Less is More

Dematerialisation as a Design Strategy
for Sustainable Architecture

The adoption of lightweight materials is a foundational strategy in dematerialised architecture.

INTRODUCTION

The construction sector is the world's most material-intensive industry, accounting for approximately 37% of global greenhouse gas emissions across its value chain. Currently, 98% of the materials used end up in landfills or are downcycled into low-value applications at end-of-life.[1] Its material demands contribute significantly to pressing sustainability challenges including biodiversity loss, deforestation, resource depletion and water scarcity. As pressure mounts to reduce environmental impacts across the built environment, there is a critical need to explore strategies that lower resource consumption without compromising performance, safety or regulatory compliance.

Dematerialisation, a design strategy that prioritises lower material and resource inputs across all life cycle stages of a building, is emerging as a compelling approach to addressing these demands. By prioritising efficient material selection, integrated system design and lighter-weight construction methodologies, dematerialisation can lower embodied carbon and minimise life cycle environmental impacts. This strategy supports circular economy principles and aligns with the increasing adoption of low-carbon design targets, offering a pathway to significantly reduce the footprint of building projects from the outset.

For architects, the relevance of dematerialisation is growing in step with the demand for sustainable, cost-effective design outcomes. As primary decision-makers in material selection and system specification, architects are uniquely positioned to influence how and where dematerialisation is applied.

This whitepaper outlines the practical application of dematerialisation as a design strategy and highlights how Siniat's lightweight systems and value engineering can contribute to more sustainable architectural outcomes.

DEMATERIALISATION IN ARCHITECTURE

What is dematerialisation?

“Dematerialisation” in architecture refers to the intentional reduction of material use in building design and construction without compromising structural integrity, regulatory compliance or functionality. This approach involves rethinking conventional design, construction systems and spatial planning to minimise the embodied resource footprint across structural elements, facades, interior fit-outs and integrated services.

The core principles of dematerialisation in the architectural context include:

- minimising material inputs through efficient design;
- optimising structural spans and load paths;
- substituting conventional materials with lighter, high-performing or recycled alternatives; and
- extending building lifespans through adaptable, modular systems.

Designing for dematerialisation integrates material efficiency into the architectural process from the earliest design stages.[2] It involves reducing material inputs while meeting all regulatory requirements, including structural performance, fire safety and acoustic standards. Achieving this requires a coordinated approach across disciplines to eliminate redundancy and optimise system design.

Outcomes and benefits

Dematerialisation aligns closely with sustainability metrics such as embodied carbon, material density and construction waste volumes. Lower material quantities translate to reduced embodied carbon and resource depletion, both of which are critical performance indicators in green building certification schemes such as Green Star and LEED. It also contributes to circular economy objectives, ensuring resources are used efficiently, retained in productive use for longer and recovered at the end of life.

In addition to environmental gains, material efficiency enhances cost savings and efficiency. Reducing the volume and weight of materials can lower procurement and logistics costs, simplify installation and reduce waste management requirements. For architects, these outcomes not only support sustainable design leadership but also improve value for clients seeking to balance performance, environmental responsibility, time and cost.

ARCHITECTURAL STRATEGIES FOR DEMATERIALISATION

Flexible spaces and layouts

Designing flexible, multi-use spaces can significantly reduce material intensity by eliminating unnecessary partitions and duplicated functional zones. For example, operable walls and sliding partitions can transform a large open-plan area into smaller meeting rooms or breakout spaces which can be reconfigured as the occupants' needs change. Incorporating raised floors and movable service modules allows for future reconfiguration of HVAC, electrical and data systems without invasive works.

Design for disassembly

Design for disassembly (DfD) enables materials and components to be removed without damage, allowing them to be reused or recycled with minimal processing. This can be achieved using mechanical fasteners in place of adhesives, modular jointing systems and exposed fixing methods. For example, demountable plasterboard partitions using screw-fixed steel studs and clip-in ceiling tiles can be disassembled and reinstalled. Timber or steel structural elements joined with bolted connections rather than welded or bonded joints also facilitate disassembly. DfD principles are increasingly supported by digital material passports, which track component origins and recovery pathways for end-of-life planning.

