

# WATERPROOF WALLS

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# **WORLD'S FIRST** **WATERPROOF** **& STRUCTURAL WALL**

**DINCEL CONSTRUCTION SYSTEM ELIMINATES THE NEED FOR WATERPROOFING MEMBRANES, SEALANTS AND CHEMICAL ADDITIVES.**

The leading Australian Research Institution, CSIRO, confirms that a wall is not waterproof unless it complies with the following tests simultaneously:

- (1) ASTM E 514 – 08, Standard Water Penetration Test on Façade/Shower Walls.
- (2) AS/NZS 4347.1:1995, 6m Head Water Pressure Test at Dincel Panel Joints.
- (3) ASTM E 96/M, Vapour Transmission, Standard Membrane Test.

It has been tested and certified by CSIRO that Dincel-Wall is **WATERPROOF** without the need of waterproof membranes.

**[\(Download – CSIRO Waterproof Dincel Wall Certificate\)](#)**

Dincel Construction System is therefore suitable for the following uses without the need of waterproof membranes.

**Water, Sewerage, Waste Water, Petroleum, Grain Storage Tanks, Chemical and Acid Bundings, Explosive Goods Storage, Swimming Pools, Sea Walls, Car-Wash, Building Façade Walls, Underground Cellar-Storage-Fire Bunkers, and Basement Walls.**

**[\(Download – Dincel-Wall Waterproofing Warranty\)](#)**

## WATERPROOF DINCEL-WALL OFFERS:

### ELIMINATION OF COSTS FOR:

- **Materials:** Reduces cement quantity normally required for concrete making, eliminates the use of membranes, vapour barriers, chemical concrete additives, steel reinforcement for crack control, excess ground excavation and backfilling behind basement walls. Eliminates the need for the use of wall insulation in warm to tropical climate zones by having thermal mass.
- **Finishes:** Allows the most cost effective applied paint finishes for any texture or colour.
- **Time:** Reduce preparation time, reduce risk of weather delay.
- **Maintenance Costs:** Cracks, water damage, concrete cancer, steel corrosion.
- **Operational Energy Costs:** Unless the building façade walls are air tight, the insulation placed in the façade walls will be useless for energy saving purposes. The majority of conventional walls are not air tight. Dincel-Wall ensures that the wall insulation is working effectively.

### INCREASE IN PROPERTY VALUE

- Single skin façade walls/space gain.
- No loss of recreational and living space, especially in basements.
- No water damage of valuables and stored possessions.
- Eliminates wall joints, cracks leading to termite damage, structural damages; concrete cancer, steel reinforcement corrosion. Maintenance free buildings are always worth more.
- Minimum property life 100+ years.
- Increased structural strength against earthquakes, hurricanes and flooding forces.
- Increased fire safety.
- Elimination of the possibility of refusal from mortgage and insurance institutions.

### YOUR HEALTH

- Significant solution to sick building syndrome, mould, mildew, biological activities, allergies, termite/pest infestation.
- Stress relief for construction managers knowing that time management is optimised and the knowledge that nothing naturally available in the environment can destroy Dincel-Wall.

## WHY WATERPROOF?

Water intrusion can severely impact upon the health of building occupants and cause great damage to the property itself. Nearly all buyers would not even consider purchasing a property with wet basements or façade walls with signs of water penetration.

Water penetration occurs either through cracks within the building walls or water bleeding through porous wall materials.

Building walls generally consist of materials of a brittle nature such as concrete, block masonry or bricks. Foundation movements, deflection of floor slabs, shrinkage and temperature movements result in cracks within the building walls which result in water penetration. Conventional materials such as sand/cement/clay are brittle and porous by nature, hence offer only limited to nil tolerance against building wall cracking. Building designers allow joints in building walls to avoid cracking; however these joints also create a point of weakness for water penetration due to excessive uncontrollable building movements or faulty workmanship. The cracks and porosity of the wall materials allow water and moisture to penetrate the interior environment of the building which leads to permanent structural damage, as well as possible health and safety concerns from mould, mildew, termites and bacteria.

