



Airtightness White Paper

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BUILDING THE FUTURE

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INNOVATIVE TIMBER PRODUCTS

The background of the page is a misty, green forest of evergreen trees. A white rectangular box is centered on the page, containing the main text. The text is in a clean, sans-serif font. The title '1. INTRODUCTION' is in a larger, bold font. There are three paragraphs of text, each with a different indentation. The first paragraph is on the left, the second is on the left, and the third is on the right. The overall aesthetic is clean and modern, with a focus on nature and sustainability.

1. INTRODUCTION

The construction industry is undergoing a transformative phase. Driven by the need for efficiency gains, environmental impact, air quality and more, this transformation is marked by the increasing adoption of Modern Methods of Construction (MMC).

Historically, construction methodologies have slowly changed, often relying on traditional techniques passed down through generations. However, the modern world's challenges, from burgeoning populations to the pressing threat of climate change, necessitates a shift in how we approach building design and construction. And right up there is the built environment's impact on our comfort, health and wellbeing.

MMC represents a confluence of innovative techniques, materials, and processes that prioritise efficiency, sustainability, and speed of construction. While these methods offer numerous advantages, including reduced construction times, lower costs, and enhanced building performance, they also introduce a new set of challenges.

One of the most significant challenges in modern-day construction is the concept of airtight buildings.

2. PROBLEM STATEMENT



The move towards MMC and airtightness is not just a trend but a necessary response to global challenges.

As building structures become more air-sealed to enhance energy efficiency and reduce environmental impact, the dynamics of indoor air circulation change dramatically. Whether it's building regulation continuing to tighten the noose on backstops for airtightness in England and Wales (set to tighten further in the Future Homes standard), or the pressure from key stakeholders to meet any number of building performance certifications such as WELL, HPI, BREEAM and LEED, this shift has profound implications for indoor air quality and moisture balance - a factor often overlooked but intrinsically linked to the health and well-being of building occupantsⁱ.

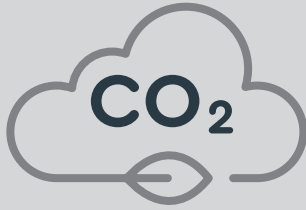
A good indoor environment is not just about the absence of certain pollutants; it encompasses a range of factors, from humidity levels to the presence of natural light. But in an airtight environment, there's a risk of trapping pollutants, leading to conditions that can exacerbate human health issues like asthma, allergies, and other respiratory conditions. Inadequate ventilation can lead to increased concentrations of harmful VOCs (Volatile Organic Compounds) and a build-up of moisture and odours. This challenge is further magnified in many areas, where external air quality might already be compromised due to environmental pollution.

However, it's essential to understand that the move towards MMC and airtightness is not just a trend but a necessary response to global challenges. Energy efficiency is no longer a luxury, but a necessity enforced by building regulations. At the COP28 UN Climate Change Conferenceⁱⁱ held in December 2023, world leaders reached a historic agreement to transition away from fossil fuels in order to keep alive the goal of the 2015 Paris Agreement, which was to prevent global temperatures rising by more than 1.5°C. Moreover, in March 2024 the European Parliament adopted the recast of the Energy Performance

of Buildings Directiveⁱⁱⁱ, which means that the current standard for new buildings; "Nearly Zero Energy Buildings" (NZEB), will be replaced by "Zero-emission buildings" (ZEB) by 2030. The purpose of these overarching regulations is to dramatically reduce the environmental impact that the built environment has on global CO₂ emissions, currently accounting for 39% of the total. These emissions are split between the operation of buildings (28%) and the materials and construction methods used (11%)^{iv}.

As the profound effects of climate change become more pronounced, the construction industry's role in mitigating its impact becomes even more critical^v. Airtight buildings, when done well, significantly reduce energy consumption, leading to lower operational carbon emissions, increased comfort levels, and contributing to broader sustainability goals. But airtightness is only one part of the solution. Material choices and designing for circularity are also critical in ensuring that buildings will perform not just for their planned lifespan but also beyond.

Decarbonising new buildings involves:



Using sustainable, biogenic building materials with low embodied carbon, in the most resource-efficient way possible.



Ensuring the building operates at net zero carbon once constructed.



Designing the building based on circular economy principles to maximise reuse of materials and minimise the eventual release of carbon emissions at the end of life.

With an ever-increasing focus on embodied carbon and the impact of the entire supply chain on outcomes, sustainable building materials in this sector answer many of these questions.

Enter sustainable engineered wood products like those manufactured by MEDITE SMARTPLY. These are not just construction materials, but advanced technical solutions designed to address the various design challenges of MMC.

