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Matti Lakkala

CONTEMPORARY LOGS FROM TECTONIC PERSPECTIVE

FINNISH PERCEPTIONS OF THE LOG AS AN ARCHITECTURAL MATERIAL

UNIVERSITY OF OULU GRADUATE SCHOOL;
UNIVERSITY OF OULU,
FACULTY OF TECHNOLOGY,
OULU SCHOOL OF ARCHITECTURE

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CONTEMPORARY LOGS FROM TECTONIC PERSPECTIVE

Finnish perceptions of the log as an architectural material

Academic dissertation to be presented with the assent of the Doctoral Training Committee of Technology and Natural Sciences of the University of Oulu for public defence in lecture hall L10, Linnanmaa, on 1 December 2023, at 12 noon

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Abstract

The aim of my dissertation is to combine the results of four articles to form an understanding of contemporary logs as an architectural material from the viewpoint of tectonics. I comprehend tectonics to address the relationship between constructional technique and architectonic space, occurring on experiential and constructional levels.

The new knowledge developed in this dissertation seeks to inform the development of logs and log architecture by architects and the log industry, as due to changes in properties and overall popularity of logs and the shift in usage from secondary to primary buildings, there is uncertainty about what logs currently are and how they should be used and developed.

The research data consists of semi-structured interviews of Finnish individuals, rooted in architectural projects. Interviews of laypersons and professionals in log pavilions addressed the experiential level, i.e., how logs are perceived. Interviews of architects within the contexts of architectural competition and published log architecture addressed the constructional level by examining the connection between tectonics of logs and architectonic quality. Analysing the data followed the iterative and inductive process of qualitative analysis.

In the results, I describe extensively the interviewees' perceptions divided into thematical categories. As a synthesis, logs are not only elongated pieces of solid wood, but also encompass a reference to construction technique. The difference in tectonics of glued and non-glued logs is highlighted. Logs evoked various positive perceptions but contradictory ones as well, connected with the well-known tradition of logs. The perceived healthiness of logs was due to their understandability and solid composition, which were seen as central for architectonic quality as well.

The findings contribute to literature on experiential qualities of wood, architectonic quality, and cultural status of logs in Finland. The dissertation's theoretical contribution is the use of the tectonics perspective in materials-related architectural research. The conclusion that non-settling logs could be viewed as longitudinal construction elements of solid wood can help to shake off the cultural cargo related to architectural use of logs in novel contexts. Further research needs related to non-settling logs are recognized.

Keywords: architectural design, architectonic quality, architect perceptions, Finnish architecture, industrial log, interviews, layperson perceptions, log architecture, log building, log industry, logs, professional perceptions, tectonics, tectonic theory in architecture

Lakkala, Matti, Nykyaikainen hirsi tektoniikan näkökulmasta. Suomalaisten käsityksiä hirrestä arkkitehtonisena materiaalina
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Tiivistelmä

Väitöskirjani tavoitteena on neljän osajulkaisun tulokset yhdistämällä muodostaa käsitys nykyaikaisesta hirrestä arkkitehtonisena materiaalina tektoniikan näkökulmasta. Tektoniikan määrittelen käsittelevän rakennustekniikan ja -materiaalin suhdetta arkkitehtoniseen tilaan rakenteen sekä kokemuksen tasoilla.

Muutokset hirsien ominaisuuksissa ja yleisessä kiinnostavuudessa sekä käytön monipuolistuminen arkkitehtonisesti vaativampiin kohteisiin aiheuttavat alalla epävarmuutta siitä, millaisena materiaalina hirsi ymmärretään, tai kuinka sitä tulisi kehittää ja käyttää. Väitöskirjassani kehitettävän uuden tiedon tarkoituksena on evästää arkkitehteja ja teollisuutta hirren sekä hirsiarkkitehtuurin kehittämisessä.

Tutkimusaineistona ovat arkkitehtuuriprojekteihin liittyvät puolistrukturoidut haastattelut, joita on analysoitu laadullisesti. Suomalaisten ammattilaisten ja maallikoiden hirteen liittyviä käsityksiä käsiteltiin hirsipaviljongeissa tehdyissä haastatteluissa, jotka tektoniikan viitekehyksen osalta koskivat kokemuksen tasoa. Suunnittelevien arkkitehtien haastattelut, joissa tarkasteltiin rakenteen tasolla hirren tektoniikan ja arkkitehtonisen laadun välistä yhteyttä, liittyivät arkkitehtuurikilpailuun sekä julkaistuun hirsiarkkitehtuuriin.

Tuloksissa kuvaan kattavasti haastateltavien käsityksiä temaattisiin kategorioihin jaoteltuina. Tulokset yhdistämällä hirsi määrittyy pitkänmuotoiseksi umpipuiseksi kappaleeksi. Hirsi sisältää viittauksen myös rakentamistapaan. Liimattujen hirsien havaittiin poikkeavan liimaamattomista tektoniikan kannalta. Hirteen liitetyt käsitykset olivat paitsi positiivisia myös ristiriitaisia hyvin tunnetun hirsiperinteen vuoksi. Hirsi koettiin terveellisenä rakenteena sen ymmärrettävyyden ja umpipuisen koostumuksen ansiosta, jotka näyttäytyivät keskeisinä myös arkkitehtoniselle laadulle.

Tulokset edistävät tietoa puumateriaalin kokemisesta, arkkitehtonisesta laadusta ja hirren kulttuurisesta asemasta. Tutkimukseni teoreettinen kontribuutio on tektoniikan näkökulman käyttö materiaaleja koskevassa arkkitehtuuritutkimuksessa. Johtopäätösten perusteella painumaton hirsi voidaan nähdä massiivipuisena rakennuselementtinä, mikä voi auttaa karistamaan kulttuurista taakkaa hirren käyttämisestä uusissa yhteyksissä. Jatkotutkimusta tarvitaan painumattomasta hirrestä.

Asiasanat: ammattilaisten käsitykset, arkkitehtisuunnittelu, arkkitehtoninen laatu, arkkitehtien käsitykset, haastattelut, hirsi, hirsirakentaminen, hirsiarkkitehtuuri, suomalainen arkkitehtuuri, maallikoiden käsitykset, tektoniikka, tektoninen teoria arkkitehtuurissa, teollinen hirsi

Perheelleni

Acknowledgements

In the autumn of 2016, when I had just started working as a project researcher in the Modern Log City project, my supervisor, Professor Janne Pihlajaniemi, as the leader of the project, proposed some preliminary article titles for me and other researchers in the project to work with. The proposed title for me was *Hirren tektoniikka,* which translates to Tectonics of logs. Little did I know, with no prior research experience, what kind of journey I was about to begin within that topic. I wonder if even Janne could have anticipated how central this first idea eventually became for my doctoral dissertation. Be that as it may, I want to thank you Janne for patient, insightful and productive guidance of my research. I have been privileged to enjoy your amazing ability to spot quickly all the relevant aspects in a research text. For me, the dissertation process has happened naturally along our other day-to-day university duties – and of course countless lunch discussions about orienteering, cross-country skiing and occasionally also architecture. For the truly well-informed and encouraging feedback since 2018 I want to also thank the members of my follow-up group, Professor Markku Karjalainen, Professor Harri Haapasalo and Dr. Aulikki Herneoja.

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I want to express my sincerest gratitude to Doctoral Researcher Eevi Juuti, with whom I have studied architecture since 2009, for the co-working within the Modern Log City project in 2016, as it laid the foundation for the overall motivation for this dissertation. Furthermore, I want to thank also other doctoral researchers in our unit for all the support I have received in our almost weekly peer group meetings, *Väikkäkahvit*, and elsewhere.

For all the interviewees that took part in this research, I want to emphasize how crucial the time and effort you donated for the benefit of this research has been, and how grateful I am for that.

