Ceiling and Wall Systems

Understanding the Plasterboard and Steel Product Life Cycle

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INTRODUCTION

Walls and ceilings are vital elements in building construction, serving not only as structural components but also shaping the aesthetic and functional aspects of interior spaces. The choice of materials for these systems has far-reaching effects on aspects like acoustics, insulation, fire resistance, and energy efficiency, all of which play a significant role in the overall performance of the building.

This whitepaper aims to provide a high-level examination of the product life cycle of steel and plasterboard within the context of wall and ceiling systems. By exploring each stage of their life cycle, from manufacturing to end-of-life disposal or recycling, it seeks to equip architects and specifiers with the information necessary to make informed product decisions. The focus is on optimising sustainability, durability, and cost-effectiveness throughout the lifespan of these materials.

These considerations are important for ensuring that the design and specification of wall and ceiling systems not only meet functional requirements but also contribute to the long-term success of building projects. As a guide, we will be looking at the product, construction, use and end-of-life stage of steel and plasterboard wall and ceiling systems.

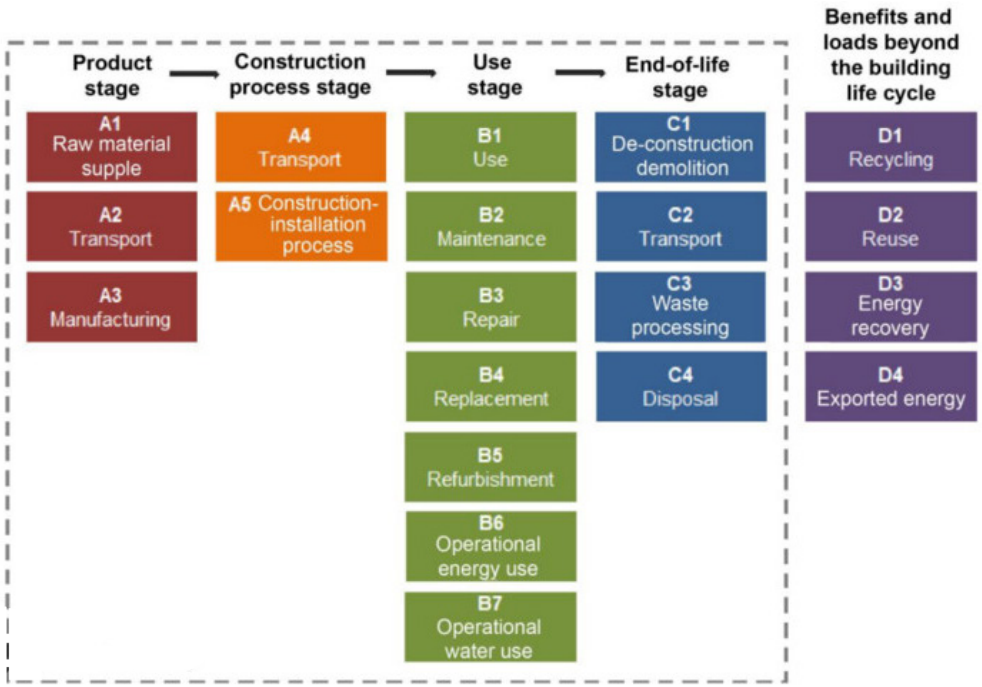


Figure 1. Life cycle stages

PRODUCT STAGE

Raw material extraction

Steel, a widely used material for framing, is typically sourced through the mining of iron ore, which is then processed into steel through methods such as blast furnace or electric arc furnace production. This stage of the steel life cycle has considerable environmental implications, particularly in terms of carbon emissions and energy consumption.

For plasterboard, gypsum is the primary raw material, and it is extracted from both natural and synthetic sources. Natural gypsum is mined, while synthetic gypsum is a byproduct of industrial processes. The mining of natural gypsum can have substantial environmental impacts, including soil erosion, habitat disruption and resource depletion. Incorporating recycling practices into plasterboard production can significantly mitigate these effects.

