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COMPARISON OF REGULATORY AND OPERATIONAL ENVIRONMENTS AFFECTING MULTI-STOREY TIMBER APARTMENT BUILDINGS IN FINLAND AND NEW ZEALAND

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ABSTRACT: Given the high emissions of construction, transforming the building sector is essential for climate change mitigation. Due to its potential to reduce embodied emissions substantially, industrial timber construction is gaining popularity worldwide. This study examines the regulatory and operational environments affecting multi-storey timber apartment buildings (MSTABs) in Finland and New Zealand (NZ). Both nations share similar demographic and economic characteristics and have long traditions in timber construction. Recently, Finland has made notable advancements in industrial timber construction partly due to state initiatives. NZ lags in utilizing its extensive forest resources for value creation through wood processing. Instead, NZ is one of the largest log exporters in the world. This paper embraces a transdisciplinary international team to map regulations around structure, acoustics, fire-safety, moisture and environmental impact, and assess the impacts of these on MSTABs. Furthermore, it explores the impacts of self-sufficiency, building consenting, market competitiveness factors, public perception, policies and incentives in promoting MSTABs. Through comparative analysis, the paper explores the potential application of Finnish practices to the NZ context in a bid to enhance NZ's ability to process timber into building products locally. This comparison helps foster international collaboration and knowledge transfer to promote the sustainable use of timber in construction.

KEYWORDS: timber apartment buildings, residential multi-storey timber buildings, residential mid-rise timber buildings, industrial timber construction, building regulations

1 – INTRODUCTION

Given that construction is responsible for 37% of global emissions, transforming the building sector is a critical component in mitigating climate change [1]. Industrial timber construction is on the rise worldwide, as it can significantly reduce construction-related emissions and dependence on unrenewable resources [2]. If 90% of the new urban population were housed in mid-rise timber buildings, 106 Gt of carbon dioxide emissions could be saved by the year 2100 [3].

Finland and NZ share similarities in size (338,462 km^2 vs 268,021 km^2), population (5.6M vs 5.2M), and wealth (GDP per capita $US54K vs $US48K), along with long traditions in timber construction. However, Finland is significantly more advanced in terms of industrial timber construction, particularly concerning MSTABs. This development is partly due to strong state initiative support [4]. In this paper, a MSTAB is a residential building with three or more storeys, a load-bearing superstructure made primarily of timber or engineered wood products (EWPs) and with multiple apartment units above and next to each other.

This paper examines how various regulations, recommendations, and practices related to structure, acoustics, fire-safety, moisture and environmental impact affect the construction of MSTABs in Finland and NZ. In addition, the impacts of self-sufficiency, building consenting, market competitiveness factors, public

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perception, policies and incentives on promoting MSTABs are compared across these countries. By examining the differences in the regulatory and operational environments between Finland and NZ, this paper promotes international collaboration and knowledge transfer when it comes to MSTABs.

2 – BACKGROUND

Finland and NZ have much in common. Particularly relevant is that both countries have vast forest resources (23M vs 10M ha). However, Finland utilizes its forests resources for local processing and value creation whereas NZ creates value from the forest as a primary industry and has evolved into one of the world's largest log exporters, with approximately 60% of its logs shipped overseas, mainly to China [5]. The purpose of this paper is to conduct a preliminary investigation into the opportunities for MSTABs in NZ versus Finland. This will facilitate the future application of practices from Finland to the NZ context, enabling NZ to better process its local timber into sustainable and long-lasting products to be utilized in construction.

2.1 Finland

Around 75% of Finland's total land area is covered by forests, the total forest area is approximately 22.9 million hectares [6]. About 60% of forests are privately owned, mainly by individuals and families, while the state owns 26%, companies own 9% and other entities own 5% of the productive forest land, respectively [7]. Finland relies mainly on its own abundant forest resources to produce wood products used in construction. EWPs such as cross-laminated timber (CLT), glulam and laminated veneer lumber (LVL), generally use Norway spruce (Picea abies) and Scots pine (Pinus sylvestris). The primary tree species grown and used for construction are native to the country. Spruce is harvested earlier (60–80 years) and mainly used in CLT and glulam. Pine is harvested later (80–100 years) and preferred for high-strength LVL and glulam beams. Both species undergo careful forest management to ensure long-term sustainability and material-efficiency.

Timber has been the primary construction material in Finland for centuries due to the country's vast forests. Traditional Finnish log buildings, such as churches, houses, and farm structures, date back to medieval times, with some surviving structures from the 16th century. In the 20th century, industrial sawmilling and prefabrication modernised timber construction, leading to the widespread use of EWPs like glulam, LVL and CLT. Since the 1990s, fire regulations and sustainability policies have promoted multi-storey timber construction, enabling its growth in urban housing [4, 8]. Since 2011, there has been a rising trend of constructing RMSTBs, though there is significant decline after 2021 (see Fig 1) [9]. Currently, there is an overall decline in construction in Finland, as the sector is facing a significant downturn. While the downturn has other contributing factors (such as rising interest rates and changing regulations), both COVID-19 and the Ukraine war have accelerated and deepened the crisis by disrupting supply chains, increasing costs, and creating economic uncertainty.