The following Canadian Building Digests are available at:

<http://archive.nrc-cnrc.gc.ca/eng/ibp/irc/cbd/digest-index.html>

which highlight the inefficiencies of currently used conventional building materials and techniques.

|         |  |
|---------|--|
| CDB 6   | Rain Penetration Of Walls Of Unit Masonry                  |
| CBD 21  | Cavity Walls   |
| CBD 30  | Water And Building Materials                               |
| CBD 40  | Rain Penetration And Its Control                           |
| CBD 48  | Requirements For Exterior Walls                            |
| CBD 57  | Vapour Diffusion And Condensation                          |
| CBD 93  | Pre-cast Concrete Walls: Problems With Conventional Design |
| CBD 97  | Look At Joint Performance                                  |
| CBD 125 | Cladding Problems Due To Frame Movements                   |
| CBD 231 | Moisture Problems In Houses                                |

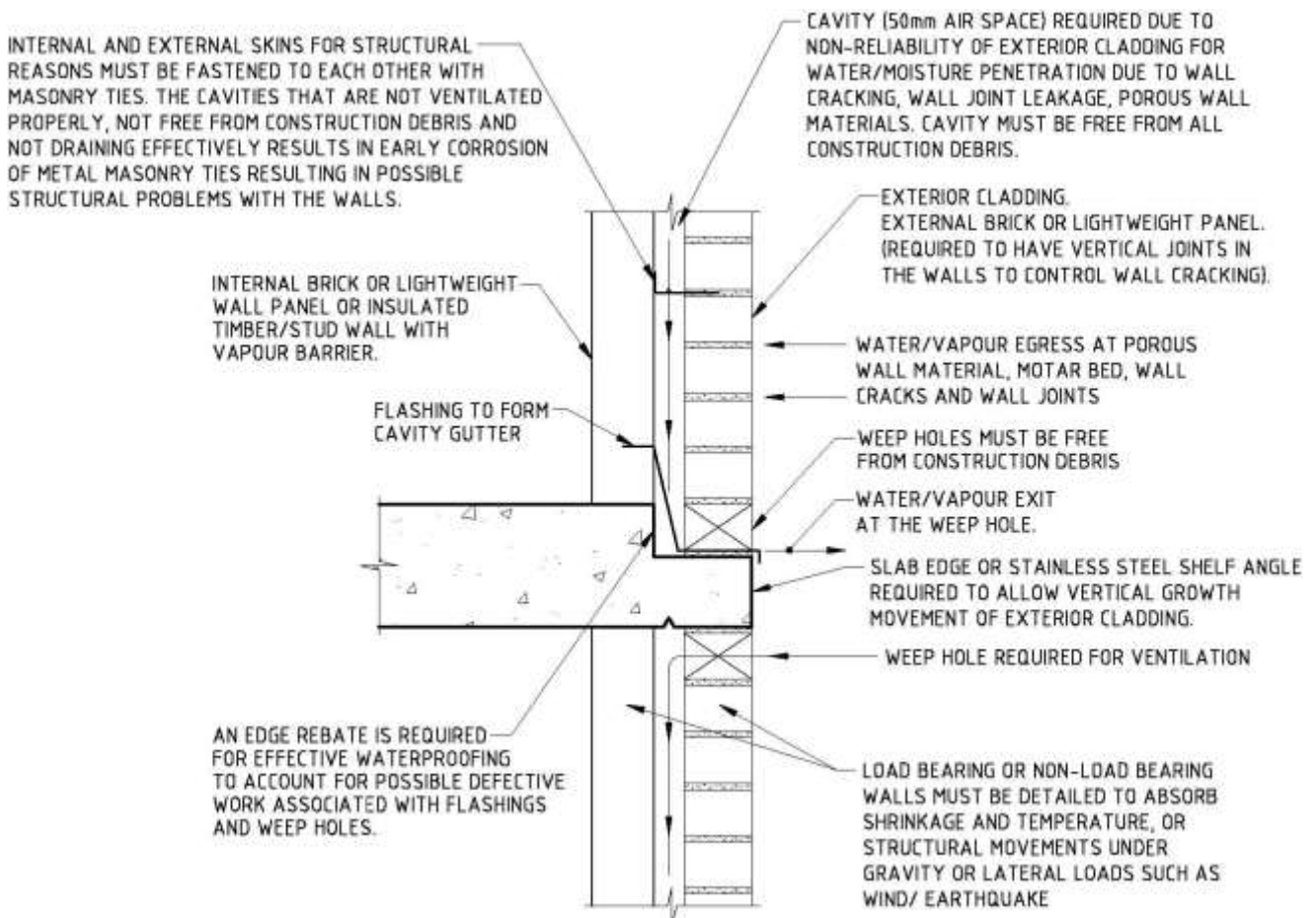
It must be very clear to the property owner that water intrusion is the most important problem for property investment as well as for the building's occupants. Therefore, waterproofing cannot be compromised. **The best waterproofing system is to stop water ingress at the wall surface as in the case of Dincel-Walls.**

