



# DINCEL STRUCTURAL WALLING

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SILOS FOR FOOD CONSERVATION



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## FOOD CONSERVATION – ABSTRACT

In most countries grains are among the most important staple foods. However, they are produced on a seasonal basis, and in many places there is only one harvest a year, which itself may be subject to failure. **This means that in order to feed the world's population, most of the global production of maize, wheat, rice, sorghum and millet must be held in storage for periods varying from one month up to more than a year.** Grain storage therefore occupies a vital place in the economies of developed and developing countries alike.

Basic human needs consist of three main essentials:

- 1. Food** – There is an increasing need to extend the life of harvested grain with our exponentially growing world population. The following documents show how to achieve this with Dincel Construction System.
- 2. Water** ([Download – Water Conservation](#)) offers a sustainable solution to our water problem.
- 3. Shelter** ([Download – Dincel Solution for Housing Affordability](#)).

## GRAIN STORAGE

The main function of storage in the economy is to even out fluctuations in market supply, both from one season to the next and from one year to the next, by taking produce off the market in surplus seasons, and releasing it back onto the market in lean seasons. This in turn smooths out fluctuations in market prices. The desire to stabilise prices of basic foods is one of the major reasons why governments try to influence the amount of storage occurring, and often undertake storage themselves.

Storage with Dincel allows the following:

- Significant reduction in construction time and cost of storage facilities including structure and mechanical facilities.
- Maintenance and supervision costs for both grain and storage facilities.
- Maintaining quality and nutritional value of grain by keeping the grain insect-free and below its safe moisture content and temperature.

## FACTORS INFLUENCING THE CHOICE OF BULK STORAGE

Compared to most other foodstuffs, such as meats and vegetables, grains are relatively easy to store. **If grain is kept insect-free and below its safe moisture content, it will keep for many years with minimal loss of quality or nutritional value.** Low temperature is an important factor in minimising insect activity and in maintenance of nutritional quality in general. Storage at or below the safe moisture content is essential for prevention of deterioration caused by micro-organisms and insects.

Where insects are present, temperatures are high, and particularly where moisture content is above safe levels, then storage of grain becomes both risky and difficult, and losses will be difficult to avoid. It is in these circumstances that the type of store and its design become critical to the safety of the stored grain. It is worth noting that the value of the grain (in dollars-per-tonne) is usually greater than the cost of the structure in which it is stored. Minor expenditure in improving the quality of the store can thus be quickly recovered if commodity losses are commensurably reduced.

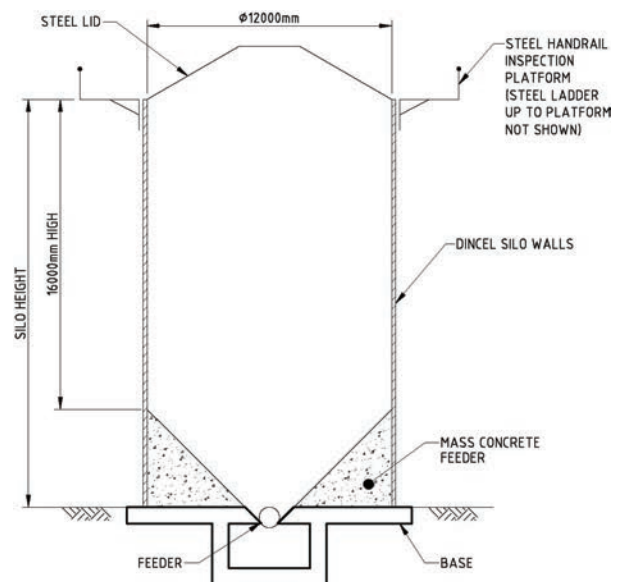
Whilst the choice of storage design is wide, the essential requirements needed to store grain safely remain the same. Essentially the storage structure must keep the grain free from water ingress, insects, rodents and birds. The store should also permit easy and economical disinfestation of grain in the event of insect infestation and, if grain is to be stored at moisture content above 'safe' levels, provision should be made for cooling the grain.

## SELECTION OF STORAGE TYPE

Once a storage need is identified, the choice arises as to the type of store that is most suitable for a particular application. The following storage options may need to be considered: round or rectangular, tall or short, steel or concrete, flat floored or hoppers, permanent or temporary.

**In terms of structural cost per tonne of storage, the walls and roofs with round tanks are more economical than rectangular ones.** The reasons are:

- Storage pressure on the walls is effectively resisted by hoop tension forces only without bending in case of round tanks.
- The roof with cylindrical structures carries its load in direct compression and tension without bending.
- Round tanks have no joints and offers air-tight structure which is better for fumigation.



**TYPICAL CIRCULAR WHEAT SILO**  
**FIGURE 1**

The circular grain storage silos can also be designed and constructed on similar principles to water tanks. For guidance refer [\(Download – Water or Liquid Storage Tanks\)](#).

## DINCEL POLYMER MATERIAL OFFERS SAFE AND SUPERIOR PROTECTION TO GRAINS STORED

Dincel polymer consists of heavy metal free stabilisers and no plasticisers. Dincel polymer has been tested and confirmed that the total volatile organic compound (VOC) measurement is below the detection level which makes Dincel polymer 50 times better than the Australian Green Star's threshold for VOC. Refer ([Download – VOC Emission Test Certificate](#))

The above qualifies Dincel polymer to be classified as better than the commonly known water and food grade polymers. To better understand the superiority of Dincel polymer for food conservation refer ([Download – Indoor Air Quality, Condensation, Mould and Mildew](#)).

