

DINCEL-WALL

WATERPROOFING

WARRANTY

EXPLAINED

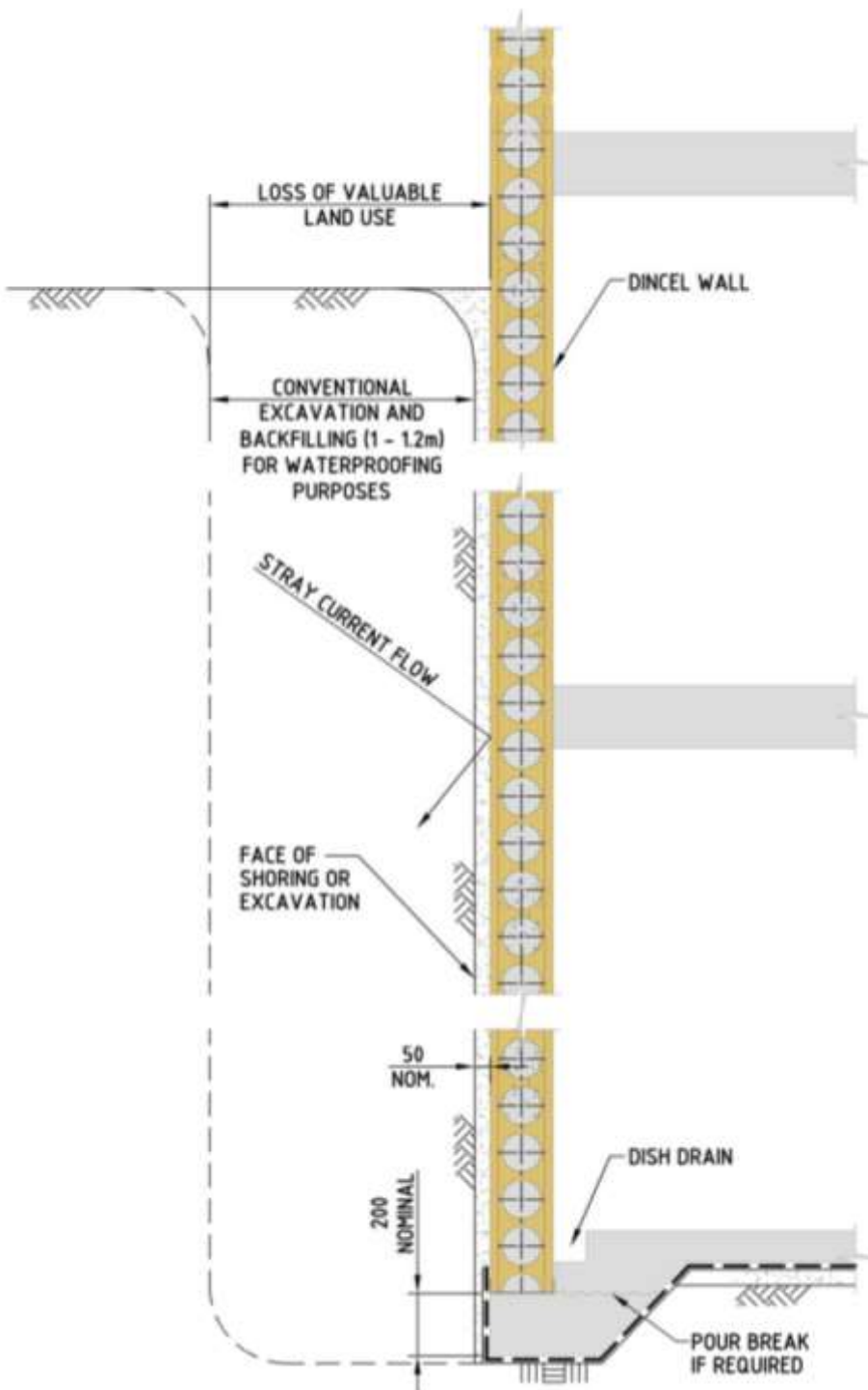
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DINCEL WALL BENEFITS



DINCEL-WALL ELIMINATES:

- Loss of valuable land use
- Waterproofing need for the wall
- Stray Current Corrosion damage
- Excavation behind the wall
- Backfilling the excavation
- Wall joints
- Agricultural lines
- Conventional footings
- Horizontal wall reinforcement
- Scaffolding
- Painting of the internal wall face
- Cleaning costs
- Wastage
- Builder's Liability for wall cracking, water damages

DINCEL-WALL ALLOWS:

- Habitable spaces in basements
- Minimum 100 years wall life
- Stronger structural walls in comparison to reinforced masonry walls
- Fastest wall construction

BASEMENT WALLS

FIGURE 1

INTRODUCTION

Waterproofing and its related damages is the most complex and biggest problem of the construction industry.

This document addresses the question of WHAT DINCEL-WALL WATERPROOFING WARRANTY IS.

Dincel polymer tested by CSIRO-Australia shows that the Dincel polymer material has 180 times less vapour transmission rates than the threshold for conventional membrane systems. Dincel Forms achieve waterproofing by encapsulating the concrete infill. The patented snapping joints of concrete filled Dincel Wall under 6 metre head of water pressure tested by CSIRO, Australia and the concrete filled Dincel Wall panel are confirmed as waterproof ([download – Waterproof Walls](#)).

There is no waterproofing testing conducted by CSIRO between Dincel Wall and the connecting footing/slab junction. Therefore, the joint between Dincel Wall and the footing/slab is required to be made watertight or waterproof by the customer and their building professionals depending on the project specific conditions.

This document analyses the risks, reasons and how to achieve a liability free Dincel Solution on behalf of all parties in the construction industry. It is important to understand the underlying principles to appreciate the superiority that Dincel Solution offers. It is therefore important to read the entirety of this document.

DINCEL INSTALLATION PTY LTD OFFERS A WATERPROOF WARRANTY WHEN 275 DINCEL IS DESIGNED AND INSTALLED BY DINCEL INSTALLATION PTY LTD.

DOES WATERPROOFING WARRANTY EXIST WITH CONVENTIONAL CONCRETE/BLOCK WALLS?

It will be very beneficial to review any warranty offered by waterproofing companies and to realise who becomes responsible for the waterproofing warranty; god, material supplier, waterproofing material specifier, builder, or a variety of contractors. This is why WARRANTIES associated with applied waterproof membranes do not offer protection to the building owner.

