Litecrete for School Construction

Litecrete lightweight precast concrete from Wilco Precast Ltd is manufactured using pumice as an aggregate, which reduces the weight of the concrete and provides excellent insulating properties. The combination of pumice and cement, together with steel reinforcing systems and polypropylene fibre, results in Litecrete's unique strength-to-weight ratio, making it 40% lighter than standard precast.

Litecrete lightweight precast concrete walls are an ideal structural option for school classrooms. They are load-bearing up to two stories. Litecrete's concrete mass means that it can easily meet acoustic insulation requirements and its inherent fire resistance exceeds the minimum fire requirements at no extra cost. The resulting repair cost following any fire will thus be reduced. Using precast concrete provides robust finishes and rapid installation, meaning a shorter and more risk free construction programme. As well as offering these benefits, Litecrete is rot proof and moisture proof, ensuring a durable and effective building system.

The design and construction of schools plays a major role in the effectiveness of teaching. Key design issues for schools for the future include:

- energy efficiency
- robustness by way of reduced maintenance for external/internal walls
- fire resistance
- Acoustics
- long-term durability
- sustainability

Energy efficiency

Litecrete 220 mm thick panels have an insulation value of R-0.8 - four times more thermally efficient than standard precast. This is the Building Code requirement for residential construction. However, in using standard precast at 150 mm thick, the mandatory insulation placed on the internal face will negate the benefits of the thermal mass of the concrete; its ability to store and transmit energy. On the other hand 220 mm thick Litecrete panels achieve R-0.8 and comply with the Building Code insulation requirements for residential construction (in Climate Zone 1). Once installed walls are complete, apart from interior and exterior decoration. No timber framing, no building paper, no cavities, no plasterboard, no external cladding . . . and no leaky building syndrome . . . ever. Exposing precast concrete surfaces allows the thermal mass to moderate peak temperatures. This has been understood by designers for decades, but until recently has not been taken advantage of. Litecrete can also be supplied at 150 mm thick.

It is becoming a more important issue because of:

- Impending regulations that will require reduction of CO_2 emissions.
- Climate change. It is now an accepted fact - and whilst the scale of temperature rise is disputed and the cause not unanimous – that most agree New Zealand buildings will be exposed to ongoing higher temperatures.

Utilisation of thermal mass can overcome the need for air conditioning and it also moderates peak temperatures. Summer overheating is already recognised as a problem for lightweight timber construction. This is a fact in school classrooms and will only get worse with the increasing temperatures associated with climate change.

Robustness/Minimisation of Maintenance

Hard durable finishes, that require minimum maintenance, are important features for a new schoolroom. Overcoming the need for suspended ceilings by designing exposed concrete soffits saves initial costs and ongoing maintenance and replacement. Internal and external walls are subject to harsh treatment and precast concrete walls have the advantage of withstanding impact and water damage.

Fire Resistance

All schools are designed to be safe in fire: as required by the Building Code. Life safety is assured. However, there is no requirement in regulations for property safety. Litecrete lightweight precast concrete structures provide the highest level of property safety because of their inherent fire resistance. BRANZ Fire Resistance Test FR 3524 resulted in a fire resistance rating of 240/240/240 based on a 150 mm thick test panel. Standard precast concrete must be 165 mm thick to achieve this rating. Schools are, unfortunately, a target for arsonists. The highest level of property safety means that the time and cost to have a building operational following a fire is at a minimum. Property safety should be a key consideration in school design. Litecrete provides the best fire resistance of any building material. It does not burn, it cannot be set on fire like other materials in a building and it does not emit any toxic fumes, smoke or drip molten particles when exposed to fire. This excellent fire performance is due in the main to Litecrete's constituent materials (i.e. cement, pumice aggregate and polypropylene fibre) which, when chemically combined, form a material that is essentially inert. It is this slow rate of heat transfer which enables Litecrete to act as an effective fire shield not only between adjacent spaces but also to protect itself from fire damage. The inclusion of polypropylene fibres also assists in fire prevention on the basis that, if the concrete is heated by fire, the fibres melt, creating passageways along which water vapor can dissipate, so avoiding a build-up of pressure to prevent the concrete fracturing (spalling), which happens when abnormal heat is applied to standard precast concrete.

Acoustics

Concrete provides excellent sound insulation performance with minimum additional finishes required. The required performance can be achieved with minimal cost because of concrete's inherent qualities. A 150 mm thick Litecrete panel achieves STC 47; 150 mm with resilient metal furring strips, insulation blanket and Gib board on one face, STC 60; 180 mm, STC 50; 260 mm thick panel, STC 55.

Sustainability

Sustainability and sustainable development are terms at risk of over-use, but they are increasingly important as the environmental limits to economic growth become apparent. Specifically, the need for environmentally sustainable development refers to two main issues:

- The emissions generated by the consumption of these resources are causing environmental degradation and are leading to global warming
- Finite natural resources are being used and discarded at a rate that we cannot sustain

Light Weight

Because Litecrete is 40% lighter than standard precast concrete more panels can be shipped on each truck, thus reducing traffic movements and CO^2 emissions. Another advantage is that smaller cranes can be used on site. Often, lighter foundations can be designed compared to those for standard precast concrete.

