

LIVING QUALITY IN WOODEN MULTI-FAMILY HOUSES

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Abstract:

There is an increased demand for multi-family houses in Sweden, which makes it important to investigate what the residents consider to be building quality in relation to their living situation and what they prioritise when selecting an apartment. Having the ability to build good housing units is an essential part of society since it directly affects people's living standard and way of life. Consequently, understanding living quality creates possibilities to adjust the construction and design of housing units accordingly. Currently, more multi-family houses are being built with wooden frames than ever before, and it is therefore interesting to compare if there is a difference in how residents experience the quality of living in a multi-family house with wooden frames compared with concrete frames.

The purpose is to show what residents consider to be living quality and if there is any quality difference in housing units using wood or concrete as construction material in the building frame. A survey has been sent out to a selected amount of multi-family houses in Sweden, Thereby, gain an understanding of the perceived quality of new building developments, which showed that the quality of living did not differ between the selected materials and the location in the city was the most important parameter when choosing accommodation for the residents.

Key words: wooden multi-family houses; living quality; wood construction; design selection; building material.

INTRODUCTION

According to Sanal (2018), the construction sector is discussing what can be done to reduce global warming in the quest for a sustainable future and one step in this direction is to increase the usage of wood-based solutions in new build projects. Using wood is environmentally favourable since it absorbs carbon dioxide throughout its lifetime up until felling when absorption of carbon dioxide in the material stops (Romero et al. 1998). It is not necessarily the best material seen from its constructional properties but equivalent to concrete in many respects if used properly. However, it supports sustainable development in the construction sector, which is in focus for an improved environmental building solution (Stehn 2010). By constructing more using a wood-based solution will consequently force the development forward, which will benefit wood construction purely in terms of development and providing improved possibilities for economies of scale. The construction industry is responsible for building good and sustainable housing in new housing production, it is, therefore, important to consider the housing quality already during the design phase. Well-planned homes make people feel good. (Nylander & Forshed 2011) and the home should also be a place for people to feel safe and maintain their health (Lee, Cho & Kim 2011).

Further, by investigating the quality of life associated with the resident's perception of their home is important as people in the Nordic countries spend 90% of their time indoors and the majority of this time is in their own home (Holmstedt 2017). The dwellings should be designed with care and reflection to provide a high quality of life (Boverket 2018). With increased construction rate in Sweden, studies are needed to see if different material types (concrete and wood) are equal to each other from the resident's perspective and their perception of actual living quality. This is increasingly more important to understand, in relation to more apartment buildings are being built with wooden frames, since cost and new building solution might be a barrier for wood-building solutions to overcome (Brege, Nord & Stehn 2017). Also, Statistics Sweden [SCB] (2016) presents statistics that the housing cost for rental properties constitutes approximately 28% of the Swedish households' disposable income, while the equivalent percentage for private housing cooperative was on average 21%. The purpose of this study is to see how the residents perceived quality and if there are any differences between residents living in multi-family houses with wooden frames versus concrete frames.

THEORETICAL FRAMEWORK

ARCHITECTURAL CONSIDERATIONS

Nylander and Forshed (2011) describe architectural quality as the relationship between three properties: comfort, durability and beauty. Together, they reinforce the overall experience, meaning that all parts of the building are well planned and executed into the end product. According to Keall et al. (2010),

housing quality has a great impact on health, safety and sustainability. Hence, it is important that it is assessed correctly in order to improve public health through building improvements and developing an effective housing policy, which should be based on housing quality and a well-informed housing market combined with a financially viable solution.

Sustainability relates to both a way of using natural materials in proven solutions, as well as using an economical perspective behind the construction of new housing projects. An example of an economic perspective is that natural materials, with high quality, are better over time reducing maintenance activities significantly compared to the cheaper and quicker to produce building materials (Nylander & Forshed 2011). Since the housing situation today is very different compared to earlier periods, having to incorporate requirements based on new family constellations such as the single household, single parents or large families, where the previously functional rooms do not fit to the same extent into this situation. It has been shown that housing with several general rooms has greater flexibility and is, therefore, more sustainable over time (Nylander & Forshed 2011).