A warranty for waterproofing is often asked for by the building owner. The product manufacturers for conventional membrane systems offer waterproofing warranty conditions which are highly conditional to workmanship and acts of god. The warranties to the building owner do not offer any realistic protection because it is impossible to clearly determine the reason for waterproofing failure which may relate to any of the following:

- (i) Selection of membrane type and manufacturing fault in the selected material.
- (ii) Workmanship fault for membrane application, including the base strata surface preparation where the membrane is applied.
- (iii) Material and workmanship fault for the backfilling applications (i.e. basement walls).
- (iv) Building movements damaging applied membranes and service penetrations. Building movements occur due to: foundation/structure settlements, ground moisture changes, shrinkage and temperature movement or act of god.
- (v) Condensation related water accumulation.

In addition to the above, the following imposed conditions by warranties deter many waterproofing claims:

- A sign of any building movement including joints and crackings (in which majority of them may be unavoidable).
- Should the waterproofing membrane be concealed, the cost of exposure of the waterproofing membrane for purposes of investigation and/or repair, such as the removal and replacement of any concrete, paving, or backfill overburden shall be the owner's responsibility.

The following is a highly technical topic which should be discussed with professional engineers skilled in waterproofing science.

HOW TO ACHIEVE WATERPROOFING IN WATER RETAINING STRUCTURES MADE WITH CONVENTIONAL CONCRETE WALLS

To appreciate the waterproofing of Dintel Walls, it is important to understand that the vast majority of conventional water retaining structures, which are most susceptible to water leakage over the last 80 years, have been constructed out of conventional reinforced concrete. It is also important to understand the fundamental principles of how these structures work.

Conventional in-situ concrete walls of water retaining tanks consist of a significant quantity of steel reinforcement designed by engineers. The fundamental of this engineered design is to maintain crack widths of 0.1mm for waterproofing purposes. Cracks are unavoidable in reinforced concrete walls during the initial drying period (i.e. plastic shrinkage cracking). The presence of steel has no contribution because the concrete has not bonded to the steel reinforcement at this stage. Following the development of concrete's bond strength, steel bars start to contribute to the concrete's drying stresses and resist concrete's crack openings further. Cracks maintained at 0.1mm width get filled with a by-product of cement hydration in time. The lime of cement and CO₂ react to develop carbonation, in other words autogenous healing (refer photo below). This process fills the small crack widths and eventually water does not leak. The smaller the crack widths, the quicker the healing process.

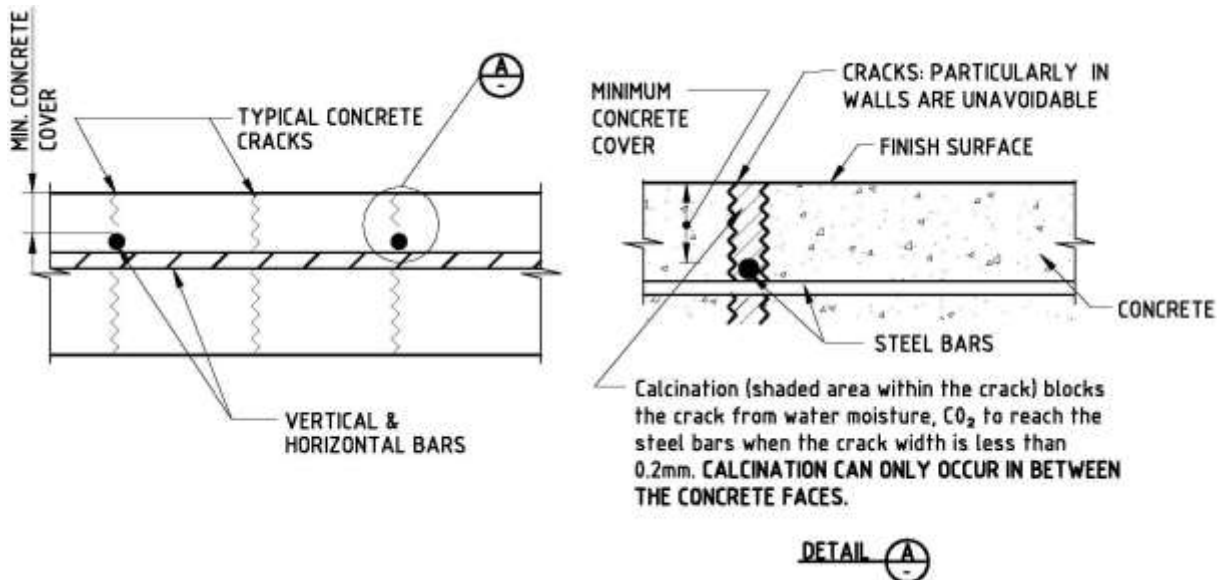


Photo showing cracked and leaking concrete water tank



Photo showing carbonation at leaking concrete wall joint

The water retaining concrete walls avoid joints for the purpose of waterproofing; hence they are heavily reinforced to control crack widths. However, water can penetrate through the wall until the cracks are sealed by the autogenous healing process. This process could continue for about 2 to 3 months, depending on the crack widths. The migration of water and vapour transmission through the cracks and the porous nature of concrete creates steel corrosion problems unless adequate concrete density with appropriate concrete cover to the reinforcement is provided. Otherwise there is no need to apply a waterproof membrane even if there is water presence as the cracks sealed by carbonation would be adequate for the life of the concrete.



Concrete cracking is unavoidable; if the crack width is less than the AS3600 allowance they are self-healed (i.e. crack is closed) because of autogenous healing (i.e. deposition of calcium carbonate). This way, corrosion of the steel and deterioration of the concrete due to environmental attacks are avoided. AS3600 – 2009, Clause 4.10.3.7 require minimum concrete cover. Membranes are not a replacement for concrete cover.

CONVENTIONAL REINFORCED CONCRETE WITH REMOVABLE FORMWORK

In non-water retaining concrete walls, the principle is to provide joints at about 6m to 8m centres. Concrete is nominally reinforced in between the joints to control the crack widths following the plastic shrinkage state which diminishes with the development of the concrete's bond strength.

As explained very simply above, the principle is to ensure that unavoidable crack widths in water retaining reinforced concrete walls do not exceed engineering standards (i.e. 0.1mm) so that the autogenous healing process can take place and prevent water leakage. **Alternatively, to the membrane, concrete cover to the reinforcement of concrete walls can be increased and denser concrete can be used to reduce the risk of corrosion. This option, without a membrane, significantly increases costs and time of construction relevant to the wall itself. However, if the ground conditions or the tank containing water consists of salts and chemicals, there is no viable solution without considering installation of membrane systems.**

It is obvious to the professionals that masonry reinforced block walls, due to their porous nature, cannot be used in contact with ground/moisture/water in the absence of waterproof membrane systems since their structural life is seriously jeopardised.

