DINCEL STRUCTURAL WALLING

CONSTRUCTION SAFETY

SUMMARY

This document shall be read in conjunction with **(Download – Dincel Solution for Construction Problems)**.

SAFETY BENEFITS OF DINCEL-WALL –VS– CONVENTIONAL WALLS	
DINCEL SYSTEM	**SAFETY BENEFIT**
Lighter	Minimise risk of back injury.
Quicker	Reduce the time exposed to an activity or risk.
Reinforcement not exposed.	Reduction in risk of cuts.
Steel reinforcement use significantly reduced.	Reduction in risk of cuts.
No stripping of formwork.	Eliminate a high risk activity.
No stripping of formwork	Eliminates the risk of crush injuries, cuts and abrasions due to falling objects.
No stripping of formwork	Reduced construction wastes – reduce landfill wastes.
Eliminate or reduce the use of a hammer.	Eliminate or reduce risk of crushing fingers.
Eliminate need for vibrator.	Reduction of manual handling injury.
Eliminate need for vibrator.	Reduction in emissions (environmental).
Eliminate need for vibrator.	Reduction in noise pollution (environmental).
No sharp edges.	Reduce risk of cuts.
Installed by hand and rechargeable power tools.	Eliminates the risk of electrocution by using 240V leads.
Replaces conventional scaffolding when required.	Eliminates the risk of falling from heights.
Most of installation takes place below a height of 1.8m which eliminates the need for scaffolding.	Eliminates the risk of falling from heights.
Eliminates scaffolding's material loading.	Eliminates the risk of scaffolding collapse.
Site cuttings reduced due to project specific cut to size factory produced Dincel modules.	• Eliminates the risk of cuts. • Reduced construction wastes – reduce landfill wastes.
The inbuilt service spacers of Dincel module eliminates the wall chasing for power/communication cables.	• Eliminates the risk of cuts. • Reduced construction wastes – reduce landfill wastes.
Non-toxic, VOC free, does not support fire.	Eliminates the risk of related construction health issues and fire.
Any wall bracings of up to 5m in height is eliminated when conventional decks are used to stabilise the top of Dincel-Forms during installations.	The absence of wall bracings eliminates trip hazards and provides clear area for the work below the deck level.

Dincel-Wall comparison can be viewed at **(Download – Wall Comparisons)**.

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INTRODUCTION

Construction accidents constitute a large and very costly occupational health and safety problem in the construction industry. **As a result, the Worker Health & Safety Act 2011 (effective from 1st January 2012) was introduced to manage and improve workplace safety.**

This construction safety problem can occur in any country due to general population increase which increases construction needs and in turn requires additional new buildings. The centralisation policy of governments requires multi-level buildings close to existing transportation centres which increases the importance of construction safety.

The greatest challenge to the worldwide construction industry is the availability of skilled labour. With growing population all around the globe, the statistics clearly demonstrate a significant shortage in skilled labour and this problem is developing very rapidly. Unskilled labour will be more vulnerable to construction accidents during construction. The safety need will further increase since unskilled labour will result in workmanship defects which in turn will require to be rectified. In the absence of safety scaffolding, the post-construction rectification work will be attended to with the use of ladders in which most of the falls and injuries occur. The following explains the scale of current construction accidents in Australia.

The report [1] shows that the total annual frequency of deaths and hospitalisations respectively for falls on building sites in Australia (which has very high world standards in construction safety) were 343 and 105,968 for the period of July 2002 to June 2005. The estimated annual cost for these deaths was AUD$250 Million and AUD$1.28 Billion for hospital admissions, excluding indirect costs. This is significantly higher than 110 deaths and 3,300 injuries in one year in Australia related to fires. (Dincel-Wall is tested by CSIRO Australia and complies with all buildings, bushfires and even hydrocarbon fires). 343 deaths is equivalent to having one significant natural disaster every year.