Today, Finland is a global leader in industrial timber construction, with innovations in prefabrication and hybrid timber structures shaping the industry. In Finland, by March 2025, there is around 200 MSTABs, comprising 6,000 apartments. The most common building height for MSTABs is 3 to 4 storeys (see Fig 2), accounting for 62% of all timber apartment buildings (with 22% being three-storey and 40% being four-storey buildings). The most common method of construction was light-weight timber (LWT) 2D elements, followed by volumetric elements (with a majority in CLT), CLT 2D elements, and a few post and beam and log buildings (see Fig 3). Regarding apartment ownership, MSTABs consist of rental apartments (58%), privately owned units (33%), right-of-residence housing (8%), and semi-privately owned apartments (1%) [4].

In Finland, for MSTABs, the most stringent legislative regulations pertain to the vibration and impact sound insulation of intermediate floors, airborne sound insulation between apartments, and fire resistance. The design of vibration and fire resistance relies on European

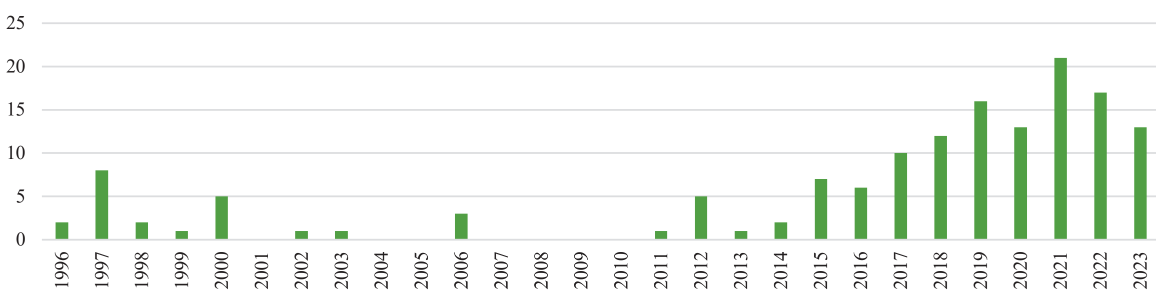

Figure 1 MSTABs in Finland 1996-2023 (year of completion). Source: PUUinfo, 2023.

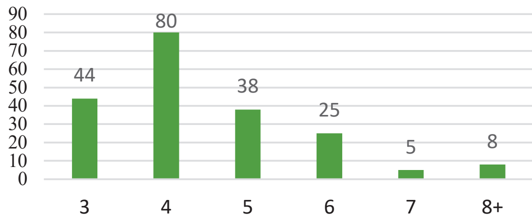

Figure 2 Height (storeys) of Finnish MSTABs. Source: Karjalainen & Ilgin (2025)

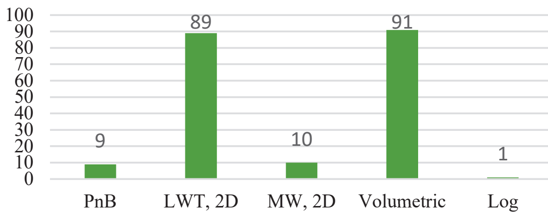

Figure 3 Structure of Finnish MSTABs. PnB = post and beam, LWT, 2D =Lightweight timber planar element. MW 2D = Massive wood (CLT, LVL, etc.) planar element. Volumetric = 3D volumetric modules in either LWT of massive wood. Source: Karjalainen & Ilgin (2025)

design guidelines (Eurocodes); however, there are no straightforward guidelines for sound insulation. In Europe, the limit values for all these design criteria have been determined country-by-country, with Finland being the most stringent.

2.2 NZ

Prior to the arrival of people in NZ around 1300CE, more than 80% of NZ's land area was covered in dense, native forest. Today, this is around 38%, with a total cover of 10.1 million hectares. Of this, 80% is native forest with the remaining exotic plantation. These two classes of forest have significantly different biology, management, and values to NZers [10].

Ownership of the forest is irrespective of the ownership of the land. The Crown owns most of NZ's protected native forests. Its two main types are beech and podocarp tress (including rimu, tōtara, miro, kahikatea and matai). Significant changes have occurred since 2003 in plantation forest ownership, resulting in a transition from public to private ownership. Today, 95% of forests are privately owned by large companies (50%), partnerships, individuals and trusts, which include Māori trusts and incorporations (30%). The Crown owns the remaining 5% of plantation forests [11]. Māori values of kaitiakitanga (guardianship) resulted in the Te Urewera Forest being assigned legal personality in 2014. In a global first, 'the forest as person' illustrates how NZ's indigenous perspectives are reshaping how a forest can be understood.

Radiata pine is generally used for EWPs in NZ and it is typically harvested for structural timber at around 25 to 30 years of age, depending on the intended use and specific market requirements. Whilst Radiata pine is not native to NZ, due to a favourable subtropical climate and fertile soils, pine grows faster in NZ (20-30 m^3/ha/year) than anywhere else in the world [12].