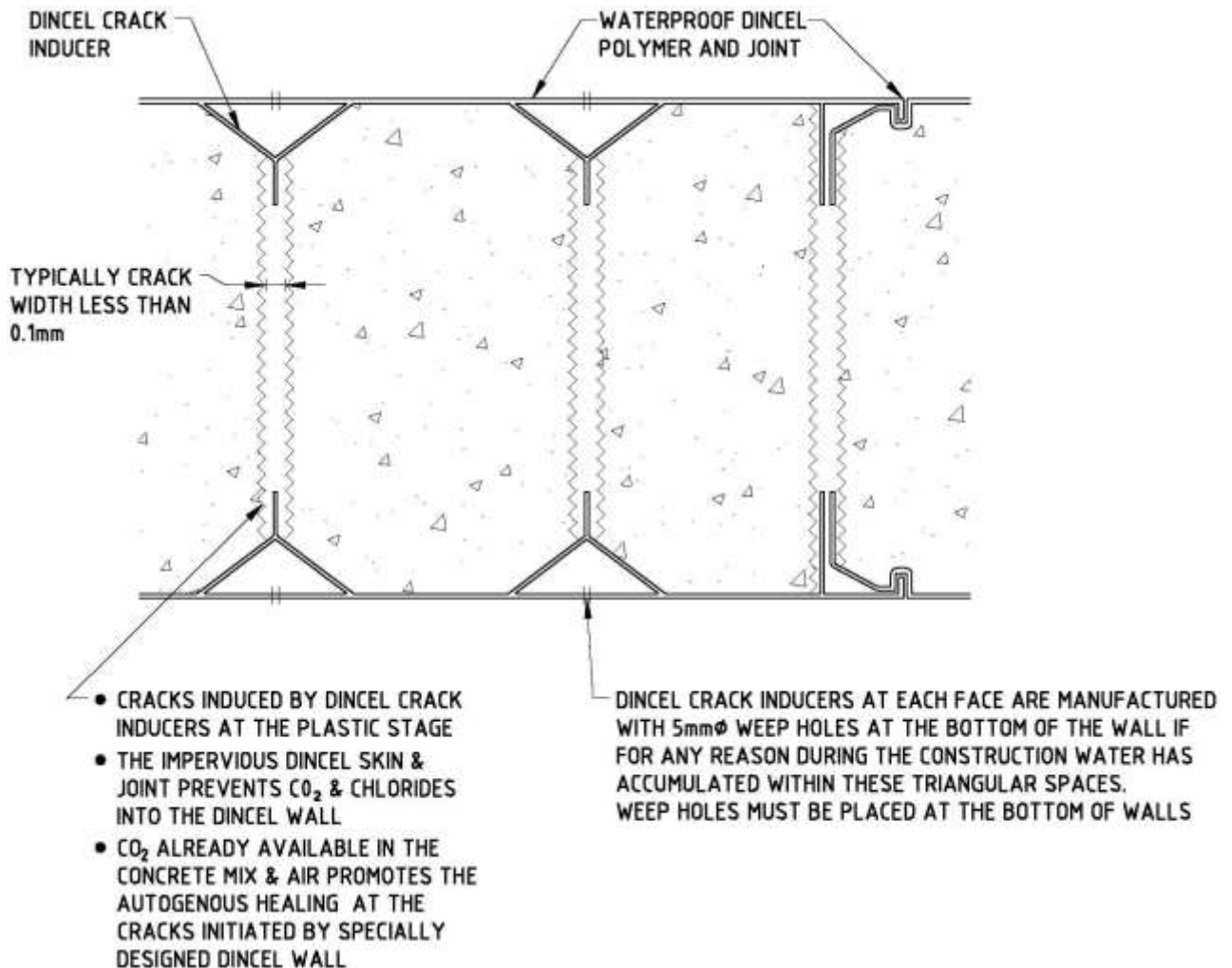
It is important to understand the reason why the industry uses a waterproof membrane. One reason is to protect the life of the structure but the other reasons are for aesthetics/marketability/avoid vapour transmission that leads to mould, mildew development/healthy air and protection against stored goods.

THE DIFFERENCE BETWEEN DINCEL AND AN APPLIED WATERPROOF MEMBRANE

Dintel Walls benefit basement construction as previously explained in this document. These benefits are generally applicable to all other usages other than basement walls.

The fundamental difference between Dintel and an applied membrane is that if an applied membrane system leaks, the water could be coming from anywhere and not necessarily at the point of leakage. This is usually discovered when it is too late and after significant damage to the wall has occurred where the membrane is supposed to be protecting the structural integrity of the wall. All it takes is a small hole (either by an act of nature or workmanship fault) in the applied membrane for water penetration where water can travel a very long distance until it finds a weak point in the wall itself to penetrate and leak. This is why it is extremely difficult to find the source of a leak in conventional walls with membrane systems.

The above is quite the opposite in the case of Dintel. If the Dintel panel leaks, and it is visible where the leakage is, the remedial work can be applied immediately at that location unlike the conventional applied membrane which requires substantial investigation to find out where the leakage is. The leakage at the Dintel panel joints can only occur under hydrostatic water pressure if both faces of the Dintel forms are damaged simultaneously (this will be clearly obvious at least on one face of the Dintel Panel) and cracking in the concrete infill exceeding 0.1mm has occurred through the entire cross section. (The Dintel Wall crack inducers ensure that crack widths of less than 0.1mm occur along the entire length of the wall and not only the damaged area). The other important point to consider, even if the Dintel Panel leaks, is that steel corrosion and subsequent structural damage cannot occur since Dintel Walls do not need horizontal reinforcement for crack control purposes which ordinarily would pass across the Dintel panel joints.



In the case of the applied waterproof membrane on a basement perimeter wall, it will be extremely difficult to implement warranty conditions as it will be nearly impossible to identify which party is responsible for the cause of the leakage as explained previously.

WHY DINCEL IS WATERPROOF

DinCEL Wall, which is a permanent polymer formwork, holds the wet concrete in place.