## CONVENTIONAL WALLS AND THEIR WATERPROOFING PROBLEMS

### Above Ground Walls

To combat waterproofing problems, conventional façade walls above ground level are most commonly constructed in brick wall construction and must provide a cavity. The reason for this is that water penetrates into the wall cavity either through the wall cracks or through the porosity of the walling material. The cavity wall must have a gutter made out of flashing at its base to collect and drain water out of the cavity through weep holes.

Properly installed flashing, ventilation and cleanliness of the cavities, including weep holes, is essential for the waterproofing performance of façade walls. There would not be the necessity for wall cavities if the walling material is free from wall cracking, free of wall joints and of non-porous nature. Other types of façade walls may consist of single skin panel construction, including pre-cast concrete or other construction materials of a brittle nature, however the waterproofness of these types of walls relies heavily upon the applied finishes and joint reliability. The articles shown above in the Canadian Building Digests highlight the many problems associated with these types of construction methodologies.



## CONVENTIONAL BUILDING FAÇADE WALL

**DINCEL-WALL ELIMINATES MASONRY TIES, CAVITY CONSTRUCTION (SPACE GAIN), FLASHINGS, ELABORATE CONCRETE SLAB EDGE FORMING**

**DINCEL-WALL PROVIDES CRACK FREE, JOINT FREE, MONOLITHIC WATERPROOF WALL**

## **COMMON WATERPROOFING PROBLEMS WITH ABOVE GROUND WALLS**

Conventional construction materials incorporating:

- Brick walls,
- Reinforced masonry block walls,
- Aerated concrete panels,
- In-situ or precast concrete walls,
- Proprietary wall systems having magnesium oxide boards or fibre-cement sheets as permanent formwork to accommodate concrete infill,

are all porous in nature and will crack, and as a result they will require joints for crack control purposes. The commercially available paint/render systems, unless they are certified as membranes, are also porous in nature as well.

**All of the above porous materials will absorb rainwater and moisture within the ambient environment by capillary action and will release this moisture back again when the ambient conditions change. This is why all of the above noted walls should have cavity construction at façade walls unless they are covered with impervious surface finishes or claddings.**

The moisture condition in external façade walls will change continuously because of rainwater and humidity levels of the external environment. The vapour transmitting through the porous wall will result in the applied paint/render finish peeling off. This is the reason why the paint manufacturers require a minimum of 2mm impervious skim coat on a porous surface before the final finish coat to eliminate this problem.

The above problem may also occur in internal walls due to encapsulation of the high water content of the concrete mix.

The Australian Concrete Structures Code AS3600 – commentary Clause 4.3 does not recognise common commercially available paint/render systems as protection to the walls for durability purposes (i.e. concrete cancer and steel corrosion) as the moisture flow, due to the porous nature, cannot be avoided.

### **Magnesium Oxide Boards as Permanent Formwork**

Magnesium oxide boards should not be used as formwork for concrete infilling. When MgO boards come in contact with water, magnesium chloride will leach out of them which degrade the integrity of the cement. Not to mention that magnesium chloride salts are corrosive to metal (including steel reinforcement) when it comes into contact with salts.

The United States of America's acceptance criteria for MgO boards, AC308 states that Magnesium Oxide Boards shall not be used in wet areas (i.e. wall subject to moisture; façade, basement and shower walls) described in IBC Section 2502 and shall not be used in showers.

### **Fibre Cement Sheets as Permanent Formwork**

Fibre cement sheets consist of organic fibres which are subjected to bacterial and chemical degradation. Mould, mildew and air voids leading to concrete cancer commonly occurs. Refer document titled **[“Leaky Buildings – Are Fibre Cement Sheets Suitable”](#)** for further information.

## **Below Ground Walls**

Conventional basement walls consist of walls that are brittle and porous in nature such as concrete walls or concrete filled masonry block walls.