The financial support I have received for my doctoral training from the Finnish Cultural Foundation's North Ostrobothnia Regional Fund for one year of working and separate grants from Tauno Tönning Foundation and Emil Aaltonen Foundation have allowed me to focus mainly on doctoral studies at crucial moments of my training. I have also experienced these grants as a recognition of the importance of this research, which has provided great moral support. For these reasons, I want to thank my funders. Almost needless to say, also my alma mater, Oulu School of Architecture, and all my colleagues here have been a huge support along my academic venture.

For the external reviewers in the pre-examination phase, Professor Olli-Paavo Koponen and Associate Professor Atsushi Takano, I wish to extend my commendation for your valuable assessments that helped me to understand the merits of this dissertation even better, as well as the parts that would benefit from further attention. After receiving your evaluations, I allowed myself to be tentatively positive that eventually this doctoral dissertation will be published. I want to also thank Aaron Bergdahl and Dr. Päivi Jokinen for your invaluable remarks regarding the language of my dissertation in the very final stages of the process. Moreover, I want to thank the anonymous reviewers of the four original articles in this dissertation for your significant assistance in the learning process of my doctoral training. I also wish to warmly thank Associate Professor Matti Kuittinen for familiarising yourself with this dissertation and coming to Oulu as my opponent.

I have dedicated this dissertation to my family, which extends beyond my nuclear family. I truly appreciate all of your support and love. My parents, Suvi and Pertti, thank you for always believing in me. My own sons, Eliel and Nooa, who I try to encourage to the same extent, thank you for being who you are. Building snow castles and playing football with you, among other things, are memories that will not fade away. Finally, and most importantly, I want to thank you Jenni for being my companion in all of this, and in so much more.

1.12.2023 Matti Lakkala

Abbreviations

Style	*Gloss Term*
CE	Common (or Current) Era
CLT	Cross-Laminated Timber
EBD	Evidence-Based Design
e.g.	exempli gratis
etc.	et cetera
EWP	Engineered Wood Product
i.e.	id est
i.a.	inter alia
MSWB	Multi-Story Wooden Building
OSB	Oriented Strand Board
PCI	Problem-Centred Interview
RED	Restorative Environmental Design
SAFA	Suomen Arkkitehtiliitto – Finlands Arkitektförbund ry (Finnish Association of Architects)
WMC	Wood in Multistory Construction

Original publications

This thesis is based on the following publications, which are referred throughout the text by their Roman numerals:

I Lakkala, M., Luusua, A., & Pihlajaniemi, J. (2020). Finnish perceptions of log and log architecture. *Scandinavian Journal of Forest Research, 35*(5-6), 296-307.

II Luusua, A., Lakkala, M., & Pihlajaniemi, J. (2019). Perceptions of Log and Log Buildings among Finnish Architectural and Building Industry Professionals. *Architectural Research in Finland, 3*(1), 133-147.

III Lakkala, M., & Pihlajaniemi, J. (2018). Architectonic quality of industrial log architecture in the scope of Tectonics–Learning from architectural competitions. *Architecture and Urban Planning, 14*(1), 46-54.

IV Lakkala, M. & Pihlajaniemi, J. (2021) Tectonics and Architectonic Quality in Recently Published Finnish Log Architecture. Corresponding Architects' Perceptions. *Frontiers of Architectural Research, 10*(4), 741-757.

Author's contribution:

In the articles in which I was the first author (I, III-IV), I was responsible for planning the studies, conducting literature reviews, analysing the research materials and writing up the articles. In these articles, other authors reviewed and commented on my work. In articles III-IV I collected the interview data by myself, while in Article I the interviews were conducted by myself, the second author and a research assistant.

In Article II, the first author was responsible for the final writing of the article. My contribution for this article was collaboratively with other authors to plan the study, including the overall research setting and the research questions, conducting the majority of the interviews and collaborating with the first author on the analysis as well. I also provided the literature review on the Finnish cultural context regarding log building. In addition, I had a central role in providing the research perspective, distinctive for architectural design, from which the study was conducted.

Contents

1 Introduction

This dissertation focuses on contemporary, industrially manufactured logs in the Finnish context, from the viewpoint of architectural design.

The English word *log* is here used as the translation for the Finnish word *hirsi*. It is not a perfect translation, however, as log can also stand for a simple cut section of a felled tree, while in Finnish there is another word for that.

Building with logs is an ancient construction method, originating in the boreal areas of the world (e.g., Phleps, 1982, pp. 52–53; Vuolle-Apiala, 2012, p. 52). With a stone axe, felled trees were notched on their corners to make a low basement for a rectangular hut, a Stone Age dwelling (Kaila, 1996, p. 158; Vuolle-Apiala, 2012, p. 8). Paralleled with the development of tools, namely the axe and more efficient iron blades, log building developed into more sophisticated forms (Affentranger, 2005, p. 28; Vuolle-Apiala, 2012, p. 8).

Eventually, after the industrialization era, logs in Finland have become an industrial product, defined in professional literature as a massive wood building component used mostly for walls, made with a plane or turning machine, comprised of a single piece or several pieces glued together. According to this definition, the minimum thickness for log is 68mm, but for buildings for year-round occupation, a minimum log thickness of 180mm is needed. Thicknesses of up to 275mm are common, while the typical height for industrial logs varies between 170mm to 275mm. (e.g., Rakennustieto, 2014; Tiainen et al., 2017)

In this dissertation, the word *log* refers to this meaning as a building component or material. Regarding English language, the use of the word log is here largely analogous to, for example *brick*, in the context of building materials.

In principle, logs can be used in a wall structure either horizontally or vertically. However, log buildings in Finland utilise mainly horizontal logs (Tiainen et al., 2017, pp. 26–27). Thus, this dissertation deals only with horizontal logs.

1.1 Background

Industrial logs today are factory-made products consisting most commonly of multiple parallel or cross lamellas of wood attached together with glue (Sinkko et al., 2019). With the ancient origin of logs in mind, industrial logs can be seen as part of novel massive timber construction techniques. The use of these techniques is increasing globally, mainly due to sustainability and technical aspects, along with rapidity of on-site construction, positively perceived appearance of timber structures and economic reasons as its drivers, although costs are recognized as a barrier also (Gosselin et al., 2017).

Logs[1] are a topical material that have developed rapidly in the last twenty years. One indication of the topicality is the growing interest in using logs. Their share as a material of all new single-family houses in Finland a decade ago was one tenth, but is approximately one fourth now (Jussila, 2020). In addition, while in the beginning of this millennium, logs in Finland were used almost solely as a material for summer cottages and detached houses in sparsely populated areas (Heikkilä, 2002, p. 17), and quality of architecture in industrial log buildings was considered weak (Jokelainen, 2005, p. 33), currently logs are utilized to build residential and public buildings in architecturally demanding milieus of detailed planned areas, as seen later in this dissertation.

The current topicality of logs in Finland could be seen also as a part of larger interest in simple, local,

[1] From this point forward in this dissertation *logs* refers to industrially manufactured glued logs, with parallel lamellas of wood. If other types of logs are addressed, different kinds of additional attributes are added to the word, e.g., non-glued logs, etc.

and renewable construction materials and techniques within the field of architecture. An increased interest in recent research towards the aspects of vernacular architecture and their contemporary applications has been recognized globally (e.g., Nguyen et al., 2019; Takano, 2015). Growing demand for healthier buildings and buildings with lower environmental impact has fostered interest in such minimally processed, often traditional materials and techniques, but combining them with contemporary architecture can also be a strategy for architectural design to support sustainable development, social engagement, or cultural continuity (Golden, 2018, pp. 1–2). However, technical and production-related improvements are usually needed for such materials in order for them to be used in contemporary buildings, and this process inevitably alters these materials' characteristics. To reach a desirable outcome in the development, an adequate understanding of such materials and techniques from both technical and cultural standpoints, must be acquired and exploited (Golden, 2018, pp. 2–3).