The design and choice of architectural details and materials have a significant role in how people experience building quality and are influenced by the authenticity of the building materials, which is considered as a sign of care during the design and construction process (Nylander & Forshed 2011). Rönn (1998) describes similarly that originality in details does not necessarily correlate to the buildings unique design language, but can feel original thanks to it being made with craftsmanship. When constructing multi-family buildings are the choice of materials and details usually made to facilitate production, both economically and in time, whereas in these cases it is better to look at the life cycle cost as it provides a more transparent picture of the building project. Natural materials are more expensive to purchase, but are better over time and maintenance is reduced, while cheaper materials are worn faster and need to be restored and maintained more often. Materials that residents consider and experience as beautiful are usually those with the best sustainability and are the materials that are easiest to maintain (Nylander & Forshed 2011) and Nordwall and Olofsson (2012) add that sustainable materials create safety because the residents know what they get providing a financially secure situation.

The soundscape is increasingly becoming an important factor for residents and is defined as vibrations in the air that cause pressure changes that propagate as sound waves. People walking in apartments give rise to oscillations in the floor that spread like sound in the air, which is observed in the apartment below (Hassan 2009). The individual's attitude to specific sounds affects how it is being perceived, as well as the time and place for when the sounds are being observed. For some people, a passing motorcycle can be experienced as something positive while others think it is noise. Noise is normally seen as undesirable and the design of the building structure determines how much noise is released into apartments (Lowry 1989). According to Naish et al. (2012) noise has proved to be a major problem for human health, as it has been shown, among other things, that it affects human sleep and physical well-being. A report from Berglund et al. (2000) tells about side effects from noise and some of these are noise-induced hearing loss, disturbance of sleep rhythm, mental illness and impaired performance. Further, the study by Park, Lee and Lee (2017) shows that the most disturbing sound perceived by residents is the sound of people walking, dropping items on the floor and the sound of moving furniture.

MATERIAL CHOICES

Concrete has existed for thousands of years and is the world's most widely used building material. Concrete can be used in a vast area of construction solutions, such as high-rise buildings, bridges, roads and sculptures. Below is presented general advantages and disadvantages of concrete (Burström 2007; Hilding & Skoogh 2009; Energihandbook 2018).

Pros:

- High durability
- Fireproof
- High flexibility in design and design
- Energy-efficient buildings
- Good sound insulation

Cons:

- Longer time to dry the building on moisture
- High U-value unlike wood
- Difficult to change something afterwards on the building
- Great environmental impact when manufacturing cement

As the development of buildings using a wood frame solution has progressed and gained momentum in Sweden, and in Europe, it has now led to the construction of more high-rise buildings with wooden frames

(Swedish Wood 2018a). Furthermore, the Träguiden (2018) states that an advantage of wood is that it is a renewable building material, which is good from an environmental perspective. Also, Swedish Wood (2018b) mentioned that the manufacture of wooden houses does not require much energy in itself compared to more traditional building materials, also resulting in reduced carbon dioxide emissions. Below are presented advantages and disadvantages for constructions of buildings using a wood frame (Burström 2007; Hilding & Skoogh 2009; Energihandbook 2018).

Pros:

- Light in relation to its strength
- Renewable
- Easy to process
- Flexible, easy to make retrospective changes on the construction site
- Low U-value unlike concrete

Cons:

- Not as fireproof as concrete
- Risk of mold and rot
- Inferior lifespan to concrete
- Inferior sound insulation in relation to concrete
- Low knowledge and experience among professionals using the material in the construction of multi-family buildings

RESEARCH PROCESS

Housing quality is a subjective issue and requires a large sample of respondents to be answered in order to provide ample reliability and validity. Further, a quantitative method was selected to provide a suitable result and by using a survey consisted of multiple-choice questions that were sent out to 450 selected respondents was deemed to provide a satisfactory sample and provide the best solution for the conducted study. The response rate to the survey was 43%, which was evaluated to be satisfactory for this study. The selected respondents had to live in a multi-family house that was between two and ten years old in order to capture up to date building technology and legislation, and the buildings were at least three floors high. The majority of respondents was 65 or older and the minority is young adults (18-25 years of age) since the minority group are in a phase of life where they normally are not capital-strong to acquire an apartment in newer residential buildings. The questionnaires were marked in a way that made it possible to identify differences between buildings using wood or concrete frames and the survey was anonymous to give the report further reliability. The survey was conducted between 2018-04-20 and 2018-05-02. The answers have only been processed quantitatively since the respondents have not been given the opportunity to reply in free text. The compilation of the questionnaire responses was done using a dedicated program and the answers were analysed to provide a comparison between buildings using a wood or concrete building frame.