The water/moisture which normally exists in below ground conditions penetrates conventional basement walls through very fine cracks which are unavoidable, or water bleeding through porous wall materials. Practically, water penetration through plain conventional basement walls is unavoidable. This is why all conventional basement walls must have a waterproofing membrane on the side that is in contact with soil moisture or water.

Depending on the ground conditions, the water/moisture penetration can result in:

- Structural degradation or even structural failure resulting in significant repair or loss of asset value.
- Loss of liveable space and significant health problems due to mould and mildew developments.

Waterproofing is costly to provide and there is no 100% guarantee for a successful installation even with a high degree of workmanship skills. **The reliance upon high standards of workmanship for applied membranes has always been in question and has therefore continued to result in ongoing problems.** There are many construction conditions that can override the limited warranty offered by the waterproofing companies. **All it takes is a small hole in the applied membrane system and it will be very difficult to find and costly to repair the problem.**

## **Concrete Additives And Waterproofing**

### **Waterproofing Agents:**

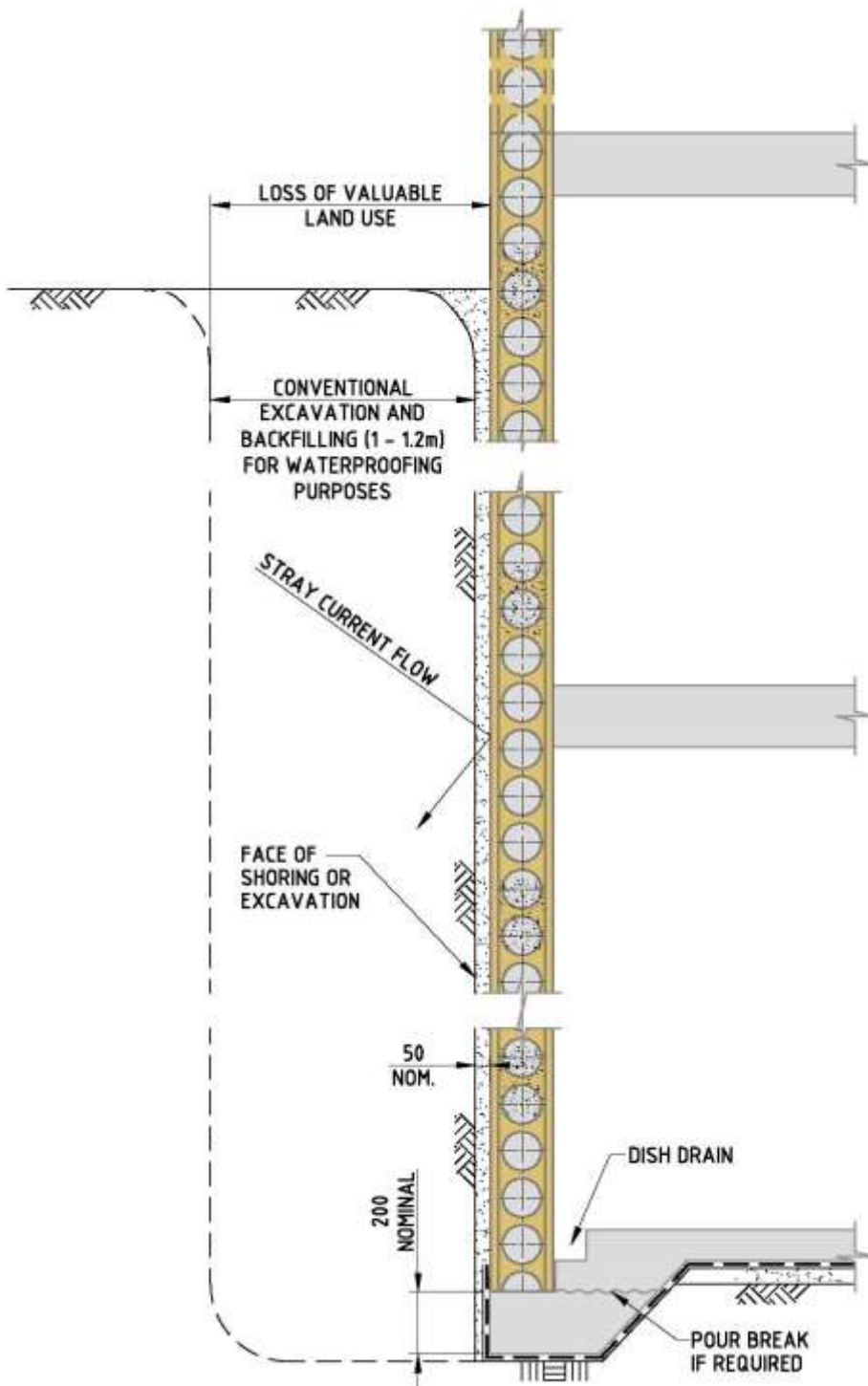
**The claim of achievement of waterproofing by the addition of chemical additives can be misleading.** It is therefore important to understand the following:

The majority of basement walls are built using reinforced masonry blocks. Masonry blocks are normally low strength and have very porous shells which are stacked at the top of each other with porous cement mortar joints. These empty shells are filled with concrete and reinforced accordingly. The end product is an extremely porous wall which has no chance of protecting the steel reinforcement against corrosion. The recognition of this problem has led the industry to add chemical additives to the concrete mix to generate crack fillers to stop water penetration. However, **it is obvious to professionals that if the crack sizes in the walls are bigger than 0.4mm (which commonly occurs and is unavoidable) or if there is a honeycombing problem that exist (i.e. air pockets, which is usually the case with block walls), the addition of chemical additives does not work effectively to stop water leakage,** in fact the use of excessive chemical additives are known to cause corrosion to the steel reinforcement as well.

### **Super-Plasticisers for Concrete Workability:**

The capillary action between porous formwork and the wet concrete mix creates friction and results in unavoidable honeycombing problems, i.e. air pockets. The problem exists even if the forms are wetted with water prior to concrete pouring. This is the reason why the workability of the concrete mix is increased (i.e. slump > 180mm). This level of viscosity cannot be achieved with water. The industry uses super-plasticisers to achieve the high viscosity without affecting the concrete's strength. The very quick drying nature of super-plasticisers exacerbates the problem further. The problem also occurs, especially when concrete is pumped with 50mm lines. The waiting period in excess of 0.5 hours causes significant stiffening of the concrete mix resulting in honeycombing. These are the main reasons why concrete walls, especially block walls end up with honeycombing in the majority of cases.

**DOWNLOAD – BASEMENT CONSTRUCTION** for basement detailing above or below the permanent water table.



#### **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**

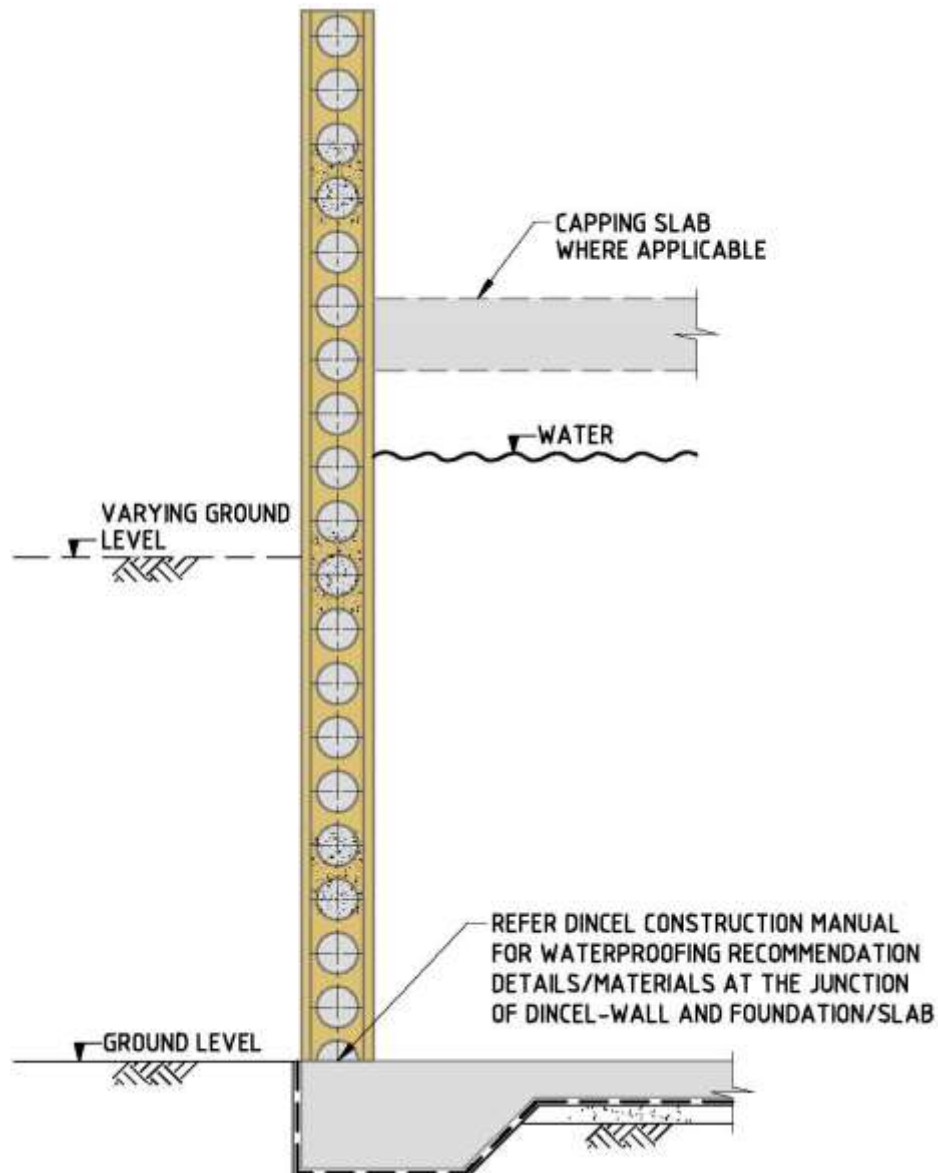
Refer to the Dincel Construction Manual – Details J1, J2 and J3 for where the water table is located below the footing/slab level. For submerged conditions, refer to the 275 Dincel Construction Manual.