Applying such traditional materials in the context of contemporary architecture continues to be an issue in the architectural discourse due to the contrast between traditional and modern (Rashid & Ara, 2015). Indeed, due to the rapid changes in technological properties and overall popularity of logs, and the shift in their usage from secondary to primary buildings, various professionals in the field, including architects, building officials and manufacturers, seem to be uncertain about what logs currently are and how they should be used, evaluated, and developed (Juuti et al., 2017, pp. 30, 139–142). Thus, a better current understanding of contemporary industrial logs as architectural material is needed.

Scientific and other literature concerning logs offer few direct cues to support such understanding. The existing, not very recent studies address log building in the context of cultural history, largely from the American perspective, from viewpoints including, e.g., log structures as symbols of ethnic identity or culture (Barrick, 1986; Kaups, 1995), and the origins of log building technique in general (Jordan, 1980, 1983). These studies show, however, that some of the influential aspects of log building in the United States came with Finnish immigrants, which alludes to log building's long-standing role in the Finnish culture. On the other hand, the national history, and developments of log building before industrialization are addressed comprehensively in Finnish literature (Jokelainen, 2005; Vuolle-Apiala, 2012), offering a sound background for current understanding in the Finnish cultural context. Additionally, the developments of industrial log building in the Finnish context up until the beginning of the 2000s have been covered in academic and professional accounts by Heikkilä (2001, pp. 17–21) and Saarelainen (Saarelainen, 1993, 1999). Moreover, regarding current industrial logs, there are recent technical studies, addressing structural stability, fire and earthquake safety, energy efficiency, and airtightness and humidity-related issues (Bedon & Fragiacomo, 2015, 2018a, 2018b; Branco et al., 2013; Branco & Araújo, 2012; Ojanen, 2016; Vinha et al., 2015). Thus, unlike the architectural viewpoint, the technical properties of logs are well covered in current literature.

The log became a target of architectural research and development towards the end of the 1990s at the University of Oulu, within the project *Hirsi kaupunkiympäristössä*, Log in the Urban Milieu, aiming to develop single-family house models that would be approved for detailed planned areas (Heikkilä, 2001, 2002). Today, the developments, both technical and appearance-related that were prioritized then, have been for the most part achieved (Lakkala & Pihlajaniemi, 2019, pp. 17–20).

However, as the use of logs in larger-scale residential and public buildings is now desired, architectural professionals and the log industry are yet again faced with questions like those two decades ago concerning single family-houses, e.g.: How should log architecture for these novel contexts and uses be adapted and developed? This theme was one of the focus areas of a more recent project conducted in the Oulu School of Architecture, University of Oulu, between 2016-2019, called *Moderni hirsikaupunki*, Modern Log City (Juuti et al., 2017; Lakkala & Pihlajaniemi, 2019). A large part of the research of this dissertation was conducted within that project.

These aspects form the motivation for this dissertation. Next, I will describe the objectives and scope of this dissertation in more detail.

1.2 Objectives and scope

The aim of this dissertation is to form a current, in-depth understanding of contemporary industrial log as an architectural [2] material from the viewpoint of tectonics. This understanding is based on insights of Finnish individuals, and the various ways that they currently view logs. It is formed by combining the contributions of each of Articles I-IV in this compiling part of the dissertation.

The new knowledge seeks to inform and support the use and development of logs in architecture, especially by architects. Such knowledge might be beneficial for the log industry as well.

The notion of *architectural material* in the above-mentioned aim of this dissertation refers to the professional outlook of an architect towards a construction material. Thus, the notion of architectural material means a construction material viewed from the distinctive viewpoint of architectural design.

Moreover, it is presupposed in this dissertation, that at least in the Finnish context, architectonic quality is a primary, inseparable part of architectural design, an overall aim recurring from project to project, as I will discuss in detail in Chapter 2, Theoretical background. Thus, the notion of architectonic quality is needed when forming an understanding of logs as architectural material, to comprehend how logs could be utilized in architecture to achieve this overall aim of architectonic quality. However, architectonic quality is not easy to define unequivocally, which serves as an additional motivation for including the notion of architectonic quality to this research.

Besides this fundamental notion of architectonic quality, the understanding of logs as *architectural material* naturally entails a myriad of aspects that an architect might consider to be related to a construction material during the design process, including, e.g., aspects related to structural performance, costs, sustainability, and other tangible and technical qualities along with more intangible aspects related to sensory effect and experience, for example visual and tactile appearance, or scent (Wastiels & Wouters, 2012). To narrow down the examination of logs as an architectural material to a feasible research topic, I have utilized the viewpoint of tectonics in this dissertation.

This viewpoint of tectonics is formed through combining aspects in existing literature by e.g., Frampton (1995), Huuhka (2018), and Foged & Hvejsel (2018), and is here understood as an approach that studies the relationship between constructional technique and material and the resulting architectonic space. Due to its focus on constructional and material aspects of architecture, I have considered tectonics as an adequate viewpoint regarding the focus on construction technique and material of logs in this dissertation. Moreover, tectonics is closely linked with the notion of architectonic quality, as it has been suggested that tectonic theory in architecture should be further developed and brought into application in everyday practice, to achieve better architectonic quality (Hvejsel et al., 2015). Additionally, a need has been recognized for such architectural research that is based on and advances the theory base of architecture itself (Aura et al., 2001, pp. 29–32; van der Voordt & van Wegen, 1996), to which tectonics in architecture fundamentally pertains.

The way in which the original Articles I-IV are combined in this dissertation, in relation to the overall aim, viewpoint of tectonics and the research questions, is illustrated in Figure 1. Within the viewpoint of tectonics, of which formation in this dissertation is viewed thoroughly in Chapter 2, Theoretical background, the abovementioned relationship between constructional technique and the resulting architectonic space is recognized to occur on two levels: experiential and constructional. Aspects related to logs as architectural material from the viewpoint of the *experiential level* of tectonics are addressed especially in Articles I and II, by examining log and log building holistically as a phenomenon in the Finnish context. The experiential level of tectonics focuses on recognizing how the use of log construction influences the holistic experience of material architectonic space, i.e., the perception of log

[2] Of the synonyms *architectural* and *architectonic*, the more common, *architectural,* is mainly used in this dissertation (architectural design, architectural material, etc.). However, *architectonic* is used with the central notion of architectonic quality, as it has been considered to be a more fluent translation from Finnish (*arkkitehtoninen laatu* in Finnish). The expression *architectural quality* appears also in the dissertation but is only used when referencing research materials from original sources.

construction, including stated sensations and associations alike.

The *constructional level*, on the other hand, focuses on recognizing how the use of log construction – material, structure, joints, details, etc. – influences the physical, material architectonic space. As I pointed out earlier, architectonic quality is necessarily included in the understanding of logs as architectural material. Moreover, according to Hvejsel (2018, p. 396), the approach of tectonics necessarily addresses architectonic quality as well. Thus, in Articles III and IV logs as architectural material are addressed by examining the connection between tectonics of logs on the constructional level – that is, in short, the tangible interplay between logs and the resulting architectonic space – and architectonic quality.

I will answer three research questions in this dissertation. The contributions of Articles I-II dealing with the experiential level of tectonics (Q1) and Articles III-IV dealing with the constructional level of tectonics (Q2) are combined to form the current, in-depth understanding of contemporary industrial logs as architectural material from the viewpoint of tectonics (Q3). The research questions of this dissertation are the following:

Q1. What kinds of perceptions of the log as a material currently exist among individual Finnish…

a. …laypersons?

b. …architectural and construction professionals?

Q2. Regarding the constructional level, how does the tectonics of logs contribute to the architectonic quality of log architecture, as perceived by individual Finnish architects in general…

a. …in the context of architectural competition?

b. …in the context of published log architecture?

Q3. Based on the synthesis of the results of Articles I-IV, what kind of understanding of contemporary industrial logs as architectural material is formed from the viewpoint of tectonics?