Manufacturing processes

Lightweight steel framing is cold-formed by passing a strip of steel through a series of rolls, with each roll gradually forming the shape. Rondo, a leading manufacturer of light gauge roll-formed steel products and systems, utilises state-of-the-art manufacturing technology and high-quality raw materials, primarily sourced from BlueScope, along with rigorous testing and quality control systems to ensure that all products meet strict specifications. The manufacturing process involves punching, bending, and cutting materials, followed by packaging for distribution.

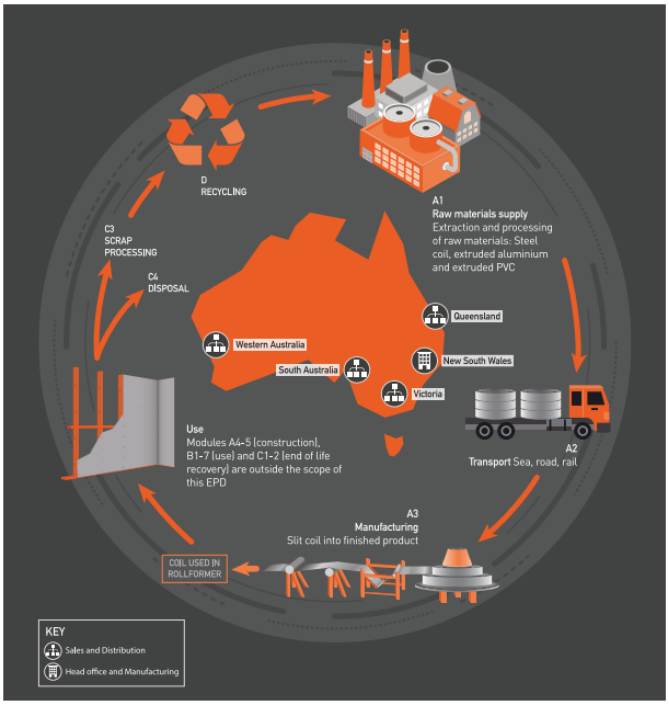
The plasterboard manufacturing process begins with calcination, where natural or synthetic gypsum is heated to remove water molecules, forming a fine powder. This powder is then mixed with water and additives to create a slurry, which is spread between layers of recycled paper. As the board moves along the production line, the gypsum recrystallises, bonding the paper to the core. After the board is cut to the required size, it passes through dryers to remove any remaining moisture, a step that requires significant energy.

Plasterboard manufacturing is generally considered to have a low environmental impact compared to many other building materials. Gypsum, the primary raw material of plasterboard, is a naturally abundant, non-toxic sedimentary rock. The energy required for its production is relatively low, making it one of the more energy-efficient building products available. Emissions from the production process are primarily limited to water vapour and the by-products of natural gas consumption, further reducing its environmental footprint.

Manufacturers such as Gyprock are continually advancing their sustainability practices.[1] For instance, all the liner boards used in their plasterboard and cornice products are made from 100% recycled materials. In addition, 95% of the manufacturing waste generated is recycled back into production or repurposed as by-products, such as soil conditioners for the agricultural sector.

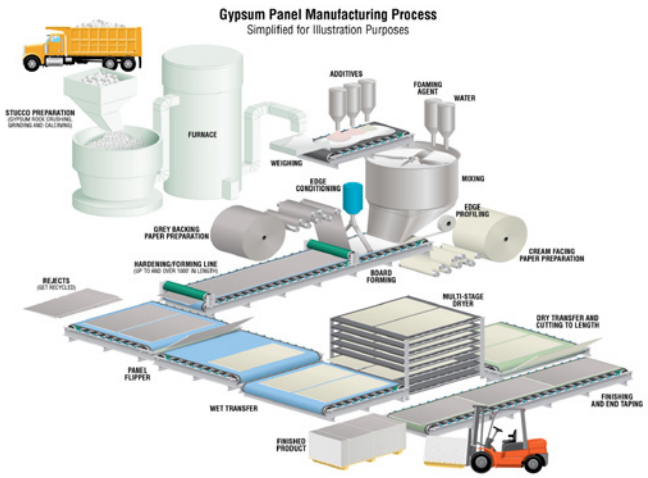
Innovations such as incorporating higher levels of recycled content into products like Gyprock Superchek and EC08 demonstrate the company's commitment to sustainability. These efforts not only improve the environmental profile of plasterboard but also contribute to the broader push toward more sustainable building practices across the industry.