They represent the company's proactive response to real-life building challenges and ensure that while we move towards more sustainable construction methods, we do not compromise on the health and well-being of building occupants, rather, we enhance it.

At this pivotal juncture, it's imperative to approach construction with a balanced perspective, ensuring that sustainability and well-being go hand in hand. The future of construction lies in harmonising these elements with wood-panel innovations like those from MEDITE SMARTPLY, that guarantee airtightness and provide predictable vapour control and durability.

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3. BACKGROUND

The construction industry, with its rich history and innovation, has always reflected societal needs and technological advancements. As we navigate the complexities of the 21st century, the industry adapts to new paradigms, with Modern Methods of Construction (MMC) at the forefront.

3.1 Evolution of Construction and the Rise of MMC

Historically, construction methodologies were rooted in local materials and traditional techniques. Buildings were naturally ventilated, relying on the inherent properties of materials like stone, brick, and wood to regulate temperature and moisture. However, as urbanisation accelerated and technological advancements emerged, there was a push for faster, more efficient construction methods. Ever more modern methods of construction, with an emphasis on off-site manufacturing, modular components, and precision engineering, emerged as the answer. These methods promise reduced construction times, minimal waste, and enhanced energy efficiency.

3.2 Airtightness: Essential component of Sustainable Building Design

With improved building regulations and more modern construction methods, the concept of airtightness has gained prominence. Opponents of airtightness may argue that it's difficult; increases costs; prevents windows being opened; creates an unhealthy sealed box; leads to overheating; etc. The simple fact is that all building projects whether new-build or energy upgrade, require a good standard of airtightness. When considered at the very start of the project (along

with a ventilation strategy for the building), airtightness can be achieved simply and cost-effectively.

Airtight buildings, by design, minimise unintentional gaps in the building envelope, ensuring optimal energy efficiency. However, this very strength can become its Achilles' heel if not done correctly. As buildings become more sealed, the dynamics of indoor air circulation undergoes a dramatic change. Without adequate ventilation, pollutants, allergens, and moisture can become trapped inside, leading to deteriorating Indoor Air Quality (IAQ).

The implications of poor IAQ are profound. Studies have consistently linked poor air quality to various health issues, from respiratory problems to cognitive impairments^{vi}. In a poorly ventilated and airtight environment, the concentration of pollutants like volatile organic compounds (VOCs), particulate matter, and allergens can reach levels detrimental to human health.

3.3 Moisture Control: The Silent Challenge

Alongside air quality, moisture control is a significant challenge in airtight buildings. Traditional buildings have allowed moisture to escape through materials or air leaks, preventing the buildup of condensation. However, in airtight structures, if not detailed correctly, moisture can become trapped, leading to conditions conducive to mould and mildew growth. Mould not only compromises the structural integrity of buildings but also poses severe health risks to occupants, including respiratory issues and allergic reactions^{vii}.

3.4 Wood: Nature's Answer to Modern Challenges

Wood, as a construction material, offers a unique solution to many of these challenges. Biogenic materials such as wood possess a unique natural ability to chemically bind with pollutants from the

atmosphere, such as Carbon dioxide (CO₂), for removal purposes. Through photosynthesis, this CO₂ is converted into Carbon which is a chemical constituent of wood.

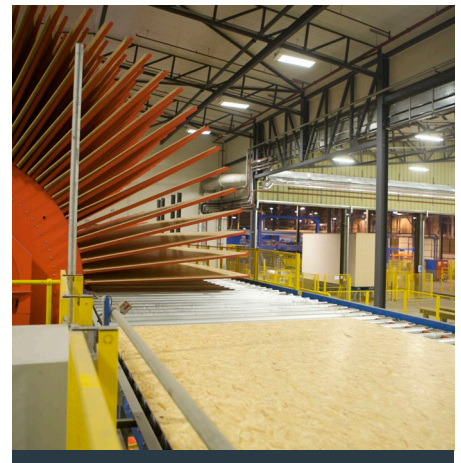
As a tree grows, it is made up of roughly 50% water and 50% Carbon. Before wood can be used as a construction material this water must be removed, but the Carbon remains chemically bound in the wood structure. Typically, solid wood products are kiln dried to below 18% moisture content before being strength graded. Engineered wood products such as MDF and OSB are manufactured with much lower moisture contents, in the range of 2-12% depending on the product and the application. The equilibrium moisture content of wood products used in the structure of a building will settle at around 10-14% in heated buildings in cool temperate climate zones found in Europe.

Because of how they grow in the forest, wood products possess another unique natural ability to absorb, adsorb and release moisture throughout the various heating cycles of a building's life, where moisture loads can fluctuate dramatically depending on their location in relation to the vapour control layer and outer cladding, thus aiding in moisture control, naturally. Moreover, wood's good insulating properties and ability to regulate humidity make it an ideal choice for MMC, ensuring that buildings are not just energy-efficient but also have optimal IAQ.