WORKER HEALTH & SAFETY ACT 2011

- The object of the act is to improve workplace safety and safe material use.
- All parties involved in a project are defined as PCBU's (person conducting a business or undertaking), have clear obligations under the Worker Health and Safety Act 2011 that non-compliance attracts severe penalties.
- Manufacturers, Importers, Designers, Specifiers, Project Managers, Builders and Installers are required to conduct an Occupational Health and Safety Analysis in order to comply with the Worker Health & Safety Act 2011.
- All parties under the safety act are individually responsible for their part as no responsibility can be transferred.
- The Dincel purchasers agree to use/understand the Dincel Construction Manual when they purchase the product in accordance with Dincel's terms and conditions of sale.
- The Dincel Construction Manual and this document (incorporating definitions of installation risks and material safety information) are prepared as Dincel's Risk Analysis under the Worker Health & Safety Act 2011.

Communication is the key. Dincel's Risk Analysis is under constant review as Dincel welcome and review all comments received from customers, installers and other interested parties.

[1] http://www.monash.edu.au/muarc/reports/muarc281.pdf - Relationship Between Slips, Trips and Falls and Design and Construction of Buildings, Report Number 281, April 2008, Monash University.

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MOST COMMON CONSTRUCTION ACCIDENTS AND DINCEL'S SOLUTIONS

There is a clear need for developing a SAFE construction system.

The six (6) most Common Building site and Construction Accidents are as follows:

(1) Falling from slab edges and openings in floor slabs.

(2) Ladders.

(3) Machinery.

(4) Falling construction materials.

(5) Trips and slips.

(6) Trench collapses.

The above noted construction accidents and solutions are briefly explained below.

(1) FALLING FROM EDGES AND OPENINGS IN FLOOR SLABS

Risk
Due to access reasons, not every construction site is suitable for the erection of safety scaffolding. Developments, particularly in the city areas adjacent to another development or narrow street are not suitable for the placement of scaffolding and cranage.

Control
Dincel-Wall along the free slab edge, when extended sufficiently above the floor slab, provides a safe fall barrier.

(2) LADDERS

Risk
Ladders are often used with conventional wall constructions, e.g. installing bolts and bracings. If the ladders are not secured properly they will cause the worker to fall.

Control
When Dincel-Walls are installed from conventionally formed decks of a multi-level building there is no need to use bracings for walls of up to 5 metres in height which eliminates the need for ladders in association with Dincel-Wall installation.

(3) ELECTRICAL HAZARD

Risk
Use of power tools.

Control
Installation with Dincel can be completed with only 12V battery equipped tools, hence cutting and electrocution related accidents can be significantly avoided. Dincel offers a custom length product which significantly minimises site cutting.

(4) FALLING CONSTRUCTION MATERIALS

Risk
Falling objects, manual handling and scaffolding is required to build masonry walls above 1.8m in height. The loading of bricks, masonry blocks and mortar on the scaffolding may overload and result in the collapse of the scaffolding. The falling material, especially from heights will cause either serious injury or death to the workers below or on the scaffolding.

Control
Dincel-Walls do not need scaffolding; hence the subject problem is eliminated.

(5) TRIPS AND SLIPS

Risk
Mortar preparation for a brick/masonry block wall or water of wet concrete mix escaping from conventional formwork or masonry block walls produces a significant quantity of water resulting in slippage of the workers.

All known conventional wall formworking systems whether temporary or permanent require bracings and create trip hazards due to the presence of bracings and bracing connections to the floors (i.e. bolts and plates).

Control
Dincel-Walls do not release water from wet concrete poured into the Dincel forms to cause slippage. Dincel-Walls, when associated with conventionally formed decks are installed without bracings, hence no trip hazards.

(6) TRENCH COLLAPSES

Risk
Trench collapse and confined space.

- To apply waterproofing (e.g. basement walls) between excavation of the wall face. Dincel Wall is waterproof; hence no waterproofing on the earth face of the basement wall is required.
- For installation in service trenches, pits, etc. where proper shoring is often ignored.

Control
A pit, culvert, tank or shaft can be built using Dincel (including the required steel reinforcement) near to the subject trench and the Dincel structure, without concrete infill can be easily lowered into the subject trench (i.e. lightweight structure) and concrete infilling can be placed after lowering the Dincel-Form in place. Thus achieving construction without any worker in the trench.

