Savolainen, J.M., Ilgın, H.E., Oinas, E. & Karjalainen, M. (2022) Finnish Multi-Story Timber-Framed Apartment Buildings: Tampere Residents' Perspectives. Buildings 2022, 12(11), 1998.

DOI: https://doi.org/10.3390/buildings12111998

buildings

MDPI

Article

Finnish Multi-Story Timber-Framed Apartment Buildings: Tampere Residents' Perspectives

Jussi Matias Savolainen [1,†], Hüseyin Emre Ilgın [2,*,†], Eveliina Oinas [3] and Markku Karjalainen [2]

[1] Built Environment and Bioeconomy, Tampere University of Applied Sciences, 33520 Tampere, Finland
[2] School of Architecture, Faculty of Built Environment, Tampere University, 33720 Tampere, Finland
[3] Läntinen Palvelualue, Suomen Metsäkeskus, 33200 Tampere, Finland
* Correspondence: emre.ilgin@tuni.fi
† These authors contributed equally to this work.

Abstract: This study aims to understand the views and experiences of Tampere residents in Finland about multi-story timber-framed apartments and wooden structures through a questionnaire. The 151 responses highlighted two main issues: (1) multi-story timber-framed apartments were rated as a good product in terms of user satisfaction, which was based on the following findings: (1a) for most of the respondents, the apartment had fresh air and a suitable temperature on cold winter days; (1b) the majority felt safe living in a multi-story timber-framed apartment; (1c) respondents generally were satisfied with the soundproofing, except for the disturbing noises from the upper floor and the stairwells; (1d) residents' opinions were mainly positive regarding most of the functional features such as storage facilities, the location and access roads of the building, exterior facade, and wood visibility level; (2) there exists a demand for multi-story timber-framed residential buildings in the market, especially in the customer segment, which is defined as 'environmentalist'. This was based on the following findings: (2a) living in an environmentally friendly, low-carbon, natural-material apartment, cozier living in a timber-framed apartment, and meaningful use of wood in interiors were notably more important for the extremely satisfied residents; (2b) building facades, and floors and ceilings inside the apartment were the places where the use of wood was most desired in the apartment. This article is intended to be a guide for key construction experts, e.g., architectural designers and developers to better understand and meet the demands and needs of timber-framed apartment residents in Finland.

Keywords: wood/timber; residents; Tampere; Finland

Citation: Savolainen, J.M.; Ilgın, H.E.; Oinas, E.; Karjalainen, M. Finnish Multi-Story Timber-Framed Apartment Buildings: Tampere Residents' Perspectives. *Buildings* **2022**, *12*, 1998. https://doi.org/10.3390/buildings12111998

Received: 3 October 2022
Accepted: 14 November 2022
Published: 16 November 2022

1. Introduction

As in other regions, Finland has also been significantly affected by global urbanization and the accompanying increase in the trend of building construction [1–12]. It is estimated that this rate will reach about 90% by 2050, with more than 80% of the Finnish population currently living in urban environments. This will lead to continued growth in the amount of working population and thus the number of urban residents in Finland's major cities such as Tampere [13].

In this sense, the construction of multi-story timber buildings can make a significant contribution to meeting the residential needs driven by increasing urbanization [14]. As in many other states that internalized a forest-based bioeconomy, in Finland, where the construction of multi-story wooden buildings has been promoted since the early 90s, these structures have the potential to create sustainable business opportunities, seen as the key to a bioeconomic transition [15].

It should be underlined here that, in line with the Finnish Government's bioeconomic policy for a carbon-neutral environment by 2035 [16], as pioneering, recyclable, and sustainable technologies, engineered timber products play a significant role in reducing

construction-based carbon emissions and embodied energy consumption [17–20] for the transition to a bio-based circular economy in a sustainable manner [21].

Furthermore, the wooden structure provides significant advantages in the fight against the climate crisis, as it can be used in place of other building materials to mitigate greenhouse gas emissions, but it also has unique characteristics, such as storing massive amounts of carbon [22–24]. Besides being used as a building material, wood can be reused as a raw material for other buildings after its service life [25,26]. The use of wood indoors contributes to aesthetically pleasing environments, preservation of physical health, emotional state, and comfort of life [27–29].

It should be noted that a properly designed and built timber structure is as fireproof as structures made of other materials. For instance, the same 60 min fire resistance requirement is applied to timber-framed residential buildings as to reinforced concrete apartments. In Finland, great attention is paid to the fire safety of timber buildings. The new regulation on fire safety in buildings, which came into force in 2018, aimed to clarify the execution and predictability of construction [30]. The new regulation allows the fire-safe usage of massive timber in the construction of 8-story residential buildings. Even more visible wood can be used for interior surfaces, as long as the structural and separating structural members can tolerate the time required for fire resistance. This arrangement allowed greater growth in wood construction than before but also imposed more stringent restrictions, e.g., the use of obligatory sprinkler systems.

Additionally, according to the Finnish fire code [30], inside the building, in P2 fire class 3–8-story timber apartment buildings, visible wood surface with fire class D is allowed without restriction: on floors, non-load-bearing and non-fire section walls, and: 20% in the surfaces of load bearing and fire section walls and ceilings. According to the fire regulations, other wooden surfaces (such as CLT) must be covered with a 10-min A2 fire class board (such as gypsum board) in 3–4-story timber apartment buildings and a 30-min A2 fire class board in 5–8-story timber apartment buildings [31]. Furthermore, all apartment buildings with more than 2-story must withstand a fire for 60 min, no matter what material they are made of. In all apartment buildings up to the 8-story (both timber and similar reinforced concrete apartments), the fire zone stairwell is sufficient, and the balconies serve as emergency exits. Timber-framed apartments with more than 2-story must have automatic extinguishing equipment (sprinkler system). The balconies of these apartments are also equipped with a sprinkler system.

As a result, multi-story apartment buildings, in which wood is used as the primary construction material, have found the opportunity to become increasingly widespread in Finland due to government support and incentives [32]. In connection with this, many studies have been carried out on different construction solutions based on the usage of engineered wood products with their technical characteristics in the Finnish context (e.g., [33–40]). Additionally, several studies are focusing on timber as a construction material in buildings from the point of view of key construction stakeholders, e.g., architectural and structural designers, and contractors (e.g., [41,42]).

However, despite its increasing reputation in the construction sector and civil society worldwide and in Finland [43], a user- or consumer-oriented approach dominated by perceptions, experience, or views is still lacking in this discussion, especially in terms of residential construction [44,45]. Furthermore, understanding is limited concerning consumer value expectations in the Finnish multi-story construction markets, which is critical to decision-making processes and the success of user-centered business strategies in the bioeconomy [46–48]. Identifying users' attitudes towards new building methods play a critical role in spreading these practices, thus contributing to the transition to a forest-based bioeconomy in the Finnish context [49].

Among the limited number of studies on the attitudes of residents or users toward wooden buildings in Finland, Karjalainen [50] conducted a survey of residents of seven of Finland's first timber-framed apartments between 1998 and 1999 with a response rate of over 81% (197 out of 242). Similarly, Karjalainen and Ilgın [51] conducted a survey of

multi-story timber-framed apartment buildings in Finland in 2017 through a questionnaire and the response rate was over 52% (308 out of 585). In both surveys [50,51], results mainly highlighted that: (a) occupants' attitudes towards wooden apartment buildings were positive; (b) positive perceptions regarding sound insulation, indoor climate, and coziness were identified; (c) there was a request for more wood inside the building and more wooden apartments. Based on Karjalainen's survey study above, Karjalainen and Ilgın [50,51] conducted a comparative study through questionnaires (1998–1999 and 2017) on Finnish dwellers' attitudes towards multi-story timber-framed apartment buildings. Karjalainen et al. [52] examined Finnish suburban residents' preferences for livable housing regions via a questionnaire, considering their perception of timber as a construction material. Their survey results mainly showed that: (i) the majority supported life in one- to two-story buildings and low-density residential environments; (ii) the attitudes of the participants towards the usage of timber in construction are mostly very positive; (iii) cost-competitiveness were issues of skepticism. Karjalainen et al. [53] focused on Finnish dwellers' attitudes toward timber facade refurbishment and extra story construction via a survey study. The results mainly indicated that: (a) the attitude of residents was generally positive for timber facade refurbishment and extra story construction; (b) respondents mostly thought will increase the attractiveness of timber facade refurbishment and extra story construction in inhabited zones; (c) the majority of them were positive about the facade refurbishment, particularly in timber. Viholainen et al. [54] studied how homeowners perceive wood before and after living in a wooden house for a year. The results of their study indicated that traditions and memories related to wood affect consumers' appreciation, for example, regarding the coziness of a wooden home. The environmental, physiological-technological, visible, and well-being characteristics of wood as a structural material were analyzed from consumers' perspectives by Lähtinen et al. [55]. According to their analysis results, there were two main user classifications based on their perceptions of the sustainability benefits of wood, i.e., the ones favoring ecological and physio-technological benefits of wood and the ones favoring aesthetic and well-being benefits of wood. In addition to Finland, various studies have been conducted on consumer perception of the use of wood as a construction material in other countries (e.g., [28,56]). Besides this, some perceptual research has concentrated on the usage of timber in interiors and furniture (e.g., [57–59]).

In the Finnish context, as in other regions, there are very limited studies [49–51] in the literature on the views and experiences of residents about multi-story timber-framed apartments and wooden structures. This paper aimed to fill this gap, based on the resident survey of multi-story timber-framed apartments in the city of Tampere from a multidimensional perspective. These dimensions include background information, recommendation to move to a timber-framed apartment, basic, functional, and emotional features of the apartment buildings, the location and functionality of the apartment building, the places where the use of wood is most desired, other thoughts about living in a multi-story timber-framed apartment building, and residents' comments and advice to designers and developers of these buildings.

Tampere is Finland's second-largest city and third-most populous individual municipality, located in the western part of Finland. Today, as the most populated inland city in the Nordic countries, Tampere is one of the main urban, financial, and cultural hubs in the whole inland region. In line with Tampere's carbon-neutral plan until 2030, it is vital to develop residential projects focused on user demands, especially in order to make timber-framed apartment building constructions, which have increased in recent years, more sustainable [60]. In this sense, this study, which focuses on the views and experiences of Finnish residents regarding multi-story timber-framed apartments, is critical.

In this paper, timber or wood refers to engineered wood products [61], e.g., cross-laminated timber, and laminated veneer lumber. The remainder of this work is structured as follows: First, a description of the materials and methods is presented. This is followed by findings based on a survey of Tampere residents. After that, a comprehensive discussion section is provided. Finally, the conclusions are given.

The study aimed to understand Tampere residents' perspectives on multi-story timber-framed apartment buildings. In doing so, this study attempted to identify background information of surveyed residents, recommendations to move to a timber-framed apartment, basic, functional, and emotional features of the apartment buildings, the location and functionality of the apartment building, the places where the use of wood is most desired, other thoughts about living in a timber-framed apartment building, and residents' feedback to designers and developers of multi-story timber apartment buildings.

