

CHANGE REPORT – BUILDING FACADES

Stratified Concrete Panels for Energy Efficient, Low Carbon Building Facades

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The energy performance of buildings in New Zealand is relatively poor and heating and cooling represents a large proportion of the country's power demand. Concrete is widely used in buildings for structural purposes and increasingly to provide thermal mass that helps moderate interior temperature fluctuations. Structural concrete is however dense and has poor insulation such that it cannot be solely used as a building façade material. Portland cement used to produce concrete also has relatively high embodied energy and carbon dioxide.

Optimum thermal performance of building facades is produced when the interior has high thermal mass while the exterior has good insulation. Such a material can be produced using concrete with different density aggregates that can be vibrated into two distinct layers as shown in Figure 1. This controlled segregation is termed stratified concrete and is able to produce a variable density panel suitable for buildings. The viability of the system can be enhanced by using waste materials with low or zero embodied energy and carbon dioxide.

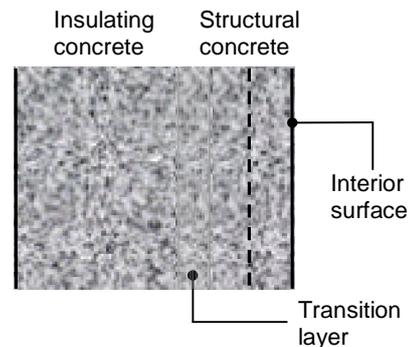


Figure 1. Schematic cross section of a stratified concrete panel orientated to maximise the effectiveness of its thermal mass.

Laboratory production of stratified concrete panels has been undertaken at the University of Canterbury over the last five years. This material incorporated recycled glass beads as lightweight aggregate and waste slag as heavyweight aggregate. Mixes were also developed that contained no Portland cement but used inorganic polymers made from waste materials such as fly ash and ground granulated blast-furnace slag. The thermal performance of the units has been shown to be good with equivalent R-values of 2.2 to 2.5 m²K/W.

The feasibility of producing stratified concrete panels is currently being assessed in a Christchurch precast yard. These trials are using imported glass beads since there is no local supplier despite an abundant supply of crushed glass. Ultimately such a system would need to be produced in a purpose-built facility, especially if inorganic polymer concrete is considered since this is sensitive to contamination or mishandling.

Changing the perception of concrete is slowly occurring as new materials and technologies gain acceptance. There is a growing number of new applications such as green, bendable and self-cleaning concrete. Stratified concrete has the advantages of being potentially cheap to produce, simple to manufacture, has good thermal performance and can be made almost entirely from waste materials.