Dincel offers significant resilience against collapsing earth excavation **(Download – Case Study – Excavation / Trench Safety and Ductility of Dincel Wall)**

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THE MOST DANGEROUS CONSTRUCTION ACTIVITY AND TILT-UP/PRECAST CONCRETE WALL PANELS

Reference No: [2] confirms that tilt-up wall panels are the most dangerous construction activity. The tilt-up construction idea has been imported to Australia from the United States of America to increase construction speed, particularly in factory/warehouse type construction. However, the limited use in residential construction is also observed.

The tilt-up wall system incorporates pouring rather large concrete wall panels on casting beds and lifting them into position with the assistance of rather large cranes.

This type of construction requires very skilled and experienced knowledge in both design and construction. Workers in the construction industry are three times more likely to suffer a fatal accident and one and a half times more likely to suffer an injury than other workers in all other sectors of the Australian workforce.[2] The consequences of an uncontrolled collapse of a concrete wall panel are serious injury or death and therefore the risk assessment and subsequent controls must be comprehensive at every stage of the work process.

The types of injuries likely to be sustained from uncontrolled collapse of a tilt-up wall panel are severe crush injuries. The severity of the injury resulting from such a collapse is so significant that prior planning is essential.

The general type injuries that are associated with construction apply here and include body stressing injuries, exposure to the weather elements and falls from heights. Accidents or system failures (e.g. connection failure) easily results in death if there is someone near to the failing tilt-up panel. The latest Australian incident is currently under investigation by WorkSafe, Victoria.[3]

Solution

As stated in reference [2] the workers associated with tilt-up walls are most likely to suffer a fatal accident. The methodology eis as

follows:

- No cranage is required.
- This is an alternative to full height tilt-up walls.
- The recommended methodology involves:

  The construction of the structural steel skeleton and incorporation of light columns which allows the bracing facility to Dincel-Wall. The steel columns become redundant after the concrete filling of the 200mm thick Dincel-Wall (i.e. 4 hours fire rating). This allows an alternative way of achieving a tilt-up wall without lifting. The fall of the panels during or after the construction period is eliminated as Dincel-Wall is monolithic, (i.e. no joints and laterally supported by the steel columns).

  Alternatively, the steel columns do not become redundant. This allows the use of the 200mm or 110mm Dincel-Walls as a cladding for full height or limited height as in the case of Dado construction (i.e. hard walls at the bottom metal sheeting above at the perimeter of the factory/warehouse wall).

Dincel system in any case eliminates the SAFETY CONCERNS ASSOCIATED WITH CRANES AND ASSOCIATED CONCRETE PANEL LIFTING.

[2] http://www.comcare.gov.au/forms__and__publications/fact_sheets - Tilt-Up Wall Panels and Precast Concrete

[3] www.freehills.com.au/5814.aspx

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DINCEL'S SAFETY FEATURES HIGHLIGHTED

• LIGHTWEIGHT

The weight of each Dincel panel (13 kg for 3 metres length) required to be transported to the construction site is significantly less than others. This makes Dincel panels man handleable without the need for lifting devices, including cranes. Dincel system eliminates the access problem with difficult construction activities such as steep sites, existing building restoration/underpinning and building against existing structures.

This feature eliminates back injuries resulting from heavy lifting associated with masonry construction or conventional removable formwork.

Manual handling injuries account for 48% of claims.

• SNAP TOGETHER CONNECTION

This is the major feature of the Dincel invention which is patented around the globe.

Snap connection joins two Dincel-Panels to each other in a horizontal direction without any mechanical fixing and without the need of vertical sliding mechanisms. (Dincel has vertical movement capability after the snap connection).

This feature allows any two Dincel-Panels, up to 4.5m in height, to snap connect to each other by one worker only without any assistance or scaffolding on a safe platform (i.e. no risk of fall). The lightweight feature (i.e. 4.5m panel weighs less than 20kgs) also assists the snap connection. Lengths of more than 4.5m require guidance at their top ends to achieve the snap-connection.