2. Materials and Methods

This research was conducted through a literature survey and questionnaires conducted between May and June 2022 in Finnish. In the survey (Appendix A), the residents of 9 multi-story timber-framed apartment buildings in Tampere were selected as the target group. The survey was carried out as part of the Wood Expertise for Pirkanmaa project and the Timber-framed Apartment Building for Growth project in Pirkanmaa.

The main population of the material was 465 households, including Finnish-speaking people, ranging in age from under 30 to over 70 in Tampere. The buildings are located in the suburbs of Tampere, Hervanta, Härmälä, Kauppi, Niemenranta, and Vuores (Figure 1). Hervanta is a large suburb or satellite city of Tampere and is located approximately 10 km south of the city center (Figure 2). Härmälä is the southwestern part of Tampere. Kauppi is in the eastern part of Tampere and is part of the larger Sampo district. Niemenranta is a district of Tampere, located approximately four and a half kilometers from the center. Vuores is an area located on the border of Tampere and Lempäälä in the Pirkanmaa region (Figure 3). The selected buildings are comparable as they are located in the same geographic area and were all built fairly recently.

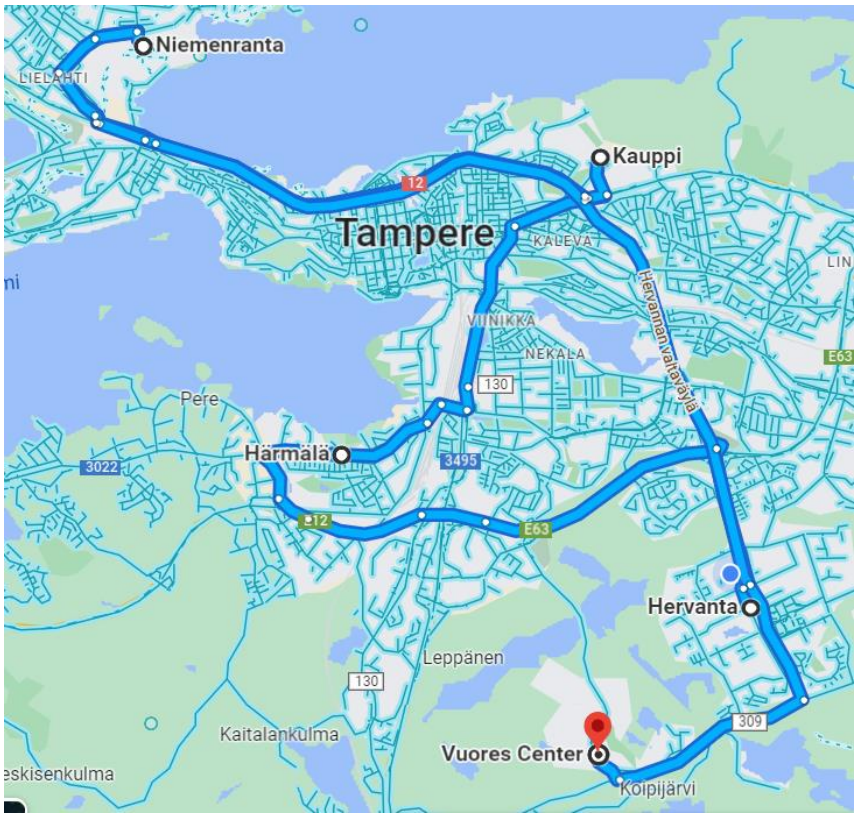


Figure 1. Hervanta, Härmälä, Kauppi, Niemenranta, and Vuores on the map.

Figure 2. Hervanta (source: Wikipedia).

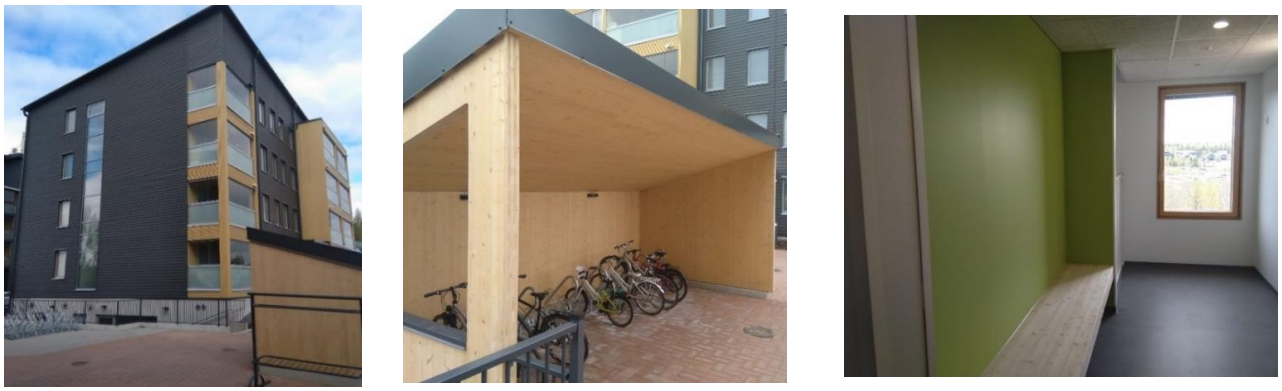
Figure 3. Vuores (source: Wikipedia).

The survey aimed to find out how the newest multi-story timber-framed apartments meet the needs of the residents and to find out the residents' views on how wood should be used in buildings in the future, as they are the most important experts. The analyzed multi-story timber-framed apartment buildings were built between the years 2016 and 2022, and they had a height of between 4 and 8 stories. The area range of apartments in VTS—Koukkurannankatu 10, VTS—Rautalepänkatu 2, As Oy Tampereen Tuohi, As Oy Tampereen Tohtori, As Oy Tampereen Härmälänsydän, As Oy Tampereen Niemenrannan Rantapuisto, TOAS—Kauppi, TA Aihkinkatu 6, A-Kruunu Tampereen Honkakuusenkatu 5 are (30–74 m^2), (30–90 m^2), (25–49 m^2), (30–59 m^2), (30–74 m^2), (25–59 m^2), (25–49 m^2), (30–90 m^2), (30–90 m^2), respectively. In addition, the heating system of all surveyed apartments is district heating. Timber-framed apartments do not differ from traditional reinforced concrete apartments in terms of heating and ventilation technology. The floor plans and surface areas of timber-framed apartments are also similar to those of reinforced concrete apartments.

The responses were handled anonymously, and no personally identifiable data were collected or used in the analysis phase. The response rate was 33% (151 out of 458) due to the reluctance of the residents who participated in the survey. The number of responses of the analyzed apartments was as follows: VTS—Koukkurannankatu 10, Vuores (n = 11) (Figure 4), VTS—Rautalepänkatu 2, Isokuusi (n = 12) (Figure 5), As Oy Tampereen

Tuohi—Toivonkuja 3, Härmälä (n = 3) (Figure 6), As Oy Tampereen Tohtori—Tieteenkatu 9, Hervanta (n = 11) (Figure 7), As Oy Tampereen Härmälänsydän—Tarmonkuja 4, Härmälä (n = 9) (Figure 8), As Oy Tampereen Niemenrannan Rantapuisto—Raamikatu 32, Niemenranta (n = 5) (Figure 9), TOAS—Kauppi, Kuntokatu 11 A (n = 36) (Figure 10), TA Aihkinkatu 6/Honkakuusenkatu 5, Isokuusi (n = 30) (Figure 11), and A-Kruunu Tampereen Honkakuusenkatu 5/Aihkinkatu 6 (n = 34) (Figure 12).

Figure 4. VTS—Koukkurannankatu 10, Vuores (photo courtesy of Suomen metsäkeskus).



(**a**) (**b**) (**c**)

Figure 5. VTS—Rautalepänkatu 2, Isokuusi: (**a**,**b**) exterior views; (**c**) interior view (photos courtesy of Suomen metsäkeskus).

Figure 6. As Oy Tampereen Tuohi—Toivonkuja 3, Härmälä (photo courtesy of Suomen metsäkeskus).

(**a**) (**b**) (**c**)

Figure 7. As Oy Tampereen Tohtori—Tieteenkatu 9, Hervanta: (**a**) exterior view; (**b**,**c**) interior views (photos courtesy of Suomen metsäkeskus).

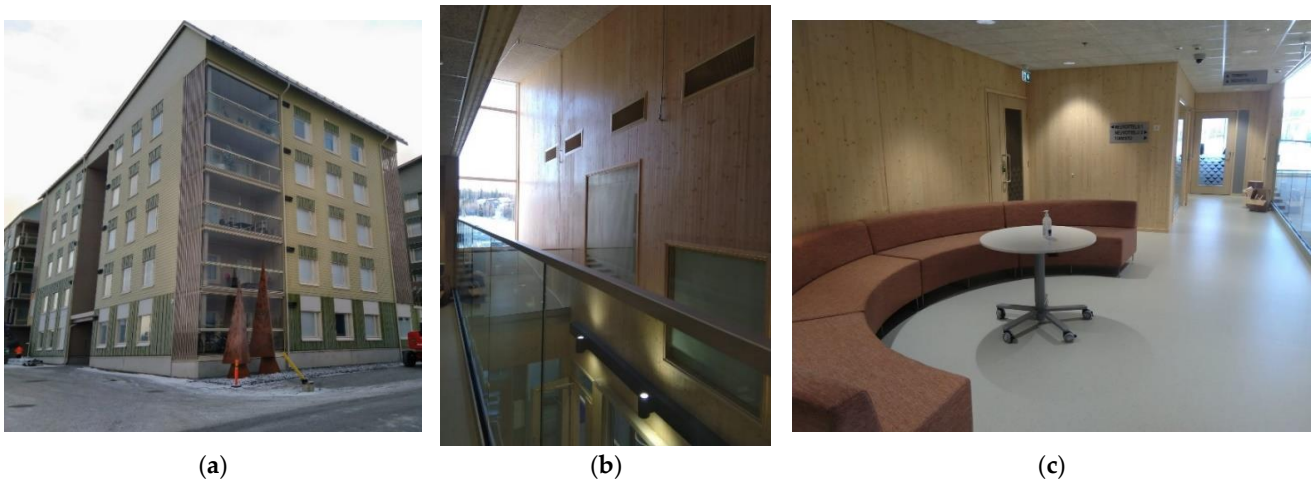
Figure 8. As Oy Tampereen Härmälänsydän—Tarmonkuja 4, Härmälä (photo courtesy of Suomen metsäkeskus).

(**a**) (**b**) (**c**)

Figure 9. As Oy Tampereen Niemenrannan Rantapuisto—Raamikatu 32, Niemenranta: (**a**) exterior view; (**b**,**c**) interior views (photos courtesy of Suomen metsäkeskus).

(**a**) (**b**) (**c**)

Figure 10. TOAS—Kauppi, Kuntokatu 11 A: (**a**) exterior view (photo by Hüseyin Emre Ilgın); (**b**,**c**) interior views (photos courtesy of Suomen metsäkeskus).