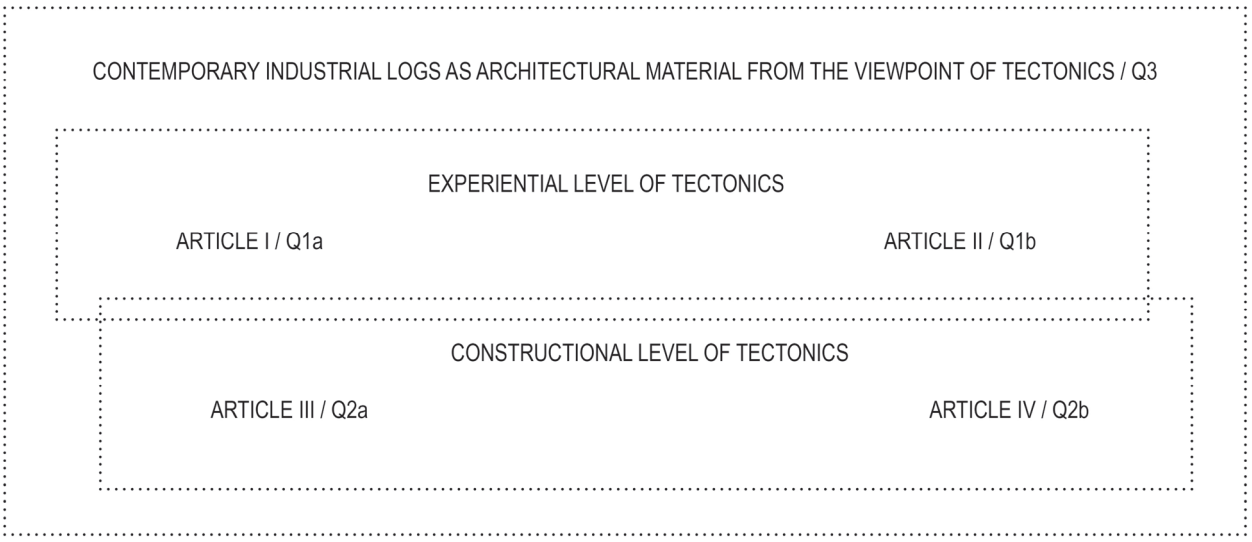

Fig. 1. The relationship of the original Articles I-IV in this compiling part of the dissertation, in respect to the research questions and framework of tectonics. Research questions Q1a and Q1b are answered by Articles I and II, respectively. Research questions Q2a and Q2b are answered with Articles III and IV, respectively. Research question Q3 is answered by outlining a broader understanding based on the synthesis of the contributions in all the articles in this dissertation. In the figure, there is a slight overlap between the rectangles presenting the experiential and constructional levels of tectonics, as in the articles, some aspects that were mainly located on one level, were clearly also intertwined with the other level aspects.

1.3 Research approach

Research methodology – entailing a research strategy or research design, and research tactics, such as data collection techniques and analytic tools – is framed by broad assumptions about the general nature of knowledge, and even broader assumptions about the nature of reality (Groat & Wang, 2013, pp. 9–11). In this section, the broader assumptions framing the methodological choices are addressed, while the next section deals with the research methodology.

Groat & Wang illustrate the role of these assumptions by using a conceptual model of four concentric frames, in which the broadest level is called the system of inquiry, or paradigm, framing the next level, the school of thought, which then frames the strategy, framing the final level of tactics (2013, p. 10). Groat & Wang note that within this conceptual model of the nested framework, there are still multiple choices to be made among a range of methodological variations, but for the research to be conceptually clarified, its methodological choices should always be framed by the appropriate system of inquiry (2013, pp. 10–11).

On a general level, ontological assumptions concern the nature of reality, and epistemological assumptions concern what knowledge is and how it is created (Groat & Wang, 2013, pp. 63–79). In a traditional dichotomization in social sciences, research is divided into quantitative research, in which reality is assumed to be objective, and qualitative research, in which multiple subjective realities are assumed to exist, as seen by participants of a study (Groat & Wang, 2013, p. 71). Regarding epistemology, respectively, the views of the researcher as independent of the participant or subject of inquiry is assumed, or in contrast, the views of the researcher as interactive with the participant of inquiry is assumed (Groat & Wang, 2013, p. 71). Within these two perspectives, the research approach in my dissertation falls into the category of qualitative research.

However, Groat & Wang (2013, pp. 71–72) note that this traditional dichotomization between quantitative and qualitative research is not a comprehensive one, because instead of ontological and epistemological assumptions, it places emphasis on differences in the level of tactics, while in a single research study, both qualitative and quantitative tactics can be utilized regardless of the chosen system of inquiry. Thus, Groat & Wang (2013, pp. 72–76) propose their own framework to classify the different systems of inquiry, grounding their epistemological model on a discussion on other established divisions beyond the quantitative versus qualitative, such as hard versus soft sciences, and a more fine-grained model of six ontological perspectives moving from subjective to objective approaches. The framework that Groat & Wang (2013, p. 76) propose is based on a positivist/postpositivist paradigm at the objective end of the spectrum, an intersubjective paradigm in the middle, and a constructivist paradigm at the subjective end. Both the positivist/postpositivist paradigm and the constructivist paradigm are further divided into two, so that within both paradigms, there is the radical end approach and an approach closer to the intersubjective paradigm, leading into five approaches, each of which are characterized with different epistemological and ontological assumptions (Groat & Wang, 2013, p. 76).

This dissertation is located clearly more in the subjective half of this continuum, but not in the most radical form of constructivism. The current, in-depth understanding of contemporary industrial logs as an architectural material from the viewpoint of tectonics that this dissertation seeks to form, is based on insights of individual Finnish participants and their experiences of logs. Thus, even though many aspects of logs as architectural material that are intersubjective may exist, this dissertation seeks also to find aspects that are totally unique, which means that multiple realities, socially constructed, are assumed to exist. In addition, it is assumed in this research that these realities depend on the Finnish cultural context. Regarding epistemology, Groat & Wang (2013, p. 79) state that in constructivism, a subjectivist perspective is adopted, in which 'knowledge emerges as the researcher(s) and respondents co-create understandings of the situation and context being studied.'

As the epistemological approach in this research assumes the interactive role of the researcher with the participant, it is necessary to articulate here how my own background as well as the backgrounds of the other authors in Articles I-IV have been represented when conducting this research. Firstly, all the authors in Articles I-IV, including myself, are architects by

education. Thus, the way of thinking, distinctive for architectural design, has guided the research process from formation of research questions to conducting interviews and analysing the interviews as well. It should also be mentioned here that I have been trained as a carpenter as well, leading to very hands-on experience with properties of wood. However, the perspective from which this study is conducted, is one particularly characterized by the education and profession of an architect.

In terms of epistemology, a closely linked concept to this perspective is designerly knowledge, which is obtained through design, understood as a valid form of inquiry when applied to field-specific problems (Archer, 1979; Cross, 1982). According to this conception, designerly knowledge is obtained through reflective practice (Schön, 1983). In other words, knowledge characteristic for design is generated in a creative design process, in which analysis and formation of ideas and alternate solutions follow one another iteratively (Lawson, 2005). Designerly knowledge is obviously at the core of research by design (Verbeke, 2014), or architectural design research, in both of which the researching architect's own creative design process is a central constituent (Fraser, 2014, pp. 1–2). This type of research is also referred to as practice-based research, and it has its roots in the creative research established in the fine arts (Lucas, 2016).

Even though this dissertation does not fall into the category of architectural design research described above, the concept of designerly knowledge is present in this dissertation in two ways. Firstly, regarding article IV (see section 1.4.4), I had been part of the architectural design team of one of the listed buildings, Pudasjärvi Log Campus, of which the corresponding architect was one of the interview participants. In addition, the second author in Article IV was the corresponding architect of another of the listed buildings, Pikku-Paavali Day-care Centre. I consider these tangible personal design experiences to have been supportive in the designerly way of comprehending the essential themes that were brought up by the participants not only in Article IV, but in Articles I-III as well. Secondly, in Articles III-IV (see 1.4.3 and 1.4.4), built log architecture or unbuilt presentations of log architecture representing architectonic quality served as the starting point for the inquiry. Thus, as highly qualified architects that were in charge of the designs were interviewed, the insights that the interviewees in Articles III-IV had, had been generated during the buildings' design processes.

