_w + C_{tr}$
110mm	207mm	62	-10	52
125mm	222mm	64	-10	54
150mm	247mm	66	-9	57

[1] **Internal Lining**
Minimum 20mm gap between precast concrete and studwork
Minimum 64mm steel or timber studs (cc 600mm)
Minimum 75mm glasswool insulation (min. 10kg/m3)
Minimum 13mm standard plasterboard (min.8.5kg/m2)

Weather Tightness

Sealing Panel Brick against the penetration of water into a building must be assessed based on the requirements stated in the National Construction Code (NCC) Part F1, FP1.4. Details are provided in this manual for recommendations on vertical and horizontal panel joint details, and details for sealing openings against water ingress.

Condensation

Risks associated with water vapour and condensation must be managed in accordance with the requirements of the NCC as stated in Part F6, FP6.1. For the purposes of condensation management, Panel Brick can be considered as single skin masonry and must have a pliable building membrane installed, unless a drained cavity is installed immediately behind the panels.

Panel Brick Performance

Thermal Performance

R-value is a measure of the thermal resistance of a building material and its ability to insulate. R-value alone is not a complete measure of thermal performance as it does not consider the effect of thermal mass. Panel Brick has a high thermal mass which can provide additional energy savings through the natural thermal inertia of the panel. Wall sections with significant thermal mass create a dampening effect when considering the movement of thermal energy through a wall section. This thermal inertia increases insulation properties beyond what can be calculated by considering the thermal conductivity values of the materials in the wall section alone.

The National Precast Concrete Association of Australia has developed an R Value calculator that is derived from the Steady State R Value taking into account the beneficial effects of mass.

Additional information about the mass-enhanced R-Value calculator can be found on the NPCAA website or by contacting Austral Precast.

Panel Brick R Values

Panel Thickness	Surface Density (kg/m²)	Thermal Resistance R-Value (m²K/W)
110mm	280 kg/m2	0.076
125mm	320 kg/m2	0.086
150mm	380 kg/m2	0.104
175mm	440 kg/m2	0.121
180mm	455 kg/m2	0.124
200mm	505 kg/m2	0.138

Wall System (see Note)	Panel Thickness (mm)	Frame	Thermal Resistance R_T Value (m²K/W) Winter	Total Thermal Resistance R_T (m².K/W) Summer
1	110mm	Steel	2.14	2.02
2	125mm	Steel	2.16	2.04
3	150mm	Steel	2.19	2.07
4	200mm	Steel	2.25	2.13
5	110mm	Timber	2.31	2.17
6	125mm	Timber	2.32	2.19
7	150mm	Timber	2.34	2.21
8	200mm	Timber	2.37	2.24

Note:

Wall systems 1 – 4 panel thicknesses (110mm, 125mm, 150mm, 200mm), 30mm air gap, non-reflective sarking, 90mm x 0.55BMT Steel Stud Framing @ 600mm c/c, 1-row noggins, 90mm glasswool insulation (R 2.5) and 13mm Plasterboard

Wall system 5 - 8 panel thicknesses (110mm, 125mm, 150mm, 200mm), 30mm airgap, non-reflective sarking, 70mm x 35mm Pine Stud Framing @ 600mm c/c, 1-row noggins, 70mm glasswool insulation (R2.0) and 13mm Plasterboard

Design Details

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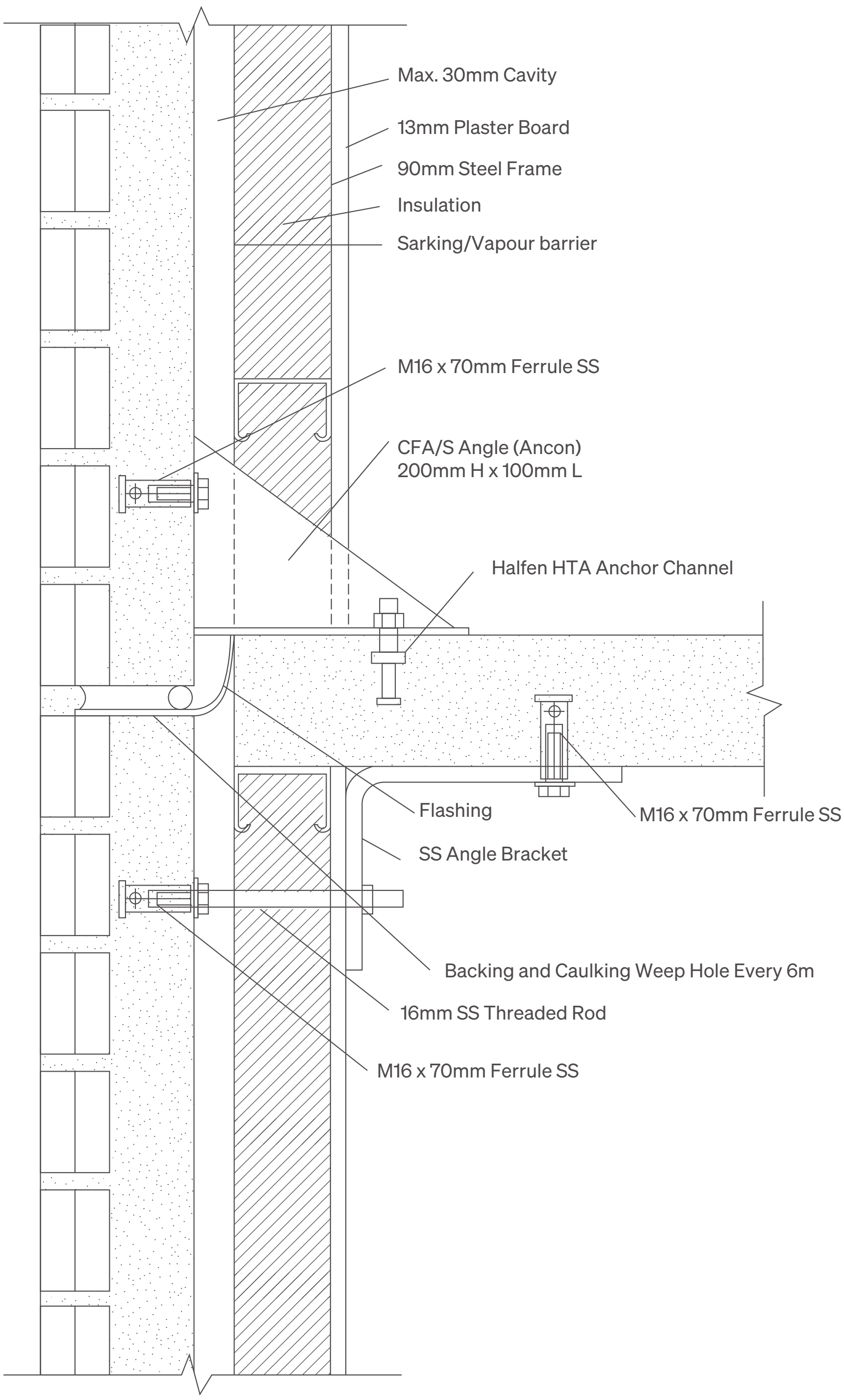
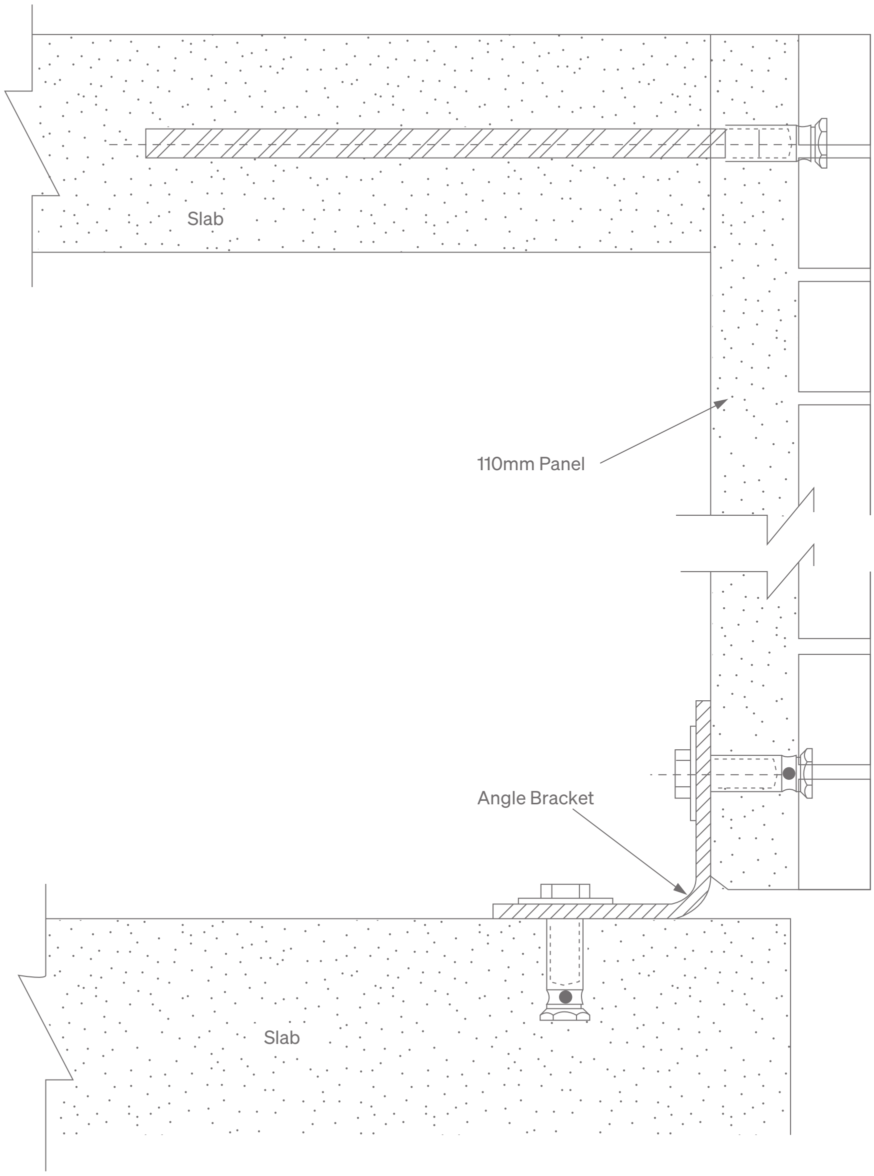
Connection Details