PHOTO No. 1

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DINCEL STRUCTURAL WALLING

SAFE INSTALLATION

BOTTOM UP – ONLY BY DINCEL

SPEED OF INSTALLATION
UP TO 25m² / 2 MAN / HOUR

PHOTO No. 2

TOP DOWN

PHOTO No. 3

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• PERMANENT FORMWORK

Dincel is a stay-in place permanent formwork which eliminates the stripping need of conventional formwork. Often with conventional formworks during stripping, falls occur and injure workers.

• FEWER ACTIVITIES FROM SCAFFOLDING AND LADDERS

Scaffolding
The convention is to use scaffolding around the perimeter of buildings and floor openings. Sometimes scaffolding is difficult to provide due to access requirements. The installation and dismantling of scaffolding also creates construction risks to, unskilled labour and other trades or passers-by in the vicinity of the scaffolding activity. Dincel allows the elimination of scaffolding provided that all window sills around the building perimeter are a minimum of 1,000mm above the floor level which satisfies the Australian fall protection barrier requirement. **(Download – Dincel Eliminates Scaffolding)**.

Scaffolding Loading
Conventional masonry wall construction with brick and masonry blocks involves loading the scaffold with the materials of the wall under construction. Overloading of the scaffolding occurs and often results in scaffolding collapse and falling of workers.

Ladders
Often used where scaffolding use is impractical, e.g. placing wall bracing prior to wall concreting or attending to workmanship defects during or after construction. When Dincel is used together with conventional floor formworks there is no need for diagonal bracing which is required with all other non-Dincel-Walls. Ladders are required to install bracings. Bracings and their floor attachments also represent trip hazards.

Dincel minimises workmanship mistakes during installation and concreting when very simple principles of Dincel-Wall concreting are adopted (refer Dincel Construction Manual).

• FEWER STEEL REINFORCEMENT BARS

Dincel-Walls
- Eliminate the need for crack control steel, e.g. no horizontal steel is required in basement or water/earth retaining walls.
- Majority of the superstructure Dincel-Walls do not need steel reinforcement, e.g. non-shear walls, party/corridor walls do not need any vertical or steel reinforcement.
- Less steel reinforcement means less cutting and less injuries.
- If steel reinforcement is provided (e.g. starter bars or dowels) they are protected by Dincel-Forms to prevent workers from tripping and falling onto the steel bars.

• ELECTROCUTION

Conventional construction require power tools, cutting machinery, etc. which operates with portable leads connected to 240V construction site's electrical power. The leads represent trip hazards and are often the major source of electrocution together with the tool that is connected to it.

Dincel installation largely only requires rechargeable battery power tools (fewer 240V leads).

• NO CHASING FOR SERVICES

The 200mm Dincel-Forms incorporate in-built service spacers which allow power/communication cables, water reticulation pipes during or after the wall installation.

The 110mm Dincel-Forms are normally finished with battens and plasterboard finishes. The batten spacing allows the installation of conduits for power/communication and water reticulation pipes after the wall installation.

The above facilities significantly reduces wall chasing, hence associated accidents.

• MINIMUM SITE CUTTING REQUIREMENT

Dincel-Forms are supplied as per order length to suit the wall height. Dincel-Forms are available at any length between 1,800mm and 7,950mm. This feature significantly reduces accidents due to cutting and electrocution from cutting equipments. This way, major reductions in site wastage are achieved, which in turn reduces trip and slip hazards on site.

For various reasons the Dincel product may need to be cut on site (e.g. cutting and removing one face of Dincel-Form to use as an edge board).

There is no reported incident associated with site cutting of Dincel-Forms (also refer to Dincel's material safety below). However, it is always recommended as a precautionary measure to wear a respiratory mask and eye protection when cutting involves Dincel products as well as other materials such as masonry, concrete, steel and timber. Also refer to Dincel's Construction Manual for cutting and other installation related matters.

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DINCEL FORMS INSTALLATION

The following criteria are assessed in association with weight lifting under the Worker Health & Safety Act 2011. The following criteria are required to be considered.

• Load characteristics, working posture and position.

• Location of the load distances moved and lifted.