There is no Acceptable Solution for MSTABs constructed from EWPs. The pathway to compliance instead uses Alternative Solutions or Verification Methods to demonstrate structural and durability compliance in line with the NZ Building Code or various NZ Standards (such as 3603:1993 – Timber Structures, AS/NZS 1170 – Structural Design Actions, AS/NZS 1720.1:2022 – Timber Structures Code). The Canterbury earthquakes (2010–11) had a big impact on governance in NZ, particularly in disaster response, urban planning, and central-local government relations. The aftermath saw major legislative changes, centralised decision-making, and increased government intervention [13].

In NZ, EWPs must be treated for compliance. This situation arose because of the 'leaky homes' crisis in NZ concerning timber-framed homes (built from the 1980s to the early 2000s) whose façade weather-tightness eroded due to new cladding materials such as plaster on cement board. The desire for housing in the post-modernist style arguably contributed to this technological failure. Prior to this, the traditional LWT and weatherboarded house had remained robust.

Due to the relative newness of MSTABs in NZ there has yet to be a stocktake. However, the authors have been able to confirm that there are at least 15 MSTABs built between 2004-2025 in the country, with heights ranging from 3 to 9 storeys, containing in total at least 379 apartments. The structural systems and the material use in these timber buildings varies greatly.

3 – PROJECT DESCRIPTION

An interdisciplinary team has been assembled for this paper. It first studies how local conditions impact the construction of MSTABs in Finland and NZ. Thereafter, the team compares findings and discusses similarities, differences, and possible synergies between the selected countries. Factors considered: structure, acoustics, fire-safety, moisture, environmental impact, self-sufficiency, building consenting, market competitiveness factors, public perception, policies and incentives.

4 – RESULTS

4.1 Structure

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Finland

The structural requirements and design guidelines for wooden buildings have been published in the Finnish Building Code's guidelines for wooden structures ("Structural Strength and Stability, Ministry of the Environment 2016). These guidelines complement the content of Eurocode 5 (EN 1995-1-1) with national annexes and detailed design instructions. There are no separate design guidelines for MSTABs, which has led to variability in the practices of analysis and design of structural stiffening systems. In Finland, very strict requirements have been set for the vibration of intermediate floors, which is why special attention has been paid to the design of intermediate floor structures. The preparation work for the updated national annexes related to the update of Eurocodes has just begun in Finland. Seismic requirements are not considered in buildings constructed in Finland.

NZ

Structural requirements for MSTABs are primarily governed by the NZ Building Code (NZBC) Clauses B1 Structure and B2 Durability. B1 focuses on the design of buildings to withstand likely wind, earthquakes, live and dead loads of people and building contents. Specific Engineered Design is required for most MSTABs as they exceed the scope of NZS3604 Timber Framed Buildings. Furthermore, NZS 1170.5:2004 (Earthquake Loads) govern how buildings must resist seismic forces based on location, soil type, and building height. Such structures must be ductile (able to flex and absorb energy without collapsing), resulting in the advanced development of timber connectors, stronger shear walls and bracing to resist lateral movement and higher design and build costs. EWPs such as CLT, LVL, and Glulam are preferred for seismic resilience because of their high strength-to-weight ratio, reducing earthquake forces, can be prefabricated for faster, controlled assembly and use post-tensioned timber systems that could self-centre after an earthquake.

B2 Durability confirms that the use of timber will remain structural for the minimum periods specified (5, 15 or >50 years).

4.2 Acoustics

Finland

The acoustical requirements for MSTABs have been given in the Decree of the Ministry of the Environment on the Acoustic Environment in Buildings (796/2017) and in the Ministry's Guide on the Acoustic Environment in Buildings (2018) as well as in the national standard SFS 5907:2022 Acoustical design and quality classes of buildings. Meeting the acoustical requirements in MSTABs requires advanced design strategies, hybrid materials, and careful detailing. The acoustical requirements consider airborne and impact sound insulation, room acoustics, noise generated by building service equipment and exterior sound sources such as traffic, and ground-borne noise and vibration. However, main focus in MSTABs is on airborne and impact sound insulation. The requirements do not distinguish MSTABs as the requirements are the same for all residential buildings regardless of the building materials applied.

Airborne Sound Insulation: The minimum weighted standardized level difference ($D_{nT,w}$) between apartments is 55 dB. This applies between apartments and between an apartment room and surrounding rooms. The minimum $D_{nT,w}$ between apartment rooms and corridors in case where a door is between the rooms is 39 dB. The $D_{nT,w}$ considers full sound transmission between rooms including sound insulation of the separating elements and the flanking sound transmission. Higher values indicate better performance.