Ancon Bracket Connection BR01

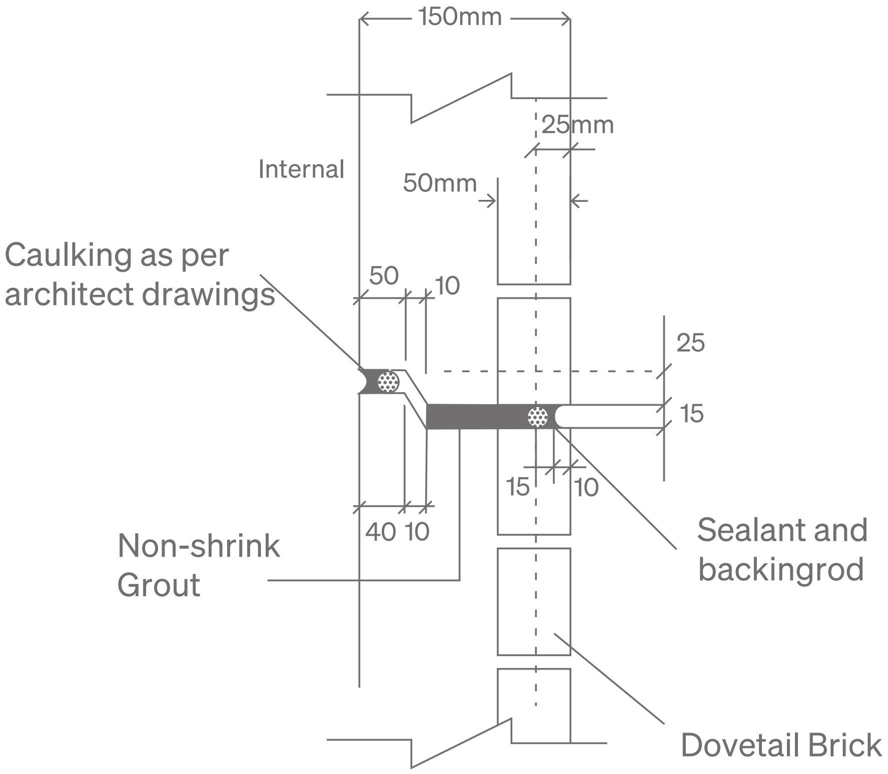


Slab Rebate Hanging Panel
BR02

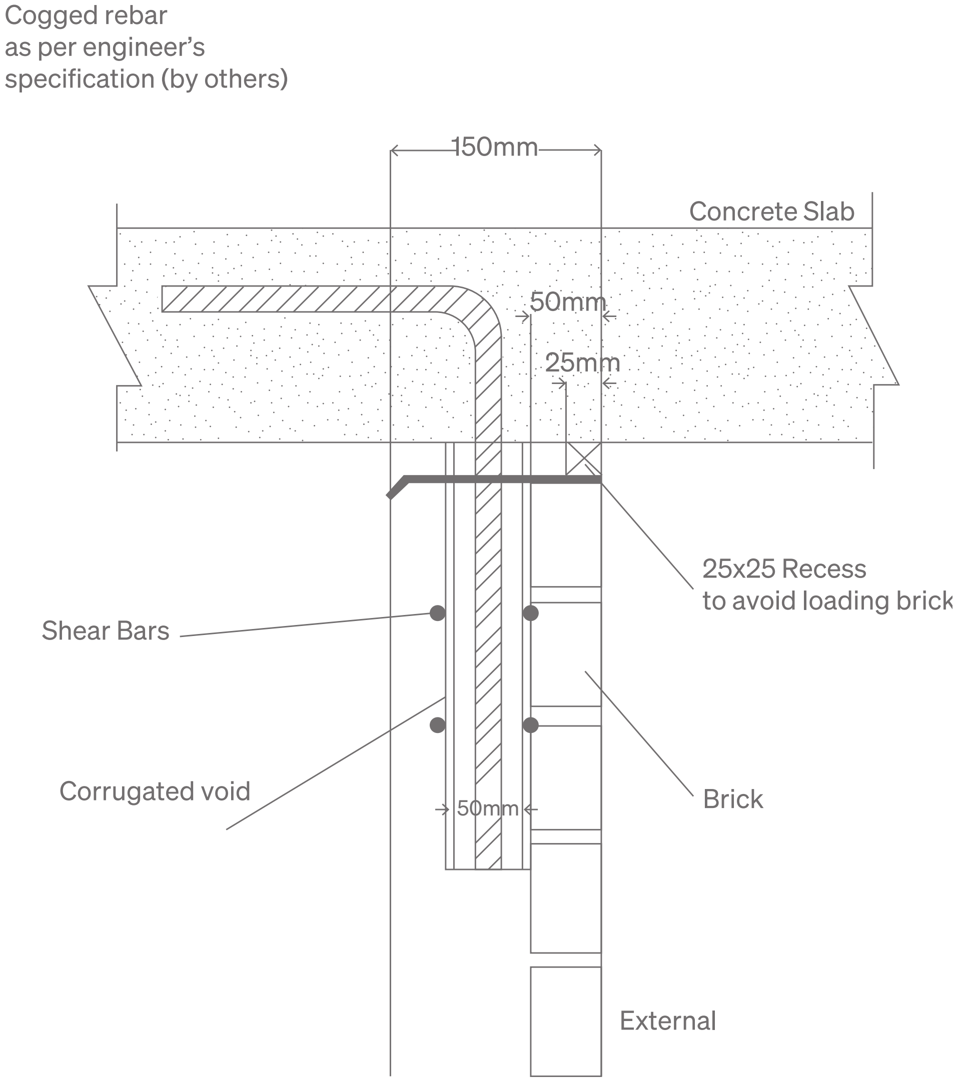


Connection Details

Panel-Panel Horizontal
Ship Lap BRO3

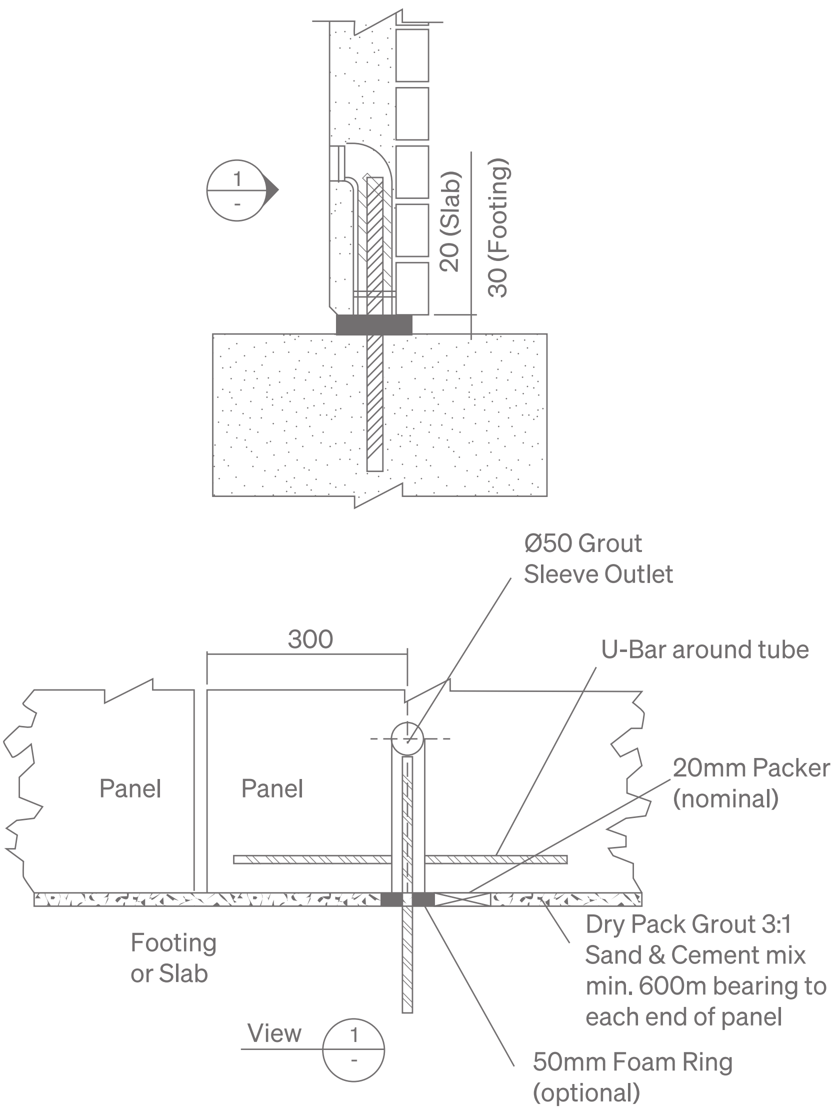


Panel-Slab Horizontal Loadbearing Slab Fixing BRO4

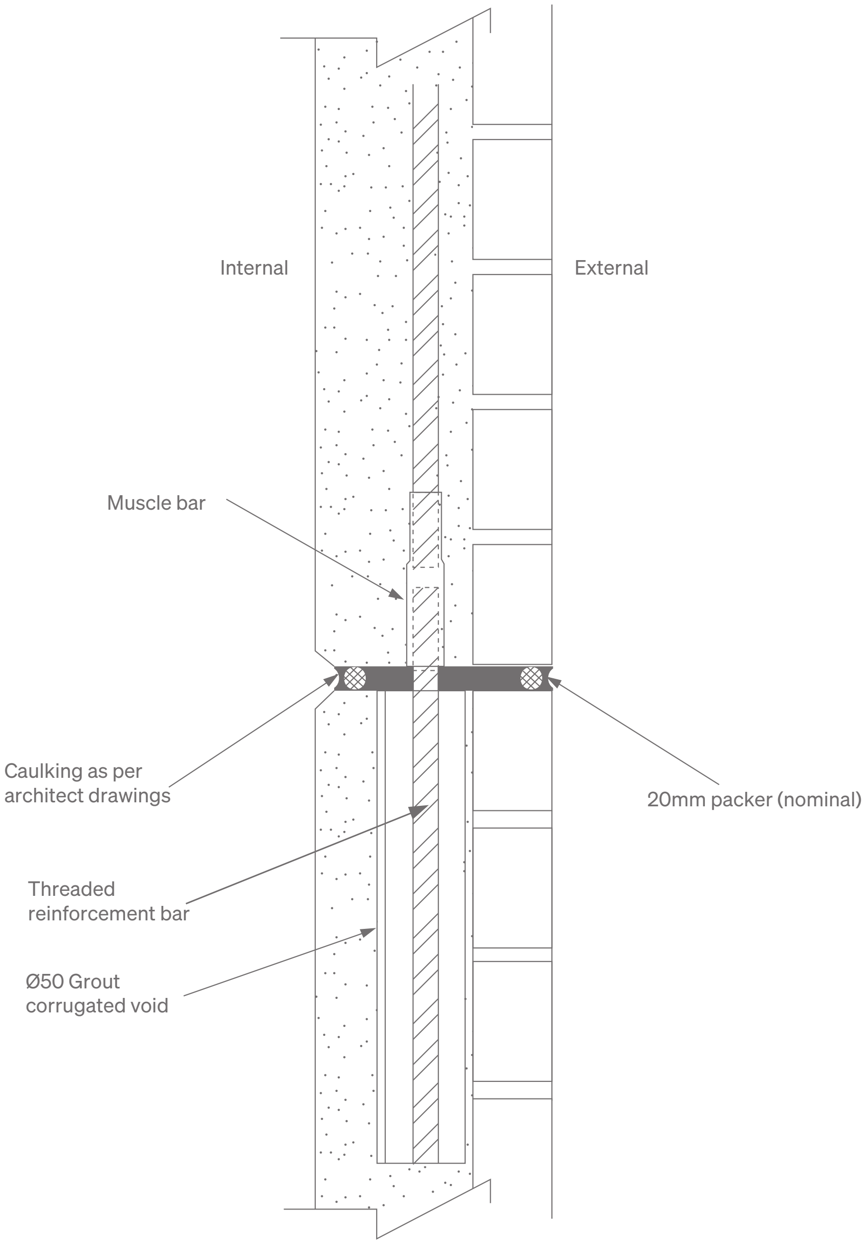


Connection Details

Dowel Pin Connection to Footing Slab BR05

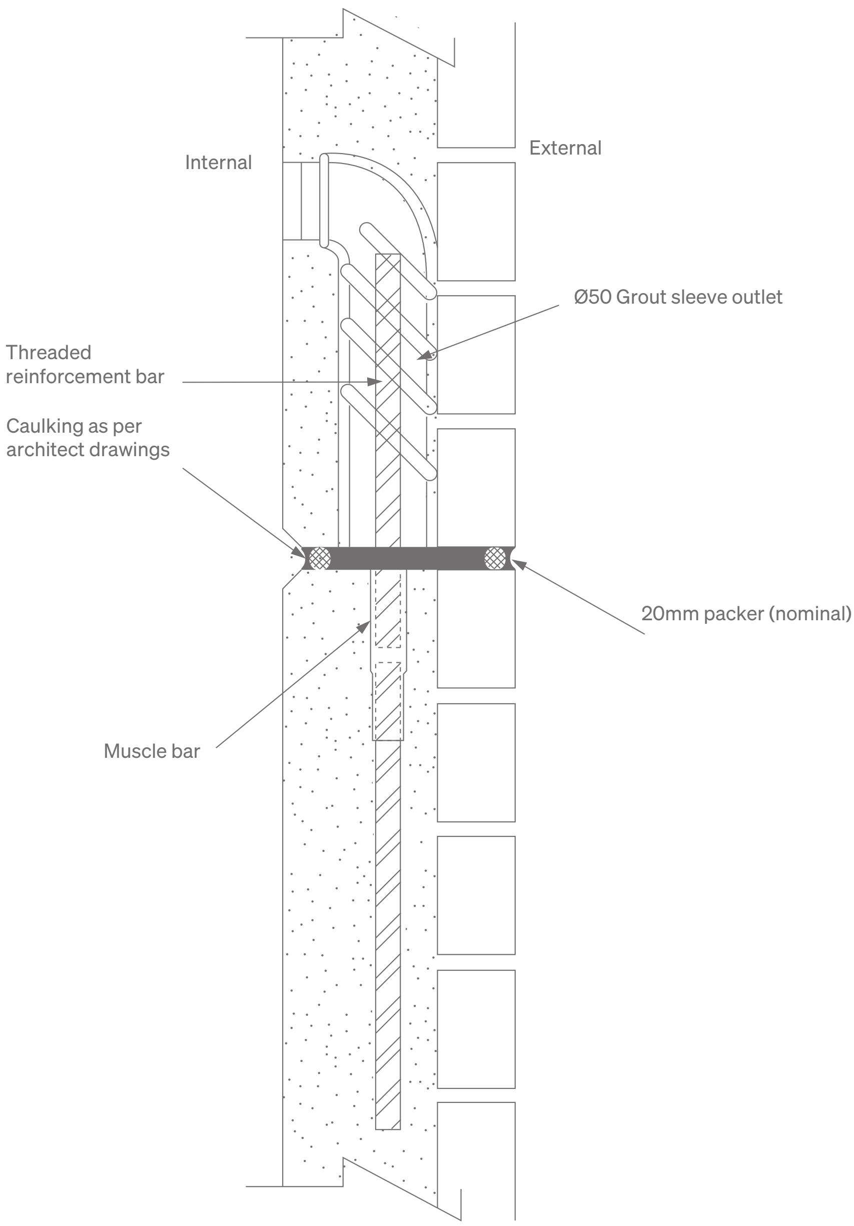


Muscle Bar Top of Panel
BR06

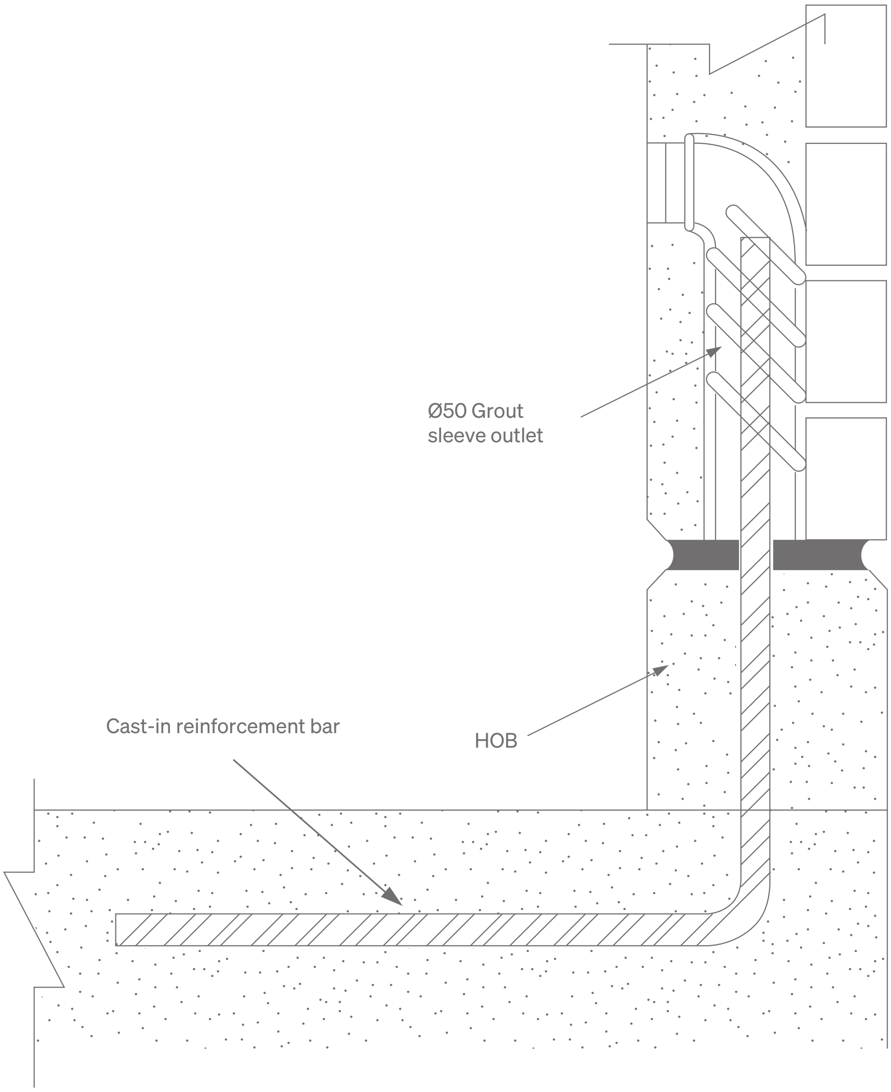


Connection Details

Muscle Bar Bottom of Panel
BR07

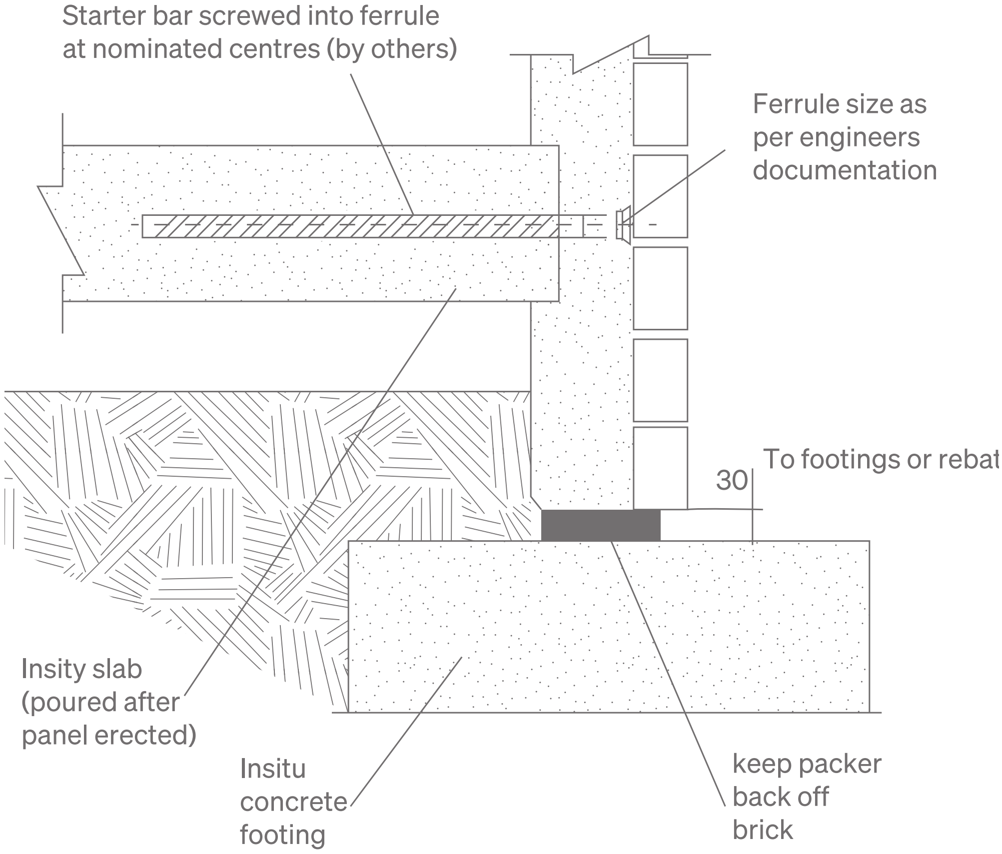


Slab Hob
BR08

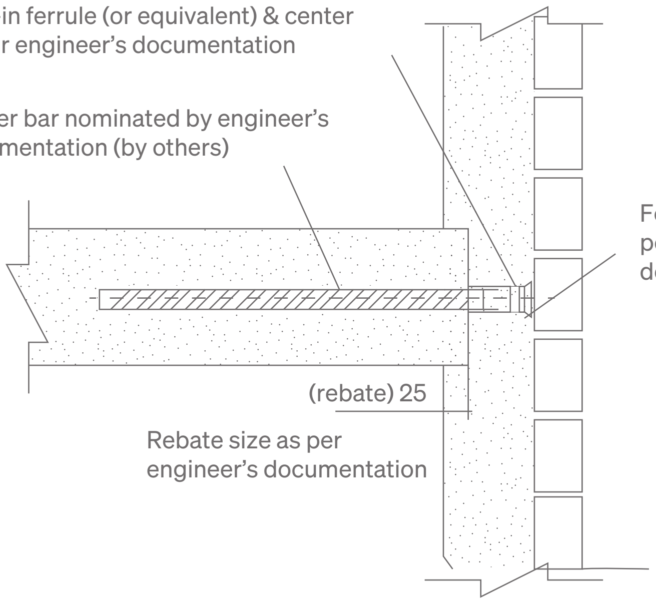


Connection Details

Panel Fixing
to Slab on Ground
BR09

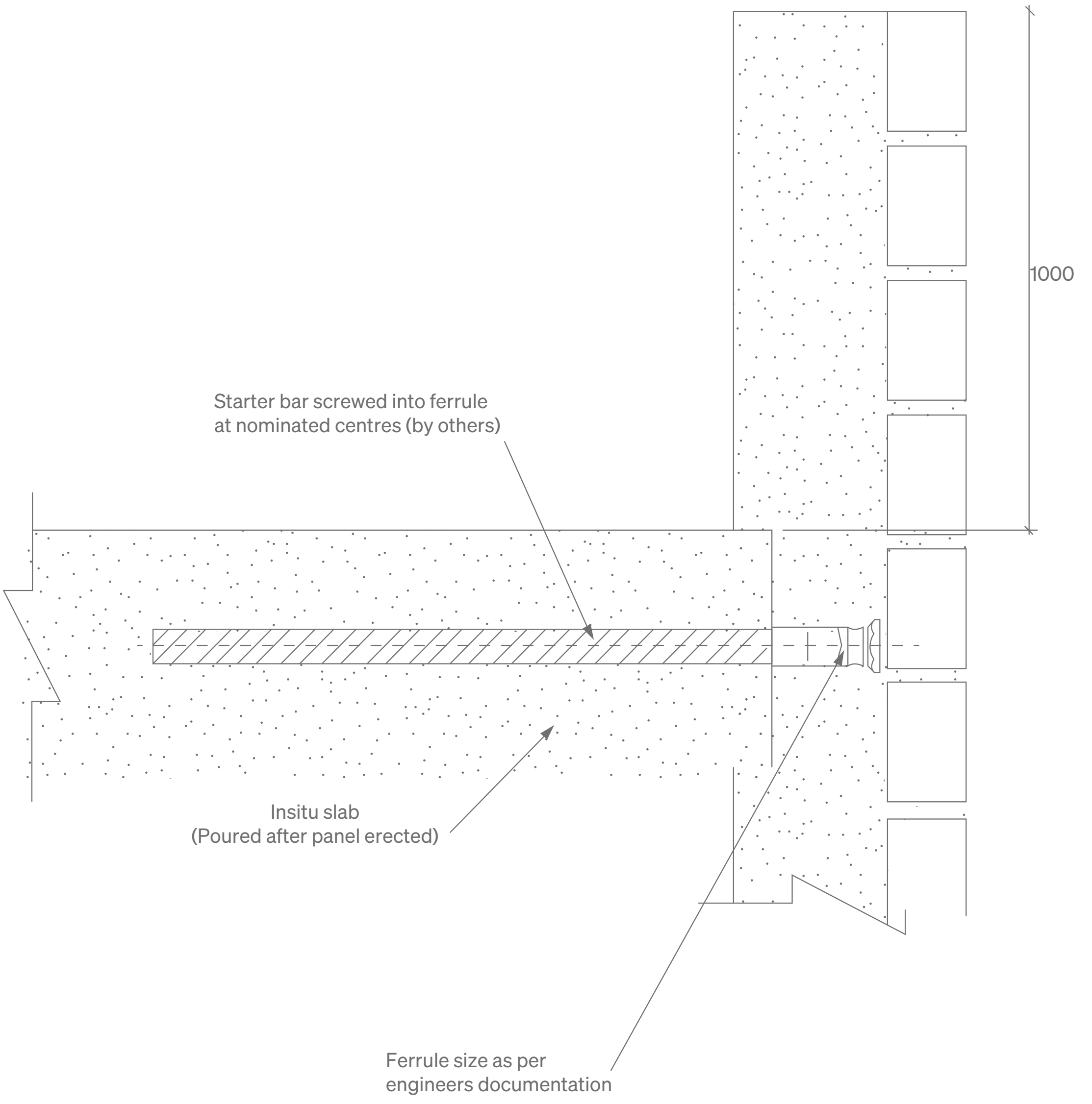


Suspended Slab Fixing
BR010



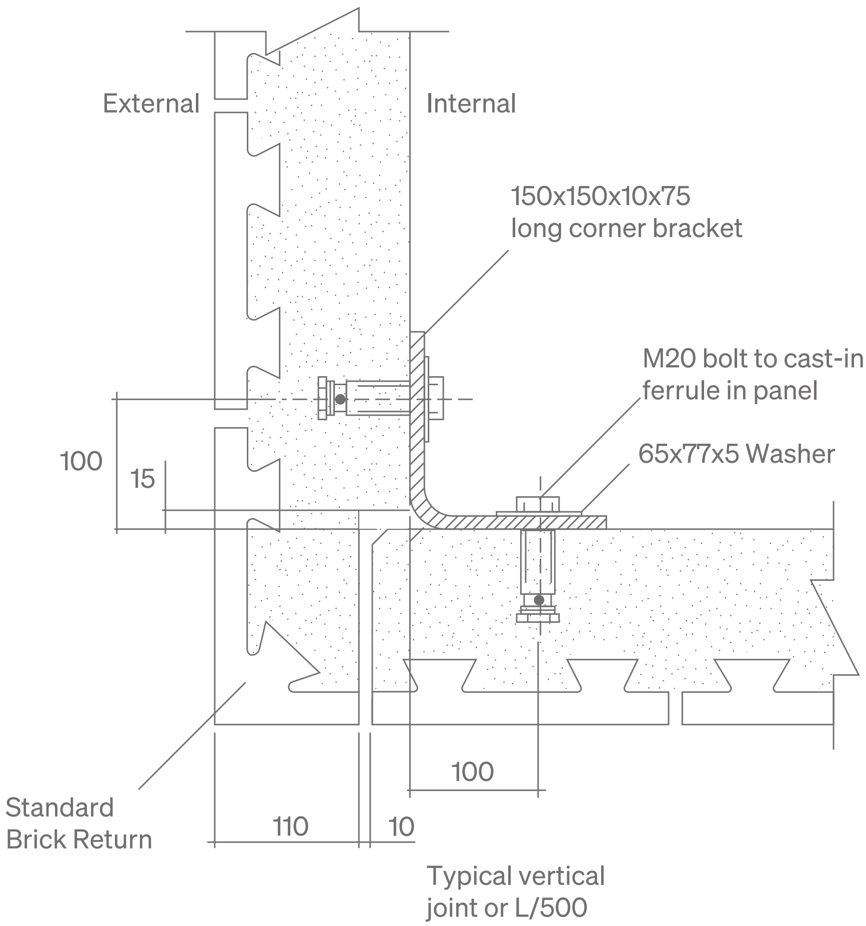
Connection Details

Edge Protection
BR11



Panel-Panel Vertical
Exposed Corner Bracket
BR12

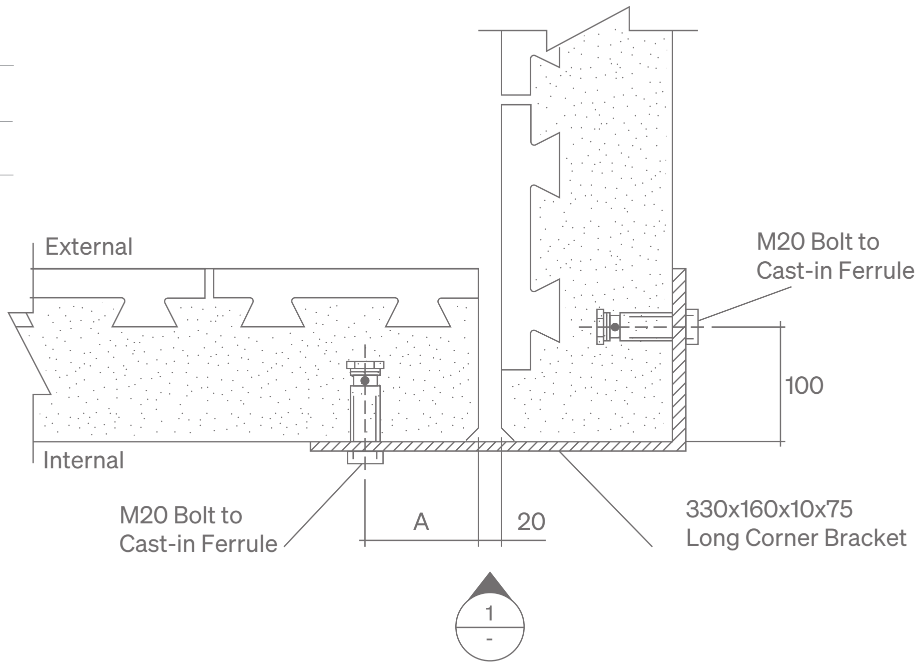
Thickness	150	175	200
A	125	105	100

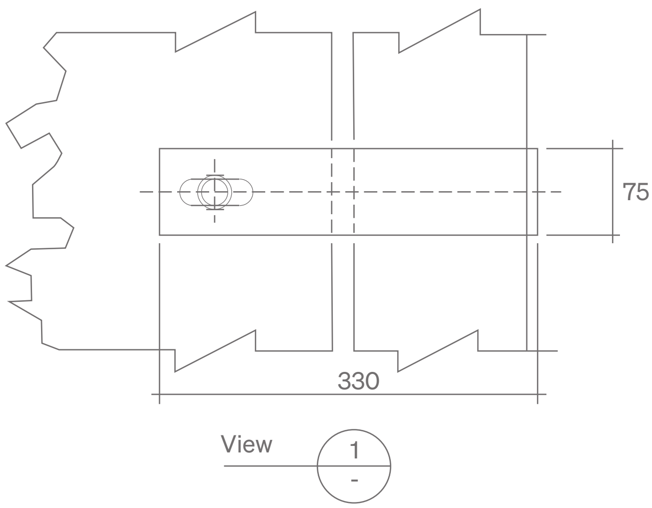


Connection Details

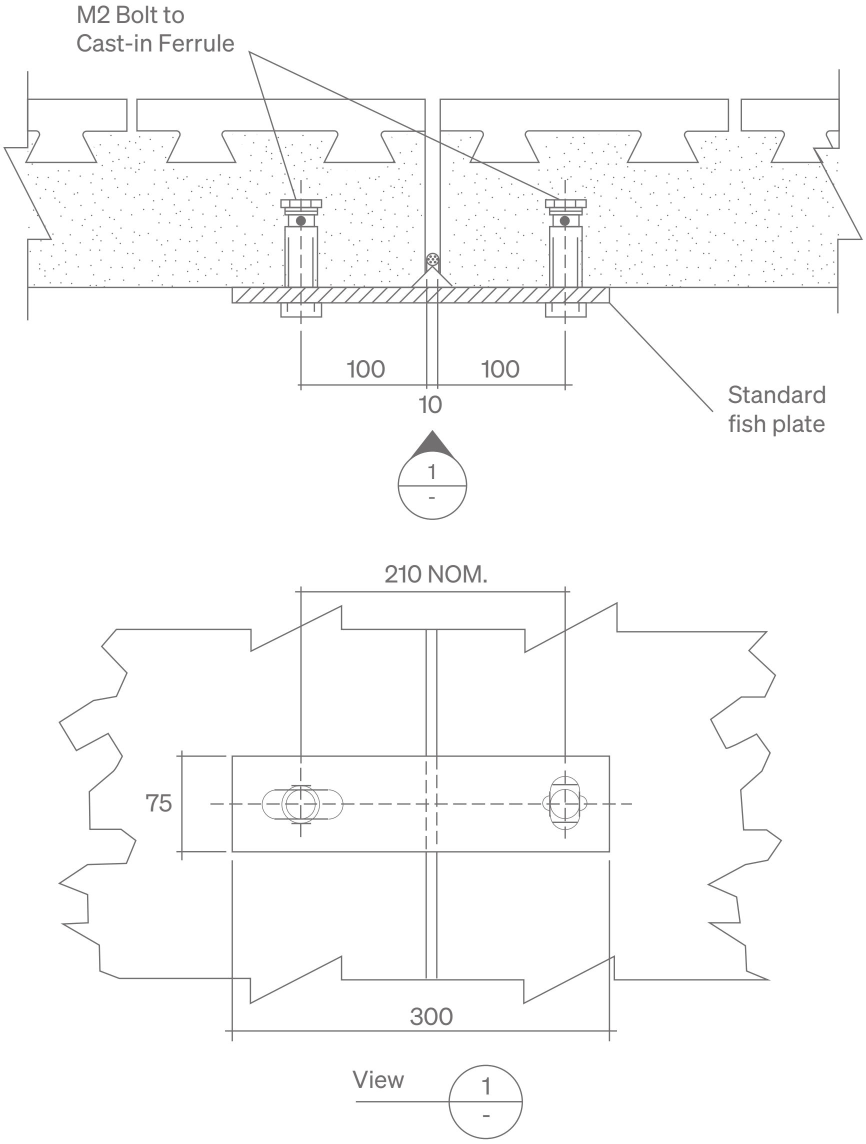
Internal Corner Bracket
BR13