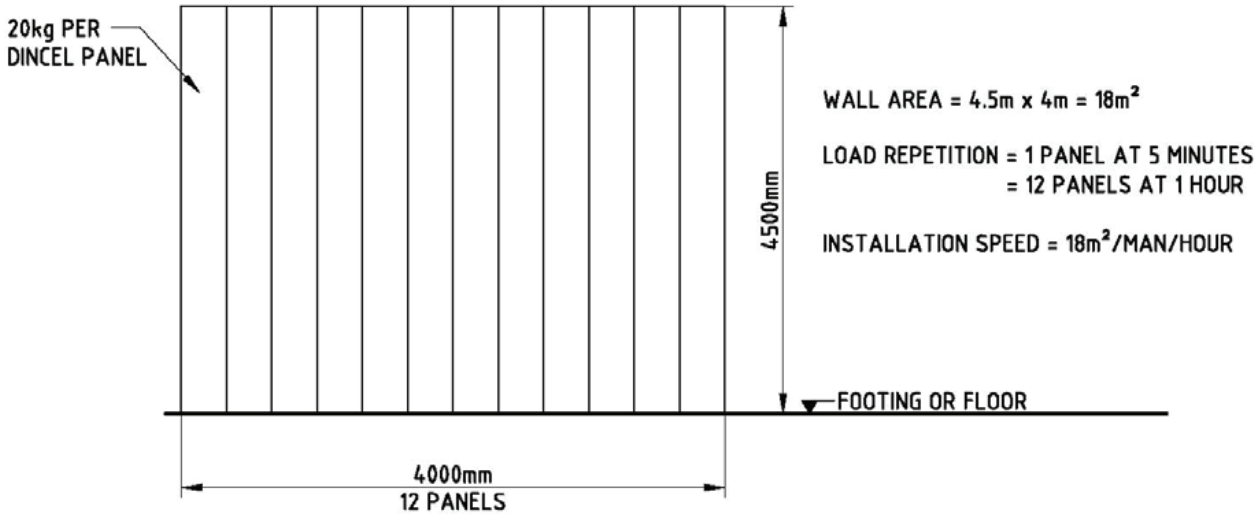
• Duration and frequency of manual handling.

Installation speed, weight, load repetition and posture.

• Dincel's desirable speed of installation is 18m2 to 20 m2/man/hour. This relates to the worker lifting maximum 20kg at every 5 minute interval during a work day.

• Dincel's snap-engagement by a single worker can be achieved for up to 4.5m length (i.e. 4.5m weighs less than 20kg).

• Dincel's panel lifting during installation occur without any awkward posture.



• Recommended weight lifting

There has been some work done on the lifting capacity of people in the workforce by Mital, Nicholson and Ayoub (A Guide to Manual Handling published by Taylor and Francis, 1997). For example they got workers to lift a 75cm box with two hands from the floor to a height of 80 centimetres. They found that:

- 10 percent of male workers had the capacity to lift 27kg safely once every 5 minutes, but they could only lift 14.5kg if asked to do so 16 times per minute.

- 90 percent of male workers were able to lift 14kg every 5 minutes but could only lift 4.5kg safely if asked to do so 16 times per minute.

• Recommended load lifting repetition of Dincel panels once every 5 minutes resulting in:

- A worker lifts a maximum 20kg panel at every 5 minute interval for a Dincel panel of 4.5m long, OR

- A worker lifts a maximum 14kg panel at every 5 minute interval for a Dincel panel of 3.2m long (majority of building walls are less than 3.2m).

- Panels heavier than 27kg and longer than 4.5m need to be handled by two workers.