Structural optimisation

Tools such as Building Information Modelling (BIM), parametric modelling and finite element analysis (FEA) allow architects and engineers to fine-tune structural systems to use the minimum amount of material needed for performance and compliance. For instance, space frame roof structures—commonly used in large-span applications like stadiums and airports—achieve strength through geometric efficiency, reducing the need for heavy beams.[3] Similarly, thin-shell concrete structures, such as the domed roof of the Pantheon-inspired Kresge Auditorium at MIT, optimise form to minimise roof thickness and material volume while distributing loads efficiently.[4]

Modular construction and prefabrication

Modular and prefabricated systems reduce waste by manufacturing elements under controlled factory conditions, where offcuts can be reused and tolerances tightly controlled. For example, Tam and Hao (2014) observed that incorporating prefabricated components in construction can reduce timber formwork waste by as much as 86.67% and concrete waste by up to 60%.[5]

By manufacturing components like bathroom pods, riser shafts and facade cassettes off-site under controlled conditions, projects can eliminate many of the high-impact processes typically performed in-situ. This results in fewer delays due to weather, improved quality control and reduced curing times. The streamlined installation of prefabricated modules not only accelerates construction schedules but also minimises noise, dust and construction waste, contributing to cleaner and more efficient building sites.

Adaptive reuse

Adaptive reuse repurposes existing structures, such as converting a former warehouse into residential units or a school into coworking spaces, thereby avoiding the embodied carbon associated with demolition and new construction. Retaining structural elements such as concrete slabs or loadbearing masonry can save hundreds of kilograms of CO_2e per square metre. Successful examples include the refurbishment of the Goods Shed in Melbourne, where the existing shell was retained and modern services integrated with minimal intervention while preserving many heritage aspects of the building.

Material optimisation

Substituting traditional materials with high-performance, lower-carbon alternatives can significantly reduce environmental impact. For instance, high-strength concrete is gaining popularity as it results in structures requiring little maintenance and using less material when compared to traditional concrete construction. Advancements in material formulations, such as low-carbon cement blends, have significantly reduced the environmental impact of concrete, lowering embodied carbon by as much as 40% compared to conventional mixes.[6]

Lightweight materials

The adoption of lightweight materials is a foundational strategy in dematerialised architecture. Products such as cross-laminated timber (CLT), plasterboard, recycled steel, geopolymer concrete and fibre-reinforced composites reduce both the volume and mass of materials required, lowering embodied carbon and easing construction logistics. Plasterboard, for example, features a gypsum core and can be scored and snapped on site, eliminating the need for power tools.

Lightweight materials also contribute to reduced structural loads, allowing for the design of slimmer floor slabs, smaller beams and lighter foundation systems. By decreasing the overall dead load of a building, these materials minimise the quantity of concrete, reinforcement and substructure required, compounding material savings across the project.

Incorporating lightweight materials in construction can also result in a reduction of Scope 3 emissions. Scope 3 emissions include indirect emissions that occur in the value chain, including and particularly in the upstream transportation and distribution category. Lightweight materials reduce the fuel needed for transportation (due to their lower weight), which can reduce emissions associated with transporting those materials.

DEMATERIALISATION IN ACTION

Wall and ceiling systems offer opportunities to reduce material use without compromising performance. By selecting lightweight panels and integrating high-performance boards that meet acoustic, fire and thermal requirements, designers can reduce the bulk of internal partitions and linings. Slimmer wall profiles and optimised framing techniques further minimise the need for excessive material use in wall assemblies. These strategies allow architects to maintain or exceed compliance standards while limiting the environmental and structural impact of internal build-ups.