Tests with CSIRO, Australia revealed ([Download – CSIRO Test Report No: 5091](#))

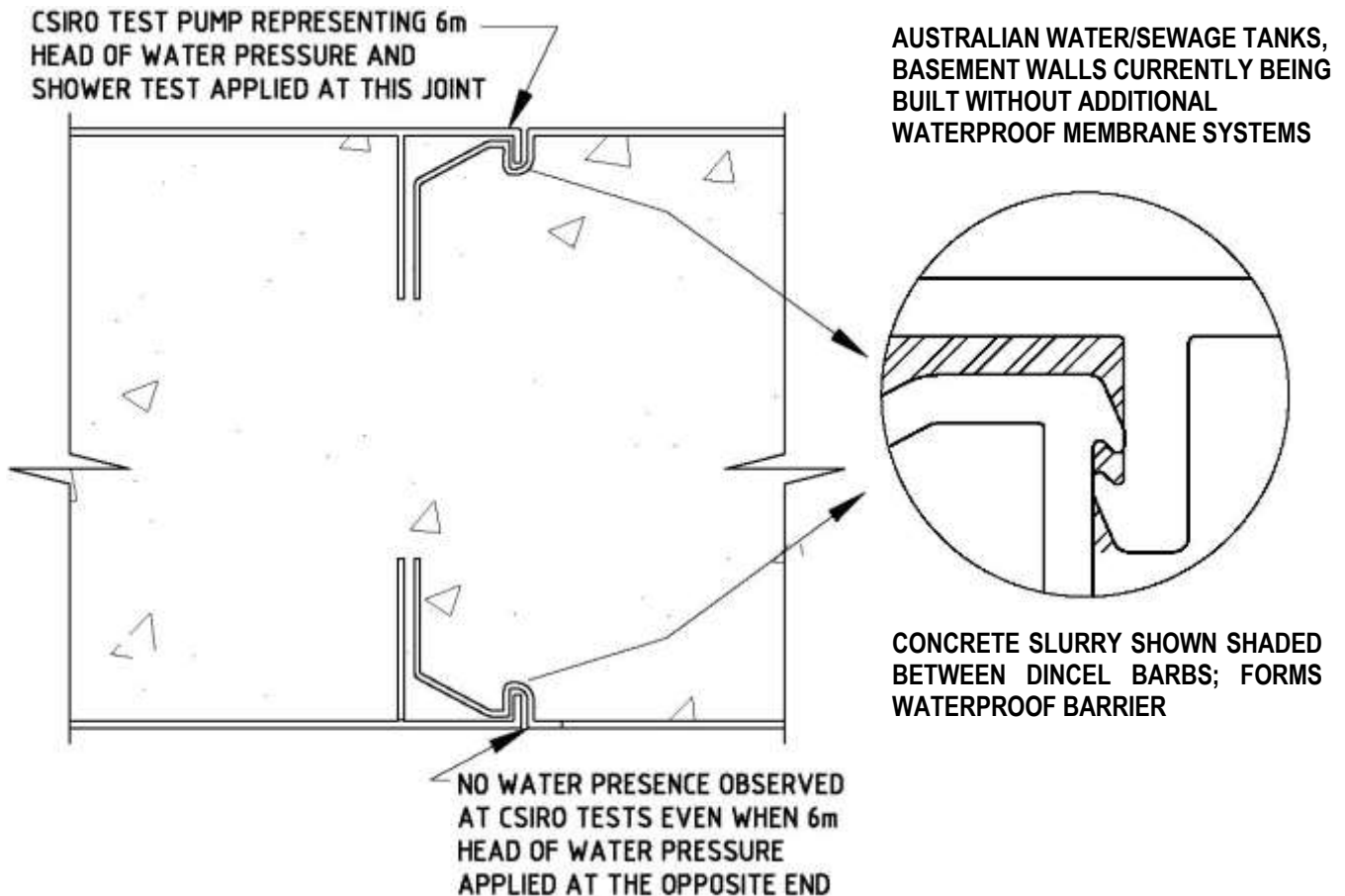
- (i) The DinCEL polymer itself has a vapour transmission rate that is 180 times better than the standard for the conventional applied membrane system.
- (ii) The DinCEL panel joints have been tested under 6m of water head pressure; hence it is waterproof.

The patented DinCEL panel joints have a special shape and incorporate special barbs which are shown in the following diagrammatic detail. The DinCEL panel joints at both faces form very tight joints when they snap connect to each other. The joints' tightness is further increased when the panel receives concrete infill. The concrete slurry consists of cement and water which further seals the snapped joints. In addition to all these, autogenous healing of the concrete slurry also occurs at the snapped joints where the barbs are located. As a result, an impregnable DinCEL Wall is achieved as proven by the testing carried out by CSIRO, Australia.

(Download) Waterproof Walls and refer to the photo on page B4 of 4 of the CSIRO test report. The photo shows that the concrete slurry has not fully filled the triangular form at the snapping DinCEL joint. Refer above photo. The voids can form depending on the concrete slump and the use of vibrators. **The CSIRO test program comprised shower testing (simulating high quantity of water with spraying, i.e. wind conditions) and also sustained high pressure testing by providing a pump attached to the DinCEL joint providing 6m head of water pressure. No water presence was observed by CSIRO on the opposite face of DinCEL.** This can be explained as no water passing through the patented DinCEL joints (acts like clutches of sheet piling) or some amount of water penetrating into the concrete through the DinCEL panel joints, water dissipates in the vertical drain established at the back of the snapping joint and/or water if passes the joint and vertical drainage hole dissipates within the concrete body itself or captured by the vertical drain hole on the opposite face subject to testing. **Hence, even under 6m head of water pressure, because of any possible combination of above, CSIRO testing observed no water at all on the opposite face of the wall where the test pump was attached.** Refer following diagram.

CSIRO TEST UNDER 6M HEAD OF WATER PRESSURE AT DINCEL PANEL

JOINTS CONFIRMED WATERPROOFING



DINCEL-WALL CROSS-SECTION – CSIRO TEST PANEL

The concreting for the CSIRO tests were organised and installed by CSIRO themselves, not by DCS. A small amount of the concrete's water could be seen at the Dincel joints at the time of concrete pouring. The concrete slurry at the Dincel joints further seals the connection similar to providing a silicon application at the joint because of the cement's presence and due to the concrete's calcination process, further seals the joint.

Based on the CSIRO test, the Dincel Wall panel can perform as a waterproof wall provided that the walls are installed and concreted in accordance with the Dincel Construction Manual.

CSIRO tests have used 110mm – 120mm concrete slump with 200mm thick Dincel profile. Dincel recommends adopting 150mm +/- 20mm slump to encourage the cement slurry to seep through the panel joints at the time of the concrete pour. Minimum 180mm slump concrete is recommended with the 275 Dincel.

