Steel

Total world production of crude steel in 2012 was 1.5 billion tonnes. Only a portion of this is used in the construction industry, principally for structural members, claddings and fasteners or fixings.

Most steel is made by one of two basic routes:

- integrated blast furnace and basic oxygen furnace, using the raw materials iron ore, limestone and coke, possibly with some scrap included
- electric arc furnace, using mainly scrap steel which is re-melted with additives.

Other methods of steel production can be used, but these are reducing yearly as technology improves. Recycling steel dramatically reduces the embodied energy of the end product, avoids mining and the production of coke.

Of the steel produced in 2012, 69.6% was by the oxygen route, 29.3% by the electric route, and 1.1% via the open hearth method.

Extraction and manufacture	
Impact of extraction	There is visual impact from removal of ironsand from New Zealand open cast mines, although once the iron is extracted the sand is returned to the mine site and the natural environment reinstated. In New Zealand sand mining and manufacturing plants are generally required to comply with specific environmental conditions under their resource consents. There is also potential for damage to local ecosystems during raw material extraction. Determine if the supplier's manufacturing plant has its own water collection and wastewater recycling system.
Energy and resource use	Significant amounts of energy are used in the manufacture of virgin steel. Recycling steel uses significantly lower amounts of energy. Embodied energy is quoted[1] as: • Steel reinforcing (recycled steel in NZ): 8.6 MJ/kg • Steel roofing, 0.4 mm, factory painted: 204 MJ/m^2 • Steel roofing 0.4 mm, zinc/aluminium: 172 MJ/m^2 • Steel roofing 0.55 mm, factory painted: 250 MJ/m^2 • Steel wire, galvanised[2]: 29 MJ/kg Water is required for cooling and during the manufacturing process. New Zealand Steel manufacturing and recycling plants are generally required to comply with specific water use and return requirements under their resource consents. At the Glenbrook Steel Mill around 1 million tonnes of water is in circulation each day throughout the steelmaking process – about 1% of this water is replenished/ discharged each day. Rainwater harvesting is used to supplement water drawn from the Waikato river.
By-products/emissions	Greenhouse gas emission factors for steel production can vary between 3.7 and 5.5 kg CO_2/tonne steel – the majority of CO_2 emissions from the iron and steel process come from the use of coke in the production of pig iron. New Zealand steel manufacturing and recycling plants are generally required to comply with specific controls on plant emissions, water use and water discharge under their resource consents. By-products include slag and heat. Approximately 80% of waste from Glenbrook is recycled or reused, including the use of slag as a sub-base material in civil construction projects. A small amount of vanadium slag is also used in other manufacturing processes.

Sourcing	
Material sources	Steel is manufactured in South Auckland from local ironsand (steel coil produced at Glenbrook) and from recycled steel (reinforcing steel and wire products produced at Otahuhu). Other steel components are imported primarily from Australia, Japan and Korea; steel from China and India may also be available. Locally-made reinforcing steel is available while structural steel sections are generally imported ready to use.
Availability	Steel components are generally available throughout New Zealand. Some heavy steel sections my need to be specifically ordered from overseas.
Transport to site	Cladding and framing components are typically light. Large-scale structural components are heavy and require appropriate transportation
Construction/installation	
Health and safety during construction/installation	Steel cladding needs to be handled carefully as edges are sharp, particularly when cut on site. Safety gear including gloves should be worn to avoid injury.
Ease of construction/ installation	Framing and cladding are lightweight and easy to handle. Structural sections will require lifting equipment. Limitations exist on the bending method for high tensile reinforcing steel.
Adaptability	Steel structures can be modified relatively easily. Screw-fixed cladding is easy to replace. Bolted structural steel construction can be readily dismantled.
Performance	
Health and safety during life of building	Steel is inert and not subject to off-gassing. Unpainted and factory-painted steel cladding is suitable for roof water catchment. Some site-painted coatings may leach chemicals. Consider VOC emissions during application of specialist protective (corrosion resistant) coatings to steel.
Structural capability	Structural steel has a high strength to weight ratio. Profiled cladding can span further than most other claddings.
Expected durability (assuming correct installation and maintenance)	Uncoated steel is not durable, but can be made so with the correct level of corrosion protection such as zinc/aluminium alloy coatings, hot-dip galvanizing and painting. Dry structural steel should last 80+ years. Profiled steel wall cladding should last 50+ years (roofing possibly less), depending on material specification, cleaning, maintenance and environment. Site-cut edges of cladding may be more vulnerable to corrosion.
Maintenance rating	Structural steel requires little maintenance in a dry, protected environment. Maintenance is high when in a corrosive environment. Maintenance requirements are low for unpainted cladding in non-corrosive environments. Cladding must be kept clean, with the frequency of cleaning dependant on the environment and amount of natural rain washing. A medium amount of maintenance is required for painted cladding and intumescent coatings on steel – cladding must be kept clean, with the frequency of cleaning dependant on the environment and amount of natural rain washing. A medium amount of maintenance is required for coated steel components in damp exterior situations.
Moisture resistance	Steel is impermeable to moisture.

Rot, mould and corrosion	Steel will corrode in damp conditions and requires corrosion protection. For high levels of corrosion resistance, stainless steel cladding and structural components (brackets, bolts, nails and plates) may be required.
Thermal performance	Steel has a high rate of heat transfer, therefore does not provide thermal insulation or thermal mass benefits. Steel framing requires thermal isolation to avoid thermal bridging.
Sound insulation	Steel provides little sound insulation – thin material can vibrate and assist sound transfer.
Fire performance	Steel won't burn – but performance in fire is poor if unprotected.
Waste disposal/recycling/re-use	
Re-use	Steel cladding in good condition can be re-used.
Recycling	Steel recycling is well established in New Zealand - approximately 300,000 tonnes of scrap metal is recycled each year. Steel has the highest recycling rates and export earnings of any material. Recycling requires much less energy input than manufacturing new steel. Steel scrap is a valuable material with a well established network of companies purchasing product. Excess steel scrap is exported from New Zealand. Specialist steels such as stainless may be sent overseas for recycling. Some alloys and compounds within the steel may make the steel more difficult to recycle.
Waste disposal	Steel can be disposed of in landfill and will very slowly degrade through rusting but does not leach toxic chemicals.

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.)

2. Nails and other fasteners are made from galvanised wire from recycled steel.