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Sustainability - Using Precast for Sustainable Construction

Sustainability is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It encourages the protection of the environment and prudent use of natural resources. Sustainable development challenges the design and construction industry to create buildings and structures that acknowledge the life cycle of the structure.

With buildings, recognising that operating a building over time is far more energy intensive than developing it, demand for durability andenergy performance is growing. Greenhouse gas emissions in buildings are due to both embodied energy and operating energy.

The importance of material choice

Choosing the right materials is a key consideration in sustainable construction. When compared with other construction materials, precast concrete is a responsible choice for sustainable development. The underlying properties of precast make a strong contribution to sustainability. Architects, engineers and builders are choosing precast for its durability, reduced maintenance and energy performance; properties not found in other construction materials like steel or timber. Benefits of using precast come from every angle… efficient manufacture, on site (during construction) and for the life of the building.

Design and manufacture

Because AS3600 recognises the high quality of precast concrete, it rewards the user of precast concrete with reduced concrete cover to reinforcement and the physical size of precast elements can be reduced by up to 15% when compared with in-situ concrete. In addition, most precast concrete flooring systems offer savings of up to 50% in concrete and reinforcing steel due to the structural efficiency of their voided or ribbed cross-sections. These dematerialisation advantages offered by precast are indeed a benefit to our environment which can be easily overlooked.

Precast concrete is manufactured in a controlled environment allowing more efficient use of materials with very little waste compared with in-situ concrete.

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The advantage of controlled manufacture becomes apparent as each part of the process can be easily monitored and controlled due to the operations being repetitive. Employment of lean production methods and sophisticated quality systems in the factory, as well as superior vibration and curing techniques, steel casting beds, repeated use of moulds and specially designed mixes mean a higher quality product with minimal production waste. The minimal waste which is generated in the factory is more readily recycled because production is in one location.

To reduce the use of virgin materials and the overall environmental burden, recycled materials such as fly ash, slag, silica fume, recycled aggregates and water can be incorporated into precast concrete. Use of such products diverts them away from otherwise being added to the growing landfill mass.

During construction
On site, precast construction creates less air pollution, noise and debris. Local materials are often used and transportation is minimised. Formwork is reduced or eliminated and buildings can be erected quickly. As well, site waste is significantly reduced as exact elements (in both size and quantity) are delivered to the construction site.

Post construction
What happens after construction can also make a solid contribution to sustainable building strategies.

Precast's high quality means that it can be left exposed in order to maximise the benefits of its inherent high thermal mass. Because of its high density, precast has the ability to absorb and store large quantities of heat. This in itself may improve heating and cooling efficiency by as much as 30% compared to other building alternatives.

Further, the high quality and integrity of precast means that maintenance and operating costs are low. For minimal on-going maintenance, precast can be left exposed (with finishes such as off-form, sandblasted, water-washed, honed, polished, coloured with oxides or stained). More durable than other materials, precast provides long service for high use applications and can easily have a life expectancy of 100 years.

When the time does come to reuse or renovate a precast structure, its durability means that the main portion of the structure is very often left in place. This helps the environment by conserving resources as a result of reduced waste (which otherwise goes to landfill) and avoiding the environmental impacts of new construction.

Increasing the sustainability of precast
Although concrete has a high level of embodied energy, designers and builders can adopt the following options to reduce embodied energy and make it more sustainable.

Recycling of concrete waste
The Australian Greenhouse Office encourages and rewards builders and designers to give due attention to the use of a significant recycled content in building construction or refurbishment. Concrete waste can be processed to produce roadbase/fill material, recycled concrete aggregate and recycled concrete fines. Extensive research has been undertaken to increase the use of recycled concrete worldwide. The primary use of recycled concrete in Australia is for roadbase material, which not only reduces the need for natural fill but is also commercially viable.

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Use of supplementary cementitious materials

The quality and properties of concrete can be improved by replacing a portion of the cement with industrial by-products known as supplementary cementitious materials (SCM) such as fly ash, blast furnace slag and silica fume. Use of these materials also reduces both mining of natural resources and greenhouse emissions associated with cement production while disposing of a waste material previously destined for landfill. Fly ash is commonly used to replace between 20–25% of portland cement in a blended cement, although higher percentages are possible and could be adopted where appropriate for a greater impact.

Increase the use of recycled water in concrete

Recycled water has been successfully used in concrete for many years. Its use, quality and limits are assessed under AS 1379. In addition, finishing processes such as polishing and honing can use recycled water.

Improving building design and specifications

This involves:

1. Developing low-energy, long-lasting yet flexible buildings and structures;

2. Exploiting the thermal mass of concrete in a structure to reduce energy demand;

3. Considering innovative or alternative design that incorporates de-materialisation such as using materials that have undergone an energy-saving process or action during manufacture or sourcing such as a filler component in cement manufacture.

Specific examples of where sustainable design using precast construction, can make a considerable environmental impact can be found in the second edition of the Precast Concrete Handbook, on sale soon from SAI Global – register at www.nationalprecast.com.au to be notified of availability.

Precast's sustainability benefits come from every angle…

- Lean manufacture, superior vibration and curing, steel casting beds, special mixes and recycling of waste means a higher quality product with minimal production waste.
- Moulds are often used repeatedly.
- Local materials are used, transportation is minimised.
- Recycled materials (eg fly ash, slag, silica fume, recycled aggregates, grey water) can be incorporated.
- Precast construction creates less air pollution, noise and waste (exact elements are delivered to site).
- Precast can be left exposed, maximising thermal mass benefits.
- Precast has a long life expectancy and maintenance and operating costs are low.
- Precast structures can be retained and refitted internally.

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LEFT: Precast concrete is manufactured in a controlled environment allowing more efficient use of materials with very little waste.

ABOVE: ANU's Hedley Bull Centre - repeated use of moulds and specially designed mixes mean a higher quality product with minimal production waste.

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