Concrete for all seasons: Insulated concrete panels – beating the cold

Lets be frank – concrete not properly insulated can be damp and cold. The medium's potential permeability can be a liability when not properly handled. But that's a problem that need never occur.

New approaches to insulation are helping to ensure the advantages of building in concrete are optimised. This article examines the impact of insulation on heat transfer and noise movement and looks at insulated concrete panels as one new system boosting the comfort of concrete.

Concrete provides thermal mass, which is able to store significant amounts of thermal energy, but it's a poor insulator, delivering an R-value of only 0.133 per 200mm thickness. Without insulation, the mass will not work: radiant energy transfer will make a dwelling unbearably hot during summer and cold in winter – a fact that anyone who has worked in an uninsulated concrete office or warehouse will readily tell you.

A significant advantage of concrete is its ability to minimise sound transfer through walls and suspended floors. Concrete on its own has an impressive sound transfer (STC) capability. However, recent research by Marshall Day Consultants has found that strapping and lining concrete with gib-board results in a significant loss of STC rating. For example, 150mm filled concrete block walls have a rated STC level of 56. On site this might be 50. With a 50x20 shot-fired batten and gib-board lining to both sides, this rating will drop down to 49 – even lower as an installed system. At this level, the Building Code is not being met. Such a system sets up a mass/air/mass block on both sides of the concrete, to create a resonance chamber that results in a big dip in the transmission loss curve and a five point drop in the STC level.

Enhancing the natural benefits of concrete

On masonry structures, insulation is traditionally placed internally as a strapped and lined system. This approach does not allow the thermal advantages of concrete to be fully realised. Additionally, dew points at the insulant/concrete interface may result in condensation leading to lining deterioration, mould development and wet insulants, with a resulting drop in performance if not planned for.

To resolve these issues, thermal insulation should be placed towards the outside of the building envelope. In fact, concrete's thermal mass characteristics can only be maintained by insulating the outside of the structural concrete.

Insulated Concrete Panels

This can be achieved with precast (onsite or offsite) panels by using an insulated sandwich panel system comprising extruded polystyrene sandwiched between concrete. To prevent thermal bridging it is important that non metallic ties and continuous insulation are used. One system which exists in New Zealand (Thermomass) uses pre-drilled extruded

requirements for the building). The panel is produced by first placing the 65 mm layer of concrete with mesh or steel fibre for reinforcing. This is followed by a continuous layer of pre-drilled Styrofoam insulation, the insertion of the insulated connector ties into the fresh concrete and the consolidation of these connectors in the fluid concrete. From this point the process is the same as for any precast/tilt-up panel.

Building with these insulated panels is no more difficult than the standard precast/tilt-up option.

Frequently Asked Questions about Insulated Concrete Panels

1. Precast on or off site?
There are now a large number of precasters throughout New Zealand familiar with the construction of insulated panels. They typically produce high quality panels with surfaces suitable for paint finishes. Panels can be produced without weather delays, while footings and floors are poured, allowing fast-track timetables to be met. This will be particularly important on constricted sites. An off-site precaster might also be able to take advantage of lower concrete costs, which will decrease the cost disadvantages associated with cartage, and have a single lift sequence. For more repetitive jobs with open sites and less emphasis on finish quality, however, tilt-up on site might be the best option.

2. How available and affordable are cranes?
There are now more large capacity cranes available at lower cost than a decade ago.

3. What is the lead time for delivery?
If manufacture is off-site, talk to your precaster about lead time; typically allow two to four weeks from order to supply. Extruded polystyrene and connector stocks are maintained in New Zealand, however it is better for the contractor to order as soon as the job is confirmed to ensure the stock they require will be immediately available in their area.

Insulated concrete panel building in Christchurch.

polystyrene and non-conductive fibre composite ties as the insulated connection system between a structural layer of concrete and a concrete outer face panel.

The panels are a sandwich of 65mm non-structural concrete, extruded polystyrene insulation (30mm – 50mm) and structural concrete (as per engineers'

4. How widely used are panel systems?
Concrete structures using the insulated sandwich panel system can be seen throughout New Zealand: as houses, institutional buildings, office blocks, stores, freezers, and recreational buildings. Word-of-mouth recommendations about the system's value-added performance and

Insulated concrete panels in position and temporarily propped.

Building nearing completion.

simplicity of construction mean it is growing in popularity.

The Maths, Statistics and Computer Science Building at the University of Canterbury, designed by Auckland firm Architectus and built using insulated concrete sandwich panels, has won both architecture and energy design awards. Thermomass 'barrel' buildings for wine storage have successfully reduced wine evaporation and the durability of the system has been recognised in its use for correctional facilities throughout the country.

5. What assistance is available for the architect?

Many buildings have been completed throughout the world using the insulated concrete sandwich panel system. Details that have been developed for these structures, which may be of use in a new project, are available to architects. Assistance is also available for the development of specific details. For more information visit the website: www.thermomass.com

Future developments

Significant advances are being made to overcome the problems with current finishing systems (linings battened to walls or insulation board direct-fixed to concrete) reducing the natural acoustic performance of concrete. The transmission loss difficulties with these finishing systems have been hard to overcome and there is a need for the industry to recognise the issues and develop systems to combat acoustic performance loss. However new technologies developed overseas, and not yet available in New Zealand, have produced insulation and lining products that can increase STC ratings. The advantage of these systems, such as Immotus R+, are their performance/thickness ratio and ease of installation.

With new approaches to insulation, concrete can deliver optimum conditions for the health and comfort of building occupants. New technology is bringing improvements in performance that will ensure the industry can meet the expectations of an increasingly discerning and demanding market.C

Thanks to John Gibbons of Composite Distributors Limited for the information in this article.