To return to the conceptual model of four concentric frames (Groat & Wang, 2013, p. 10) described in the beginning of this section, Groat & Wang note that even though a system of inquiry is often linked to a school of thought, it is not mandatory to align the design of a research study with a particular school of thought. This is the case with my dissertation – it has not been aligned with an established school of thought. However, within the qualitative research strategy, the school of thought of phenomenological inquiry, and within it the category of existential-phenomenological inquiry (Groat & Wang, 2013, p. 232), has similarities with this dissertation. As a strand of qualitative research, the goal of phenomenological inquiry is an endeavour to understand lived experience from the viewpoint of those living it (Groat & Wang, 2013, p. 228). A basic underlying principle of phenomenological inquiry is that the researcher uncovers essential qualities of the phenomenon by relying on his or her intuition, setting aside any prejudgments (Groat & Wang, 2013, p. 228). Existential-phenomenological inquiry is seen as particularly relevant in terms of architectural practice as it focuses on specific experiences of specific individuals in actual settings (Groat & Wang, 2013, p. 232). This school of thought assumes that meaningful themes are revealed when 'individual descriptive accounts are thoughtfully analyzed' in a sensible manner pertinent to the inductive process of qualitative research (Groat & Wang, 2013, p. 232).

These abovementioned features are in line with the explorative element of this dissertation, resulting from the novelty of contemporary logs as a material of larger-scale residential and public buildings, and as a topic of architectural research, as was outlined earlier. In addition, the features are in line with this dissertation's focus on experiential aspects, as the interviews address the experiences of participants.

To conclude, then, the research approach in this dissertation, in terms of a system of inquiry or paradigm, could be described as constructivist, but situated in between radically subjectivist constructivism and the intersubjective paradigms. In

addition, the research is not aligned with a particular school of thought, but the overall qualitative research strategy could be described as experiential, explorative, and designerly and culturally informed.

1.4 Research methods and materials

1.4.1 Overview of the research design and qualitative interviews

The empirical material of this doctoral dissertation was collected with semi-structured interviews (n=46), during a period of three years between 2017-2020. The interviews were conducted separately for each of Articles I-IV. For Articles I-III, the interviews were conducted within the Modern Log City research project, executed in Oulu School of Architecture between 2016-2019. I worked in the project as a project researcher during that time. The interviews were conducted by me, Dr. Aale Luusua and architecture student Miia Nätynki. Luusua was a researcher and Nätynki a research assistant in the Modern Log City project. For Article IV, I conducted the interviews funded by a personal research grant from the Finnish Cultural Foundation. In Table 1, the amount of the interviews, the year they were conducted and interviewer are presented.

In Articles I and II, the interviews were conducted as two-part, first indoors and immediately after that in "Timber Tetris" (see Figures 2 and 3 below), which was an architectonic construction, or pavilion, designed and built during a student workshop within the Modern Log City Project. In 2017 when the pavilion construction was in Helsinki, architectural and building industry professionals were interviewed. Laypersons were interviewed in 2018 when the construction was in Oulu.

In Article III, the interviews included in this dissertation were related to the outcome of an open Finnish architectural competition called Monio – open architectural competition for new learning environment and multipurpose building. The author of the winning proposal and the jury's main architect members were interviewed.

In Article IV, log architecture that had been recently published in architectural publications served as a starting point, as the corresponding architects of these projects were interviewed.

The interviews were analysed qualitatively. In Articles I-II, the inductive analysis was not guided by any theoretical concept settled in advance, but the idea was to remain open for any perceptions the participants might have regarding the research topic. In Articles III-IV, the analysis was inductive as well, but informed by concepts of tectonics and architectonic quality, as the aim was to examine the connection between the tectonics of logs and architectonic quality. As all the interviews were related to actual architectural projects, a deep knowledge of these projects was also needed in order to analyse the interviews addressing these projects.

Table 1. Breakdown of the dissertation's interviews by article, year and interviewer.

Article (year of publication)	All interviews (n=46 in total)	Interviews by Matti Lakkala (n=25 in total)	Interviews by others (n=21 in total)	Year of the interviews
I (2020)	18	1	17	2018
II (2019)	15	11	4	2017
III (2018)	3	3	-	2018
IV (2021)	10	10	-	2020

The qualitative research interviews

I considered the qualitative interviews as an adequate means to gain rich, in-depth qualitative data, which I deemed suitable regarding the overall aim and the explorative element of this dissertation, producing the kind of knowledge that could support the use and development of logs in architecture by architects and the log industry.

Asking somebody questions to gain knowledge about something is and supposedly has been common among humans since the use of language was mastered, and the qualitative research interview makes use of this ancient human habit (Witzel & Reiter, 2012, p. 1). Research interviews can be categorized by their level of structure, ranging from survey interview, which is tightly structured, to only a loosely formatted unstructured interview, in which the topics discussed are participant-driven, in opposition to more structured interviews, where the interviewer has decided the topics already in advance (Roulston & Choi, 2018). In semi-structured interviews, which have been utilized in this dissertation, qualitative data is collected from participants by asking a series of

open-ended, predetermined questions (Given, 2008, pp. 810–811) Semi-structured interviews allow the interviewer to ask follow-up questions related to what the participants have already said (Roulston & Choi, 2018). While one common application for structured interviews is to provide open-ended views to supplement results of research primarily relying on quantitative data (Given, 2008, pp. 837–838), semi-structured interviews are often used as the primary method of the research (Roulston & Choi, 2018).

Thus, I deemed semi-structured interviews appropriate, as the topic to be investigated was quite well outlined. However, remaining open to any views that the participants might have was desired due to the explorative element in this dissertation.

Within the qualitative interviews, categorizations can be done also by other aspects than level of structure. In this dissertation, all the interviews are in line with the basic definition of in-depth interviews, that is, a 'conversation designed to elicit depth on a topic of interest', which is especially effective when answering research questions of how and why (Guest et al., 2013a).

There are also different types of conceptions regarding the type of knowledge that is produced in the interaction during interview. Different approaches include, for example, phenomenological, hermeneutic, feminist, and ethnographic interviews, which are theoretical perspectives by which the interviews are informed to serve a variety of research purposes (Roulston & Choi, 2018). Brinkmann and Kvale (2018, pp. 19–21) have used metaphors of miner-interviewer and traveller-interviewer to illustrate the division of the approaches to two different conceptions. A miner-interviewer unearths nuggets of valuable metal, which represent knowledge that is existing, and that can be collected by the interviewer. On the other hand, the traveller-interviewer is described as a traveller wandering in a distant country, conversing with people he or she meets, walking with the locals and encouraging them to share their experiences. According to Brinkman and Kvale (2018, pp. 19–21), the miner approach regards interviews as a data collection site that is separated from the data analysis done later, whereas in the traveller approach, the interviewing and analysis are intertwined, and the knowledge is understood as socially constructed.

Due to the explorative element in this dissertation, the approach in the interviews could not be the miner's. However, as the research focus is well defined, it is not totally reminiscent of the traveller's either. Instead, a qualitative interview approach called the problem-centred interview (PCI) (Witzel & Reiter, 2012) has similarities with the approach in this dissertation. In PCI, in regard to the miner-traveller metaphor discussed above, 'interviewers take the role and attitude of a well-informed traveller' (Witzel & Reiter, 2012, p. 2). In this approach, background information is obtained beforehand, which guides the journey. However, the eventual knowledge that is considered relevant depends on the interviewees' insights.

All in all, a wide variety of ways to use and discuss qualitative interviews exists. Thus, I will describe the interviewing processes of this research article by article in the next three sub-sections. After these, I will describe the analysis of the research data.