DINCEL ENSURES THAT SMALLER CRACK WIDTHS OCCUR AS REQUIRED BY CONVENTIONAL WATER RETAINING STRUCTURES

The photo below shows improved concrete quality due to extended concrete hydration offered by Dincel and actual concrete formation at the panel joint.



Dincel form is manufactured with multiple chambers in between the webs joining each face of Dincel-Form. The webs holding each Dincel form face together work as crack inducers as shown in the photo below.



DINCEL CRACK INDUCER

200 DINCEL WALL



275 DINCEL CONCRETE FILLED AND CORED



275 DINCEL WALL

Any engineer can calculate that a maximum concrete crack width would be 0.01mm if the distance between joints is 125mm (maximum distance between Dincel's crack inducer is 125mm) even if they adopt the ambient temperature variation of 40° by using AS3600 Australian Concrete Structures Code (AS3600 is virtually identical to the American and British Concrete Structures Code). Alternatively, engineers can refer to Dincel's Structural Engineering Design Manual (which has been certified by the University of New South Wales) which shows that the conservative crack width at each Dincel crack inducer is 0.01mm.

This value of 0.01mm is less than the 0.1mm crack width allowed in water retaining reinforced concrete structures. Therefore, autogenous healing with Dincel occurs much quicker than the conventional reinforced concrete structures. The other obvious issue is that the joints provided by crack inducers do not need any crack control reinforcement at all ([Download – Why Engineers Can Omit Crack Control Steel in Dincel Wall](#)) for a detailed explanation. Dincel Wall will require vertical reinforcement for flexural purposes to resist stresses due to earth/water pressure of a basement or water tank wall. However, this does not necessitate the need for horizontal reinforcement which is normally used for crack control but not flexural purposes.

THERE IS NO POTENTIAL FOR STEEL CORROSION WITH DINCEL

The absence of horizontal reinforcement within Dincel Wall eliminates the risk of steel corrosion and the need for waterproofing protection for the **steel reinforcement across the Dincel panel joints** if perceived to allow water leakage in the presence of hydrostatic pressure. (It is assumed that where the wall joins the slab/footing, vertical bars are protected by appropriate waterproofing measures, e.g. water-stops).

As previously stated, Dincel panel joints have been tested at 6-meter head of water pressure by CSIRO Australia and established that **Dincel joints do not leak**.

IS IT POSSIBLE FOR DINCEL PANEL JOINTS TO LEAK?

The answer is “NO” in accordance with CSIRO tests at the Dincel panel joints. However, the wall-footing junction must receive waterproofing detailing as required by the project's engineer.

Two cases to consider for Dincel Wall concrete filled panels only:

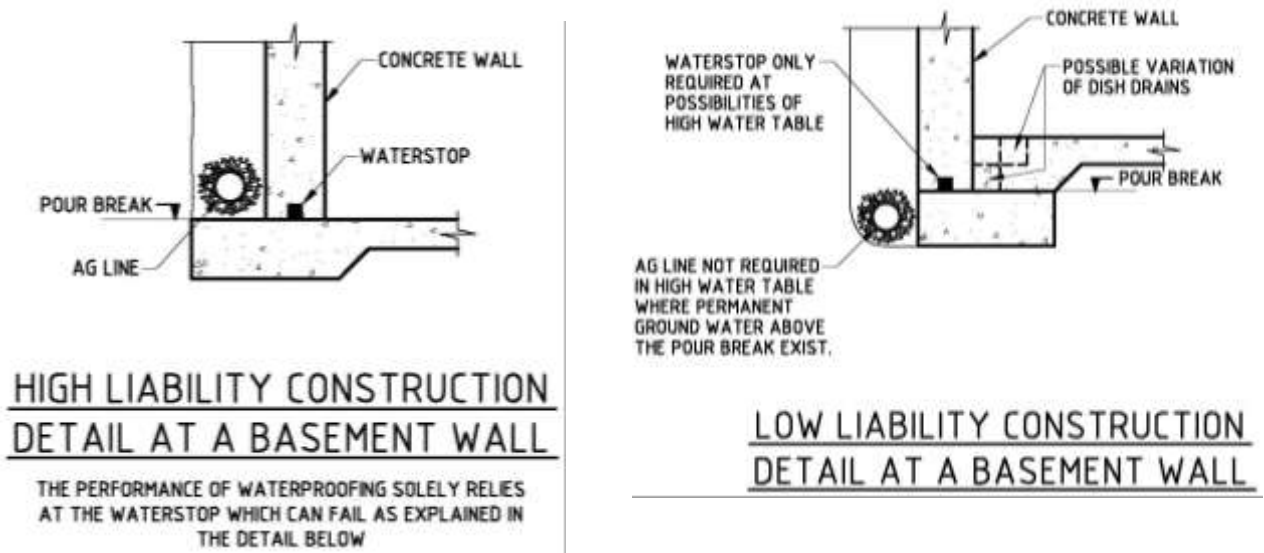
- **Definitely NO in the case of non-permanent water presence.** All building façade walls and most of the basement walls above the permanent water table fall into this category (i.e. no hydrostatic water pressure at the panel joints). As explained above, the reason for this is that Dincel crack inducers form crack widths of a maximum of 0.01mm which will be adequate to satisfy the waterproofing conditions together with the autogenous healing process. **The 200 Dincel profile (or even the 155 Dincel profile) would be adequate for this use.**
- **The second case is the presence of high water table behind basement walls or water tanks (i.e. panel joints subject to hydrostatic water pressure).** For Dincel waterproofing in between the panel joints not to be working, both faces of Dincel panels have to be damaged simultaneously. In fact, the male tongue incorporating a barb must be damaged to the extent where the snap connection is no longer waterproof. It must be appreciated that the above occurrence to the snap connection in both faces simultaneously is an extremely remote chance. However, if this occurs the damage will be visible to the naked eye and hence easily repairable. As explained before, the source of leakage in a conventional damaged membrane system is nearly impossible to find and to attend to the problem. **Dincel recommends using the newly developed 275 Dincel for basement walls subject to hydrostatic pressure (i.e. permanent water table is above the footing level).**

Water leakage at snapped joints or corner joints (if constructed in accordance with [download – Basement Construction](#)) will be eliminated if good workmanship requirements as outlined in Dincel Construction's Manual are adopted.