Description of the buildings included in the study

- Vallen is a newly built area and will eventually consist of about 200 apartments. The selected apartments were built in 2015 and include 60 rental apartments, varying from one to three bedrooms in sizes.
- The private housing cooperative Limnologen consists of 4 eight-storey houses that were built in 2009. Including 134 tenant-owned apartments with one to four bedrooms.
- Passet consists of 5 six-storey houses that were built in 2015 including 80 rental apartments with one to 3 bedrooms.
- The buildings included in Portvakten was built in 2016 and consists of three house bodies with six to eight floors and a total of 60 rental apartments. The size of the apartments varies between one to 4 bedrooms.
- The building project Minnet was built in 2015 and is built in four floors with a concrete frame and brick facade using details in wood. In total there are 70 rental apartments with one to 3 bedrooms.
- The neighbourhood Förstäven is 16 floors high made of concrete and consists of 59 tenant-owned apartments with one to 4 bedrooms.

RESULT AND ANALYSIS

Respondent's awareness of the house structure, i.e. concrete or wood

Of those who live in wooden frames, 82% respond that they knew that they live in a house using wooden frames, whereas 7% answered concrete and 11% replied that they did not know. Of those who live in concrete frames, 75% answered that they knew that they were living in a house using a concrete frame, 13% answered wood and 11% replied that they did not know. In total, 79% of the residents living in concrete

or wooden frames were aware of the building material used for their buildings, 10% did not know and 12% answered that they did not know.

What building material is preferred by the respondents

61% of the respondents living in houses with wood frames prefer houses with wooden frames, while 33% answered that it does not matter. 38% of the residents in houses with concrete frames prefer houses with concrete frames, while 42% answered that it did not matter and 13% preferred to live in houses with wooden frames. Also, 29% of the responded in wood frame buildings feel that there is better living quality in buildings using a wood frame and 28% felt that it is better for the environment, whereas 9% responded that they think it would be better from a sound perspective and 33% replied that it did not matter. 25% of the responded living in buildings using a concrete frame feel that there is better building quality living in a building using a wood frame and 12% believe that it equates to lower building quality. Further, 19% of the respondents in wooden houses answered that they perceive it as better with respect to the environment.

Important parameters for choosing an apartment

17% of the respondents living in wood frame buildings believe that the location in the city is the most important parameter and 16% respond that the size of the apartment is important, closely followed by a bright apartment (15%) and 15% believe that good sound insulation is the most important (Fig. 1). The equivalent response from respondents living in a building with a concrete frame is 19% believe that the location in the city is the most important parameter, 16% answer a light apartment, followed by the size of the apartment (15%) and 14% believe that good sound insulation is the most important (Fig. 1). Four specific parameters show a stronger impact on what the residents consider to be most important, i.e. the location in the city, light, size of the apartment and good sound insulation are parameters that get 14% or more, whereas parameters displaying a value between 5–7% is the appliances, open floor plan and a suitable amount of bedrooms.