Lastly, all the interviews have been anonymized to allow the interviewees to speak freely. In the results chapter, when I have considered a comment in the interviews especially illustrative, I have quoted them directly. In the following three sub-sections, there are tables that provide some information about the interviewees. In these tables, the interviewees are given pseudonyms such as *Staff member #1, Student #2, Official #3, Corresponding architect #4,* etc. To link an interviewee with a single quote in the results, without compromising anonymity, an abbreviation of the above-mentioned pseudonyms is connected to the direct quotes, e.g., *SM1, S2, O3, CA4*, respectively.

1.4.2 "Timber Tetris" pavilions in Helsinki and Oulu (Articles I-II)

In Articles I-II, a log-structured pavilion constructed within the Modern Log City research project, called "Timber Tetris" (Hirsitetris in Finnish), was utilized as the venue for the second half of the interviews. The pavilion, constructed of industrial lamella logs of spruce, which are 90mm in width and 185mm in height, was designed and built during two student workshop courses in the Oulu School of Architecture, University of Oulu. The untreated and pre-cut logs, that are roughly one half to one third of such logs' thickness that are commonly used in normal buildings such as single-family houses or schools, were

assembled on site. The logs are composed of two adjacent lamellas of wood glued together.

Pavilion in Helsinki in 2017

The pavilion was first created in a workshop in 2017. The purpose of the workshop course was to design and build a pavilion constructed of logs to be used as an event space and, to draw attention to the Museum of Finnish Architecture, where the pavilion was located during the 2017 summer season. In addition to architecture students at the University of Oulu, the building architect students from Oulu University of Applied Sciences took part in the course. Students made their proposals for the design in small groups, after which the tutoring teachers – me and professors Janne Pihlajaniemi and Matti Sanaksenaho – created the final design based on the students' ideas and consulting the log manufacturer. After that, the pavilion was erected by the students in Helsinki, in the courtyard between the abovementioned museum and Design Museum Helsinki (see Figure 2 on the following page).

Pavilion in Oulu in 2018

The following year, a similar workshop was arranged. The pavilion had been dissembled in Helsinki in the autumn of 2017, and was to be relocated to Oulu, next to one of the main entrances of the University of Oulu. This time, the task for the students was to envision a roof structure for the pavilion. Through a similar process as the year before, the pavilion was reassembled in Oulu, with heightened log walls and a roof (see Figure 3 on page 27).

Participants

The interviews for Article I were conducted in Oulu, by me, another researcher and a research assistant of Modern Log City project (see Table 1). The aim of the interviews was to map Finnish layperson perceptions. As there are nearly 12 000 students enrolled and 3000 members of staff from Finland in the University of Oulu (*University Figures*, 2022), the study participants were recruited among this group of Finns, which was also convenient due to the placement of the pavilion. The university's intranet and students' email list were utilized to send invitation, with a promise of a movie ticket for taking part. This type of passive recruitment approach can lead to self-selection bias, but it is considered as a strength in the context of in-depth interviews, as people who take the time to respond to an invitation are probably interested in the study's topic and thus will have something to say about it (Guest et al., 2013a). Altogether 18 people were interviewed. No prior knowledge of the subject was required, which was stated in the invitation as well, but of all the people who responded to the invitation, the final participants were chosen so that female and male genders would be almost equally represented (10 and 8, respectively), both students and staff would be represented (10 and 8 respectively) and that male and female genders would be included both in staff participants as well as student participants.

The most common age group of the participants was 20-29 years of age, while the other age groups were represented quite equally. The backgrounds of the participants regarding their discipline within the university varied: humanities, technology, economics, and medicine were represented, along with interviewees working in non-academic duties. The well-balanced sample of study participants made it possible to gain a diverse view of the perceptions of Finnish individuals. For the breakdown of the participants, see Table 2.

Table 2. Participants in Article I. (Modified from Article I)

Participant	Discipline	Female/male	Age range
Staff member #1	Languages	Female	30–39
Staff member #2	Natural sciences	Male	30–39
Staff member #3	Economics	Female	20–29
Staff member #4	Supporting duties	Female	60–69
Staff member #5	Construction techn.	Female	40–49
Staff member #6	Education	Female	40–49
Staff member #7	IT	Male	50–59
Staff member #8	IT	Male	60–69
Staff member #9	Administration	Female	50–59
Staff member #10	Education	Female	30–39
Student #1	Natural sciences	Male	20–29
Student #2	Economics	Female	20–29
Student #3	Medicine	Male	20–29
Student #4	IT	Male	20–29
Student #5	Music	Female	20–29
Student #6	Process techn.	Female	20–29
Student #7	Economics	Male	10–19
Student #8	Economics	Male	20–29

Fig. 2. The Timber Tetris pavilion in its original appearance in the urban milieu of Helsinki in 2017. Besides the horizontal lines between the logs, there are also some visible vertical seams within the logs, because of the finger joints that are used to lengthen the timber of the lamellas. Photo: Aki Markkanen. (Published with permission)

Fig. 3. The developed Timber Tetris pavilion in 2018, with heightened log walls and a roof in front of one the main entrances of the University of Oulu. Photo: Matti Lakkala.

In Helsinki, the interviews for Article II were conducted by me and another researcher from the Modern Log City project (see Table 1). With the aim of mapping perceptions among Finnish architectural and building industry professionals, a total of 15 of such professionals took part in the study as interviewees. As it is desirable to include multiple viewpoints when addressing a research question (Guest et al., 2013b), the interviewees were chosen to include four practitioners in architectural design, four architects that were office holders working in a local building control authority and in a local planning authority with the City of Helsinki, four master's level architect students from Aalto University, and three professionals working in the log and wood building industry. The local master's level architecture students were recruited with an email ad sent to Aalto University's student email list. For recruiting the rest of the participants, the purposive sampling approach was utilized, which is a form of non-probabilistic sampling (Guest et al., 2013b). Practitioners who were asked to take part were based in Helsinki and considered as renowned professionals in the field of architecture. The architects that were office holders were considered to be information-rich, especially regarding the issue of logs' suitability to the urban[3] milieu and representing the views of the local building control and planning authority. Two of the office

[3] A dichotomization between countryside/rural (maaseutu/maaseutumainen in Finnish) and city/urban (kaupunki/kaupunkimainen) appears frequently in this dissertation and was used in the interview guides as well. Both these terms should be understood in the Finnish context. In this sense, the city centers of Helsinki and Oulu are tangible examples of such urban environments in the Finnish context, as the interviews in Articles I-II were conducted in these cities. It should be noted however, that this dichotomization is a rough one, and does not comprehensively reflect the spectrum of various types of population centres and other types of less populated milieus in Finland. Thus, whenever the interviewees have expressed a more fine-grained definition of rural or urban environment, it is brought up in the results. Otherwise, when the terms urban or rural are used, it should be understood to refer to a Finnish city centre or Finnish countryside in general, respectively.

holders were acquaintances of the responsible leader of the Modern Log City project and considered as renowned professionals as well. The other two were contacted due to their public office at the city of Helsinki. The building industry professionals that were invited to take part, worked in log and wood building industry, as project manager, design manager and managing director.

Eventually, seven (7) participants were female, and eight (8) were male participants. The breakdown of the participants is presented in Table 3. In the students and industry representative groups the division between genders was equal, but the office holders were all female while the practitioners were all male.

Table 3. Participants in Article II. (Modified from Article II)

Educational background/profession:	Female/male	Age range
Design practitioner #1	Male	40–49
Design practitioner #2	Male	30–39
Design practitioner #3	Male	70–79
Design practitioner #4	Male	60–69
Official #1	Female	40–49
Official #2	Female	60–69
Official #3	Female	30–39
Official #4	Female	60–69
Industry representative #1	Male	50–59
Industry representative #2	Male	50–59
Industry representative #3	Female	40–49
Architectural student #1	Female	30–39
Architectural student #2	Male	20–29
Architectural student #3	Male	20–29
Architectural student #4	Female	20–29

As both students and experts were included in the interviewees, the ages of the participants ranged from early twenties to one over seventy years old individual, while most were middle-aged. Thus, also the education and employment backgrounds of the interviewees were well varied, which enabled obtaining a broad range of individual professionals' – current and future – views and experiences.