LIABILITY FREE BASEMENT WATERPROOF WALL

The most practical approach with Dincel, without expecting or relying on an act of god, material or workmanship standards is to adopt a dish drain at the bottom of a basement wall ([download – Basement Construction](#)) to see recommended details). If any leakage for any reason occurs, which will be absolutely minimum, the leakage can be collected at the dish drain. Common sense also suggests that this is a liability free approach for the following reasons:

1. The end user understands the fact that a 100% warranty cannot be achieved because of the previously explained reasons.
2. Complete waterproofing of a basement wall requires installed Dincel Wall which is waterproof and the junction of Dincel – footing/slab is waterproofed as well. The waterproofing at this junction can only be achieved with the use of non-Dincel waterproofing system as shown in Dincel's Construction Manual. Again, even at this joint anything could go wrong. The following detail below explains the possible problems at water-stop. This is why the dish drain option at the bottom of the wall represents the ultimate last defence against all possibilities including the non-Dincel related ones. ([download – Basement Construction](#)) to see recommended details).

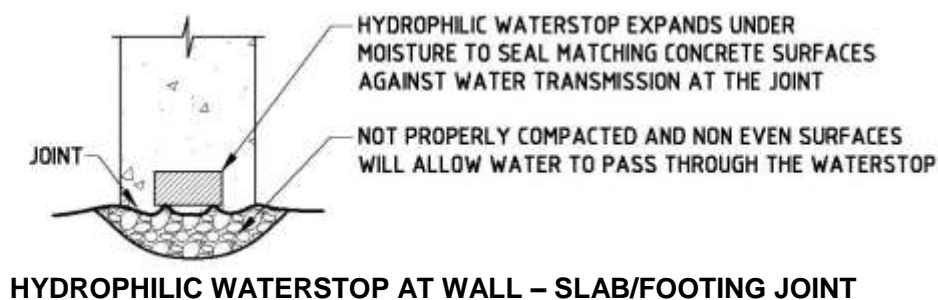


Why water-stop can fail / How the impact of this possible failure is managed

The recommended engineering detail for the project may incorporate a hydrophilic water-stop at the bottom of the walls where the possibility of a high water table exists.

The high ground water table possibilities may occur in the following conditions:

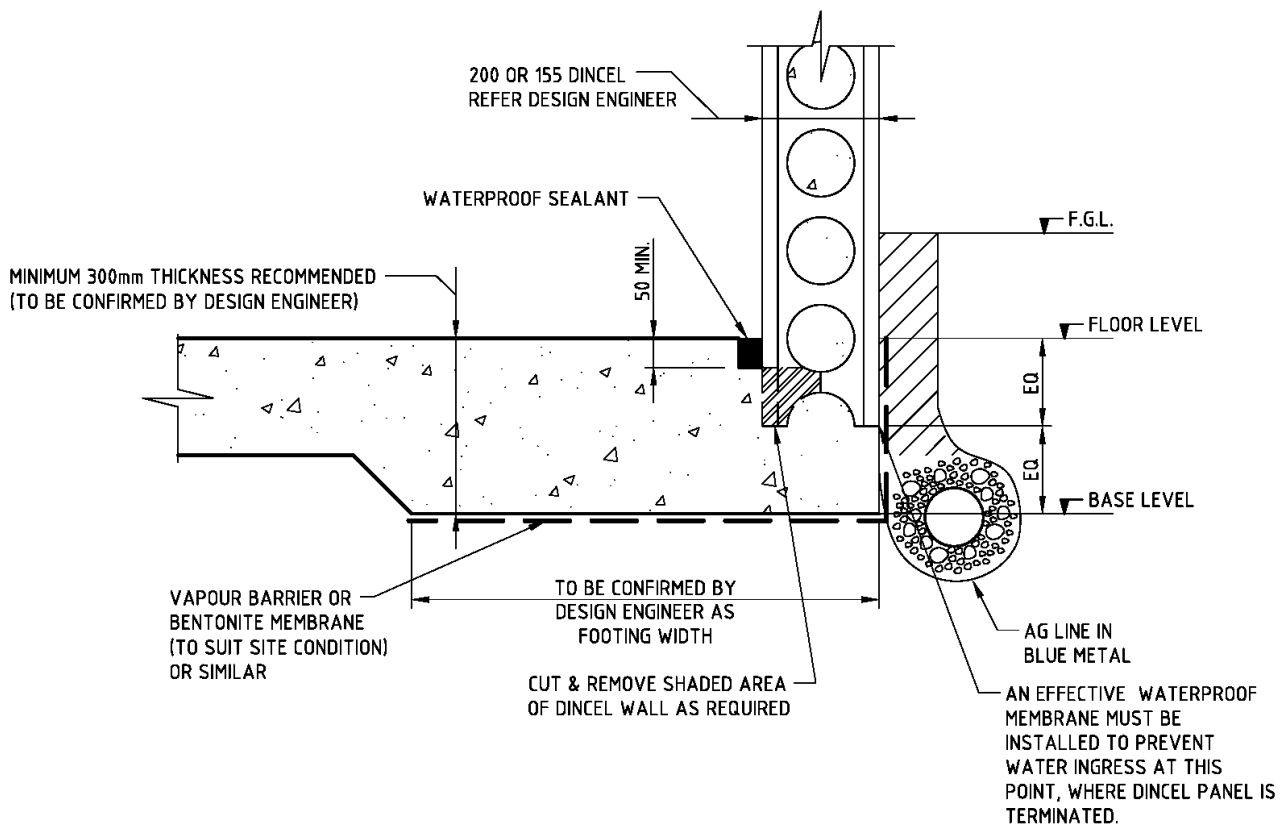
- Permanent ground water position being above the wall/slab pour break.
- Seasonal and tidal fluctuations pushing ground water level above the wall/slab pour break.
- Blocked agricultural lines.
- Positioning of the agricultural line above the wall/slab pour break.



The uneven and improperly finished surfaces are the reasons why a hydrophilic water-stop cannot function properly. **This is the main reason why Dincel recommends a dish drain at the bottom of the walls to compensate for the workmanship related faults at the water-stop.**

The hydrophilic water-stops cannot be left exposed to the weather for extended periods of time, i.e. wet weather days, submerged site conditions. Concreting over the hydrophilic water-stop should take place as soon as possible; otherwise it will dry, crack and lose its functionality. If this becomes an issue the water-stop can then be eliminated by pouring Dincel-Wall and the base slab together. **Figure No: 2 below shows a monolithic joint without a pour break,** hence without a water-stop. It must be noted that the waterproofing performance of the wall/slab intersection will be subjected to workmanship skills of the concreter. A good vibration (with denser concrete use, especially in basement conditions) and good concrete slab curing practice (e.g. flooding the slab) at the wall/slab junction is required.