## Water/Sewerage/Petrol Tanks and Swimming Pools

The presence of permanent water requires the most stringent waterproofing requirements at the wall face that is in contact with water.

Water pressure will require steel bars in the walls. Failure of waterproofing will result in steel corrosion, concrete degradation and structural failure of tank walls.



## WATER TANK

**DINCEL-WALL PROVIDES CRACK FREE, JOINT FREE, MONOLITHIC, WATERPROOF WALL WITHOUT THE NEED OF WATERPROOFING AS TESTED BY THE CSIRO**

## **HOW DINCEL-WALL PROVIDES WATERPROOFING**

Dincel Construction System (DCS) has the solution for waterproofing problems for all building walls.

DCS offers permanent polymer encapsulation for concrete. In other words, it is an integral part of the concrete wall with a flexible/non-brittle, waterproof permanent membrane skin with ready finish on both faces of the concrete wall.

Dincel-Wall eliminates the root causes of water problems which are porosity of walling material, leaking wall joints and wall cracks. The waterproofing solutions offered by Dincel-Wall are as follows:

- **Non-permeable Dincel Form Concrete Encapsulation**

Dincel-Polymer (shown below as ①) is already non-porous which will not allow water through the polymer itself. **The tests by CSIRO have proved that Dincel-Polymer is non-permeable.** Therefore, the only possible ingress point for water is at the joints of each adjacent module. The polymer membrane of Dincel-Wall provides the perfect environment for the curing and hydration process of concrete. This results in denser concrete which is stronger, both in tension and compression.

- **Waterproof Dincel Panel Joints**

The tests conducted by CSIRO [Download – CSIRO Waterproof Dincel-Wall Certificate](#) show that the Dincel panel joints are waterproof even when the panel joints were tested under 6m head of water pressure.

Dincel Wall possesses the following patented panel joint to achieve waterproofing.

1. Dincel's snap connection mechanism (shown below as ③) which occurs at each adjacent module consists of special barbs similar to clutches of sheet piling. The panel joint is already tight and further tensioned when the panels are filled with concrete.
2. The joint with the presence of special barbs further receives concrete slurry filling the gaps in between the barbs. The calcination occurs after concrete placement (i.e. concrete's chemical reaction) further fills any gaps in between the barbs at the panel joint.
3. If any water under hydrostatic water pressure penetrates through the Dincel panel joint (the entire panel joint including the barbs must be damaged for this to occur) the water is captured by the vertical drainage holes at each face of the panel.

Refer [\(download\) Dincel Wall Waterproofing Warranty](#) for detailed explanation of the above mechanism.

- **Concrete Mix**

Refer to the Dincel Construction Manuals.