Figure 2. Rondo product lifecycle



Source: https://www.rondo.com.au

Figure 3. Manufacturing process for gypsum board



Source: https://gypsum.org/making-gypsum-board

CONSTRUCTION STAGE

Selecting the right materials is essential to align with the building's structural design and functional requirements. Lightweight Steel framing, known for its tensile strength, durability, and fire resistance, is a preferred choice for many commercial and industrial applications. Plasterboard, with its versatility, provides excellent sound insulation and moisture resistance when used in the right configurations. The design phase should account for factors such as load distribution, acoustic needs, and fire safety to ensure that the selected materials perform optimally within the specific building requirements.

Early collaboration with builders, contractors, and design engineers is essential to plan functional wall and ceiling system designs, which are key to pinpointing opportunities for project efficiency, minimising risk during construction, and ensuring compliance with building codes and standards. Engaging design engineers at early stages can also greatly impact the amount of material waste produced during construction. Rondo Design Engineers work to optimise wall and ceiling designs specifying custom lengths of steel, prefabricated framing, and innovative products like DUPLEX Stud which is one stud that can replace two.

Compliance with building codes and industry standards is crucial to the long-term success of any installation.

Lightweight steel framing and plasterboard systems play an essential role in meeting compliance standards for fire safety. Acoustic and thermal insulation properties must also be considered. In addition, ensuring proper condensation management within wall and ceiling cavities can prevent issues like mould growth, structural degradation, and energy losses over time.

Figure 4. Steel-framed plasterboard wall

Source: https://www.rondo.com.au

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USE STAGE

Once installed, lightweight steel framing and plasterboard wall and ceiling systems provide functional support, fire resistance, and sound insulation in a variety of building types. Steel's durability and strength make it ideal for supporting wind and seismic loads in commercial buildings, while plasterboard contributes to a smooth finish and enhances interior aesthetics and acoustics.

Maintenance requirements for lightweight steel framing and plasterboard systems are generally minimal, contributing to their cost-effectiveness over the life of the building. Steel is resistant to pests and does not warp or degrade easily. However, periodic inspections are necessary to ensure that there is no corrosion, especially in environments with high humidity. Plasterboard may need regular cleaning and minor surface repairs, such as patching holes or cracks. Maintaining the integrity of plasterboard also involves ensuring that it remains dry and free from moisture, as exposure to water can compromise its strength and cause damage.

In the event of damage, steel framing rarely needs replacement, as repairs are typically limited to addressing specific issues like corrosion in isolated areas. The risk of corrosion can be minimised with the installation of lightweight steel framing that has been adequately coated with zinc protection. Plasterboard, however, may require more frequent repairs or replacement in high-traffic areas or where it has been exposed to moisture. Refurbishment of plasterboard systems is generally straightforward, involving resurfacing or re-installing sections.

During a building's operational phase, steel and plasterboard systems contribute indirectly to energy efficiency by supporting HVAC, insulation, and other building services. For example, plasterboard with integrated insulation can reduce heating and cooling demands. Neither material directly impacts operational water use, though their performance can support overall building efficiency by maintaining proper insulation and reducing energy needs.

END-OF-LIFE STAGE

During the end-of-life stage, the demolition of steel framing and plasterboard wall and ceiling systems can be carried out with minimal environmental impact if managed correctly. Steel, being highly durable, often remains intact and can be easily separated from other building materials during demolition. Its recyclability makes it a valuable asset, and care is typically taken to salvage as much of it as possible.