The designers must note that pouring a monolithic wall/slab junction is the reason for restrained shrinkage or tensioned floor slab which may result in the concrete cracking at the junction which may also compromise waterproofing, especially for conditions below the permanent water table (refer above definition for high ground water possibilities).



MONOLITHIC FOOTING / DINCEL WALL DETAIL

- THE ABOVE DETAIL IS NOT SUITABLE IF THE FLOOR SLAB IS BELOW THE PERMANENT WATER TABLE
- INTERNAL DISH DRAINS ARE RECOMMENDED IF AG LINES CANNOT BE RELIED UPON FOR UNUSUAL STORMWATER SURCHARGE OR PERMANENT/TEMPORARY WATER TABLE CONDITIONS. REFER TO DETAIL J/2
- THE WALL & SLAB SHOULD BE DESIGNED FOR HYDROSTATIC PRESSURE IN THE ABSENCE OF WATER PRESSURE RELEASE SUCH AS AG LINES OR NATURAL DRAINAGE
- IT IS THE DESIGN ENGINEERS RESPONSIBILITY TO DESIGN/WATERPROOF THE FLOOR SLAB

FIGURE 2

DINCEL RECOMMENDS THE USE OF FIGURE NO: 5's INJECTION TYPE OF WATERSTOP FOR THE REASONS EXPLAINED ABOVE.

HOW TO DEAL WITH WATERPROOFING AT THE JOINT BETWEEN DINCEL WALL AND FOOTING/SLAB?

Dinzel Construction System Pty Ltd (DCS) as a manufacturer, states that Dinzel Wall itself shall be waterproof provided that:

- Dinzel is not damaged, bulged, modified, bridged or otherwise interfered with by any person or any act, matter or thing beyond the reasonable control of DCS.
- DCS shall not accept any responsibility for waterproofing around the vicinity of the service penetrations and wall – floor/footing junctions.

The recommendations of this article and Dinzel's Construction Manual are generic; not project specific details. The "project specific" detailings are the responsibility of the project's design engineers.

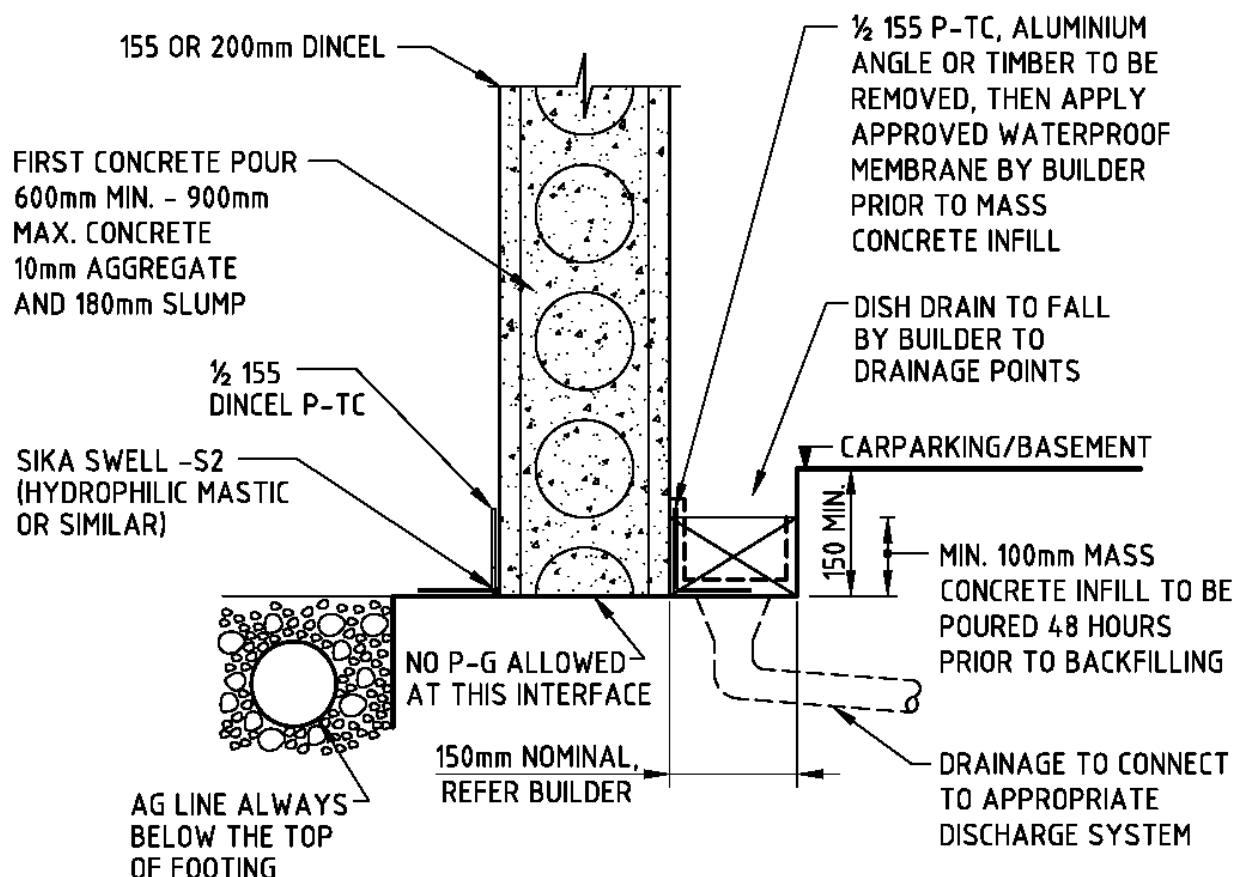
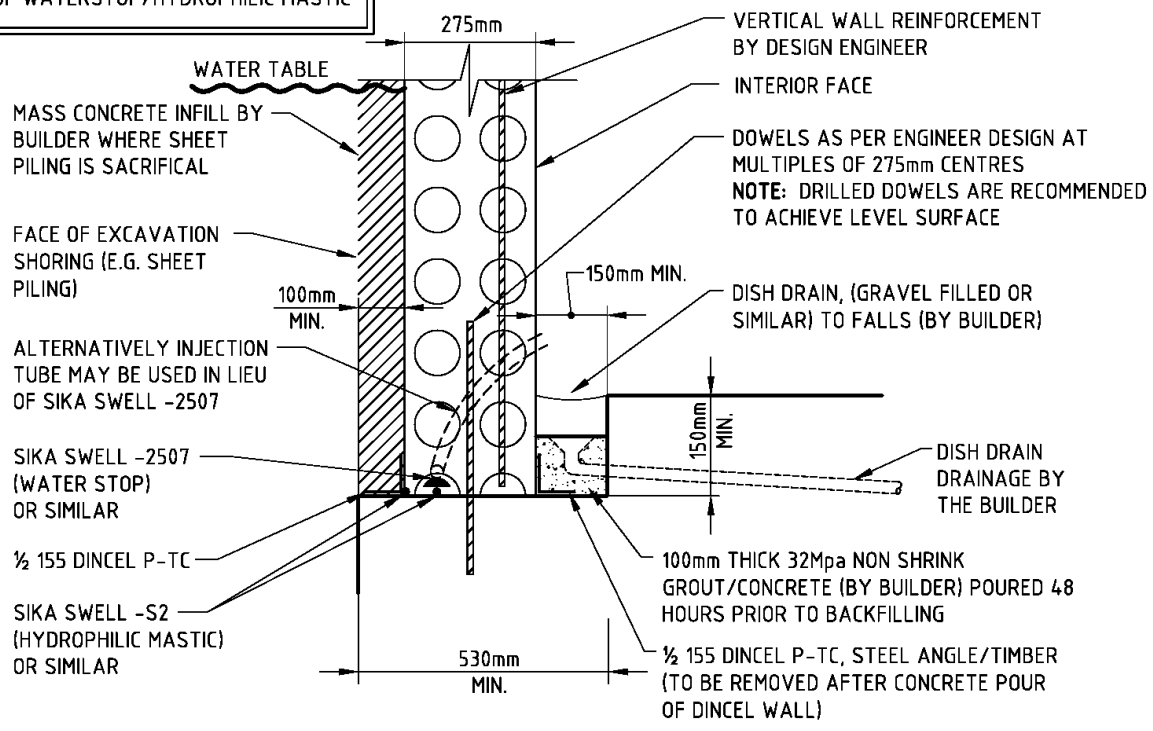