Thickness	150	175	200
A	125	105	100



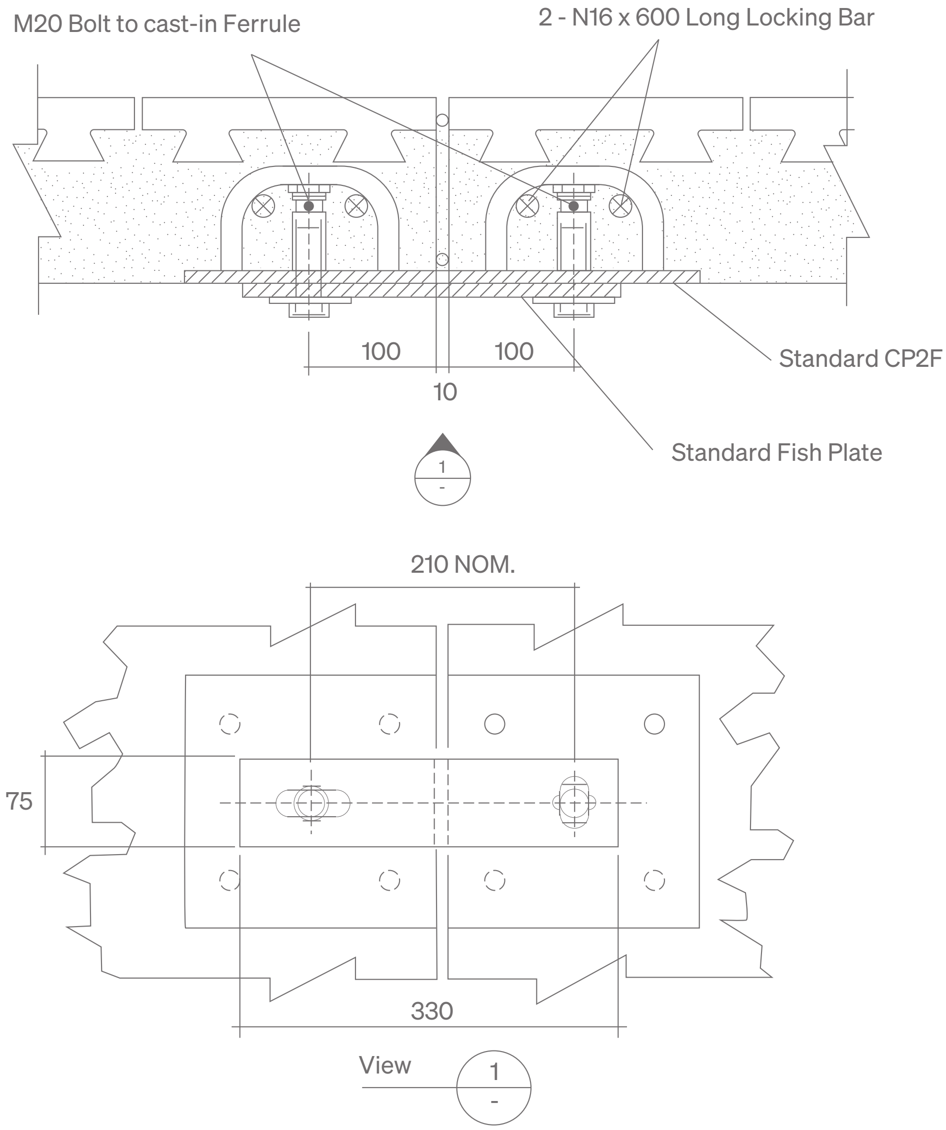


Non-Recessed Bolted Fish Plate BR14



Connection Details

Non-Recessed
Fish Plate to Cast
BR09



Installation Details

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Installation with Panel Brick

When installing Panel Brick, special care must be taken to ensure damage to the panels is avoided. Panel Brick is delivered to site as a finished product which means there should be no need for cleaning, sealing or repair once the panel is installed.

Panel edge protection must always be used in situations where panels are being levered into place to avoid brick damage. Packers should be placed towards the back of the panel where possible to avoid panel weight bearing directly on bricks.

Close care must also be taken to ensure panels are installed in precisely their correct location. Misaligned panels will show clearly in the incongruency of mortar joints across adjacent panels. If panels or building slabs show significant deviation from their intended design pre-install, please contact an Austral Precast Project Manager before proceeding.

Panel Quality