(**a**) (**b**) (**c**)

Figure 11. TA Aihkinkatu 6/Honkakuusenkatu 5, Isokuusi: (**a**) exterior view; (**b**,**c**) interior views (photos courtesy of Suomen metsäkeskus).

Figure 12. A-Kruunu Tampereen Honkakuusenkatu 5/Aihkinkatu 6 (photo courtesy of Suomen metsäkeskus).

In addition to the following preliminary information in the invitation letter—the main aim of the survey, the name of the project it is a part of, and the contact information of the people who conducted the survey—this statement was given: "The building you live in is one of the newest multi-story timber-framed apartments built in Finland. According to the current fire code in Finland, residential apartment buildings with more than 2-story, timber frames, and facades can be built up to 8-story and even higher floors with functional fire design. Since 1995, 2-story timber-framed apartments with a total of 4150 apartments have been built around Finland. In addition, there are about 10,000 new timber-framed apartments under construction. The popularity of timber-framed apartment buildings has increased in recent years, mainly due to environmental concerns".

It should be noted that the fire safety levels provided by wooden buildings in Finland have increased over the last decade. To date, double security measures are still common to protect a wooden structure against the risk of fire [62]. As a result of these measures (e.g., sprinkler system), fire safety was not a concern among Finnish residents. In a study conducted between 1998 and 1999 [50], timber-framed apartments were evaluated positively in terms of fire safety. Similarly, in 2017, research [51] among timber-framed apartment residents showed that the fire safety of their buildings is quite satisfactory due to technical measures (i.e., fire alarm system, automatic sprinkler system). These findings were confirmed by the findings of another recent Finnish study conducted by Viholainen et al. [54]. As these findings showed, fire safety in timber-framed apartments is a positive rather than a concern among Finnish residents, and these apartments are perceived as safer against fire risk compared to concrete apartments. Thus, the fire safety phenomenon was not specifically addressed in this study.

The main idea of the questionnaire design was to indicate general satisfaction and its components through separate sets of questions. The Net Promoter Score (NPS) was used as a general satisfaction indicator. In the NPS system, the respondents are divided into three groups based on a single question: would you recommend the service/product to your friend or colleague? The three groups are detractors, passives, and promoters. The scale is 0 to 10, and answers 0 to 6 are recognized as 'detractors', 7 and 8 as 'passives', and 9 and 10 as 'promoters' [63].

To analyze the components the satisfaction, the questions were divided into three sets, basic needs, functional needs, and emotional needs, according to the customer need categorization of Lundström et al. [64]. The questions were formed into statements that reflect the customer needs that are supposed to be fulfilled by the built environment, and the answers were given on a scale of 1 to 5 where 1 completely disagreed and 5 was completely agreed (in between there was somehow agree/disagree and neural). The logic in using this categorization is to map, how fulfilling needs that belong to different categories affect the level of respondents' satisfaction.

According to an earlier study with a similar setup [65], there are two hypotheses when using Lundström et al. [64] categorization: (1) Fulfilling basic needs does not trigger promoter-level satisfaction, but the inability to serve basic needs probably leads to detractor behavior. (2) Promoter-level satisfaction is triggered by the aligned bundle of needs that are fulfilled properly. The bundle includes needs from every category but reaching the promoter level of satisfaction does not require fulfilling every need, on the contrary, people allow even significant lacks, if the alignment of the selected needs is achieved correctly.

In line with these hypotheses, this study was designed to recognize the features of timber-framed multi-story buildings that can form an attractive alignment of fulfilled needs. Yet the study was designed to recognize whether some basic need-related features have not been delivered properly, and thus the detractor behavior was instigated.

Additionally, questionnaire items were designed considering previous perceptual studies on wood construction (e.g., [49–51]) and expressed equally in positive and negative formats to avoid any bias. In the questionnaire of this study (Figure 13), five-point Likert-type scales, NPS on a scale from 'not at all likely (0)—extremely likely (10)' as mentioned above, multiple choice, and open answer options were given. In the survey

questionnaire consisting of 20 questions in total, general information about the residents and their residency (e.g., address, gender, age, apartment size, the form of residence) of the apartment was requested in the first 9 questions. In the following two questions, they were asked about their experience with the timber-framed apartment and how much they would recommend moving to a wood-framed apartment to their acquaintances. In the first two of the next three questions, participants were asked to rate the basic features of their apartment building (e.g., suitable temperature, safeness, disturbing sound), and in the last question, the functional features (e.g., cooking facilities, storage premises) on a five-point Likert-type scale was used (from strongly disagree to strongly agree) and open answers. In questions 15 and 16, surveyed residents were asked to evaluate the location and functionality of their apartment building on a five-point Likert-type scale and open answers. In the next question, perceptual questions about living in a timber-framed apartment building (e.g., residential satisfaction, coziness) were asked. In question 18, the participants were asked where they would like more wood to be used in timber-framed apartments. The last two questions of the survey were about living in a timber-framed apartment and feedback for designers and developers, demanding open answers.

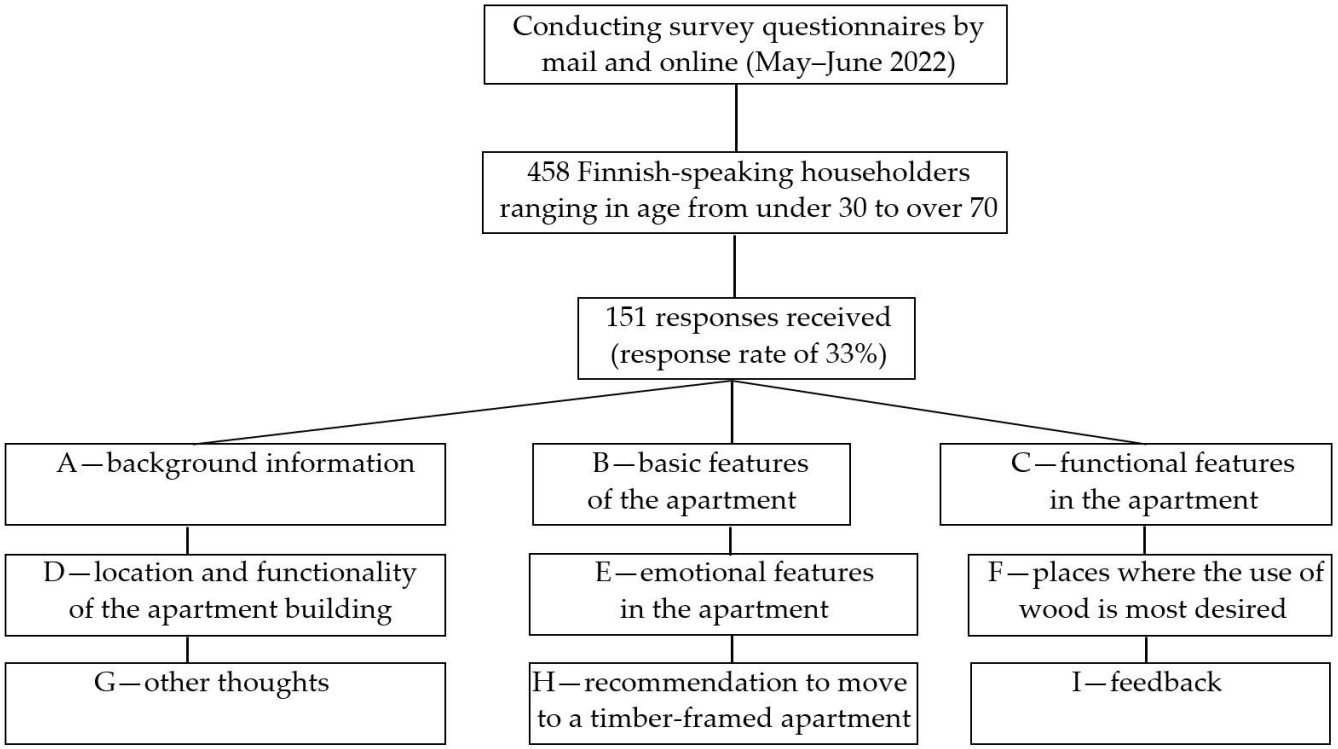


Figure 13. Research methodology.

3. Results

3.1. Background Information

Surveyed participants mostly resided in newly constructed multi-story timber-framed apartment buildings, TOAS—Kauppi, Kuntokatu 11 A (24%), TA Aihkinkatu 6/Honkakuusenkatu 5, Isokuusi (20%), and A-Kruunu Tampereen Honkakuusenkatu 5/Aihkinkatu 6 (23%). Participants were predominantly female (>62%) and under 30 years of age (>60%). About twenty percent of the residents were between the ages of 30 and 40. The size of their apartments was single (34%), double (34%), triple (23%), and quadruple room (23%), respectively, in percentile order. The area of their apartments was mostly 30–39 m^2 (34%), followed by 30–39 m^2 (24%). In terms of households, one adult household dominates with 58%, followed by two adults with 42%. Among the forms of residence, apartments for rent were preferred with a dominant rate of 80 percent. The floor of the flat where the

participants live was as follows, in order of percentile majority: fourth floor (25%), second floor (22%), third floor (18%), and first floor (13%). While the overwhelming majority of the respondents (>83%) lived in a multi-story timber-framed apartment for less than a year, the rate of those who lived between 1–2 years was 11%. All surveyed residents were aware that they lived in a multi-story timber-framed apartment.

3.2. Recommendation to Move a Timber-Framed Apartment

NPS was selected to provide an overall glance at the level of satisfaction of each respondent. The system relies on a single question "how likely are you to recommend the product or service to a friend or colleague", i.e., "how much they would recommend moving to a wood-framed apartment to their friends or acquaintances" and based on answers on a scale of 0 to 10 the respondents are divided into three categories: detractors (0–6), passives (7–8), and promoters (9–10). The main idea is to probe the share of customers, who probably will make unprompted actions to promote the company, and thus will support the business. In addition, the score considers the unprompted actions to warn about the bad customer experience, as the score is calculated by subtracting the detractors from the promoters, and the result is divided by the number of all respondents [63].

$$\text{NPS} = \frac{\text{Promoters} - \text{Detractors}}{\text{All respondents}}$$

In this survey, as seen in Figure 14, the NPS calculated from all respondents was 31 (n = 151, promoter f = 72, passive f = 54, detractor f = 25). Almost half of the respondents recommended moving to a timber-framed apartment. The result was further analyzed in the discussion section.