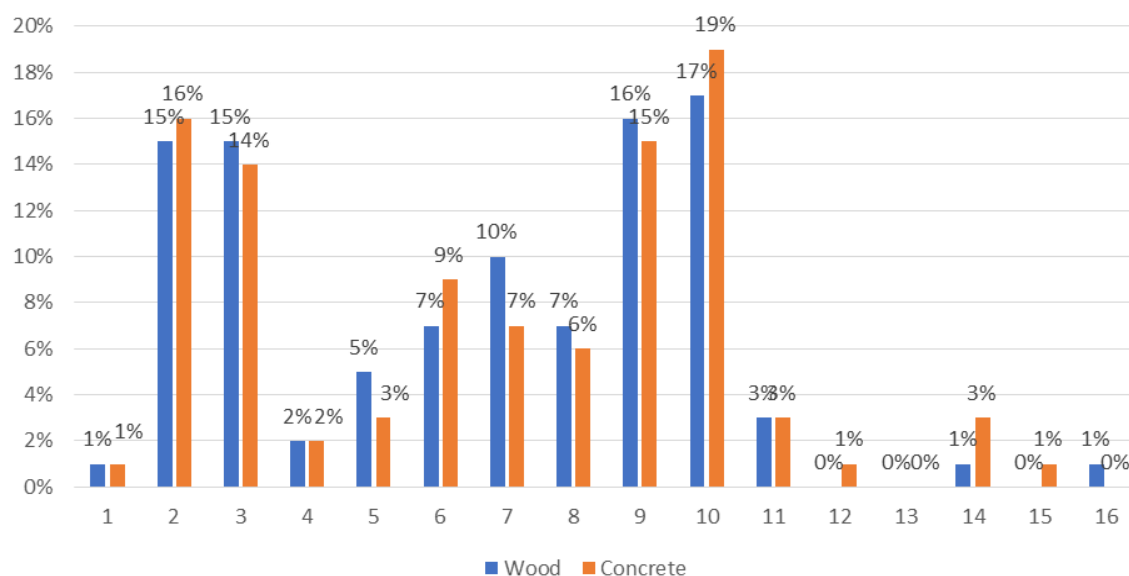


Fig. 1.
Selected parameters related to living quality.

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|--------------------------|--------------------------|-----------------------------|
| 1. Building frame | 7. Open plan | 13. Public staircase |
| 2. Light | 8. Nr. of bedrooms | 14. Separate bedrooms |
| 3. Good sound insulation | 9. Size | 15. Accessible apartment |
| 4. Ceiling height | 10. Location in the city | 16. Visually open apartment |
| 5. Natural materials | 11. Furnitureable | |
| 6. Appliances | 12. Large common areas | |

Importance of sound insulation

59% of the residents in wooden frame houses consider that sound insulation between apartments is the most important, while 67% of those in concrete frame consider this important. Also, 40% of residents in wooden frame houses and 31% of those in the concrete frame have a positive feeling of sound from the outside environment (Fig. 2).

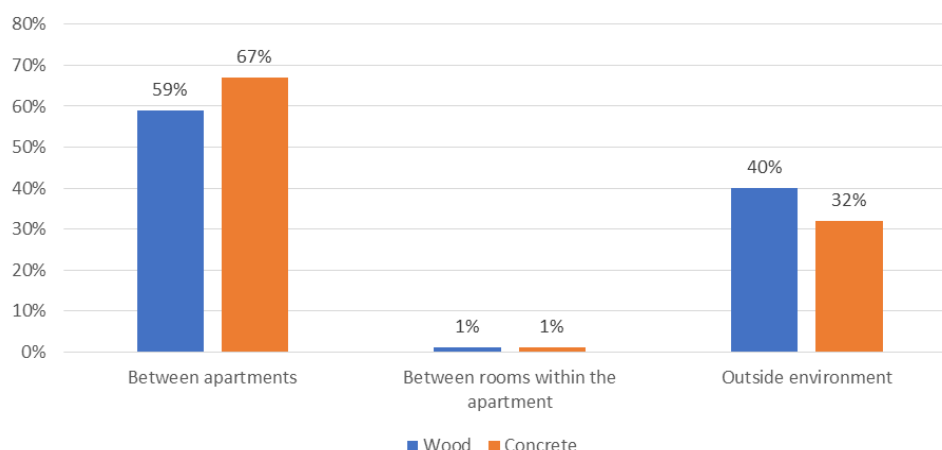


Fig. 2.
Importance of sound insulation.

The perceived importance of the facade material when choosing an apartment

The average perceived importance displayed for residents in houses with wooden frames was 5.7 and for residents in concrete frames 5.3 on a ten-graded scale, where 1–3 have limited importance, 4–7 average importance and 8–10 great importance. Fig. 3 display the results of all the respondents.