Interviews

In Articles I-II the interviews consisted of two parts. The first part was conducted indoors nearby to the pavilion. In Oulu, it was a meeting room at the Oulu School of Architecture. In Helsinki, it was a cafeteria in Design Museum Helsinki. The second part took place directly after the first. It was conducted as a go-along style interview in the Timber Tetris pavilion. This type of interview has its roots in ethnographic research and is place-based, giving researchers 'access to situated perceptions and meanings' (Kusenbach, 2018), which makes it a pertinent method for architectural research. Within this field, go-along style interview, or walking interview, has been used previously, e.g., by Luusua (2016). In addition, it has been noted that previous perception studies regarding wood material usually do not focus on any specific application of wood, which brings forth a need for studies in field settings considering the impacts of context and application for the perceptions of wood materials (e.g., Jonsson et al., 2008; Nyrud et al., 2008; Nyrud & Bringslimark, 2010).

It is important when formulating the interview guide to generate questions that will likely elicit descriptions relevant to the research question and, to begin with broader questions (Roulston & Choi, 2018). In the first part, interview questions were focused on mapping participants' general views of logs and log building from their personal viewpoint. Questions addressed perceptions related to aspects like:

- overall associations and image of logs,
- detailed attributes of logs,
- rural and urban milieu and logs,
- experiences of log building,
- logs' technical properties including safety, costs, and sustainability.

In the second part while moving around and within the pavilion, interviewees were instructed at first to express any initial impressions of the pavilion that might emerge. Followed by that, questions were presented regarding:

- the overall appearance of the pavilion and its suitability to its surroundings,
- shape, size and surface texture of the logs
- corner joints,
- composition of the logs as a composite of wood and glue and views of whether the material is considered log or not, also in the light of the participants' initial views during the first part of the interview.

Participants were also asked if they had any ideas for improvement related to the abovementioned aspects. The professionals were also asked what a building material of their dreams would be like.

Utilizing the tangible log pavilion in a real-life environment had many benefits in respect of the research aims of this dissertation. It enabled obtaining very specific and nuanced views, which could be seen important in providing applicable information in terms of architectural design. It made also sure that the views of participants were related precisely to log building, instead on wood in general, as the application of wood with its context was present. In addition, besides deepening the understanding of the participants' opinions in general, the differences in opinions between "ideal" logs and industrial, glued logs could be discussed and recognized.

The audio of both parts of the interviews were recorded. Additionally, the second part was filmed with a GoPro video camera attached to the interviewer's chest. Thus, in addition to the vocal communication, also the body language of the interviewees was captured. Interviews in Oulu for the first article yielded some nine hours of audio recordings, which were transcribed verbatim into approximately 120 pages of text documents. Interviews in Helsinki for the second article yielded approximately 146 pages from roughly eight hours of audio. In the analysing phase, while the transcriptions were the subject of analysis, the video could be used to check the exact spot on the pavilion under discussion when necessary. The using of the video also made it possible for me to get acquainted with and analyse the interviews conducted by the other two members of our research team in a reliable way.

1.4.3 Monio – Open architectural competition (Article III)

Architectural competition as a research context

The interviews of Article III that are included in this dissertation were related to an open architectural design competition called Monio – Open architectural competition for new learning environment and multipurpose building, which was concluded in February 2018. The competition had 57 anonymized entries, and in the winning entry, the building was proposed to be made from contemporary industrial logs.

The Finnish procedures of architectural competitions have evolved over a period of more than 140 years, and have become exemplary also internationally (Kaipiainen, 2013). In such competitions the main task of the jury is to select a proposal that provides the best architectonic solution for the design task outlined in the competition programme (Kazemian & Rönn, 2009). Anonymity of the entries is required to ensure that the assessment is based solely on the merits of the proposals themselves. According to Andersson et al. (2013, pp. 10–11), architectural competitions generate future-oriented knowledge about the best possible solutions to a design problem through architectural projects.

In Monio, among other goals, the competitors were requested to propose a solution that is of high architectonic quality and that utilizes wood construction (*Monio. Uuden Oppimisympäristön Ja Monitoimitalon Yleinen Suunnittelukilpailu 2.6.-18.9.2017. Kilpailuohjelma.*, 2017). Consequently, the winning proposal represents a possible future solution to a design problem of a contemporary urban public building that can be considered to represent architectonic quality and that utilizes log construction.

Due to the novelty of contemporary log building as a phenomenon, there are few prominent existing buildings utilizing contemporary industrial logs, and the architectural use of logs could be expected to be developing currently quite rapidly. Thus, in terms of the overall aim of this dissertation – to form a current, in-depth understanding of contemporary industrial logs as architectural material – the outcome of the Monio competition created a wonderful, current, and fruitful opportunity for scrutiny. This is even emphasized when considering the prominence of the notion of architectonic quality in architectural competitions, as described above, since architectonic quality is recognized here to be a central constituent when forming an understanding of logs as architectural material, as described earlier in 1.2 Objectives and scope, and further in the Theoretical background chapter.

Participants and interviews

When selecting the participants for the interviews in Article III, the sampling approach was purposive. This approach assumes that regarding a given subject, some individuals simply are more knowledgeable compared to others, which is highlighted in the key informant concept (Guest et al., 2013b).

The jury of open architectural competitions in Finland generally consists of professional, usually architect, and non-professional members that are appointed by the organiser of the competition. In addition, Finnish Association of Architects (SAFA) appoints two impartial expert members to the jury (*SAFA Competition Rules*, 2008). The central role of the impartial expert members is highlighted by Kazemian and Rönn (2009) as they point out that usually the jury members representing the organising party trust in the evaluation made by the impartial expert members.

Thus, the main author of the winning proposal was interviewed, along with the two (2) impartial expert members of the jury appointed by SAFA, to gain insight into the winning proposal's merits from the perspective of both the author and the jury. All three interviewees were architects by education. The jury members were female, and the main author was male.

Among other aspects to be considered when formulating interview guides, mentioned above in section 1.4.2, the conceptual frames applied in analysing the data must be considered (Roulston & Choi, 2018). The theoretical background of this dissertation on architectonic quality and tectonics, which I will present in Chapter 2, was present similarly in the interview guides of both Articles III and IV, as these articles had the same focus on examining connections between tectonics of logs – on the constructional level – and architectonic quality.

The notion of architectonic quality was addressed in the beginning of each interview because it appeared as such in the interview questions as well. As I will discuss more thoroughly in 2.1.2, the definition of architectonic quality is ambiguous. Thus, it was seen important that the concept of architectonic quality is defined by the interviewees, to make sure that it is understood similarly by both me as the interviewer and the interviewee. The definitions provided by the interviewees had similarities but included also rarer remarks, as will be shown in the results chapter. I then used these definitions by the interviewees in the analysis both individually with a corresponding interview and as a more general understanding when proceeding with the qualitative analysis.

Tectonics as a term, however, did not appear in the interview guides in Articles III-IV, but the theoretical understanding of tectonics guided the formation of the interview guide. In addition to more general topics, the interview questions addressed various topics that I deemed to be essential from the viewpoint of tectonics. In Article III, the topics that were addressed were the following:

- general associations and image of logs, also compared to wood in general,
- logs in rural and urban milieus,
- the evaluation process of the proposals (for the jurors only),
- the design process of the winning proposal (for the author only),
- fundamental characteristics of the proposal (in general and related to logs), in terms of architectonic quality,
- proposal's log structure and its relation to architectonic quality,
- implications of construction methods and materials in general,
- the homogeneity of logs,
- the concept of logs and log building,
- the central strengths and weaknesses of logs in terms of architectonic quality and otherwise.

The interviews were conducted in the summer of 2018 and took place in Helsinki, in the office spaces of each three interviewees. The interviews were audio recorded and transcribed in verbatim. This yielded some 2.5 hours of audio material and roughly 20 pages of text documents. Before the interviews, I familiarized myself thoroughly with all the material related to the winning proposal.