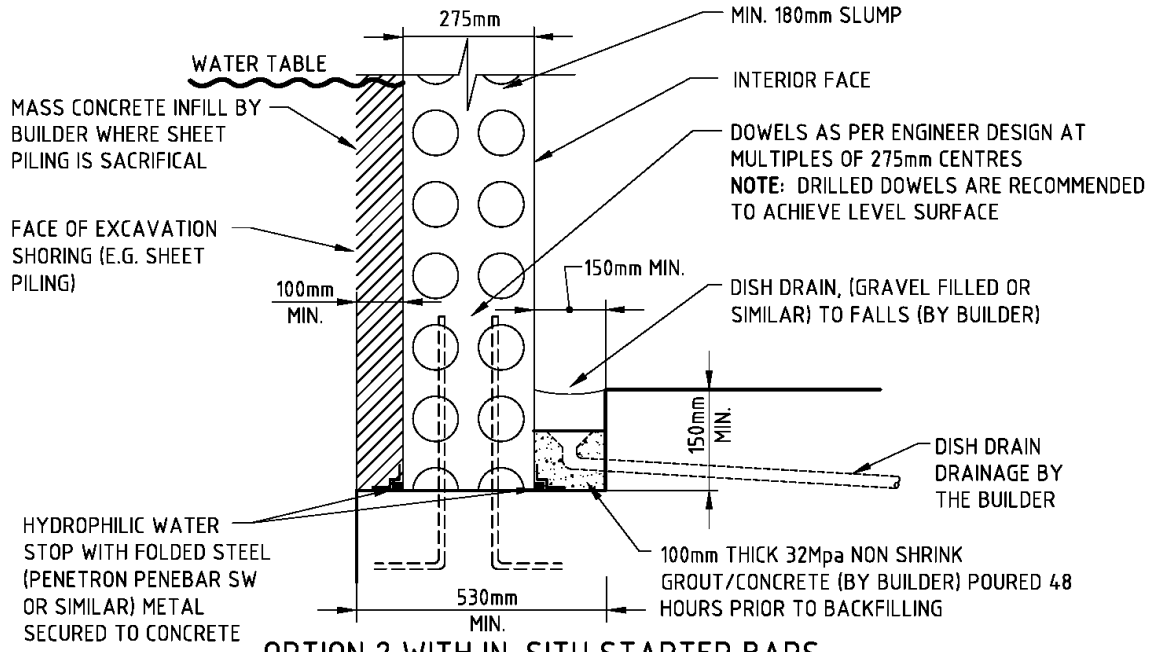
FIGURE 4 –WATER TABLE BELOW THE TOP OF FOOTING

POURING OF DINCEL WALLS MUST BE WITHIN 48 HOURS OF INSTALLATION OF WATERSTOP/HYDROPHILIC MASTIC



OPTION 1 WITH DRILLED STARTER BARS

NO DINCEL ACCESSORY PROFILES ARE ALLOWED UNDERNEATH THE DINCEL WALL



OPTION 2 WITH IN-SITU STARTER BARS

DETAIL 1

BASEMENT CONSTRUCTION FOR PERMANENT WATER TABLE ABOVE THE FOOTING LEVEL

FIGURE 5 – DETAIL BELOW THE PERMANENT OR TIDAL WATER TABLE

CONCLUSION

The performance of a basement wall incorporating Dincel Wall depends on the ground conditions, design/detailing, material handling and workmanship issues at the construction site.

The waterproofing warranty question can be addressed as follows:

1. **Basement walls where the water table is BELOW the footing level** – Refer Figure 4. (Also refer to the Dincel Construction Manual for additional alternative details).

Accept that the wall is a WET WALL; the dish drain at the inner face of the basement wall collects any seepage water. **The customer who requires waterproofing warranty may consider the following option:**

2. **Basement walls where the water table is ABOVE the footing level** – Refer Figure 5. (Refer to the 275 Dincel Manual for alternative details).

Dincel Installation Pty Ltd, subject to the availability of resources, can provide waterproofing warranty under the following conditions:

- (i) 275 Dincel is used and Dincel designed wall/footing junction detail is adopted.
- (ii) The wall is engineered (or engineering design is approved) by Dincel.
- (iii) Footings by others shall be finished flat and level to the requirements of Dincel.
- (iv) The 275 Dincel wall is supplied and installed by Dincel Installation Pty Ltd.