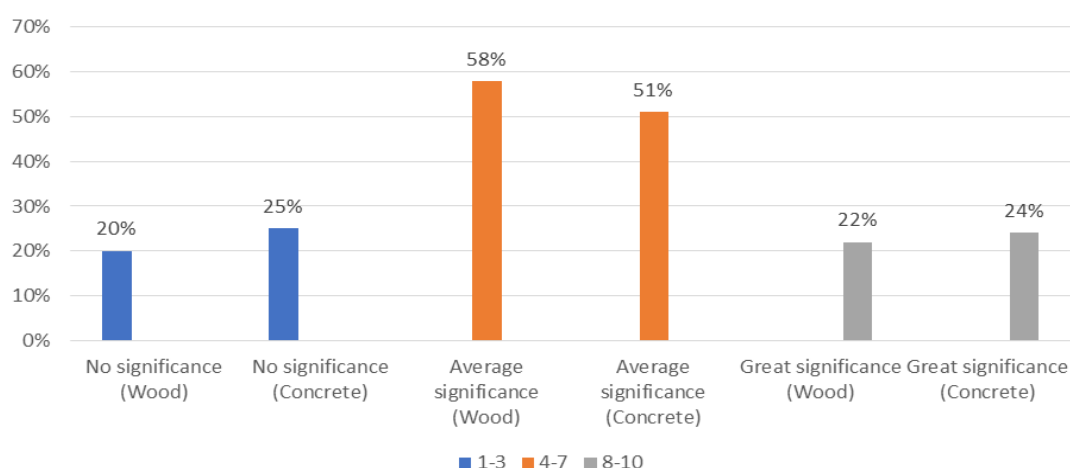


Fig. 3.
Importance of the material in the façade when choosing an apartment.

Resident's willingness to pay more for an apartment using a wood frame vs. concrete frame

Close to 64% of the residents living in houses with wooden frames were not willing to pay extra, while 36% would consider paying extra. Similarly, 90% of the residents living in houses with a concrete frame were not willing to pay extra for an apartment in a building using a wood frame and only 10% would agree to an extra cost for this option (Fig. 4).

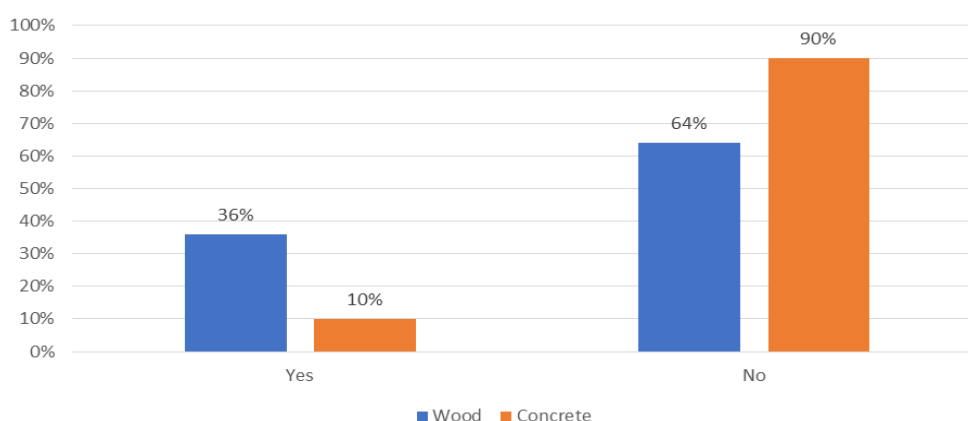


Fig. 4.
Resident's willingness to pay more to live in an apartment in a wood frame building than concrete.

The majority (79%) of the respondents are aware of the building material in their buildings. Respondents in multi-family buildings using a wooden frame (will henceforth be referred to as W) prefers wood as building frame material in relation to concrete. Further, residents in multi-family buildings with concrete frames (will henceforth be termed with large C) prefer concrete as building frame material. A majority (61%) of the residents in W have answered that they prefer houses with wooden frames, which is opposed to those in C where 42% responded perceive it does not matter what material the building frame has. The difference in attitude can be a result of those in W, to a greater extent, have made a conscious choice, and are more aware than those living in C. The respondents in both W and C (wood 29% and concrete 25%) chose their respective material because they felt it provided better living quality, where 28% of W choose wood because they consider it better with regard to the environment while the residents in C choose concrete believing it to be a lower cost. Those living in C can be assumed to a lesser extent have chosen accommodation based on the building frame.