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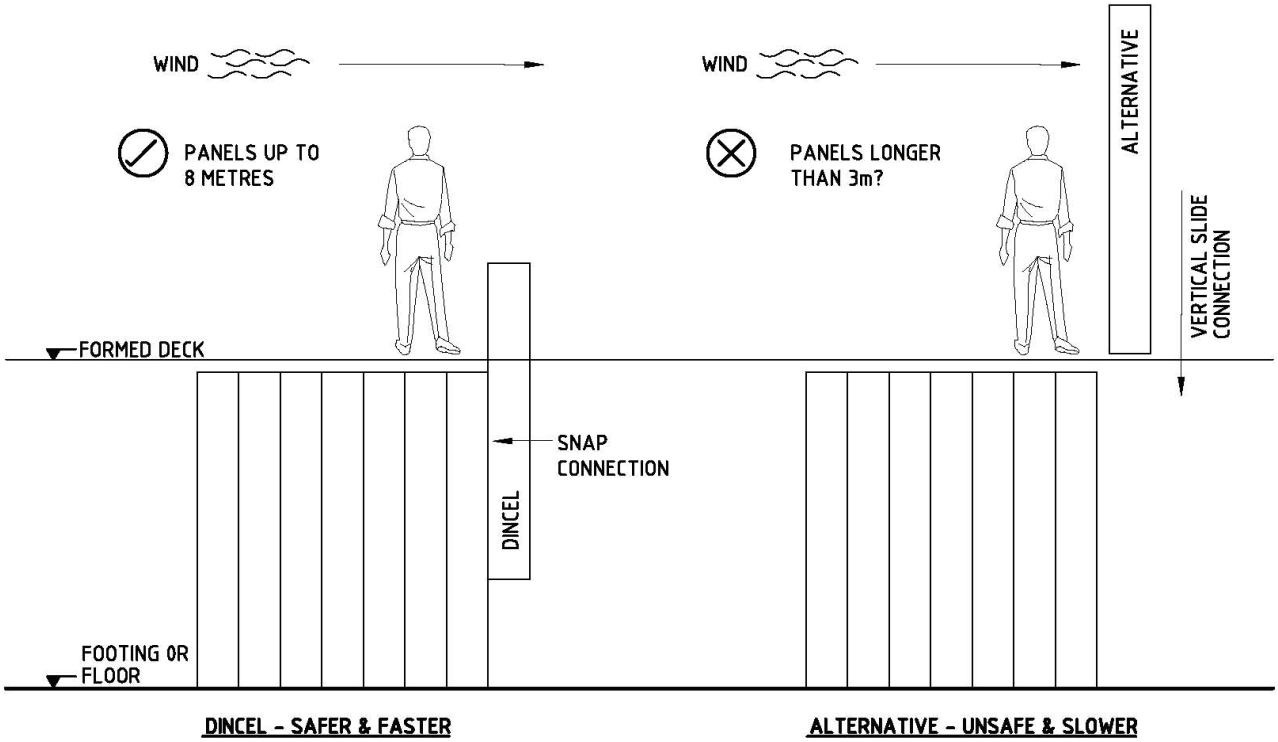
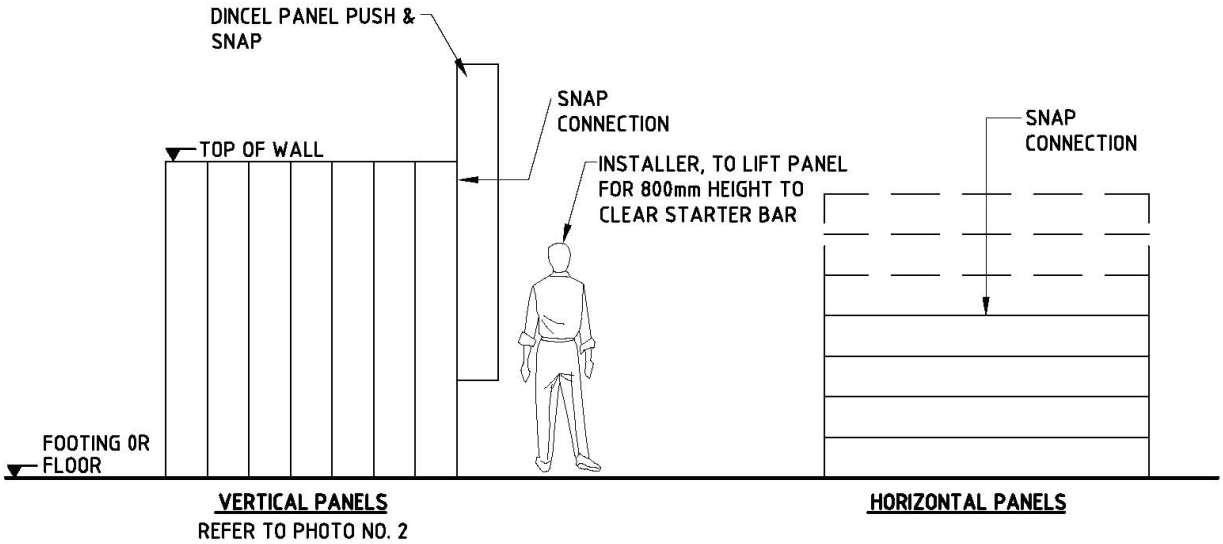