Panels with visible defects such as cracked bricks, misplaced bricks, unfilled mortar joints, over-filled mortar joints or any other defect or concern should not be installed. Panel repair is to be undertaken at ground level wherever possible. An Austral Precast Project Manager should be contacted immediately if there is any concern over the quality of a panel delivered to site.

Caulking

Where possible, caulking material should be colour matched to the mortar colour of Panel Brick. Where fire ratings are required, 4-hour fire rated caulking must be used. See Panel Brick details for caulking depth and other details.

Brick Cleaning Procedure

Panel Brick is a finished product and requires no chemical cleaning. The panel may need a wash-down to remove surface dirt upon delivery. High Pressure cleaning should not be used as this will damage the brick work.

Any discolouration or staining of the brickwork is taken on a case-by-case basis and photo documentation should be sent to Austral Precast before installation continues.

Brick Replacement Procedure

If a panel arrives to site with clear damage to one or more bricks it is significantly more time and cost effective to repair this before the panel is installed on the building. If it is not feasible to return the panel to the Austral Precast yard for repair than an Austral precast certified patcher will come to site to do the repair. Please ensure that the panel is accessible and that the work area is flat, secure and away from moving machinery. The replacement mortar must cure for 24 hours before the panel can be installed.

Safe Access - Use Crane Box for Access

In some scenarios it will be necessary to access the installed Panel Brick from the outside. This may include; installing caulking, cleaning bricks or repairing damages. Where possible, a boom lift or a crane box offer the largest amount of versatile access to the panel face.

Appendix
A

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Appendix A

The following appendix outlines the calculation methods for Panel Brick design capacities in a variety of applications.

Out-of-Plane Bending (Outwards)

Panel Dimensions					
Panel height	H	=	3000	mm	
Panel length	L	=	4550	mm	
Panel total thickness	t	=	125	mm	
Masonry Properties					
Masonry product type		=	Austral Dovetail unit		