Impact Sound Insulation: The maximum standardized impact sound pressure level ($L'_{nT,w} + C_{I,50–2500}$) between apartments is 53 dB. This applies between apartments and between an apartment room and surrounding rooms. The maximum $L'_{nT,w} + C_{I,50–2500}$ between apartment rooms and corridors is 63 dB. The spectrum adaptation term $C_{I,50–2500}$ considers the low-frequency range down to 50 Hz. In case the $C_{I,50–2500}$ is below 0 dB, it is not considered in the sum $L'_{nT,w} + C_{I,50–2500}$. The $L'_{nT,w} + C_{I,50–2500}$ considers full sound transmission between rooms including sound insulation of the separating elements and the flanking sound transmission. Lower values indicate better performance.

Building Services Noise: The maximum equivalent A-weighted sound pressure level ($L_{Aeq,T}$) from HVAC systems inside apartment rooms is 28 dB, inside bathrooms and utility rooms is 38 dB and in other rooms is 33 dB. The required maxima of maximum A-weighted sound pressure level ($L_{AFmax,T}$) from HVAC systems are 5 dB higher than the requirements for the $L_{Aeq,T}$.

Noise from Exterior Sources: The maximum equivalent A-weighted sound pressure level ($L_{Aeq,T}$) from exterior sources such as from traffic inside apartment rooms is 35 dB at daytime and 30 dB at nighttime.

Ground-borne Noise and Vibration: The maximum statistical noise criterion (L_{prm}) is either 30 dB (tunnels) or 35 dB. The L_{prm} related to the measured maximum noise level (L_{pASmax}) and 95% confidence interval.

In case of the abovementioned requirements, the verification of conformity is usually performed by field measurements in a finished building. However, the conformity can also be shown based on laboratory measurements, field measurements performed in the construction stage of the building, calculations or computational analyses, prototypes, or previously approved solutions.

NZ

The only clause of the NZBC that relates to acoustics in multi-unit housing is G6. The objective of this clause is 'to safeguard people from illness or loss of amenity as a result of undue noise being transmitted between abutting occupancies'. The minimum performance requirements for walls and floors set by the clause are: 1. Sound Transmission Class of walls and floors – STC 55; 2. Impact Insulation class of floors – IIC 55. These requirements are the laboratory performance of the wall or floor assembly. In the Verification Method, a 5-point leeway is provided for on-site performance. It is important to note that Clause G6 is very limited in scope compared to the range of acoustic issues present in multi-unit housing, including sound insulation between dwellings and common areas such as corridors, HVAC and plumbing noise, and external sources such as roads, rail or adjacent land uses. A designer should consider all of these when designing a building, not just the Code minimum.

BRANZ research report ER30 (Acoustical design of medium-density housing) noted that NZ's Code-minimum performance is poor. Higher levels of acoustic performance should be targeted to improve user satisfaction. Ratings of STC 65 and IIC 65 result in greater than 75% of occupants being satisfied with the acoustic performance. More research is required in relationship to flanking sound and impact sound resulting from acoustic underlays. An underlay that provides a 20 IIC point improvement on a concrete floor may only provide a 2 IIC point improvement on a lightweight floor.

4.3 Fire-safety

Finland

Fire safety can be demonstrated in two alternative ways: either through prescriptive design (classifications P1, P2, P3) or through case-specific performance-based fire design (P0) based on the assumed fire development. MSTABs are generally P2 class.

In P2 class, loadbearing structures might be out of timber, but the height is limited to eight storeys and 28 meters. MSTABs with at least three storeys require the installation of an automatic fire suppression system. In buildings over two storeys in P2 fire class, the surfaces of escape routes, stair landings, stairs, and fire barriers must be covered with at least K_2 10, A2-s1, d0 class fire-protective cladding. For other internal surfaces, 20% can be left uncovered, but the rest need to be clad with at least K_2 30, A2-s1, d0 covering. The area of uncovered surfaces can be increased if the fire resistance of loadbearing and separating structures is increased. If the fire resistance duration of building components is increased by 30 minutes, up to 80% of unprotected surface is allowed. If the fire resistance duration is extended by 60 minutes, no coverings are required. In P2 class MSTABs over two storeys, insulation in exterior walls must be at least A2-s1, d0 class. The exterior wall external surface and ventilation gaps external surface class requirement is at least D-s2, d2. If windows or balconies are used as fire escapes, the surface material near them needs to be at least B-s2, d0. Ventilation gaps internal surfaces need to be covered with at least K_2 10, A2-s1, d0.

Over 8-story MSTBs belong to the P1 (or P0) fire class, in which the requirements for load-bearing structures are greater as they must withstand the fire and decay phase without collapsing. In P1 class, loadbearing structures need to be non-combustible, at least class A2.

In performance-based design (P0 class) there are no exact limits for height, materials or surfaces. Methods need to be proven valid (e.g., through test and calculation methods in accordance with approved EN or ISO standards, provided they are applied within their scope of validity). In performance-based fire design, the fire load of the building must always be determined separately for each specific case. In buildings over two storeys, load-bearing structures must withstand fire and decay phases. The fire load is based on the 80% fractal of statistical or computational value. The minimum design fire load for buildings over two storeys is 600 MJ/m² and for buildings over eight storeys, it is twice the fire load and at least 900 MJ/m².