- **Crack Free Wall**

Dincel-Forms consist of in-built crack inducers (shown below as ④) at every 125mm centres which results in concrete having cracks of very small widths at each crack inducer. These very small crack widths of about 0.01mm (at 40°C temperature variation) are healed by the concrete's natural autogenous healing process in the space of a couple of days, making the entire concrete matrix within the Dincel-Form impregnable by water. This mechanism virtually ensures a crack free wall. Engineers requiring detailed explanation [Download – Information for Design Engineers](#)

- **No Steel Corrosion – No Concrete Deterioration**

Dincel-Wall's permanent polymer encapsulation and controlled wall cracking by in-built crack inducers eliminate the need for horizontal wall reinforcement which is mainly used for crack control purposes. [\(Structural Engineering Design Certification – download\)](#). However, the use of horizontal reinforcement across the Dincel panel joints may be required other than for crack control purposes (i.e. flexural reasons). The waterproof Dincel-Wall, as tested by CSIRO, is waterproof thus eliminating the possibility of steel reinforcement corrosion and concrete deterioration.

## DINCEL-WATERPROOFING

### ① **DINCEL<sup>®</sup> POLYMER**

- Provides a perfect concrete curing environment which results in stronger concrete, with durable, waterproof surfaces.
- Ready finish for most applications.

### ② **CONCRETE INFILL**

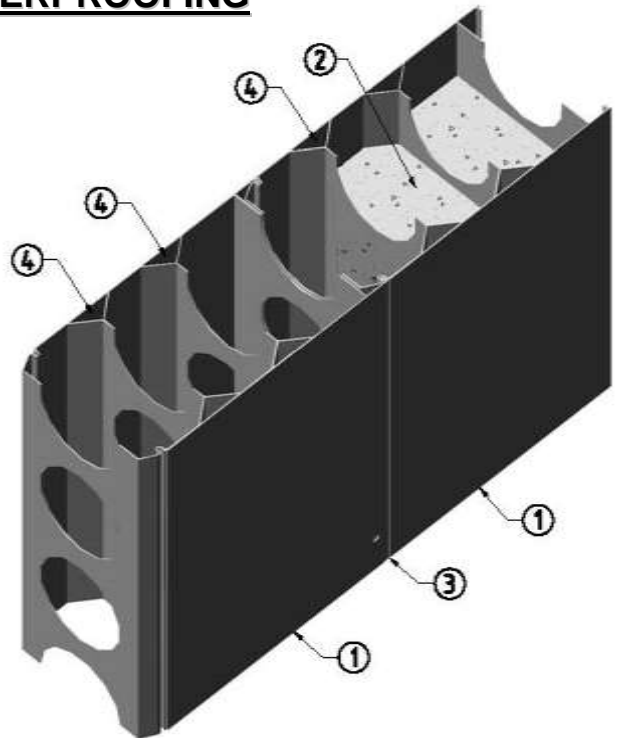
- Durability limitations of concrete eliminated by **DINCEL<sup>®</sup>** polymer. Lower strength concrete (i.e. less cement) can be used for majority of structural applications. **DINCEL<sup>®</sup>** provides 100 year plus lifespan for structures.
- **DINCEL<sup>®</sup>** with concrete infill creates earthquake, cyclone and hurricane proof buildings through ductile composite action, thus achieving greater safety for occupants than offered by concrete alone.

### ③ **SNAPPING JOINTS**

- Patented snap connection mechanism at each adjacent module as tested by the Australian CSIRO is waterproof.

### ④ **CRACK INDUCERS**

- Crack inducers ensure that concrete cracks occur in a controlled fashion, as shown in the photo on the right. The crack control achieved by **DINCEL<sup>®</sup>** polymer means that reinforcement to control cracks caused by shrinkage and temperature variations is eliminated, i.e. no horizontal reinforcement. Crack free walls are achieved as confirmed by many 60m to 80m long, joint free Dincel-Wall constructions that have been built to date.



## CONCLUDING COMMENTS

The tests conducted by CSIRO have conclusively proved that Dincel-Wall is waterproof.

The reliability of the waterproofing of DCS will be increased with the following:

1. Installation of Dincel-Wall must be in accordance with the "DINCEL CONSTRUCTION MANUAL".
2. A basement or water tank will leak at the wall-slab junctions. The treatment of joint detailing between Dincel-Wall and floor slabs/footings is therefore important.

The reader may refer to the Dincel Construction Manual for recommendations.