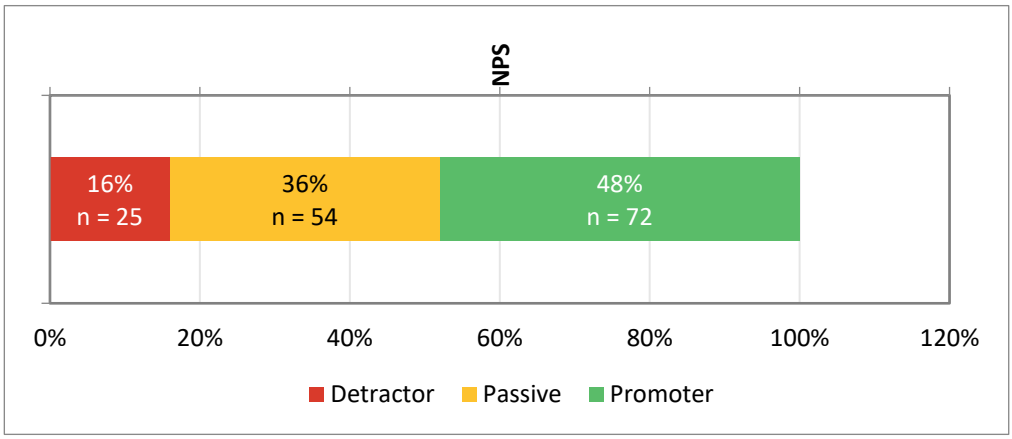


Figure 14. Recommendation to move to a timber-framed apartment.

3.3. The Basic Features of the Apartment

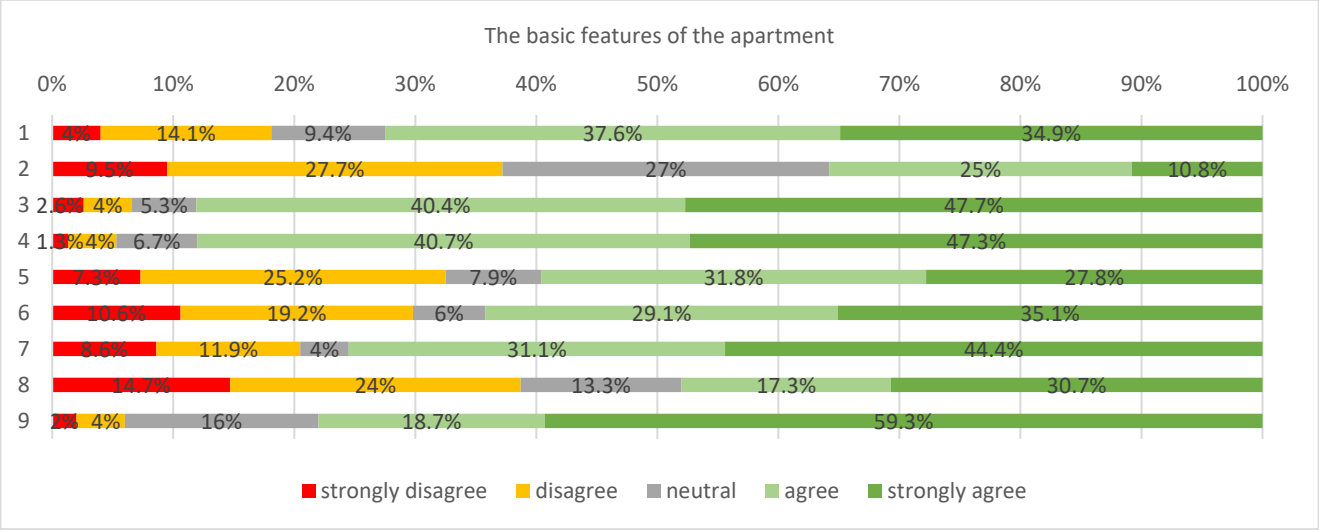
Figure 15 highlights the main features of the apartment in which the surveyed Tampere residents live. Most of the respondents (the total occurrence of "strongly agree" and "agree" options > 72%) thought that timber-framed apartments had a suitable temperature on cold winter days, while it came to summer days, the ratio of those who (strongly) agree with 37% and (strongly) disagree with 36% was very close to each other. The vast majority of respondents (>88%) thought they had fresh air in the apartment. In support of these results, dissatisfaction with the indoor temperature of the apartment in summertime and satisfaction with it in the wintertime is expressed in the following open answers.

Similarly, most (88%) felt safe living in a timber-framed apartment. Most of the participants stated that there was no disturbing noise from outside, from the stairwell, from the neighboring apartment, and from downstairs and the satisfaction rates (the total occurrence of "strongly agree" and "agree" options) in question are as follows: 60%, 64%,

75%, and 78%. However, when asked about the upstairs, 48 percent of residents said they were not bothered by the noise. As seen below, in open answers that support the above results but provide more specific information, the participants brought up the noise coming from the upstairs, neighboring apartment, outside, and stairwell, respectively.

According to the open responses (101 responses) in this part of the study, the most frequently mentioned issues related to timber-framed apartments by the participants are listed below in order of importance (Note: some responses have addressed more than one issue.):

(1) Disturbing noise from upstairs (impact sound): 38 responses;
(2) Unsuitable temperature on summer days: 26 responses;
(3) Disturbing noise from the neighboring apartment: 24 responses;
(4) Disturbing noise from outside: 23 responses;
(5) Disturbing noise from the stairwell: 18 responses;
(6) Suitable temperature on winter days: 18 responses;
(7) Fresh air inside: 10 responses;
(8) Dry air in wintertime: 10 responses.



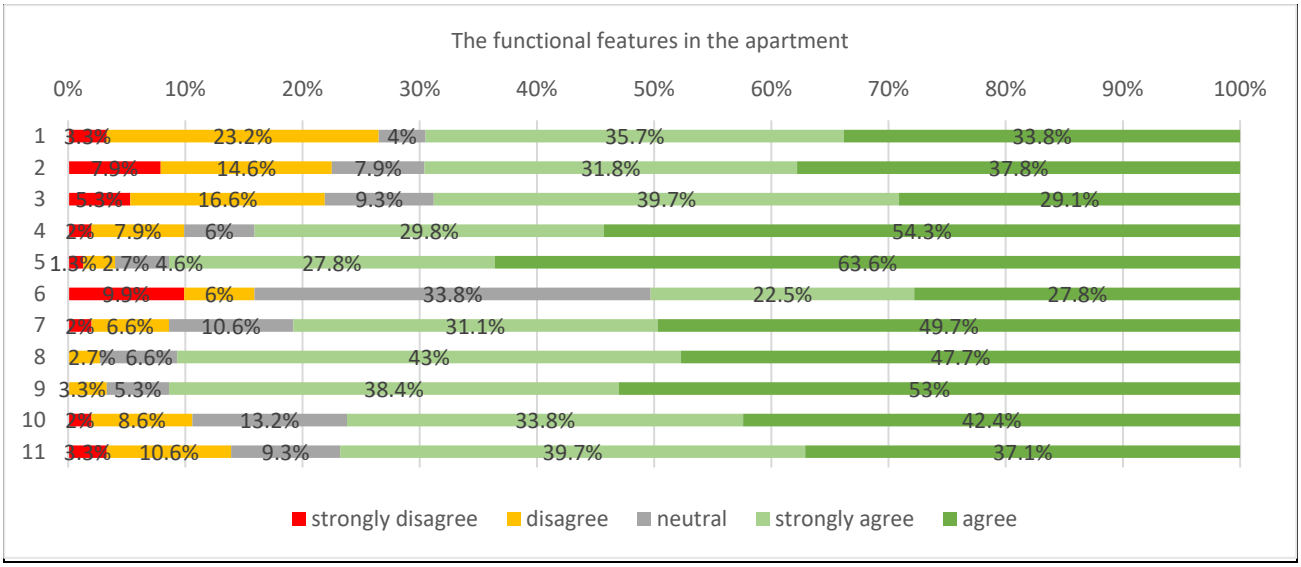
1—Apartment has a suitable temperature when cold during the year.
2—Apartment has a suitable temperature when warm during the year.
3—Apartment has fresh air inside.
4—A timber-framed apartment building feels safe to live in.
5—No disturbing noises from outside the apartment.
6—No disturbing noises from the stairwell in the apartment.
7—No disturbing noise from the neighboring apartment.
8—No disturbing noise from upstairs.
9—No disturbing noise from downstairs.

Figure 15. The basic features of the apartment.

3.4. The Functional Features of the Apartment

Figure 16 indicates the functional features in the apartment in which the surveyed Tampere residents live. According to the responses given by 151 participants, it was observed that they were generally satisfied (>70%) with the functional aspects of the timber-framed apartments they lived in, excluding the sauna. Washing, chore, and recreational facilities came to the fore with rates exceeding 90 percent (the total occurrence of "strongly agree" and "agree" options) among the activities where the functional opportunities offered by the timber-framed apartment were suitable, followed by sleeping (84%) and laundry (81%), respectively. On the other hand, when it comes to sauna facilities, half of the

participants were satisfied with the adequacy of the functional facilities of the apartment building, while a third took a neutral stance.



1—Some areas to wear, take off, and store are very convenient for your use.
2—It is very useful for storing food and utensils, for cooking and eating in convenient places.
3—You have adequate and very useful convenient storage facilities.
4—Some facilities are very convenient for you to use for sleeping.
5—Some facilities are very convenient for your use for washing.
6—Some facilities are very suitable for saunas.
7—Some facilities are very suitable for laundry.
8—Your apartment is very suitable for daily work.
9—Your apartment is great for hanging out and relaxing in suitable places.
10—You have very suitable facilities for your guests.
11—Your apartment has a perfect layout.

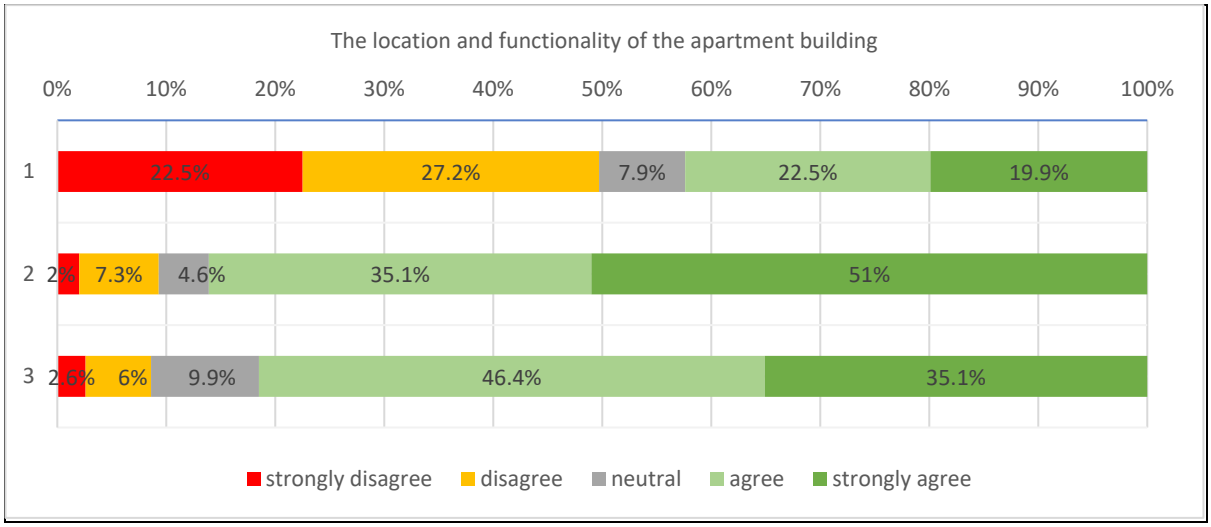
Figure 16. Functional features in the apartment.