Facade and envelope strategies also benefit from a dematerialised approach. Designing external skins with fewer material layers and selecting integrated insulation and cladding systems can dramatically reduce facade thickness and overall mass. When well-executed, this strategy maintains thermal and weatherproofing performance while simplifying construction and lowering life cycle impacts. Key to this approach is balancing material reduction with durability, ensuring leaner facades remain robust and effective across the building's life.

Leading projects illustrate the practical outcomes of these principles. The Edge in Amsterdam demonstrates how lightweight construction materials, solar integration and BIM-based design coordination can reduce both material use and operational energy demand.[7] In Sydney, International House showcases the power of CLT to deliver a high-performance, low-mass structure.[8] Here, dematerialisation was further achieved by eliminating conventional wall and ceiling linings, embracing the aesthetic and structural integrity of exposed timber.

VALUE ENGINEERING AS A PATHWAY TO DEMATERIALISATION

Value engineering is a structured methodology that seeks to maximise the functional value of a building while minimising unnecessary material use and cost. Unlike cost-cutting, which may compromise performance or longevity, value engineering maintains design intent and compliance by refining how materials and systems are selected and applied. This approach aligns closely with the goals of dematerialisation, offering a practical route to achieving material efficiency without sacrificing architectural quality or regulatory standards.

A key benefit of value engineering is its ability to identify over-specification in building designs. By scrutinising material choices, component dimensions and detailing, architects and engineers can often remove redundancies or excess tolerances that inflate material usage. For example, internal wall assemblies may be over-designed for fire or acoustic performance in non-critical areas or structural members may exceed load requirements due to conservative assumptions. Rationalising these elements to suit actual performance needs leads directly to a reduction in volume, weight and embodied carbon.

By prioritising efficient material selection, integrated system design and lighter-weight construction methodologies, dematerialisation can lower embodied carbon and minimise life cycle environmental impacts.

SINIAT'S ROLE IN ADVANCING DEMATERIALISED ARCHITECTURE

As the built environment continues to respond to climate pressures, material efficiency has become a central concern in sustainable design. Siniat, part of the global innovator in lightweight construction solutions Etex, plays a pivotal role in enabling this shift. Through its lightweight wall and ceiling systems and value engineering expertise, Siniat helps architects achieve performance targets using fewer materials, reducing the need for heavy structural elements, over-engineered detailing and redundant layers across building assemblies while still meeting structural, acoustic and fire requirements.

Siniat's Interhome system is a good example. Siniat Interhome is a separating wall system that contains a central fire barrier built between timber or steel house frames and offers an efficient alternative to the traditional double-brick walls. Compared to other separating wall systems, Interhome offers easier installation because it allows non-fire-rated installation of internal linings and non-fire-rated penetrations of the wall linings during construction. Double-brick walls require rendering on both sides to meet acoustic targets, adding to installation cost, time and labour.

Another example is Siniat's acoustic stud wall systems that offer a good alternative to double-stud or staggered wall systems, resulting in fewer components needed, thinner wall profiles, and quicker and simpler installation while meeting the required acoustic and fire performance of the wall.

Furthermore, Siniat's Siniat Select tool, available through its My Siniat portal, supports builders and specifiers in choosing cost-effective systems based on actual project needs. It assists users in avoiding overdesign and using unnecessary layers and can sort systems based on cost-effectiveness. It also allows users to filter systems based on fire rating, acoustic performance and materials.

Siniat's technical team can also help reduce the building materials required while achieving compliance and performance through their value engineering expertise. Siniat's studs are backed by extensive structural testing, and due to optimised stud size and spacing, the overall steel use in a project can be reduced. This allows specifiers and builders to meet performance and compliance requirements without overengineering, allowing them to balance cost with structural needs.

For architects seeking to reduce embodied carbon and deliver smarter, more resource-conscious buildings, Siniat's lightweight systems and innovative tools offer a proven and progressive path forward.

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