All the respondents answered that the location in the city was the most crucial parameter (18% on average) when choosing an apartment. The impact placed on the location in the city is mentioned by Liliedahl (2010) as the most important factor when choosing an apartment. Thus, being close to service, entertainment, public transport and suitable schools where deemed to be drivers for choosing an attractive location in the city. The respondents agreed that the light and size of the apartment were second in priority (15.5% on each) after the location in the city. Hence, personal preferences about the layout and size of the apartment derived from the respondent's specific living situation contribute, placing the apartment size among the top three factors of importance when choosing an apartment. Not far behind the second and third factor is the importance of having good sound insulation, placing it in fourth place (14.5%) by the residents, which also was discussed by Naish et al. (2012) have a significant impact for residents living quality. The residents mostly prioritized sound insulation between the apartments (63%), were people talking was considered one of the most annoying sounds. Also, the residents want to prioritize sound insulation from the outdoor environment, which is confirmed by Lowry (1989) discussing the importance of adjusting the sound insulation to the environmental pre-conditions.

All residents considered the facade's visual appearance and the material choice to be of average importance, i.e. 5.5 on a scale from 1 to 10, which indicates that it does not have such great significance or impact when choosing an apartment. Residents in C rate this 5.3 while those in W rate it 5.7, indicating that those in W value this slightly higher and might be more aware of the materials used in their buildings. The residents, equally between W and C, are prepared to pay more for certain factors in the apartment, e.g. appliances and specific material used in the apartments. Also, 15% of the respondents was prepared to pay extra for additional sound insulation and 11% of the respondents said that they were content with the current living quality, which could be derived from their current apartments having a fairly high standard and using high-quality materials, as discussed by Nylander and Forshed (2011). In addition, a large majority (75%) of both residents in W and C, where not willing to pay more for an apartment in a multi-family house using a wooden frame instead of concrete, however, the respondents who live in a building using a wooden frame are about 26% more likely to pay more for an apartment in a building with wooden frames than those who live in concrete frames.

CONCLUSIONS

What residents really consider as the main factors related to the quality of living is, according to the survey, the location in the city, light and open apartment, the size of the apartment and finally good sound insulation towards neighbouring apartments. Out of these criteria's, only the size of the apartment is something that residents can influence based on their own finances and personal preferences. Improved sound insulation between apartments, on the other hand, is something that the residents want to be developed further, which also is out of the resident's control. Architects and builders can by using these initial findings as support when contributing to future building projects as it verifies what the residents consider to be living quality or what they choose to prioritize when selecting an apartment. The result derived from the survey confirms the theoretical discussions related to living quality.

Also, the survey showed that there is no major difference between perceived quality of living between apartments in buildings using a concrete or a wooden frame. In some cases, some variations could be seen between the material used in the building frame, but they are considered so small that it cannot be determined whether there is any significant value in addressing the resident's choices based on the material used in the building frames. The biggest difference that could be seen between the frames was that the residents in wood frames are more aware of the environmental aspects of sustainable construction. This may be because most respondents live in Växjö and are aware of Växjö's sustainability program that is usually spoken of in Växjö. In addition, it was concluded that the majority of all the respondents were not willing to pay more for the privilege of living in an apartment using a wood frame. The focus was to find an affordable living situation since the cost of living consumes a larger part of the disposable income than ever before.

When building homes that people like, and according to their needs, is to the advantage of all the actors on the current housing markets, such as managers, builders and, above all, the residents. By increasing the awareness and understanding what the residents expect from their apartment helps, both the market to sell and rent out apartments. The results found in this study could be used to design and build quality housing that meets the requirements that residents place on their homes, and serve as a basis for architects and builders during their work. This study could be enhanced if being replicated in a few years when a larger amount of wooden multi-family buildings are built, thereby investigate if the resident's perception has changed based on a larger market presence of buildings using wood frame solutions.

ACKNOWLEDGEMENT

With special thanks to the contribution provided by Daniel Beijbom and Fredrik Hög.

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