3.5. The Location and Functionality of the Apartment Building

Figure 17 highlights the location and functionality of the apartment building in which the surveyed Tampere residents live. The vast majority of respondents (>80%) considered that there were very convenient storage facilities, such as bicycles at home or in the garden, and that the building was in the best possible place for their daily commute. On the other hand, almost half of the residents complained that there was not enough parking space, while 43 percent found the parking space sufficient.

According to the open answers (78 responses) in this part of the study, the most frequently mentioned issues related to location and functionality are listed below in order of importance (Note: some responses have addressed more than one issue.):

(1) Lack of parking space: 23 responses;
(2) Poor kitchen design such as insufficient storage space: 19 responses;
(3) Inappropriate outside bike storage: 15 responses;
(4) Lack of storage space at home: 14 responses;
(5) No private sauna/insufficient public sauna facilities such as fewer available reservations: 13 responses;
(6) Insufficient laundry space: 6 responses.



1—There is enough parking space near the building.
2—There are very convenient storage facilities such as bicycles in the house or the garden.
3—The building is in the best possible place for my daily commute.

Figure 17. The location and functionality of the apartment building.

3.6. Emotional Features in the Apartment

Figure 18 indicates the following features in the apartment building in which the surveyed Tampere residents live. Based on the statistical data of the survey, the majority of the participants (≥80%) supported the proposition that the apartment is in a suitable area for them (>90%), the apartment looks beautiful from the outside (>87%), the access roads to their apartments are pleasant (>86%), and the use of wood in the building is visible enough (80%). There was a consensus among the surveyed residents (>65%) that it is important to live in an environmentally friendly apartment, that living in a timber-framed apartment is cozier than other apartments, and that the wooden interior is used in a meaningful way. Similarly, more than half of those surveyed embraced the idea of living in a low-carbon, natural-material apartment. On the other hand, about half of those surveyed valued living in a timber-framed apartment, while 38 percent had a neutral view of it.

3.7. The Places Where the Use of Wood Is Most Desired

Figure 19 highlights the places where the use of wood is most desired in the apartment building in which the surveyed Tampere residents live. Those places were as follows, in order of importance: on building facades (70%), on the floors inside the apartment (66%), on the ceilings inside the apartment (58%), on the doors and windows of the apartment (49%), and balconies (47%).

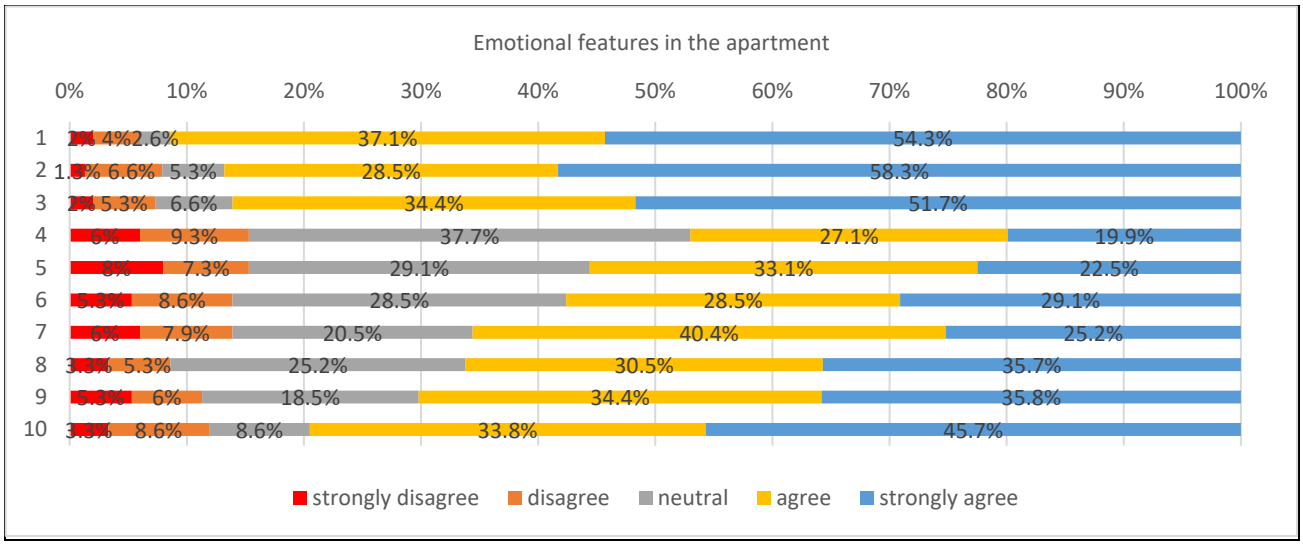
3.8. Other Thoughts about Living in a Timber-Framed Apartment Building

In this section, the most emphasized issue among the 53 responses of the residents surveyed was the cozy and pleasant atmosphere of the timber-framed apartment (20 responses). Sound insulation is another issue mentioned, with 5 out of 8 finding it satisfactory and 3 finding the quality insufficient.

3.9. Feedback for Developers and Designers of Timber-Framed Apartment Buildings

The residents were asked to give feedback to designers and developers of wooden apartment buildings. Among 43 answers, comments were in the following order of frequency: (1) demand for better sound insulation (9 responses); (2) demand for more timber-framed apartments and more timber as a visible surface material (8 responses);

and (3) demand for better ventilation (3 responses); better door locking system for door and windows (3 responses).



1—The house is in an area that feels right to me.
2—The house looks nice from the outside.
3—Access roads to my apartment are pleasant.
4—Living in a wooden house is important to me.
5—Living in a low-carbon house is important to me.
6—Living in a house made from natural materials is important to me.
7—Living in an environmentally friendly home is important to me.
8—Living in a timber-framed apartment feels cozier than in other apartments.
9—Wooden interior surfaces were used in the apartment in a meaningful way.
10—The use of wood in the building is visible enough.

Figure 18. Emotional features of the apartment.

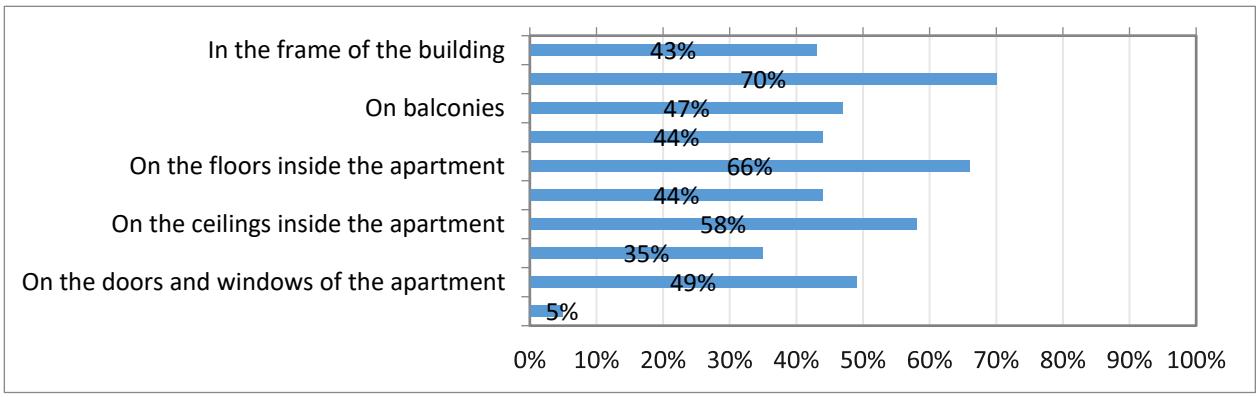


Figure 19. The places where the use of wood is most desired.

4. Discussion

The findings of this paper regarding attitudes towards wooden buildings, building location, and environmental concerns validated some of the results stated in Finland and other countries (e.g., Sweden), such as Karjalainen and Ilgın [49,51], and Lindblad [66]. On the other hand, differences were found in several studies in the literature such as sound insulation. It is worth noting that the surveys conducted by Karjalainen [50] and thus the comparative study based on these Finnish surveys by Karjalainen and Ilgın [49,51] are

frequently used for comparison purposes in this section, especially since the themes in the surveys were similar to those in our study.

In this study, the respondents were predominantly female (>62%) and under 30 years of age (>60%). Similarly, in Karjalainen's [50] study, residents surveyed were mostly females (>60%) and over 60% of those surveyed were relatively young, i.e., under 40 years of age. On the other hand, in the study of Karjalainen and Ilgın [51], most respondents were female (>69%), with more than half of those surveyed over the age of 45.

According to the statistical data collected in this study, all residents surveyed were aware that they lived in a timber-framed apartment. Similarly, in the study of Karjalainen and Ilgın [51] on Finnish residents of wooden multi-story apartments and Lindblad's [66] Swedish survey on quality of life in timber multi-family homes, almost all (304 out of 308) and more than 80 percent, respectively, of the residents surveyed knew they lived in a timber-framed apartment.

In the survey analysis, the NPS provided the most surprising result. If compared to Reichheld's observations [63] including over 1000 companies in over 40 industries, the score of 32 was relatively high, as in typical well-doing business the share of promoters was approximately 10%, the share of passives was over 80%, and the share of detractors was about 2%. However, Reichheld observed that if the score was over 50, the company would probably experience fast organic growth due to the accelerating customer demand. In our case, the share of promoters was almost 50%, but also the share of detractors was ten times higher than Reichheld's distribution for normal businesses would forecast.

Based on the results, it was obvious that there are some defects in the timber-framed apartment buildings that should be fixed to reduce the number of detractors. Survey results indicate that at least noise from staircases, outside the building, and from upper apartments should be investigated. However, there were also a lot of very satisfied respondents, and it should be noted that there are only a few neutral answers to the sound insulation-related questions. Unlike many other products, each apartment is unique due to the location of the building and the apartment's position in the building. If one side of the building is facing noise from traffic, for example, the other side may be facing a silent park, lake, or forest. Additionally, the residents on the top floor rarely complain about noise from the upper floor.

Even though the apartments are unique, there is also something in common between the promoters: they were very unanimous in emotional needs-related questions, especially in statements reflecting environmental values. Those respondents, who share an environment-friendly worldview, were very often promoters. For them it did not matter that there were some defects; instead, they were able to forgive them, presumably because they felt it was a convenient price to pay for getting an environment-friendly apartment. Therefore, we suggest that there exists a customer segment, who would prefer to have an apartment in timber-framed buildings, even though there would be some defects that concrete-framed buildings would not include. We call people in this segment "the environmentalists".