The background of MMC and the challenges of airtightness, air quality, and moisture control highlight the intricate balance the construction industry must achieve between building science and buildability. As we move towards a sustainable future, understanding this balance and leveraging materials like wood becomes crucial in creating buildings that are efficient but also healthy and comfortable for their occupants.

4. SOLUTION

The challenges posed by the rapid adoption of MMC and the emphasis on airtightness necessitate innovative solutions that not only address the immediate concerns but also pave the way for a sustainable future. MEDITE SMARTPLY, with its range of sustainably sourced wood-based panel products, offers comprehensive answers to these concerns, ensuring that buildings can be as energy efficient and healthy as possible, and conducive to the wellbeing of their occupants.



4.1 SMARTPLY AIRTIGHT

SMARTPLY AIRTIGHT stands out as a pioneering airtight OSB/3 panel specifically designed for structural use in energy-efficient buildings. Its patented manufacturing process guarantees the highest level of airtightness in the industry, backed by independent certification from the Passive House Institute and validated on numerous building projects with n50 results as low as 0.08 air changes (m³/hr.m²) in blower door tests. Applied on the warm side of insulation, the product also has an integral high-performance vapour control layer^{viii} which eliminates the need for additional airtight and vapour control membranes^{ix}.



4.2 SMARTPLY SURE STEP DB

SMARTPLY SURE STEP DB is a great example of combining durability with precision. Similar in technical performance to **SMARTPLY AIRTIGHT**, **SURE STEP DB** is a certified airtight OSB/3 panel with a weather-resistant coating, making it ideal for applications like flooring or roof decking in wet climates. The surface of the panel has a high slip resistance, a crucial factor for safety during construction^x.



4.3 MEDITE VENT

MEDITE VENT strongly complements **SMARTPLY AIRTIGHT** in addressing air quality and moisture control challenges in airtight buildings. Applied on the cold side of insulation, it is a structural racking panel with very low water vapour diffusion resistance^{xi} (i.e. highly breathable) which helps to regulate moisture levels within the building fabric thereby ensuring overall building durability^{xii}.

All **MEDITE SMARTPLY** products are produced from sustainable timber from well-managed forests and come with FSC® certification, as well as independently verified Environmental Product Declarations (EPD). Importantly, they also comply with the most stringent current European standards governing the release of formaldehyde and other VOCs, thereby addressing health concerns related to indoor air quality, especially in under-ventilated buildings, irrespective of which side of the airtight vapour control layer they are positioned.

4.4 Case in Point

The 'COP26 House' serves as an example of MEDITE SMARTPLY's commitment to sustainable construction. Built for the 2021 UN Climate Change Conference in Glasgow, this zero-carbon, timber frame building was constructed by Beyond Zero Homes, showcasing low-carbon, circular solutions in building and living. MEDITE SMARTPLY played a pivotal role in this project, with its products being central to the construction of this house. The house was designed to use homegrown C16 Spruce, eliminating the need for imported timber, and its construction was based on a grid that facilitated easy offsite prefabrication of structural components, as well as being designed for disassembly and reuse at end of life^{xiii}.

In County Wexford, Ireland, there's an exemplar building called 'Project Net Zero Home' that serves as a hands-on educational case study for sustainable construction, taking into account its design, construction, lifetime operation and end of life scenario. The home is a highly energy-efficient Passive House, utilising advanced timber frame construction methods and high-quality, low-carbon wood and

engineered wood products (EWPs), including loose blown wood-fibre insulation sandwiched between SMARTPLY AIRTIGHT panels on the inside and MEDITE VENT sheathing panels on the cavity side to form wall and roof components that are 'water vapour-diffusion open' towards the outside, thereby mitigating the risk of interstitial condensation by controlling the passage of air and vapour within the building components.

The house boasts one of the best airtightness results on record in Europe; achieves the highest possible Building Energy Rating (BER) in Ireland - without the use of PV or other on-site renewables microgeneration; and beats the RIAI 2030 Climate Challenge targets for embodied carbon with considerable ease. However, the overall aim of the project is to determine whether it's actually possible to achieve the pinnacle of Net Zero Whole Life Carbon by accounting for both embodied and operational carbon emissions (currently there is only regulatory requirements governing the latter). It's a tough ask, and it's very complicated, especially where biogenic carbon is concerned, but whether it succeeds or falls short, it's real-life data generated from

ambitious forward-thinking projects like this that will help the industry to understand the challenges, and perhaps more importantly identify false claims and 'net zero greenwash', and ultimately move forward more quickly in the pursuit of true net zero^{xiv}.