Plasterboard, on the other hand, is more susceptible to damage during demolition. Plasterboard waste can pose challenges if contaminated with other materials or if it has been exposed to moisture. However, with careful handling, a significant portion of plasterboard can be collected for recycling, reducing the amount of waste sent to landfills.

Steel is 100% recyclable, and the recycling process offers significant energy and resource savings. For every 1,000 kg of recycled steel, over 1,400 kg of iron ore, 740 kg of coal, and 120 kg of limestone are conserved, making steel recycling an environmentally friendly practice.[2]

Plasterboard is also fully recyclable. Gypsum, its main component, can be reprocessed into new plasterboard by heating and crushing it back into a powder form. Australian companies like Gyprock and Regyp provide plasterboard recycling services, allowing offcuts and even used plasterboard to be reintroduced into the supply chain.

HOW CSR GYPROCK AND RONDO ARE IMPROVING THEIR PRODUCTS' SUSTAINABILITY

Across Australia, CSR Gyprock and Rondo provide industry-leading wall and ceiling systems, delivering high-performance solutions tailored for both residential and commercial applications. Their commitment to quality and sustainability ensures durable, efficient, and environmentally responsible products.

CSR Gyprock is actively working to reduce the life cycle impact of plasterboard products through its commitment to recycling and sustainable manufacturing practices. By implementing a gypsum board waste take-back scheme across Australia, Gyprock collects plasterboard offcuts and demolition material, significantly reducing the amount of waste that ends up in landfills. The company's recycling process allows for the complete reintroduction of both gypsum and paper into the production of new plasterboard. With over 95% of its manufacturing waste either recycled back into the production cycle or converted into useful by-products like agricultural soil conditioners, Gyprock demonstrates its focus on minimising the environmental impact of its manufacturing operations.

In addition to reducing waste, Gyprock's recycling efforts help conserve natural resources and decrease reliance on raw materials. By recycling gypsum, the need for virgin gypsum is reduced, leading to energy savings and decreased environmental degradation associated with quarrying. Furthermore, Gyprock's focus on managing plasterboard waste aligns with its broader goal of promoting sustainable practices in the construction industry.

Rondo is actively improving the life cycle impact of its steel framing products through a comprehensive sustainability strategy. One key initiative is the company's Environmental Product Declaration (EPD), which provides transparent, standardised data on the environmental footprint of their products, covering nearly the entire range of steel profiles and clips. By offering products with an EPD, Rondo helps builders meet the requirements from the Green Building Council of Australia (GBCA). Additionally, Rondo has earned Climate Active certification, allowing customers to Opt-In for carbon-neutral products, offsetting the emissions from producing the steel framing's system.

Further contributing to its sustainability efforts, Rondo has achieved Steel Sustainability Australia (SSA) Level 2A certification, which boosts its Responsible Products Value (RPV) score to 13. This score enables customers to achieve higher Green Star ratings, which helps them become recognised for leadership in sustainability while also having proven financial benefits such as higher annual return on builds.

In addition, through its ISO 14001 Environmental Management System certification, Rondo ensures its operations continually improve their environmental performance by reviewing and introducing new technology, suppliers, and packaging advancements to continue to produce the best systems for customers.

For every 1,000 kg of recycled steel, over 1,400 kg of iron ore, 740 kg of coal, and 120 kg of limestone are conserved, making steel recycling an environmentally friendly practice.

References

1 Gyprock. “Manufacturing.” Gyprock. https://www.gyprock.com.au/about-us/manufacturing (14 October 2024).

2 Australian Steel Institute. “Reduce, Reuse and Recycle.” ASI. https://www.steel.org.au/what-we-do/focus-areas/sustainability/reduce,-reuse-and-recycle (accessed 14 October 2024).

All information provided correct as of December 2024

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