Unit type		=	Clay		
Bedding type		=	Full		
Mortar type		=	M4		
Characteristic unconfined compressive strength	f'_{uc}	=	15	MPa	
Unit height	h_u	=	76	mm	
Unit facing thickness		=	25	mm	
Unit dovetail thickness		=	25	mm	
Unit total thickness		=	50	mm	
Mortar bed joint thickness	t_j	=	10	mm	
Joint thickness factor	k_h	=	1.00		
Compressive strength factor	k_m	=	2		
Characteristic compressive strength of masonry	f'_m	=	7.75	MPa	
Grout Properties					
Grout Density	y_g		2300	kg/m^3	
Characteristic 28 day compressive strength	f'_c	=	50	MPa	
Youngs modulus of concrete	E_c	=	33,539	MPa	§3.1.2 AS3600
Reinforcement Properties					
Reinforcement mesh		=	SL92		
Reinforcement yield stress	f_{sy}	=	500	MPa	
Youngs modulus of reinforcement	E_s	=	200,000	MPa	

Area of reinforcement	A_{st}	=	250	mm^2/m	
Cover to internal face	c_{int}	=	34	mm	
Effective depth to external face (vertical bars)	d_{ext}	=	79.5	mm	
Effective depth to internal face (vertical bars)	d_{int}	=	45.5	mm	
Ultimate Limit State Strength for In-Service Conditions					
Design Actions In service					
Axial load					
Permanent axial load	N_G	=	0.0	kN/m	
Permanent axial load factor		=	1.2		