NZ

Fire safety regulations for MSTABs are primarily governed by the NZBC, particularly Clauses C1–C6, which focus on fire protection measures. These clauses outline the objectives and performance criteria to ensure occupant safety and property protection in the event of a fire. The challenge for the NZ industry is that there are ultimately few restrictions or limitations on the use of timber in relation to fire design. This lack of regulatory compliance provides little certainty and is, effectively, a barrier to industry uptake.

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Designers can demonstrate compliance with fire safety requirements through the following pathways:

Acceptable Solutions: MBIE publishes recognised design solutions that, if followed in full, are not subject to a Fire Engineering Brief (a process supported by Fire and Emergency NZ in which stakeholders are engaged early to agree on design methodology and specific requirements) and are deemed to comply with the code. C/AS1 and C/AS2 are the Acceptable Solutions for MSTABs, where Risk Group C/AS1 has no additional requirements, and Risk Group C/AS2 can have escape heights exceeding 25m.

Verification Methods: A performance-based approach that demonstrates the MSTABs' ability to meet fire safety requirements through standardised calculations, modelling and testing. For example, Verification Method C/VM2, Framework for Fire Safety Design, provides a means of compliance. Such methods could allow for exposed timber if safety can be demonstrated. Risk Group C/VM2 can also have escape heights exceeding 25m.

Alternative Solutions: Innovative, bespoke and non-standardised (high-rise, i.e. over six floors) designs that achieve compliance through in-depth detailed fire assessment requiring specific approval from building consent authorities. Design strategies would include: encapsulation (the covering of combustible materials); charring (allows exposed timber with sacrificial charring layers); active protection (smoke extraction and compartmentalisation); self-extinguishment (including sprinklers, demisters, adhesive testing and fire ignition retardants)

According to the Supplement to C/AS2 and C/VM2 for multi-storey mass timber buildings, the following guidelines apply for prescriptive design. If 3-4 storey buildings are made from timber, and no sprinkler system is installed, only a surface area <100% of the floor area can be exposed to timber and the fire resistance rating (FRR) is 60 minutes. If a sprinkler system is installed, no restrictions to exposed timber apply if FRR is 60 minutes. If FRR is 30 minutes, only a surface area <100% of the floor area can be exposed timber. In 5-6 storey timber buildings with no sprinkler system, no exposed wood is allowed, and FRR is 90 minutes. With a sprinkler system, a surface <200% of the floor area can be exposed timber, and the FRR is 60 minutes. In 7-9 storey timber buildings, a sprinkler system is highly recommended, and a surface <100% of the floor area can be exposed timber, and the FRR is 90 minutes.

4.4 Moisture

Finland

Structural timber is not treated for moisture protection. However, significant attention is given to moisture planning, ensuring adequate ventilation and moisture control in structures and materials.

NZ

Structural timber is commonly treated with preservatives to protect against moisture. Typical treatments include creosote (Hazard Class H6, 1920s), Copper-Chrome-Arsenic (H3.2-H6, 1940s), Boron (H1.2-3.1, 1950s-1970s), Light Organic Solvent Preservatives (H3.1-3.2, 1980s) and Azole-based treatments (H3.2-H4, 2000s). Other advances include acetylation and thermally modified wood processing.

4.5 Environmental impact

Finland

EPDs (Environmental Product Declaration) are widely in use though still voluntary. These documents report a product's greenhouse gas emissions from a life cycle perspective. EPDs are prepared in accordance with the standards ISO 4025 and EN ISO 15804. Additionally, there is a national co2data open-source database, with necessary data for doing life cycle assessment (LCA). All commonly used timber-based materials can be found in the database.

The goal of achieving a carbon-neutral Finland by 2035 has led to increasing interest in sustainable building materials, where timber plays a key role. LCA in the form of carbon footprint and handprint assessment will become obligatory in 1.1.2026. Finland has its own LCA method outlined by the Ministry of the Environment Finland. The method has been developed based on EN standards (15804, 15978, and 15643) and the European Commission's Level(s) method. Carbon budgets that consider only carbon footprints will also be introduced, and no building permits will be issued for apartment buildings unless LCA is used to prove that the projects' emissions are low enough. Emission accounting and carbon-neutrality goals are promoting MSTABs.

NZ

EPDs in NZ are developed in accordance with international standards, such as ISO 14025:2006 and the EPD Australasia Programme. Generally, only larger local manufacturing companies have EPDs. The two primary forms of EPDs evident in New Zealand are Product-Specific EPDs and Average Product EPDs, which represent the average environmental impact of products within a certain category or industry sector, offering a benchmark for comparison. Both play a significant role in sustainable building certifications, like Green Star, by providing verified environmental data that supports sustainable construction practices.

The Life Cycle Association of New Zealand (LCANZ) provides methodologies promoting Best Practices whilst tools like LCAQuick, assist architects, designers, and engineers in making sustainable design decisions by evaluating the carbon footprint and other environmental impacts of building designs. LCA and environmental accounting through various certifications gaining popularity promotes the use of timber.

