



DINCEL STRUCTURAL WALLING

SOLUTION FOR MINE SUBSIDENCE AREAS



ABSTRACT

The building construction in mine subsidence areas represents challenges with the conventional brittle natured materials such as bricks and masonry blocks which easily crack even with the slightest movement. This handicap significantly limits the development potential in the mine subsidence zones. Dincel Construction System, being non-brittle, crack and joint free overcomes this problem.

BUILDING'S STRUCTURAL BEHAVIOUR IN THE MINE SUBSIDENCE AREAS

The overall building behaviour in the mining areas represents concerns to building authorities because the earth which carries building footings is significantly weakened due to the immediate or nearby underground tunnelling activities.

This man-made change to the earth's structure is important in sand, sand-clay, clay, and weak to medium shale materials. Any of these materials can display settlement, hence damages to the structures are due to:

1. Moisture change to the upper surface earth layers due to underground tunnelling activities. If there is a void, the moisture will move towards the void. Tunnels can be sealed, however there could be enough damage to the structures above before complete sealing of the tunnel and ground moisture equilibrium can take place.
2. Nearby mining blasts sends shock waves, hence the foundation material supporting the structures above moves and settles.
3. Long wall mining operations.

All of the above ground movements will cause significant displacement in building structures built in mining structures.

The commonly available building materials are:

- Brick – weak mortar joint subject to cracking even with small movements due to settlement and brick growing.
- Block walls – if they are reinforced they behave better than bricks. However, due to their brittle nature they also crack because of settlement, shrinkage and temperature movements.
- Reinforced concrete would be the best option, if it was crack free (concrete cracks due to shrinkage/ temperature and ground settlements) and cost effective formworking is available.

As a result, the industry has relied upon bearers, joists and claddings material which are lightweight, easy to handle and transport in the mine subsidence areas. However, most importantly, because of their flexible nature, they could absorb a lot of displacement which occurs daily in mine subsidence areas. They only existed because there was no waterproof, crack free or a cost effective system like Dincel Construction System.

CONVENTIONAL WAY TO BUILD IN THE MINE SUBSIDENCE AREAS

The following documents which belong to the NSW – Australia Mine Subsidence Board is an example in identifying the problem and the Board's solution. It must be noted that the Board's solution is based on conventional brittle materials which has every chance of cracking, even with the slightest ground or shrinkage/temperature movements. This is the reason why the recommendations of the Board consist of extensive articulation of the walls which aim to minimise cracking. However, more joints mean more air leakage, hence air tightness and therefore energy efficiency is compromised.

DinCEL-Wall is a joint free, airtight and monolithic system. If engineered, they can act as deep beams spanning or even cantilevering significant distances. This will be in all mine subsidence, especially in pothole subsidence, would be a significant solution.

The following documents have been collated from the Mine Subsidence Board's website ([Download – Conventional Design for Mine Subsidence](#)).

DINCEL SOLUTION IN THE MINE SUBSIDENCE AREAS

No doubt people in mine subsidence areas wish to own properties of solid structures which is basic human desire. However, property damage associated with building structures has always forced people to have flexible structures due to unavoidable property damages in mine subsidence areas.

The problem with mine subsidence areas is having cracks due to ground movements as explained above. If the cracks are eliminated, the land of the mine subsidence areas will be much more valuable due to people's desire to have solid construction.

The permanent polymer of DinCEL-Forms provides the following:

- Protects the concrete infill and provides 120 years life.
- Provides joint free and waterproof barrier.
- The crack inducers force the concrete infill of DinCEL to crack at 125mm intervals. As a result, the induced cracking cannot be bigger than 0.01mm which results with blocking of cracks with the by-product of concrete which is called calcinations or autogeneous healing.

The abovementioned functions of DinCEL-Forms provide joint free and crack free waterproof walls.

The joint free and crack free DinCEL-Walls, together with or without concrete floor slabs, forms an extremely stiff structure. This cannot be provided by conventional reinforced concrete walls because they have to have joints at 8m (maximum) centres to control the shrinkage and temperature crackings between the joints. As a result, those walls consisting of joints will display significant movements if they are not strengthened by an additional stiff foundation system. The additional costs associated with conventional concrete walls will be cost prohibitive to be used in any location, let alone in mine subsidence areas.

The important issue to remember is that DinCEL Construction System offers stiffness, joint free, crack free and a waterproof structure simultaneously.

The combination of the concrete infill and DinCEL-Polymer results in the composite material behaving in a non-brittle and ductile manner. Thus, the entire DinCEL-Wall becomes a resilient, solid and a very stiff building element which will not crack under the activities of mine subsidence areas.

In general terms, damages to structures in mine subsidence areas occur in any of the below noted parameters or a combination of them. These parameters are vertical subsidence, horizontal ground displacements, horizontal ground strain, ground curvature and tilts. The principal of the mine subsidence design is based on the following principles.

- Lateral ground movement is not restrained by deep footings.
- Differential footing settlement achieved by footing design (usually waffle raft slab) and the walls are articulated to absorb the effect of the differential settlements.

Any mine subsidence area could be subject to reactive soil conditions as well. The ground movements, due to soil moisture changes, will also exacerbate the settlements and result in building damages. To combat this problem, the building will be required to have a very stiff foundation structure. However, all this can be avoided with the presence of a raft slab tied to DinCEL-Walls, thus creating a much stiffer foundation system than what conventional footing or waffle raft slab systems can ever achieve. The other advantage of the solution with DinCEL-Wall is that the footings are not embedded into the ground (i.e. even shallower than the waffle raft slab), thus avoiding the effects of the ground movements caused by long wall mining and soil reactivity.

This way, DinCEL Construction System opens unlimited potential of development, not only for private housing, but for multi-storey building structures in mine subsidence areas.

A raft slab and Dincel-Wall combination, like a box foundation, will be very strong to cater for ground movements that are conventionally experienced in mine subsidence areas. The following is an example to illustrate the stiffness of Dincel-Walls:

The University of Technology Sydney has tested Dincel-Walls under beam flexure and earthquake forces. The University has reported that Dincel-Walls do not crack even under magnitude 9 earthquake forces. ([Download – Building Solution for Earthquake Prone Regions](#)). The resilience of Dincel displayed by the earthquake testings as shown by the videos in the above link is a testimony to the increased ductility of Dincel which is equal to at least twice the ductility of conventional concrete. Therefore, Dincel-Wall can be used as a solution in mine subsidence areas without hesitation.

CONCLUSION

The current recommendations by the building authorities are provided to suit conventional building materials which are brittle and easy to crack.

Dincel Construction System is a new innovative way of designing and building in the mine subsidence areas due to its following characteristics:

- Absorbs shocks and impacts.
- Resilient, non-brittle and ductile.
- No cracking, no joints and waterproof.

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