Overall, the majority of respondents advised their friends to move to a timber-framed apartment. Similarly, in the open answers about living in a timber-framed apartment, the comfortable and pleasant atmosphere of the timber-framed apartment was the most prominent. This was similar to that in the survey of Karjalainen and llgın [49]. They observed that the participants generally had positive attitudes towards wooden buildings and multi-story timber-framed apartments. Rooted wooden building culture [67] and the growing appreciation of wood as a competitive alternative to concrete as a frame material, particularly in multi-story construction [68] in Finland, may have contributed to a positive perception of wood among building occupants. State-based policies promoting the usage of wood in the Finnish construction sector [14] and the built environment based on wooden structures as the main pursuits in Finland [69] can explain the positive attitude among residents, particularly in terms of tackling the climate crisis.

Most of the respondents were of the opinion that timber-framed apartments have clean indoor air and suitable temperature in winter, especially on cold winter days. This finding resembled the findings in the survey of Karjalainen and Ilgın [49]. In their comparative study, the good indoor climate was considered a prominent feature of multi-story timber-framed apartment buildings. Additionally, living in a timber-framed apartment was evaluated as cozier than other apartments among the participants. This was also reported in several Finnish studies (e.g., [50,70]).

Our findings showed that the participants were mostly satisfied with the sound insulation of the timber-framed apartment, but the disturbing noise from upstairs was on the agenda. While this result was also evident in the open answers, besides the upper floors, some participants mentioned the disturbing noise, especially from outside, from the stairwell, and the neighboring apartment. These issues were similar to the findings in the studies by Karjalainen [50] and Karjalainen and Ilgın [51] where impact soundproofing was still an issue. Additionally, in Lindblad's research [66], most apartment residents rated sound insulation between apartment units as one of the most serious considerations. Similarly, in the Swedish study of 85 residents by Bard et al. [71] on the acoustic comfort of wooden residential buildings, impact noise from neighbors, installation noise from inside, and low-frequency noise outside the building were reported to be very disturbing. However, the overall level of acoustic comfort in contemporary timber buildings in Sweden was found satisfactory. Similar results were obtained in Ljunggren's study in Sweden [72]. Although the sound insulation performance of wooden structures is still skeptical in some studies (e.g., [73,74]), recent research on the enhancement of sound insulation of wooden apartments (e.g., [75]) in the Finnish context (e.g., [76]) may have contributed to the positive course of this perception in our study.

The functional properties of timber-framed apartments (e.g., layout, laundry, and recreation facilities) were generally satisfactory to the survey respondents, excluding the sauna. Similarly, in the comparative study by Karjalainen and Ilgın [49], the most of residents were satisfied with the functionality of the apartment building, the quality of furnishings and appliances, and the number of furnishings and appliances. In terms of the location and functionality of the apartment building, while the vast majority of residents were satisfied with the location and storage facilities, both in the apartment and in the garden, 40 percent of respondents highlighted the lack of parking. Similarly, the location of the building was identified as an important input in the work of Lindblad in the Swedish context [66] and Karjalainen and Ilgın [49] in the Finnish context. The fact that the considerations related to layout, functionality, and the immediate vicinity are among the important planning criteria in Finnish residential architecture may be the explanation for the satisfaction of the participants on these issues [77–79].

From the perspective of the residents of Tampere, living in an eco-friendly, natural-material, low-carbon apartment was among the propositions supported by the survey respondents. Similarly, the concept of environmental friendliness as the advantages of timber-framed apartment buildings in the research of Karjalainen [50], while the ecological aspects as the parameter of apartment selection in the survey by Karjalainen and Ilgın [51] were among the topics discussed. In addition, regarding our study findings, Lähtinen et al. [55] and Kylkilahti et al. [70] addressed the environmental benefits of using timber in residential construction among Finnish users. In this sense, it can be thought that state-sponsored initiatives and promotions related to combating the climate crisis and emphasizing the environmental advantages of wood will positively affect the perceptions of timber-framed apartment residents (e.g., [80]). Moreover, regulation in Finland provides municipalities with specific tools to exercise their powers and thereby affect the sustainability and environmental impacts of their regions. The use of urban planning and land allocation practices can have a major effect [62].

The residents of Tampere demanded to see more wood, especially on the building facade, the floors inside the apartment, and the ceilings inside the apartment. Additionally, in open answers regarding feedback for developers and designers, residents' demand for

more timber-framed apartments and more timber as a visible surface material was among the most prominent. Similarly, according to the findings of Karjalainen and Ilgın [49], there was a common desire to have more timber as a visible surface material within the building and more timber-framed apartments. This finding can also be associated with the findings of Viholainen et al. [54] highlight the importance of using wood for the building facade in creating more attractive structures.

Considering the feedback from the participants, better sound isolation was among the critical expectations of the designers and developers, mostly addressing the impact sound issue as mentioned above. Similarly, in the resident survey conducted by Karjalainen and llgın [49] study, participants stated that timber-framed apartment designers and developers should pay particular attention to this issue. This shows that the measures taken against impact noise in multi-story timber-framed apartments are still insufficient [81,82].

5. Conclusions

Looking at the profile of the respondents, most were women, under 30 years old and living in a rented single room of less than 40 square meters. While all were aware that they lived in a timber-framed apartment, the majority had lived in a timber-framed apartment for less than a year. The majority of respondents had advised their friends to move to a timber-framed apartment. For most of the respondents, timber-framed apartments had fresh air and a suitable temperature on cold winter days. The majority felt safe living in a timber-framed apartment and were satisfied with the soundproofing, except for the disturbing noises from the upper floor.

According to the responses given by 151 participants, almost half of the respondents recommended moving to a timber-framed apartment. Most of the respondents (>72%) thought that timber-framed apartments had a suitable temperature on cold winter days and the vast majority of respondents (>88%) thought they had fresh air in the apartment. Similarly, most (88%) felt safe living in a timber-framed apartment. Most of the participants stated that there was no disturbing noise from outside, from the stairwell, from the neighboring apartment, and from downstairs and the satisfaction rates in question are as follows: 60%, 64%, 75%, and 78%. People were mostly satisfied (>70%) with the functional aspects of the timber-framed apartments they lived in, excluding the sauna. Washing, chore, and recreational facilities came to the fore with rates exceeding 90%. The vast majority of respondents (>80%) considered that there were very convenient storage facilities, such as bicycles at home or in the garden, and that the building was in the best possible place for their daily commute. The majority of the participants ($\geq$80%) supported the proposition that the apartment is in a suitable area for them (>90%), the apartment looks beautiful from the outside (>87%), the access roads to their apartments are pleasant (>86%) and the use of wood in the building is visible enough (80%). There was a consensus among the surveyed residents (>65%) that it is important to live in an environmentally friendly apartment and similarly, more than half of those surveyed embraced the idea of living in a low-carbon, natural-material apartment. Additionally, building facades (70%), floors (66%) and ceilings (58%) inside the apartment, doors and windows (49%), and balconies (47%) were the places where the use of wood was most desired in the apartment. Residents demanded more timber-framed apartments, more usage of timber as a visible surface material, and better sound insulation from designers and developers.

As a result, it is believed that the findings of this research will be an important guide for architects and developers who will take part in the wooden house design or renovation process. Thus, a deeper and more functional perspective on housing demand and the expectations of future generations can be developed to produce more end-user-focused business models in the Finnish housing industry.

Author Contributions: Conceptualization, J.M.S., H.E.I., E.O. and M.K.; methodology, J.M.S., H.E.I., E.O. and M.K.; software, J.M.S., H.E.I. and E.O.; formal analysis, J.M.S., H.E.I., E.O. and M.K.; investigation, J.M.S., H.E.I., E.O. and M.K.; data curation, J.M.S., H.E.I., E.O. and M.K.; writing—original draft preparation, J.M.S. and H.E.I.; writing—review and editing, J.M.S. and H.E.I.; visualization, J.M.S., H.E.I. and E.O.; supervision, J.M.S., H.E.I., E.O. and M.K.; project administration, J.M.S., E.O. and M.K.; funding acquisition J.M.S., E.O. and M.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Wood Expertise for Pirkanmaa project (ESR EU—Funding, No: EURA 2014/10797/09 02 01/2020/KESELY) and the Timber-framed Apartment Building for Growth project in Pirkanmaa (EAKR EU—Funding, No: EURA 2014/6738/09 02 01/2018/PL).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Survey

1. Name/address/(year of completion) of your housing association:

- VTS—Koukkurannankatu 10, Vuores (2016)
- VTS—Rautalepänkatu 2, Isokuusi (2021)
- As Oy Tampereen Tuohi—Toivonkuja 3, Härmälä (2019)
- As Oy Tampereen Tohtori—Tieteenkatu 9, Hervanta (2020)
- As Oy Tampereen Härmälänsydän—Tarmonkuja 4, Härmälä (2020)
- As Oy Tampereen Niemenrannan Rantapuisto—Raamikatu 32, Niemenranta (2021)
- TOAS—Kauppi, Kuntokatu 11 A (2021)
- TA Aihkinkatu 6/Honkakuusenkatu 5, Isokuusi (2021–2022)
- A-Kruunu Tampereen Honkakuusenkatu 5/Aihkinkatu 6 (2021/2022)

2. Your gender?

- Woman
- Male
- Other
- I don't want to answer

3. Your age?

- Under 30
- 30–40
- 41–50
- 51–60
- 61–70
- Over 70

4. The size of your apartment?

- Single room
- Double room
- Triple room
- Quadruple room

5. The area of your apartment?

- less than 25 m^2
- 25–29 m^2
- 30–39 m^2
- 40–49 m^2
- 50–59 m^2

- 60–74 m^2
- 75–90 m^2
- more than 90 m^2

6. Number of people in your household?

- Choose 1–2 answer options according to your living situation.
- One adult
- Two adults
- Three adults or more
- and one child (<18 years)
- and two children (<18 years)
- and three children (<18 years)
- and four or more children

7. Form of residence?

- Apartment for rent
- Owned apartment
- Right-of-occupancy apartment
- Co-ownership apartment
- Own apartment

8. What floor do you live on?

- 1st floor
- 2nd floor
- 3rd floor
- 4th floor
- 5th floor
- 6th floor
- 7th floor
- 8th floor
- 9th or above

9. How long have you lived in the current apartment?

- Less than a year
- 1–2 years
- 2–5 years
- More than 5 years

10. Did you know you live in a timber-framed apartment building?

- Yes
- No

11. How likely would you recommend moving to a timber-framed apartment building to a friend or acquaintance?

Not at all likely (0)—Extremely likely (10)

12. Evaluate the following basic features in your apartment.

Strongly disagree/disagree/neutral/agree/strongly agree

- Apartment has a suitable temperature when cold during the year.
- Apartment has a suitable temperature when warm during the year.
- Apartment has fresh air inside.
- A timber-framed apartment building feels safe to live in.
- No disturbing noises from outside the apartment.
- No disturbing noises from the stairwell in the apartment.
- No disturbing noise from the neighboring apartment.
- No disturbing noise from upstairs.
- No disturbing noise from downstairs.