VERTICAL PANELS INSTALLED FROM FORMED DECK

REFER TO PHOTO NO. 3

- UTILISE SCAFFOLDING, SAFETY RAIL OR EXTEND DINCEL PANELS AT THE EDGE OF THE FORMED DECK TO FORM A SAFETY BARRIER



ONLY DINCEL PANELS CAN BE INSTALLED WITHOUT FORMED DECK

- ALTERNATIVES REQUIRE SCISSOR LIFTS CHERRY PICKERS OR MOBILE SAFETY PLATFORMS
- DINCEL PANELS CAN BE SUPPLIED UP TO 8m LENGTHS

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DINCEL'S MATERIAL SAFETY

Since 15th January 2009 the Green Building Council of Australia provides positive credit to the use of PVC.

(1) The use of Dincel's product material is in compliance with "PVC Made Using Best Environmental Practice" recognised by the Green Star PVC credit.

(2) **Dincel's material safety data sheet (MSDS)** is available on the Dincel website http://www.dincelconstructionsystem.com/documents/Dincel%20Wall%20Material%20Safety%20Data%20Sheet.pdf

(3) It is the Building Code of Australia's requirement that all test reports are to be obtained from the Australian N.A.T.A. registered testing authority.

(4) **Dincel-Wall Fire Assessment** is available on the Dincel website http://www.dincelconstructionsystem.com/documents/Dincel%20Wall%20Fire%20Assessment.pdf for the following:

Dincel offers compliance with the BCA.

(i) **Wall Linings** – Full compliance with the Building Code of Australia, BCA – Specification C1.10 – Clause 4:

- Group 1 Material: Best performance for flammability (provides no fire limitation to Dincel's use without any protection).
- Smoke Criteria: better than the BCA threshold.

(ii) Dincel's test results by CSIRO demonstrate that Dincel's **combustibility rating** is better than some of the materials accepted as non-combustible.

(5) **Volatile Organic Compound (VOC)**

An important item for indoor air quality for the Green Star rating.

Dincel's product offers a VOC reading which is 50 times better than the Green Star threshold.

Dincel's VOC certificate by CETEC is available on the Dincel website **http://www.dincelconstructionsystem.com/documents/VOC%20Emission%20Test%20Certificate.pdf**

(6) **Chemical Resistance:** Dincel polymer has been tested successfully against exposure to sulphuric acid, nitric acid, potassium sulphate, hydrochloric acid, petroleum and diesel fuel. Test results are available on request. Dincel is a plasticiser free and heavy metal stabiliser free PVC polymer. The Dincel polymer represents better value than the Australian potable water and food grade PVC with the above features. PVC polymers are used in hospitals for hygienic reasons.

(7) **Waterproof Walls and Indoor Air Quality:** The Dincel-Wall, as tested by CSIRO Australia including its joints, is waterproof and has 180 times better vapour transmission rate than the threshold of the conventional flexible membranes (which consist of plasticisers). This feature is also a major breakthrough for eliminating the two most important reasons **(Download – Breathable Wall – FAQ – Sustainability – Question No: 11)** for condensation which usually results in mould, mildew and sick building syndrome.

DISCLAIMER

The information contained in this document is intended for the use of suitably qualified and experienced architects and engineers and other building professionals. This information is not intended to replace design calculations or analysis normally associated with the design and specification of buildings and their components. Dincel Construction System Pty Ltd accepts no liability for any circumstances arising from the failure of a specifier or user of any part of Dincel Construction System to obtain appropriate professional advice about its use and installation or from failure to adhere to the requirements of appropriate Standards and Codes of Practice, and relevant Building Codes.

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