Concrete

Concrete has traditionally been used for foundation walls, floor slabs and paving in New Zealand homes. Use of precast concrete as a wall construction system has increased markedly since the 1990s.

Extraction and manufacture	
Impact of extraction	Quarrying for aggregate and removal of sand creates dust, noise and a visual impact. There is also potential for damage to local ecosystems during raw material extraction.
Use of energy and other resources	Embodied energy for concrete is quoted[1] as 0.9 MJ/kg for 17.5 MPa ready mix concrete and 1.2 MJ/kg for 30 MPa ready mix concrete. Manufacture of concrete uses significant amounts of water. The first New Zealand company to get a registered environmental product declaration (a verified document that reports environmental data of products based on life cycle assessment) under the Australasian EPD programme was a concrete company (Allied Concrete Ltd). In March 2021 the Golden Bay Cement works in Whangārei began using waste tyres as fuel. Up to three million used tyres per year will no longer go to landfills. It is expected that the change will reduce coal use by 15% and reduce carbon emissions by about 13,000 tonnes a year.
By-products/emissions	Cement manufacture releases significant amounts of dust and carbon dioxide to the atmosphere. Concrete also absorbs carbon dioxide over the life of a building, but opinion is divided as to whether there is enough absorption for concrete to be considered a carbon sink.
Sourcing	
Material sources	Aggregate comes from local quarries. Cement is manufactured in New Zealand or imported. Recycled crushed concrete may be used as part of the mix for low grade applications. Industrial waste products such as fly ash, ground blast furnace slag and silica fume may be incorporated into specifically designed concrete mixes to reduce the amount of cement and therefore reduces embodied energy and emissions.
Availability	Ready-mix concrete, and concrete raw materials, are readily available throughout most of New Zealand.
Cost	Up-front costs are medium to high depending on the construction process used. With poured concrete, there are on-site costs including preparation and disposal of formwork. On-site costs are lower for large-scale precast panels.
Transport to site	Concrete and concrete raw materials are heavy to transport. Transport costs increase with distance from manufacturing plant. Concrete requires specialised lifting equipment. Liquid concrete requires specialised transport and handling equipment.
Construction/installation	
Health and safety during construction/installation	Safety equipment is required when handling cement (gloves, overalls) or cutting/drilling concrete with a masonry saw or drill (ear muffs, safety glasses, mask and overalls) to eliminate risk of skin irritation and lung damage due to dust inhalation. Protect skin from the highly alkaline wet concrete. WorkSafe has produced some guidelines on the safe handling, transportation and erection of precast concrete elements at: www.worksafe.govt.nz/topic-and-industry/concrete/safe-work-with-precast-concrete

Ease of construction/ installation	Concrete is a heavy construction method when used for walls. Heavy lifting equipment is required for precast components. Building with concrete or using it as a weatherskin or decorative material requires specialised skills. Cement-rich wastewater (which may set) must be kept from drainage systems.
Adaptability	Once built, concrete is difficult to adapt.
Performance	
Health and safety during life of building	Concrete is inert, non-toxic and not prone to off-gassing of volatile materials.
Structural capability	Concrete has excellent strength in compression. Steel reinforcing improves strength in tension.
Expected durability (assuming correct installation and maintenance)	80-100+ years. Concrete remains durable even if wet.
Maintenance rating	Low to medium – maintenance requirements will increase if coated.
Moisture resistance	Moisture absorption into good dense concrete is very low. Concrete can be used as an impermeable finish in domestic wet areas.
Rot, mould and corrosion	Steel reinforcing can corrode in poor quality concrete. Lichens and mosses will grow on damp, weathered surfaces.
Thermal performance	Concrete provides low levels of thermal insulation unless a specific insulating material such as polystyrene is incorporated into the element design. Concrete provides high thermal mass when it is exposed to a home's interior and direct warming from the sun (see www.level.org.nz/passive_design). Thermal mass is reduced if the concrete is isolated from interior warmth by insulation. Most thermal mass in NZ homes is provided by concrete slabs on ground.
Sound insulation	Concrete's high mass provides very good sound deadening.
Fire performance	Concrete will not burn but may spall when heated. It is readily incorporated into fire resistant rated construction.
Waste disposal/recycling/re-use	
Re-use	Only when recycled as below.
Recycling	Concrete can be crushed and reused as aggregate in new concrete or for paving/ roading. Specialised demolition equipment/skills are required. Demolished materials are heavy to transport. New concrete with more than 30% recycled concrete aggregate may use more water, be less workable, and have lower strength. Quality of crushed material is variable and may contain contaminants.
Waste disposal	Demolition material can be used as fill. However, the large volumes can overwhelm a dumping site. Concrete is inert when disposed of in landfill but large volumes will fill an area quickly.

1. Embodied energy figures taken from work © J. Andrew Alcorn, 2010. (Alcorn, J. Andrew, *Global Sustainability and the New Zealand House,* a thesis submitted to Victoria University of Wellington in fulfilment of the requirements for the degree of Doctor of Philosophy in Architecture, Wellington, 2010.)