Imposed axial load factor	N_Q	=	0.0	kN/m	
Imposed axial load		=	1.5		
Self-weight axial load	N_{sw}	=	8.83	kN/m	
Self-weight axial load factor		=	1.2		
Total factored axial load at mid height	N*	=	5.30	kN/m	
Total factored compression stress at mid height		=	0.04	MPa	
Total factored compression stress at mid height limit		=	$0.03f'_c$		
		=	0.96	MPa	
Is panel still suitable to be designed as a slab?		=	OK		§11.1 AS3600
Axial load eccentricity	e	=	0	mm	
Bending moment (at mid height) due to axial load eccentricity	M^*_{ecc}	=	0.00	kNm/m	
Wind load	w	=	1.5	kPa	
Wind load factor		=	1.0		
Factored out-of-plane wind load	w	=	1.50	kN/m	
Bending Moment (at mid height) due to out-of-plane wind load	M^*_w	=	1.69	kNm/m	
Earthquake					
Seismic force	F_i	=	$0.5W_i$		§8.2 AS1170.4
Seismic weight of component or structure	W_i	=	G + Q		§6.2.2 AS1170.4
Permanent action	G	=	39.2	kN	
Imposed action	Q	=	0.0	kN	
Seismic weight of component or structure	W_i	=	39.2	kN	
Seismic lateral force	F_i	=	19.6	kN	
Seismic out-of-plane pressure		=	1.44	kPa	
Load along top/bottom edge connections		=	3.2	kN/m	
Bending Moment (at mid height) due to out-of-plane seismic load	M^*_e	=	1.6	kNm/m	