4.6 Self-sufficiency

Finland

Finland is largely self-sufficient in key construction materials like timber, aggregates, and cement. The country has a strong domestic supply of these materials thanks to its natural resources. However, for more specialized materials like high-performance glass, metals (aluminium), and certain chemicals, Finland still relies on imports. These materials are generally imported from other EU countries. In 2024, 31% of imported materials were industrial supplies, which includes building materials [14].

NZ

Geographically, unlike Finland, which is embedded within the mainly land-based common market of the European Union, NZ undertakes most of its trade by sea and is by far the world's most isolated industrialised country. In 2021, approximately 90% of all building products sold in NZ were either imported (70%) or relied on imported products (20%) [15]. While NZ has a significant domestic timber industry, it also imports EWPs to meet specific needs and supplement local supply.

4.7 Building consenting

Finland

The use of LWT, CLT, glulam, and LVL is widely accepted. MSTABs, as similar buildings in other materials, just need to be compliant with the Finnish Construction Law and local land-use plans and zoning regulations. The building permit application includes architectural, structural, fire safety, and acoustic designs.

NZ

In NZ, there is no Acceptable Solution for MSTABs constructed from mass timber. The pathway to compliance uses Alternative Solutions or Verification Methods) to demonstrate structural and durability compliance in line with the NZ Building Code or various NZ Standards (such as 3603:1993 – Timber Structures, AS/NZS 1170 – Structural Design Actions, AS/NZS 1720.1:2022 – Timber Structures Code). This makes the building consenting process for MSTABs as Alternative Solutions more complex and riskier for the developer in comparison to Acceptable Solutions [16].

Alternative Solutions require expert reports and technical evidence such as structural engineering analysis (in some cases, Eurocodes such as EN 1995-1-1 for timber structures may be referenced), fire-safety report (showing massive timber meets NZBC fire resistance requirements), and acoustic performance evidence. Test results, technical studies, or overseas precedents can be used to prove compliance. Additionally, consent processing time for alternative solutions is generally longer as these require a case-by-case evaluation.

External expert input may also be required to issue a permit. Building consent authorities may seek independent peer reviews or third-party engineering assessments before issuing a building permit.

4.8 Market competitiveness

Finland

Construction processes and delivery models have been optimized for the conventional structural solutions. Technical price of a timber products might be competitive but factors such as lack of information and unclear responsibilities increase the cost calculation risks for construction process operators, which are priced into the bid. Additionally, there are challenges to compare bid information and generate accurate cost estimations in timber projects. Usually, different contractors are required to deliver timber and concrete components. Investor risk management is also challenging with unproven product solutions and with low number of projects.

There are smaller and lower number of timber construction specialized companies compared to conventional solutions. This is a challenge for the competitiveness of the tendering phase.

FISE (Finnish Certification of Professionals in the Built Environment) qualification system plays a pivotal role in ensuring the competence of professionals involved in the design and construction of MSTABs. There is a notable disparity in the number of certified structural design professionals across different structural materials. According to the FISE registry [17], approximately 500 structural engineers are certified to design concrete apartment buildings exceeding eight storeys. Only about 20 professionals hold the necessary qualifications to design similar wooden apartment buildings. For 3-7 storey concrete apartment buildings, approximately 600 professionals hold the right qualifications, whereas only

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85 are qualified to do similar buildings in timber. Understanding the physical behaviour of wood in construction requires specialized knowledge, which is not yet widely available, though many upskilling initiatives are in progress and mainly funded by the government. Lack of expertise slows down the adaptation of MSTABs.

Additionally, there is lack of expertise in contractors to work and manage MSTABs projects. Furthermore, lack of established practices and standardized solutions increases complexity of planning and construction resulting in higher possibility of planning mistakes and increase the time frame of the planning phase.

NZ

NZ's construction industry includes a substantial number of businesses involved in timber construction. Most, however, will be engaged in LWT framed construction, the historic means of housebuilding in NZ. Given the lack of state support and fiscal incentives for the wood processing industry, the MSTABs share of the overall housebuilding market will be small, given that in 2023, of the 37,239 dwelling units granted, 7% were for apartments [16]. This means that there is little to no appetite for specialist timber contracting. However, it is not unimaginable that a manufacturer such as RedStag TimberLab (RSTL) might diversify from being a EWP supplier into a mass timber contractor and has declared an interest in volumetric construction. As of today, RSTL is the only local manufacturer of CLT.

To build traction and demand for MSTABs in NZ, the solution is likely to be found in a smaller-scale stepping stone: terrace or town housing. Typically, three storeys, in 2023, represented 45% of all dwelling units granted [16]. For MSTABs to become increasingly competitive in NZ, mass timber will need to compete with the traditional LWT frame, which requires less timber volume at three storeys.

4.9 Public perception

Finland

Finland ranks second after Spain in terms of the proportion of multi-storey apartment buildings in Europe, with nearly 47% of housing units located in such buildings. Approximately 74% of new dwellings are in apartment buildings [18].