CO_2 Emissions

Shortly, Litecrete will be manufactured using HR Cement's ECOCEM. This sustainable cement has a 25% pozzolan replacement (25% of the cement will be replaced with perlite) which means savings in CO_2 emissions and qualification for Greenstar points . . . all at no extra cost. Litecrete has less embodied energy and CO_2 than a timber-framed building and more importantly, in service, due to its thermal mass, out performs other materials.

Concrete Reabsorbs CO_2

Recent studies have shown that during the life of a concrete structure, the concrete carbonates and absorbs the CO_2 released by calcination during the cement manufacturing process. Once concrete has returned to fine particles, full carbonation occurs, and all the CO_2 released by calcination is reabsorbed. The study indicates that in countries with the most favourable recycling practices, it is realistic to assume that approximately 86% of the concrete is carbonated after 100 years. During this time, the concrete will absorb approximately 57% of the CO_2 emitted during the original calcination. About 50% of the CO_2 is absorbed within a short time after concrete is crushed during recycling operations.

Durability

Concrete builds durable, long-lasting structures that will not rust, rot, or burn. Life spans for concrete building products can be double or triple those of other common building materials. Building Code requirements for structural walls require minimum of 50 years durability. Litecrete panels come with a 50-year warranty. University of Auckland "sorptivity" test showed that Litecrete had superior moisture resistance when compared to normal 30 MPa precast concrete.

Thermal Mass

Classrooms built with concrete walls, foundations, and floors are highly energy efficient because they take advantage of concrete's inherent thermal mass—or ability to absorb and retain heat. This means reduced heating and cooling bills and smaller-capacity HVAC equipment.

Minimal Waste

Litecrete panels can be produced in the exact quantities needed for each project, thus reducing waste. After a concrete structure has served its original purpose, the concrete can be crushed and recycled into aggregate for use in new concrete pavements or as backfill or road base.

No Toxic Mould

Exposure to toxic mould in damp buildings has been blamed for ailments ranging from headaches to severe respiratory infections and immune system disorders. Children are more susceptible than adults. Mould can thrive on any organic material, especially in warm, moist, humid conditions. In addition to carpeting, mould can feed on plasterboard lining paper, timber joists and framing and other wood-based materials. Litecrete precast panels do not have organic components in the mix, therefore won't support the growth of toxic mould.

Rot-Proof

Litecrete is rot-proof. You will never, ever, have to experience the trauma associated with "leaky building syndrome" when building with Litecrete.

External Surface finishing

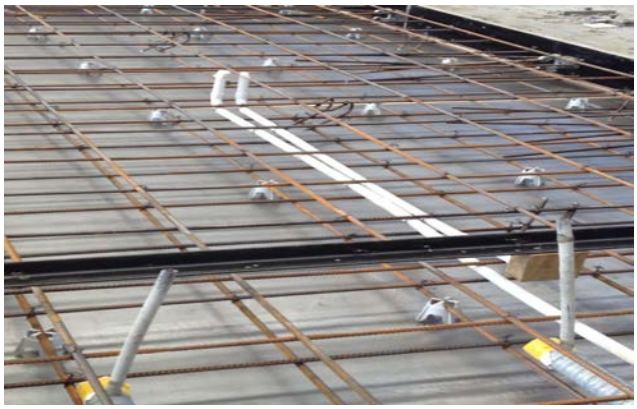
The flat exterior surface of the panel is produced off a steel casting bed. This means that once installed the panels are ready for plastering or painting. Designs, such as school logos, can be replicated on the surface of the panels using simple rebates or sophisticated urethane formliners. However, when painting or plastering, vapour-permeable systems should be used. We also recommend systems that have been BRANZ appraised and/or meet the NZBC requirements. Where a natural concrete finish is required, permanent graffiti-resistant coatings can be applied directly to the precast concrete surface or durable translucent concrete stains can provide colour options.

Internal Surface finishing

The interior face of the panel has a rougher, trowelled finish, as opposed to the exterior face, which is off a smooth steel mould. This surface can be painted as delivered with a high-build system, however we recommend a 1-2 mm skim coat applied first as the base, to provide a superior painting surface. Plasterboard, ceramic tiles, etc, can also be glue-fixed to the internal walls. Note that if the panels are to be plastered, control joints should be installed over each vertical panel-to-panel V-joint so that they can cope with any structural/seismic movement without fracturing the plastered surface.

Electrical Services

Plastic conduits can be cast-in to the panels for electrical services/cabling, as shown in photo at right. Or chases can easily be cut into the panels on site using a diamond-tipped router.



The above facts are a good reason to at least consider whether or not Litecrete would be an appropriate option for your school project.