Appendix A

Inwards Bending Capacity (reinforced masonry design)					§8.6 AS3700
Reinforced masonry bending capacity	M_d	≤	$ff_{sy}A_{sd}d[1-(0.6f_{sy}A_{sd})/(1.35f'_m bd)]$		
Capacity factor	ø	=	0.75		T4.1 AS3700
Area of tensile reinforcement for design	A_{sd}	=	lesser of $(0.29)1.3f'_m bd/f_{sy}$ & A_{st}		
	A_{sd}	=	315	mm^2/m	§8.6 AS3700
Inwards bending capacity	M_d	=	8.32	kNm/m	
Inwards vert. bending moment capacity vs action	M_d	>	$M^*_{ecc} + M^*_w$ & $M^*_{ecc} + M^*_{eq}$ OK		
Outwards Bending Capacity (reinforced concrete design)					
Design of reinforced concrete members for bending					
Reinforcement ratio when section is balanced	p_B	=	$a_2 g(f'_c/f_{sy})[600/(600+f_{sy})]$		
Compression strength factor	a_2	=	0.775		§8.1.3 AS3600
Compressive stress block factor	y	=	0.845		§8.1.3 AS3600
	p_B	=	0.0357		
Additional reinforcement	A_{st+}	=	0.000	mm^2/m	
Tensile reinforcement ratio of section	p_t	=	0.0069		
Section type		=			
Moment capacity for under reinforced section	$øM_u$	=	$øA_{st}f_{sy}d[1-(0.6A_{st}f_{sy})/(bdf'_c)]$		
Bending moment capacity reduction factor	ø	=	0.65		T2.2.2 AS3600
	$øM_u$	=	4.46	kNm/m	
Moment Magnification					
Modular ratio (Es/Ec)	n	=	E_s/E_c		
		=	5.96		
Effective steel area	A'_{st}	=	$(N^* + A_{st}f_{sy})/f_{sy}$		
		=	325.2	mm^2	
Modular ratio x % steel	np'	=	nA'_{st}/bd		
		=	0.043		
Depth of triangular stress block	k'd	=	$[\sqrt{(np'2+2np')} - np']d$		
		=	11.5	mm	
Cracked moment of inertia	I_{cr}	=	$A'_{st}n(d-k'd)^2 + b(k'd)^3/3$		
		=	2,748,414.6	mm^4	
Bending stiffness	k_{bf}	=	$48E_cI_{cr}/5H^2$		
		=	98,323.2		
Bending moment magnification factor	δ_b	=	$1/(1-N^*/k_{bf})$		
		=	1.1		

Magnified moment	M^*_{max}	=	$\delta_b[\max(M^*_{ecc} + M^*_w, M^*_{ecc} + M^*_{eq})]$		
		=	1.8	kNm/m	
Outwards vert. bending moment capacity vs action	$øM_u$	>	M^*_{max} OK		

Out-of-Plane Bending (Inwards)

Using the same panel dimensions and parameter as above for outwards bending, the inwards out-of-plane bending can be calculated as below.

Inwards Bending Capacity (reinforced masonry design)					§8.6 AS3700
Reinforced masonry bending capacity	M_d	≤	$øf_{sy}A_{sd}d[1-(0.6f_{sy}A_{sd})/(1.35f'_m bd)]$		
Capacity factor	ø	=	0.75		T4.1 AS3700
Area of tensile reinforcement for design	A_{sd}	=	lesser of $(0.29)1.3f'_m bd/f_{sy}$ & A_{st}		
	A_{sd}	=	315	mm²/m	§8.6 AS3700
Inwards bending capacity	M_d	=	8.32	kNm/m	
Inwards vert. bending moment capacity vs action	M_d	>	$M^*_{ecc} + M^*_w$ & $M^*_{ecc} + M^*_{eq}$ OK		

Lintel Beam In-Plane Bending and Shear

Panel dimensions					
Lintel height	D	=	334	mm	
Lintel span	L	=	2400	mm	
Panel total thickness	t	=	125	mm	
Masonry Properties					
Masonry product type		=	Austral Dovetail unit		
Characteristic unconfined compressive strength	f'_{uc}	=	15	MPa	
Unit height	h_u	=	76	mm	
Unit facing thickness		=	25	mm	
Unit dovetail thickness		=	25	mm	
Unit total thickness		=	50	mm	
Durability					
Internal concrete face exposure classification		=	B1		
Minimum concrete strength		=	32	MPa	T4.10.3.3 AS3600
Minimum cover	$c_{int.min}$	=	30	mm	T4.10.3.3 AS3600
Grout Properties					
Grout Density	y_g	=	2300	kg/m³	
Characteristic compressive strength	f'_c	=	50	MPa	

Appendix A

Lintel Beam Reinforcement Properties					
Bottom reinforcement bar diameter size		=	12		
Number of reinforcement bars		=	2		
Internal face reinforcement yield stress	f_{sy}	=	500	MPa	
Internal face area of reinforcement	A_{st}	=	226	mm^2	
Bottom cover	c	=	30	mm	
Min. cover requirement check	c_{check}	=	OK		
Effective depth of lintel	d	=	298.0	mm	
Strength In-Service					
Beam Bending Capacity					
Reinforcement ratio when section is balanced	p_B	=	$\alpha_2 y(f'_c/f_{sy})[600/(600+f_{sy})]$		
Compressive strength reduction factor	α_2	=	0.775		§8.1.3 AS3600
Compressive stress block depth reduction factor	y	=	0.845		§8.1.3 AS3600
Reinforcement ratio when section is balanced	p_B	=	0.0357		
Tensile reinforcement ratio of section	p_t	=	0.0074		
Section type		=	Under reinforced		
Moment capacity for under reinforced section	$øM_u$	=	$øA_{st}f_{sy}d[1-(A_{st}f_{sy})/(2a_2bdf'_c)]$		
Bending moment capacity reduction factor	ø	=	0.65		T2.2.2 AS3600
	$øM_u$	=	20.48	kNm	
Beam Shear Capacity					
Beam shear strength due to concrete only	V_{uc}	=	$k_v b_v d_v (f'_c)^{0.5}$		
Effective shear depth	d_v	=	268.2	mm	
Shear factor	k_v	=	0.1		
Effective web width	b_v	=	75.0	mm	
Beam shear strength due to concrete only	V_{uc}	=	14.2	kN	
Capacity reduction factor for beam shear	ø	=	0.7		T2.2.2 AS3600
Beam shear capacity due to concrete only	$ø V_{uc}$	=	10.0	kN	

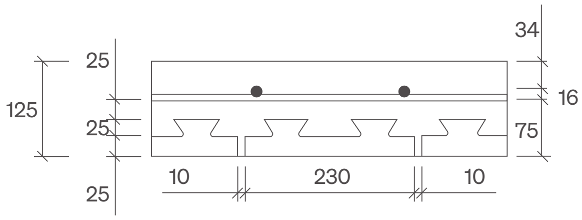
Compression

Panel dimensions					
Panel height	H	=	3000	mm	
Panel total thickness	t	=	150	mm	
Masonry Properties					
Masonry product type		=	Austral Dovetail unit		
Grout Properties					
Characteristic compressive strength	f'_c	=	50	MPa	
Effective Height					
Thickness of wall for compression capacity	t_w	=	100	mm	
Support conditions of wall		=	Laterally supported both sides and top		
Buckling mode		=	Two-way buckling		
Horizontal distance between intersecting support walls	L_1	=	6000	mm	
Vertical distance between lateral support	H_w	=	3000	mm	
Effective height factor	k	=	0.8	mm	§11.4 AS3600
Effective height	H_{we}	=	2400	mm	§11.4 AS3600
Ratio of effective height to wall thickness		=	24 (>20 but <30 so must be doubly reinforced)		
Ultimate Limit State Compression Capacity (Simplified method)					
Ultimate axial compression strength	$øN_u$	≤	$f (t_w - 1.2e - 2e_a)0.6f'_c$		§11.5.3 AS3600
Capacity factor	ø	=	0.65		T2.2.2 AS3600
Type of floor supported by panel		=	Discontinuous floor		
Eccentricity of load	e	=	33	mm	
Additional eccentricity	e_a	=	23	mm	
Ultimate axial compression strength	$øN_u$	=	417.6	kN/m	

Appendix A

Durability

25mm panel with dovetail units



Site location from surf coast	500 m	5 km
External face		
AS 3700 exposure environment	Severe marine	Marine
Cover required (T5.1 AS3700)	25 mm	15 mm
Cover provided	25 mm	25 mm
Is cover sufficient?	Yes	Yes
Internal face (assuming it's a drained cavity)		
AS 3600 exposure environment	B2	B1
Characteristic concrete strength	50 MPa	50 MPa
Cover required (T4.10.3.3 AS3600)	25 mm	20 mm
Cover provided	34 mm	34 mm
Is cover sufficient?	Yes	Yes

Backed by Brickworks

Local expertise. Global quality. Brickworks Building Products is one of Australia's biggest building material producers. With heritage going all the way back to one of Australia's founding brick producers, we're proud of our reputation for design, innovation and sustainability.

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NORTH AMERICA

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