4.5 Broader Implications and Outreach

MEDITE SMARTPLY's involvement in projects like those outlined above is not just about product showcases but also about education and outreach. Specifiers are understandably cautious about manufacturers sustainability claims. However, by partnering with trusted platforms like Architecture Today, AECB and Passive House+, MEDITE SMARTPLY regularly engage with key stakeholders via industry forums, conferences, webinars, videos, technical articles, roundtable discussions, bringing together architects, specifiers, and industry experts. These events delve deep into the challenges emerging from the aforementioned global climate discussions and their implications for the construction industry. More recently the company sponsored the Association for Environment Conscious Buildings



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(AECB) annual conference, taking part in a discussion called "Sponsors under scrutiny!" The session provided an opportunity for AECB members to scrutinise manufacturers sustainability claims, and how to recognise the kind of misinformation that is so rife across the construction industry. Such initiatives underpin MEDITE SMARTPLY's commitment to not just providing product solutions and technical support, but also shaping the discourse around sustainable construction and ESG, including transparency and disclosure in a world full of false and misleading claims.

The solutions offered by MEDITE SMARTPLY represent a holistic approach to the challenges posed by MMC and airtightness. By integrating innovation, sustainability, and health considerations, these products are setting new benchmarks for the construction industry. As we navigate the complexities of modern construction, solutions like these will be instrumental in shaping a future that harmonises efficiency, sustainability, and well-being.



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CONCLUSION

The construction industry, with its intricate blend of art, science, and engineering, has always reflected societal aspirations and challenges. As we stand at the cusp of a new era marked by the adoption of Modern Methods of Construction (MMC) and the emphasis on airtightness, the role of innovative solutions becomes paramount.

MEDITE SMARTPLY represents a philosophy and a commitment to a sustainable future. Buildings, as permanent fixtures in our landscapes, have long-term implications for energy consumption, environmental impact, and human well-being. Our choices in terms of construction materials, techniques, and designs will shape the legacy we leave for future generations.

Products like SMARTPLY AIRTIGHT, SMARTPLY SURE STEP DB and MEDITE VENT, are not just construction materials. They are solutions, meticulously designed to address the multifaceted challenges posed by MMC, airtightness and moisture control.

The brand's emphasis on technical leadership is an important element. In an industry as dynamic as construction, staying abreast of technological advancements, research findings, and global best practices is crucial. MEDITE SMARTPLY, with its focus on research and development, ensures that its products are not just compliant with current standards but are also future-ready. A proactive approach to addressing emerging challenges, be it in terms of building science, environmental considerations, or health implications, positions them as leaders in the field.

It's essential to recognise that the challenges faced by the construction industry are not isolated. They are intertwined with global challenges like climate change, urbanisation, and societal well-being. As we envision a future where buildings are energy-efficient, environmentally conscious, and conducive to human health, brands like MEDITE SMARTPLY will play a pivotal role. Their products, initiatives, and philosophy are shaping a new narrative in construction, one that harmonises efficiency, sustainability, and well-being. As we move forward, it's collaborations, innovations, and commitments like these that will light the way.

Sources

- ⁱ (Brambilla 2020) Mould growth in energy-efficient buildings: Causes, health implications and strategies to mitigate the risk <https://www.sciencedirect.com/science/article/abs/pii/S1364032120303841>
- ⁱⁱ <https://unfccc.int/cop28>
- ⁱⁱⁱ https://ec.europa.eu/commission/presscorner/detail/en/qanda_24_1966
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- ^v https://constructingexcellence.org.uk/wp-content/uploads/2021/12/Benefits-of-MMC-in-housing-Performance-data-and-case-studies_final.pdf
- ^{vi} <https://www.aivc.org/resource/tn-68-residential-ventilation-and-health?volume=33978>
- ^{vii} <https://www.gov.uk/government/publications/damp-and-mould-understanding-and-addressing-the-health-risks-for-rented-housing-providers/understanding-and-addressing-the-health-risks-of-damp-and-mould-in-the-home--2>
- ^{viii} Equivalent air layer thickness (Sd-value): 9.4m±1.0m (dry cup); 5.2m±0.6m (wet cup), tested in accordance with EN 12572
- ^{ix} <https://mdfosb.com/en/products/smartply-airtight>
- ^x <https://mdfosb.com/en/products/smartply-sure-step-db>
- ^{xi} Equivalent air layer thickness (Sd-value): 0.11m (dry cup); 0.1m (wet cup), tested in accordance with EN 12572
- ^{xii} <https://mdfosb.com/en/products/medite-vent>
- ^{xiii} <https://mdfosb.com/en/sustainability/our-sustainable-solutions/cop26-house>
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