## CONSTRUCTION MATERIALS

The choice of construction material for the silo wall is usually between steel and concrete.

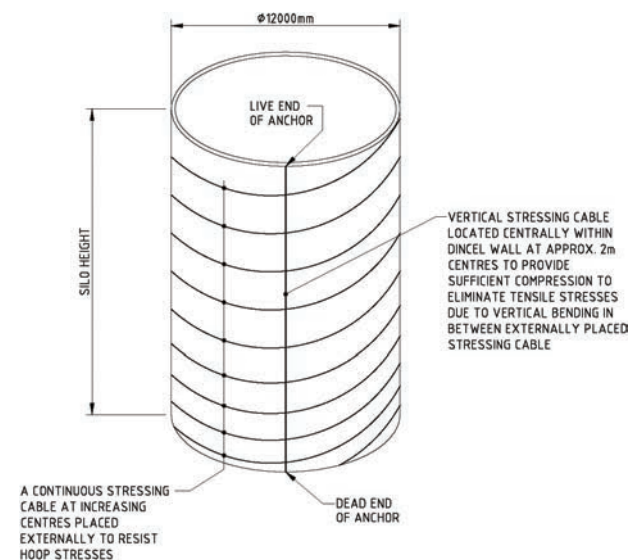
The choice between steel and concrete is dependent on a number of considerations, all of which ultimately comes down to capital and operational costs. The fact that in most countries conventional steel and concrete are both so widely used indicates that these costs are generally not dissimilar.

Conventional concrete is usually the preferred construction material in coastal areas or where high corrosion risk is severe. The concrete is also preferred where bins have to be very tall (above 30 metres). However, the construction of Dincel storage tanks is far more economical than conventional concrete (reinforced or pre-stressed) tanks. The reasons for this are as follows:

- Dincel's formwork is at least half the price of conventional formwork and much faster to erect.
- The permanent water and air-tight polymer formwork eliminates the issues for concrete's durability and crack control. This in turn eliminates issues normally related to:
  - Porosity of concrete and corrosion of reinforcement.
  - The use of steel reinforcement for crack control. Refer ([Download – Why Engineers Can Omit Crack Control Reinforcement](#)).
  - The Dincel-Walls have been tested by CSIRO Australia. The tests revealed that Dincel joints were tested under 6m head of water pressure and found to be waterproof. The vapour transmission of Dincel polymer was also tested and found to be 180 times less porous than the standard for conventional membrane systems. Refer ([Download – CSIRO Certificate](#)). This will achieve the following:

- > Control of leakage of air in or out of the tank walls.
- > Control of condensation and fungal growth.
- > High levels of air-tightness for fumigation in concrete silos. The use of CO<sub>2</sub> for disinfection of grain is normally not used in conventional concrete silos without protective membranes on the concrete surfaces to avoid causing corrosion problems. The permanent Dincel polymer automatically eliminates this problem.
- > Significantly sealed grain silo with reduced oxygen content.

- The solid construction with waterproof and crack free Dincel-Wall prevents entry of rodents into the storage tank and offers maintenance free ready finish.
- Appropriate cost effective insulation techniques applied to Dincel will achieve the following:
  - Keeps the storage below 17°C ~ 20°C which will eliminate infestations of most insects.
  - Elimination of heat conductivity type of condensation for fungal growth in grain silos.



A TYPICAL WHEAT SILO FOR ENGINEERING DESIGN PURPOSES

FIGURE 2

**NOTE:** Externally applied individual stressing cables rather than continuous ones as shown above may also be applied. The continuous cable significantly simplifies installation, eliminates the need for scaffolding at each cable level and reduces cost/time related issues associated with cable installation.

As a rule of thumb, the costs of conventional modern bulk grain storage and handling facilities can be broken down roughly as follows:

Storage Component	<b>40% to 60%</b>
Structures and Support	<b>10% to 20%</b>
Mechanical Equipment	<b>20% to 40%</b>
Electrical and Controls	<b>10% to 20%</b>

Subject to the usage of Dincel with the appropriate insulation temperature technique, the abovementioned costs (storage component to remain unchanged) are significantly reduced.

However, most importantly, the stored grain and the structure will have a much longer life span and less maintenance costs.

## **CONCLUSION**

As stated above, steel silos are expensive to build and have high maintenance costs. The presence of even further reduces the cost of concrete silos because of its ready and easy to install polymer formwork.

Dincel-Wall provides a total seal against vapour, air, water, rodents and insects. The permanent polymer presence offers the function without the risk of corrosion when CO<sub>2</sub> fumigation is used.

The thermal mass of Dincel polymer will provide much better insulation in comparison to steel silos which is essential for the life of stored grains. Dincel-Walls can be complimented easily with additional heat insulation (e.g. externally sprayed foam application) in warm to tropical climates to keep the internal silo's temperature below 17°C.

The above ensures that the storage structure and stored grain will have a much longer life span than what is currently achieved.