Existing MSTABs are predominantly perceived as welcoming, comfortable, and offering a superior indoor environment. They have also been assessed as being highly functional, exhibiting architectural excellence, and demonstrating fire resistance and acoustic insulation [19-20]. Nevertheless, the findings underscored the necessity of improving impact sound insulation in some lightweight intermediate flooring systems. Furthermore, residents of MSTABs indicate a pronounced preference for greater utilization of wood, especially in interior cladding for stairwells, balconies, and residential units.

NZ

The public perception of apartment living in NZ is evolving, influenced by factors such as housing affordability, urbanisation, and personal experience. The mid-20th Century Kiwi dream of the single-family dwelling was based on a stand-alone house of 120 m^2 centred on a 1,000 m^2 ‘section’. Today, there is a growing acceptance of medium to high-density housing options, including apartments. Yet ongoing work in paradigm shifting is required to increase NZ’s acceptance of MSTABs and apartment buildings in general. This will include disrupting perceptions around safety, sense of place, lifestyle enjoyability, sense of community and visual appeal [21].

4.10 Policies and Incentives

Finland

The Finnish government has actively supported wood construction through its policies and incentives. The National Wood Construction Programme, launched in 2016 and extended to 2023, aimed to increase the share of wooden buildings, especially multi-storey housing. The government also supports upskilling of engineers, architects, and developers when it comes to industrial wood construction by financing the creation of courses for professionals already working in the construction sector.

The Ministry of the Environment has developed a low-carbon construction strategy, which supports the wider use of timber. Public funding has also been provided to developers using sustainable materials like timber. The state-owned housing provider ARA (The Housing Finance and Development Centre of Finland) has promoted MSTABs through financial support and pilot projects.

More than 60% of Finland’s municipalities have already established goals and regulations for promoting wood construction [4]. Some municipalities, e.g. Helsinki, Turku and Tampere, have allocated some urban areas just for MSTABs in their zoning plans and guidelines exist for other municipalities willing to do the same [22].

NZ

While there are no mandated sustainability policies, there are some government initiatives that support the use and development of timber as a sustainable building material.

The Onshore Processing Wood Growth Fund is aimed at promoting the domestic processing of timber and wood products. Its primary focus is on supporting the growth and development of the local forestry and wood processing industries, encouraging innovation, sustainability, and value-added processing within the country.

The NZ Climate Change Response (Zero Carbon) Amendment Act 2019 is committed to achieving net-zero emissions by 2050, which promotes the use of low-carbon materials like timber in construction. The Wood Processing Industry Development Plan promoted wood as a sustainable resource for NZ's building industry (although a change of govt saw the Plan abandoned).

The NZ Forestry Strategy outlines goals for growing the forestry and wood processing industries, including the development of innovative products. This strategy supports the transition to more sustainable building solutions and promotes the use of timber products in construction.

The National Policy Statement on Urban Development provides guidance on land-use planning and development, promoting compact, sustainable, and low-carbon urban environments. The use of mass timber is encouraged as part of these sustainable urban development policies to reduce the environmental impact of buildings and improve the energy-efficiency of construction.

The NZ Green Building Council encourages the adoption of green building standards such as Green Star and Homestar, which promote sustainable building materials like timber.

5 – CONCLUSIONS AND RECOMMENDATIONS

This paper underscores that while Finland excels in MSTABs due to a robust regulatory framework and strong government support, NZ faces unique challenges that require solutions tailored to a different cultural and climatic context. Strict regulations in Finland, particularly those concerning acoustics and fire safety, have been identified as barriers to mainstreaming MSTABs [8, 23-24], though they efficiently tackle trust-issues like those NZ might face because of the lenient regulations when it comes to RMSTABs.

In Finland, to date, double safety measures mitigate the risk of fire MSTABs. On prescriptive design over two storeys, MSTABs require an automatic fire suppression system in Finland, whereas in NZ it is not required, but adding such decreases required fire resistance of structures and cladding. However, in Finland, more wood can be left visible in over four storey buildings compared to NZ by increasing structures fire resistance. The fire regulations make it difficult to fully embrace the aesthetical features of timber, increases the use of materials such as gypsum, and require the installation of sprinkler systems.

Sound regulations have been identifies as a prominent barrier to competitiveness of MSTABs in Sweden [25]. The Finnish sound insulation regulations for residential multi-storey buildings are among the strictest in Europe, surpassing even those in Sweden [26] and NZ. Compliance with the regulations often requires careful detail design, addition of mass or other structural layers, which typically involves concrete or gypsum, especially in intermediate floors. The identified risk in NZ is that MSTABs may get an acoustically bad reputation because the acoustic requirements are too lenient. Possible stigmatization in this regard can lead to an undesirable situation where MSTABs are considered problematic, even though good acoustic solutions exist.