13. We would be happy to hear more detailed information on temperature, indoor air, and disturbing sounds and feeling.

. . . . . .

14. Evaluate the following functional features in your apartment.

Strongly disagree/disagree/neutral/agree/strongly agree

- Some areas to wear, take off, and store are very convenient for your use.
- It is very useful for storing food and utensils, for cooking and eating in convenient places.
- You have adequate and very useful convenient storage facilities.
- Some facilities are very convenient for you to use for sleeping.
- Some facilities are very convenient for your use for washing.
- Some facilities are very suitable for saunas.
- Some facilities are very suitable for laundry.
- Your apartment is very suitable for daily work.
- Your apartment is great for hanging out and relaxing in suitable places.
- You have very suitable facilities for your guests.
- Your apartment has a perfect layout.

15. Evaluate the location and functionality of your apartment building.

Strongly disagree/disagree/neutral/agree/strongly agree

- There is enough parking space near the building.
- There are very convenient storage facilities such as bicycles in the house or the garden.
- The building is in the best possible place for my daily commute.

16. We would be happy to hear more detailed information regarding the functionality of the apartment and the house.

. . . . . .

17. Evaluate the following features in your apartment.

Strongly disagree/disagree/neutral/agree/strongly agree

- The house is in an area that feels right to me.
- The house looks nice from the outside.
- Access roads to my apartment are pleasant.
- Living in a wooden house is important to me.
- Living in a low-carbon house is important to me.
- Living in a house made from natural materials is important to me.
- Living in an environmentally friendly home is important to me.
- Living in a timber-framed apartment feels cozier than in other apartments.
- Wooden interior surfaces were used in the apartment in a meaningful way.
- The use of wood in the building is visible enough.

18. Where would you like wood to be used in timber-framed apartment buildings?
You can choose several options.

- In the frame of the building
- On building facades
- On balconies
- In stairwells
- On the floors inside the apartment
- On the walls inside the apartment
- On the ceilings inside the apartment
- The fixed furniture of the apartment
- On the doors and windows of the apartment
- Elsewhere, where? . . .

19. We would like to hear your other thoughts about living in a timber-framed apartment building.

. . . . . .

20. Other comments and feedback for developers and designers of timber-framed apartment buildings:

. . . . . .

References

1. Ilgın, H.E. Core Design and Space Efficiency in Contemporary Supertall Office Buildings. In *Sustainable High-Rise Buildings: Design, Technology, and Innovation*; Al-Kodmany, K., Du, P., Ali, M.M., Eds.; The Institution of Engineering and Technology: London, UK, 2022. [CrossRef]
2. Ilgın, H.E. Interrelations of Slenderness Ratio and Main Design Criteria in Supertall Buildings. *Int. J. Build. Pathol. Adapt.* **2022**, *in press*. [CrossRef]
3. Ilgın, H.E. Use of Aerodynamically Favorable Tapered Form in Contemporary Supertall Buildings. *J. Des. Resil. Archit. Plan.* **2022**, *3*, 183–196. [CrossRef]
4. Ilgın, H.E. Space Efficiency in Contemporary Supertall Residential Buildings. *Architecture* **2021**, *1*, 25–37. [CrossRef]
5. Ilgın, H.E. Space Efficiency in Contemporary Supertall Office Buildings. *J. Archit. Eng.* **2021**, *27*, 04021024. [CrossRef]
6. Ilgın, H.E. A study on interrelations of structural systems and main planning considerations in contemporary supertall buildings. *Int. J. Build. Pathol. Adapt.* **2022**, *in press*. [CrossRef]
7. Ilgın, H.E.; Ay, B.Ö.; Gunel, M.H. A study on main architectural and structural design considerations of contemporary supertall buildings. *Archit. Sci. Rev.* **2021**, *64*, 212–224. [CrossRef]
8. Ilgın, H.E.; Gunel, H. Contemporary Trends in Supertall Building Form: Aerodynamic Design Considerations. In Proceedings of the LIVENARCH VII Livable Environments & Architecture 7th International Congress OTHER ARCHITECT/URE(S), Trabzon, Turkey, 28–30 September 2021; Volume 1, pp. 61–81.
9. Gunel, M.H.; Ilgın, H.E. *Yüksek Bina: Taşıyıcı Sistem ve Aerodinamik Form*; METU Faculty of Architecture Press: Ankara, Turkey, 2014; ISBN 978-975-429-278-7. (In Turkish)
10. Ilgın, H.E. A Search for a New Tall Building Typology: Structural Hybrids. In Proceedings of the LIVENARCH VII Livable Environments & Architecture 7th International Congress OTHER ARCHITECT/URE(S), Trabzon, Turkey, 28–30 September 2021; Volume 1, pp. 95–107.
11. Gunel, M.H.; Ilgin, H.E. *Tall Buildings: Structural Systems and Aerodynamic Form*; Routledge: London, UK; New York, NY, USA, 2014.
12. Ilgın, H.E. Potentials and Limitations of Supertall Building Structural Systems: Guiding for Architects. Ph.D. Dissertation, Department of Architecture, Middle East Technical University, Ankara, Turkey, 2018.
13. Suomala, T. Understanding the Perceptions of Urban Citizens Concerning a Forest-Based Bioeconomy. Master's Thesis, Department of Forest Sciences, Faculty of Agriculture and Forestry, University of Helsinki, Helsinki, Finland, 2019.
14. Dahlbo, H.; Bacher, J.; Lähtinen, K.; Jouttijärvi, T.; Suoheimo, P.; Mattila, T.; Sironen, S.; Myllymaa, T.; Saramäki, K. Construction and demolition waste management—A holistic evaluation of environmental performance. *J. Clean. Prod.* **2015**, *107*, 333–341. [CrossRef]
15. Bosman, R.; Rotmans, J. Transition governance towards a bioeconomy: A comparison of Finland and the Netherlands. *Sustainability* **2016**, *8*, 1017. [CrossRef]
16. Finnish Ministry of Environment. Wood Building Programme. 2020. Available online: https://ym.fi/en/wood-building (accessed on 2 October 2022).
17. Ilgın, H.E.; Karjalainen, M. Preliminary Design Proposals for Dovetail Wood Board Elements in Multi-Story Building Construction. *Architecture* **2021**, *1*, 56–68. [CrossRef]
18. Tulonen, L.; Karjalainen, M.; Ilgın, H.E. *Tall Wooden Residential Buildings in Finland: What Are the Key Factors for Design and Implementation?* IntechOpen: London, UK, 2021.
19. Rinne, R.; Ilgın, H.E.; Karjalainen, M. Comparative Study on Life-Cycle Assessment and Carbon Footprint of Hybrid, Concrete and Timber Apartment Buildings in Finland. *Int. J. Environ. Res. Public Health* **2022**, *19*, 774. [CrossRef]
20. Järvinen, J.; Ilgın, H.E.; Karjalainen, M. Wood Preservation Practices and Future Outlook: Perspectives of Experts from Finland. *Forests* **2022**, *13*, 1044. [CrossRef]
21. European Commission. *A Sustainable Bioeconomy for Europe: Strengthening the Connection Between Economy, Society and the Environment*; Publications Office of the European Union: Luxembourg, 2018.
22. Kazulis, V.; Muizniece, I.; Zihare, L.; Blumberga, D. Carbon storage in wood products. *Energy Procedia* **2017**, *128*, 558–563. [CrossRef]
23. Lehtonen, J.; Ilgın, H.E.; Karjalainen, M. Log Construction Practices and Future Outlook: Perspectives of Finnish Experts. *Forests* **2022**, *13*, 1741. [CrossRef]
24. Häkkänen, L.; Ilgın, H.E.; Karjalainen, M. The Current State of the Finnish Cottage Phenomenon: Perspectives of Experts. *Buildings* **2022**, *12*, 260. [CrossRef]
25. Soikkeli, A.; Ilgın, H.E.; Karjalainen, M. Wooden Additional Floor in Finland. *Encyclopedia* **2022**, *2*, 578–592. [CrossRef]
26. Ilgın, H.E.; Karjalainen, M.; Koponen, O.; Soikkeli, A. *A Study on Contractors' Perception of Using Wood for Construction*; IntechOpen: London, UK, 2022.