The high demand for apartment buildings in Finland has created an excellent opportunity to increase the use of timber in urban environments. Even though multiple technical advancements have been made regarding building solutions in Finland, a larger breakthrough in the market share of these building types is still unfolding. This highlights the fact that the shift toward a market where MSTABs are competitive compared to conventional solutions is not just a technical challenge. Therefore, other factors have to be examined to provide a comprehensive understanding of what developments are required to promote change. For example, increased competitiveness is driven by construction process development and a comprehensive understanding of competitiveness factors throughout the value chain. Nevertheless, the construction and real estate industries are slow to adopt change, and due to various factors, new innovations and breakthroughs do not occur frequently. Implementing innovative products increases the risk of a construction project, but this risk can be mitigated through testing and proven case examples. This is why, in addition to technical understanding, Finnish examples of timber use provide valuable data on process-level and economic factors, which form the foundation of competitive timber projects.

NZ should adopt best practices from Finland's construction sector and establish clear regulatory pathways, while both countries should continue to enhance government support and promote public awareness to facilitate the wider adoption of sustainable

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timber buildings. Due to the relative newness of apartment living in NZ in general and current lack of strong incentives for MSTABs, a natural 'stepping stone' is terrace or town housing out of massive timber.

7 – REFERENCES

[1] United Nations Environment Programme, 'Global Status Report for Buildings and Construction: Beyond foundations - Mainstreaming sustainable solutions to cut emissions from the buildings sector', 2024

[2] L. Tupenaite, L. Kanapeckiene, J. Naimaviciene, A. Kaklauskas, and T. Gecys, 'Timber Construction as a Solution to Climate Change: A Systematic Literature Review', Buildings, vol. 13, no. 4, p. 976, 2023.

[3] A. Mishra et al., 'Land use change and carbon emissions of a transformation to timber cities', Nat Commun, vol. 13, no. 1, p. 4889, 2022.

[4] M. Karjalainen and E. Ilgin, 'A Comprehensive Statistical Analysis of Multi-Story Timber Residential Buildings in Finland (1995-2025)', in 8th International Conference of Contemporary Affairs in Architecture and Urbanism, 2025.

[5] Ministry for Primary Industries [MPI], 'Forestry and Wood Processing Industry Transformation Plan', 2022.

[6] Ministry of Agriculture and Forestry, 'Forest resources in Finland'.

[7] Finnish Forest Industries, 'Facts about Finnish forests'.

[8] H. Vihemäki, A. Toppinen, and R. Toivonen, 'Intermediaries to accelerate the diffusion of wooden multi-storey construction in Finland', Environmental Innovation and Societal Transitions, vol. 36, p. 43, 2020.

[9] PUUinfo, 'Suomessa toteutetut puukerrostalot' (EN: Finnish multi-story timber apartment buildings).

[10] MPI, 'About New Zealands Forests'.

[11] MPI, 'National Exotic Forest Description 2023', 2023.

[12] NZ Farm Forestry, 'Pine - Radiata pine, Pinus radiata'.

[13] NZ Government, 'Canterbury Earthquake Recovery Act 2011'. 2016.

[14] Finnish Customs, 'Distribution of imports to Finland 2024, by product category'.

[15] EBOSS, 'Construction Supply Chain Report 2021', 2021.

[16] A. Hoete, 'ModelDocs: Transforming Building Consenting Behaviour for Better Housing', BRANZ, 2024.

[17] FISE, 'Certification registry'.

[18] Statistics Finland, 'Dwelling stock 2020'.

[19] M. Karjalainen and H. E. Ilgın, 'The Change over Time in Finnish Residents' Attitudes towards Multi-Story Timber Apartment Buildings', Sustainability, vol. 13, no. 10, p. 5501, 2021.

[20] J. M. Savolainen, H. E. Ilgın, E. Oinas, and M. Karjalainen, 'Finnish Multi-Story Timber-Framed Apartment Buildings: Tampere Residents' Perspectives', Buildings, vol. 12, no. 11, p. 1998, 2022.

[21] K. Bryson, 'Study report SR378 The New Zealand Housing Preferences Survey: Attitudes towards medium-density housing', 2017.

[22] K. Ylä-Anttila, E. Oinas, P. Tamminen, D. Somelar, and M. Karjalainen, 'Puurakentamisen edistämisen ja ohjauksen keinot kaavoituksessa -opas [EN: Guide to Methods for Promoting and Regulating Timber Construction in Zoning]', 2020.

[23] E. Wiegand and M. Ramage, 'The impact of policy instruments on the first generation of Tall Wood Buildings', Building Research & Information, vol. 50, no. 3, pp. 255, 2022

[24] M. Maniak-Huesser, L. G. F. Tellnes, and E. Zea Escamilla, 'Mind the Gap: A Policy Gap Analysis of Programmes Promoting Timber Construction in Nordic Countries', Sustainability, vol. 13, no. 21, p. 11876, 2021.

[25] M. Andersson, J. Barkander, J. Kono, and Y. Ostermeyer, 'Abatement cost of embodied emissions of a residential building in Sweden', Energy and Buildings, 2018.

[26] B. Rasmussen, 'Sound insulation between dwellings – Comparison of national requirements in Europe and interaction with acoustic classification schemes', Proceedings of the ICA 2019 and EAA Euroregio: 23rd International Congress on Acoustics, 2019.