27. Sakuragawa, S.; Miyazaki, Y.; Kaneko, T.; Makita, T. Influence of wood wall panels on physiological and psychological responses. *J. Wood Sci.* **2005**, *51*, 136–140. [CrossRef]
28. Gold, S.; Rubik, F. Consumer attitudes towards timber as a construction material and towards timber frame houses—Selected findings of a representative survey among the German population. *J. Clean. Prod.* **2009**, *17*, 303–309. [CrossRef]
29. Rhee, P. Beyond green: Environmental building technologies for social and economic equity. *Arch. Des.* **2018**, *88*, 94–101. [CrossRef]
30. The National Building Code of Finland—Structural Fire Safety, Decree of the Ministry of the Environment. 2017. Available online: https://ym.fi/en/the-national-building-code-of-finland (accessed on 2 October 2022).
31. Ilgın, H.E.; Karjalainen, M. Tall Wooden Buildings: Potentials, Benefits, Challenges and Prospects. *Wood Magazine*, 22 October 2022; 58–65. Available online: https://puuinfo.fi/2022/10/22/tall-wooden-buildings-potential-benefits-challenges-and-prospects/?lang=en(accessed on 2 October 2022).
32. Vihemäki, H.; Ludvig, A.; Toivonen, R.; Toppinen, A.; Weiss, G. Institutional and policy frameworks shaping the Wooden Multi-Storey Construction markets: A comparative case study on Austria and Finland. *Wood Mater. Sci. Eng.* **2019**, *14*, 312–324. [CrossRef]
33. Karjalainen, M.; Ilgın, H.E.; Yli-Äyhö, M.; Soikkeli, A. *Complementary Building Concept: Wooden Apartment Building: The Noppa toward Zero Energy Building Approach*; IntechOpen: London, UK, 2021.
34. Ilgın, H.E.; Karjalainen, M.; Koponen, O. *Review of the Current State-of-the-Art of Dovetail Massive Wood Elements*; IntechOpen: London, UK, 2021.
35. Karjalainen, M.; Ilgın, H.E.; Metsäranta, L.; Norvasuo, M. *Wooden Facade Renovation and Additional Floor Construction for Suburban Development in Finland*; IntechOpen: London, UK, 2022.
36. Ilgın, H.E.; Karjalainen, M.; Pelsmakers, S. Contemporary Tall Timber Residential Buildings: What are the Main Architectural and Structural Design Considerations? *Int. J. Build. Pathol. Adapt.* **2022**, *in press*. [CrossRef]
37. Ilgın, H.E.; Karjalainen, M.; Koponen, O. Dovetail Massive Wood Board Elements for Multi-Story Buildings. In Proceedings of the LIVENARCH VII Livable Environments & Architecture 7th International Congress OTHER ARCHITECT/URE(S), Trabzon, Turkey, 28–30 September 2021; Volume 1, pp. 47–60.
38. Karjalainen, M.; Ilgın, H.E.; Somelar, D. Wooden Additional Floors in old Apartment Buildings: Perspectives of Housing and Real Estate Companies from Finland. *Buildings* **2021**, *11*, 316. [CrossRef]
39. Karjalainen, M.; Ilgın, H.E.; Somelar, D. *Wooden Extra Stories in Concrete Block of Flats in Finland as an Ecologically Sensitive Engineering Solution, Ecological Engineering—Addressing Climate Challenges and Risks*; IntechOpen: London, UK, 2021.
40. Ilgın, H.E.; Karjalainen, M. *Tallest Timber Buildings: Main Architectural and Structural Design Considerations*; IntechOpen: London, UK, 2022.
41. Ilgın, H.E.; Karjalainen, M. *Perceptions, Attitudes, and Interest of Architects in the Use of Engineered Wood Products for Construction: A Review*; IntechOpen: London, UK, 2021.
42. Ilgın, H.E.; Karjalainen, M.; Pelsmakers, S. Finnish architects' attitudes towards multi–storey timber–Residential buildings. *Int. J. Build. Pathol. Adapt.* **2021**, *in press*. [CrossRef]
43. Sposito, C.; Scalisi, F. High-rise timber architecture: An opportunity for the sustainability of the built environment. In *PROINNOVATION: Process Production Product*; De Giovanni, G., Scalisi, F., Eds.; Palermo University Press: Palermo, Italy, 2019.
44. Geels, F.W.; McMeekin, A.; Mylan, J.; Southerton, D. A critical appraisal of sustainable consumption and production research: The reformist, revolutionary and reconfiguration positions. *Glob. Environ. Chang.* **2015**, *34*, 1–12. [CrossRef]
45. Toppinen, A.; Autio, M.; Sauru, M.; Berghäll, S. Sustainability-driven new business models in wood construction towards 2030. In *Towards a Sustainable Bioeconomy: Principles, Challenges and Perspectives*; Leal-Filho, W., Pociovalisteanu, D.M., Borges-de-Brito, P.R., Borges-de-Lima, I., Eds.; Springer: Cham, Switzerland, 2018; pp. 499–516.
46. Carù, A.; Cova, B. *Consuming Experience*; Routledge: London, UK, 2007.
47. Høibø, O.; Hansen, E.; Nybakk, E. Building material preferences with a focus on wood in urban housing: Durability and environmental impacts. *Can. J. For. Res.* **2015**, *45*, 1617–1627. [CrossRef]
48. Lähtinen, K.; Häyrinen, L.; Jussila, J.; Harju, C.; Toppinen, A.; Toivonen, R. Branding Wooden Multi-storey Construction—Real-Estate Agents as Gatekeepers for Enhancing Consumer Value in Housing. *J. For. Econ.* **2022**, *37*, 0538. [CrossRef]
49. Karjalainen, M.; Ilgın, H.E. The Change over Time in Finnish Residents' Attitudes towards Multi–Story Timber Apartment Buildings. *Sustainability* **2021**, *13*, 5501. [CrossRef]
50. Karjalainen, M. *The Finnish Multi-Story Timber Apartment Building as a Pioneer in the Development of Timber Construction*; University of Oulu: Oulu, Finland, 2002. (In Finnish)
51. Karjalainen, M.; Ilgın, H.E. Residents' Experience in Timber Apartment Buildings in Finland. *J. Green Build.* **2022**, *17*, 187–201. [CrossRef]
52. Karjalainen, M.; Ilgın, H.E.; Metsäranta, L.; Norvasuo, M. Suburban Residents' Preferences for Livable Residential Area in Finland. *Sustainability* **2021**, *13*, 11841. [CrossRef]
53. Karjalainen, M.; Ilgın, H.E.; Metsäranta, L.; Norvasuo, M. Residents' Attitudes towards Wooden Facade Renovation and Additional Floor Construction in Finland. *Int. J. Environ. Res. Public Health* **2021**, *18*, 12316. [CrossRef]
54. Viholainen, N.; Kylkilahti, E.; Autio, M.; Toppinen, A. A home made of wood: Consumer experiences of wooden building materials. *Int. J. Consum. Stud.* **2020**, *44*, 542–551. [CrossRef]

55. Lähtinen, K.; Harju, C.; Toppinen, A. Consumers' perceptions on the properties of wood affecting their willingness to live in and prejudices against houses made of timber. *Wood Mater. Sci. Eng.* **2019**, *14*, 325–331. [CrossRef]
56. Larasatie, P.; Guerrero, J.; Conroy, K.; Hall, T.; Hansen, E.; Needham, M. What does the public believe about tall wood buildings? An exploratory study in the US Pacific Northwest. *J. For.* **2018**, *116*, 429–436. [CrossRef]
57. Nyrud, A.Q.; Bringslimark, T. Is interior wood use psychologically beneficial? A review of psychological responses toward wood. *Wood Fiber Sci.* **2010**, *42*, 202–218.
58. Hakala, I.; Autio, M.; Toppinen, A. Young Finnish and German consumers' furniture acquisition-Wooden, inherited or just low price? *Int. J. Consum. Stud.* **2015**, *39*, 445–451. [CrossRef]
59. Häyrinen, L.; Toppinen, A.; Toivonen, R. Finnish young adults' perceptions of the health, well-being and sustainability of wooden interior materials. *Scand. J. For. Res.* **2020**, *35*, 394–402. [CrossRef]
60. The City of Action, Tampere City Strategy 2030. Available online: https://www.tampere.fi/sites/default/files/2022-06/The%20Tampere%20City%20Strategy%202030_0.pdf (accessed on 2 October 2022).
61. Ilgın, H.E.; Karjalainen, M.; Koponen, O. *Various Geometric Configuration Proposals for Dovetail Wooden Horizontal Structural Members in Multistory Building Construction*; IntechOpen: London, UK, 2022.
62. Maniak-Huesser, M.; Tellnes, L.G.F.; Zea Escamilla, E. Mind the Gap: A Policy Gap Analysis of Programmes Promoting Timber Construction in Nordic Countries. *Sustainability* **2021**, *13*, 11876. [CrossRef]
63. Reichheld, F. *The Ultimate Question: Driving Good Profits and True Growth*; Harvard Business School Press: Boston, MA, USA, 2006.
64. Lundström, A.; Savolainen, J.; Kostiainen, E. Case study: Developing campus spaces through co-creation. *Archit. Eng. Des. Manag.* **2016**, *12*, 409–426. [CrossRef]
65. Savolainen, J.M.; Saari, A.; Männistö, A.; Kähkonen, K. Indicators of collaborative design management in construction projects. *J. Eng. Des. Technol.* **2018**, *16*, 674–691. [CrossRef]
66. Lindblad, F. Living quality in wooden multi-family houses. *Pro Ligno* **2019**, *15*, 434–441.
67. Karjalainen, M.; Ilgın, H.E. A Statistical Study on Multi-story Timber Residential Buildings (1995–2020) in Finland. In Proceedings of the LIVENARCH VII Livable Environments & Architecture 7th International Congress OTHER ARCHITECT/URE(S), Trabzon, Turkey, 28–30 September 2021; Volume 1, pp. 82–94.
68. Ilgın, H.E.; Karjalainen, M. *Massive Wood Construction in Finland: Past, Present, and Future*; IntechOpen: London, UK, 2022; p. 96.
69. Toppinen, A.; Röhr, A.; Pätäri, S.; Lähtinen, K.; Toivonen, R. The future of wooden multistory construction in the forest bioeconomy—A Delphi study from Finland and Sweden. *J. For. Econ.* **2018**, *31*, 3–10. [CrossRef]
70. Kylkilahti, E.; Berghäll, S.; Autio, M.; Nurminen, J.; Toivonen, R.; Lähtinen, K.; Vihemäki, H.; Franzini, F.; Toppinen, A. A consumer-driven bioeconomy in housing? Combining consumption style with students' perceptions of the use of wood in multi-storey buildings. *Ambio* **2020**, *49*, 1943–1957. [CrossRef] [PubMed]
71. Bard, D.; Vardaxis, N.G.; Sondergard, E. Acoustic Comfort Investigation in Residential Timber Buildings in Sweden. *J. Sustain. Archit. Civ. Eng.* **2019**, *24*, 1. [CrossRef]
72. Ljunggren, F. Sound insukation, residents' satisfaction, and design of wooden residential buildings. In Proceedings of the EUROREGIO BNAM 2022, Joint Acoustics Conference, Aalborg, Denmark, 9–11 May 2022.
73. Kuperstein Blasco, D.; Saukkonen, N.; Korhonen, T.; Laine, T.; Muilu-Mäkelä, R. Wood material selection in school building procurement—A multi-case analysis in Finnish municipalities. *J. Clean. Prod.* **2021**, *327*, 129474. [CrossRef]
74. Kylliäinen, M.; Talus, L.; Lietzén, J.; Latvanne, P.; Kovalainen, V. Assessment of the low-frequency procedure in the field measurements of impact sound insulation between dwellings. *Appl. Acoust.* **2022**, *185*, 108399. [CrossRef]
75. Frescura, A.; Lee, P.J.; Soeta, Y.; Ariki, A. Effects of spatial characteristics of footsteps sounds and non-acoustic factors on annoyance in lightweight timber buildings. *Build. Environ.* **2022**, *222*, 109405. [CrossRef]
76. Jäppinen, J.; Pesonen, J. The Acoustics of Structures in Wooden Apartment Building—Case Joensuu Lighthouse. Master's Thesis, Civil Engineering, Karelia University of Applied Sciences, Joensuu, Finland, 2019.
77. Häkkänen, L.; Ilgın, H.E.; Karjalainen, M. Cottage Culture in Finland: Development and Perspectives. *Encyclopedia* **2022**, *2*, 705–716. [CrossRef]
78. Verma, I. Housing Design for All? The Challenges of Ageing in Urban Planning and Housing Design—The Case of Helsinki. Ph.D. Thesis, Department of Architecture, Aalto University, Espoo, Finland, 2019.
79. Karjalainen, M.; Ilgın, H.E.; Tulonen, L. Main Design Considerations and Prospects of Contemporary Tall Timber Apartment Buildings: Views of Key Professionals from Finland. *Sustainability* **2021**, *13*, 6593. [CrossRef]
80. Wood in Public Construction, Finnish Ministry of Environment. Available online: https://ym.fi/en/wood-in-public-construction (accessed on 2 October 2022).
81. Rasmussen, B. Building acoustic regulations in Europe—Brief history and actual situation. In Proceedings of the Baltic-Nordic Acoustics Meeting, Reykjavik, Iceland, 15–18 April 2018.
82. Kylliäinen, M.; Saarinen, A. New Finnish building acoustic regulation. In Proceedings of the 23rd International Congress of Acoustics, Aachen, Germany, 9–13 September 2019.