1.4.4 Recently published Finnish log architecture (Article IV)

Published log architecture and participants

The initial setting and approach of the interviews in Article IV was very similar than that of Article III. However, while the context in the previous article was architectural competition, that is, imaginary presentations of architecture, the context in Article IV is built log architecture.

Built log architecture that served as the starting point for the interviews in Article IV were sought by information retrieval of two Finnish architectural publications. One was the primary architectural publication in Finland called Arkkitehti (Finnish Architectural Review) published by SAFA. The other one was an architectural and technical publication Puu-lehti (Wood Magazine) that focuses on timber architecture. Puu-lehti is published by Puuinfo, which is a promoting company of Finnish wood. Whereas in Article III the winning proposal of the competition could be assumed to represent architectonic quality due to its success in an open competition, in Article IV, the fact that the buildings had been published demonstrate that these buildings represent architectonic quality as well, through the institutional concept of architectonic quality (Pihlajaniemi, 2014, pp. 63–66). I will address the institutional concept of architectonic quality in detail in Chapter 2 Theoretical background. Looking into these two publications was considered appropriate in finding an adequate number of relevant examples of Finnish log buildings representing architectonic quality. As the focus of this dissertation is on contemporary log architecture, a publishing period of the previous ten years, 2010–2019 was selected.

As a result of going through all the volumes of the two publications from the selected period and listing all the Finnish buildings utilizing logs as outer wall material, fifteen (15) buildings were found, designed by thirteen (13) architectural offices or architects. The corresponding architects of the listed buildings were then asked to take part to the interviews. Ten (10) corresponding architects agreed for the interview. They were responsible of twelve (12) listed buildings. These buildings comprehended a variety of scales, uses and log types utilized, as showcased in Table 4 (following page). The buildings were in eleven municipalities or cities, geographically distributed from Lapland to southern Finland, as seen in Figure 4.

Besides the built examples, also the High School and Community Centre Monio was included even though it had not been built, since its designing had progressed from the competition phase to execution phase and thus the corresponding architect was considered to have important experience in respect to the research interest in Article IV as well.

Fig. 4. The geographical distribution of the listed buildings in Article IV on the map of Finland.

Table 4. Breakdown of the listed buildings, of which corresponding architects were interviewed in Article IV. (Modified from Article IV)

No	Title and the corresponding architect	Year	Use	Area	Log type	Source
#1	Custom Home II. Seppo Mäntylä, M.A.R.K. Architect's office Mäntylä	2011	Single-family house	400 m²	Industrial planed non-settling logs	(Viljakainen, 2015b)
#2	Villa Valtanen. Lauri Louekari, Architect's office Louekari	2012	Summer cottage	64 m²	Industrial planed lamella-logs	(Louekari, 2012a, 2012b)
#3	Pikku-Paavali Day-care Centre. Janne Pihlajaniemi, Architects m3 Ltd	2013	Public building	1323 m²	Industrial planed lamella-logs	(Pihlajaniemi & Tervaoja, 2013)
#4	Sauna Moisala. Lauri Louekari, Architect's office Louekari	2013	Sauna cottage	16 m²	Industrial planed lamella-logs	(Louekari, 2018)
#5	House EVO. Seppo Mäntylä, M.A.R.K. Architect's office Mäntylä	2014	Single-family house	203 m²	Industrial planed non-settling logs	(Viljakainen, 2015a)
#6	Naava Chalet. Janne Kantee, Honkatalot	2016	Apartment hotel	1181 m²	Industrial planed and brushed non-settling logs	('Naava Chalet', 2017)
#7	Pudasjärvi Log Campus. Kristian Järvi, Lukkaroinen architects	2016	Public building	9778 m²	Industrial planed lamella-logs	(Lukkaroinen, 2016)
#8	Smoke Sauna in Asikkala. Tuomo Siitonen, Architect's office Tuomo Siitonen Ltd	2016	Sauna cottage	27 m²	Industrial sawn non-glued logs	(Siitonen, 2018)
#9	Lonna's Public Sauna. Anssi Lassila, OOPEAA Office for Peripheral Architecture	2017	Commercial sauna	190 m²	Hand-hewn non-glued logs	('Lonnan Sauna', 2017)
#10	Housing co-op Vuoreksen Tiera. Jussi Hietalahti, HIMLA Architects	2018	Detached houses	5 x 142 m²	Industrial planed non-settling logs	(Hietalahti, 2019)
#11	Smoke Sauna in Inkoo Archipelago. Marko Huttunen, Architect's office Livady	2018	Sauna cottage	30 m²	Hand-hewn non-glued logs	(Huttunen & Saarinen, 2019)
#12	High School and Community Centre Monio. Mikki Ristola, AOR Architects Ltd	Not built	Public building	ca. 11000 m²	Industrial planed non-settling logs	(Ristola, 2018)

Table 5. Breakdown of the means for the interview in Article IV. (Modified from Article IV)

Participant	Means for the interview
Corresponding architect #1	Videocall
Corresponding architect #2	Telephone
Corresponding architect #3	Face to face
Corresponding architect #4	Telephone
Corresponding architect #5	Telephone
Corresponding architect #6	Face to face
Corresponding architect #7	Telephone
Corresponding architect #8	Telephone
Corresponding architect #9	Face to face
Corresponding architect #10	Videocall

Interviews

The interviews took place during the first three months of 2020. They were conducted via telephone or videocall, or face to face, according to the preferences of the participants. For a breakdown of the means used for the interviews, see Table 5. The interviews were recorded and transcribed verbatim, yielding approximately 10 hours of audio material and 115 pages of text documents.

The way in which the theoretical background on architectonic quality and tectonics was present in Article IV was identical to Article III, which was described above in the previous sub-section. The following matters were addressed in the interviews in Article IV:

1) Architect's general views related to logs
   a) professional experience with logs
   b) listed example building(s) of the architect and related background information, i.a. the log types used
2) Creative design process, in general and in relation to logs
   a) architectonic quality and its role in relation to the practice of the interviewee
   b) logs' characteristics that need to be considered in the design
   c) design process related to logs after the initial sketching phase, the unforeseen setbacks
3) The log structure of the listed example building(s) and how it is connected with architectonic quality

a) important features in general, and related to log structure
b) construction methods' and materials' implications in general
c) log structures with load-bearing function
d) visible log surfaces in the interiors and exteriors
e) logs' homogeneity

4) Detail features of logs in the example buildings and their relation to architectonic quality
   a) shape, size, and surface texture of the logs
   b) cornering
   c) additional details
5) Logs' main strengths and weaknesses in terms of architectonic quality – concluding remarks.

1.4.5 Analysing the interviews

Before delving deeper into the conducting of the analysis, it should be noted that it is not mandatory to use specific systematic analytic tools to analyse qualitative interviews (Brinkmann & Kvale, 2018, p. 134). According to Roulston (2014) as well, a single right way to analyse interview data qualitatively does not exist, but the analyses and representation should be coherent considering the framework and audience of the study. Thus, the process of analysing the interviews is next described as precisely as possible.

The overall approach for analysing the interviews qualitatively (e.g., O'Leary, 2009, pp. 256–269) was similar in all the articles, and through an iterative process, it aimed at preserving the richness of the accounts of the interviewees and reaching a meaningful understanding of the research topic at the same time. In addition, as Groat & Wang (2013, p. 218) note, it is characteristic for qualitative research to have an underlying emphasis on an inductive process. Indeed, an inductive logic was used when analysing the interviews in all Articles I-IV. According to Groat & Wang (2013, p. 71), inductive inquiry seeks 'clarification of *multiple critical factors* affecting the phenomenon.' Inductive reasoning means drawing generalizations from given information beyond what is embedded in that information (Groat & Wang, 2013, p. 396).

In the first two articles, the perceptions of logs and log building were mapped in a very holistic way, and no prior theories or concepts were utilized in the analysis. Instead, ideas and categories or themes were allowed to emerge freely from the materials. This is characteristic of qualitative research – to ground the research work in the empirical reality of the interviews, to make sense of phenomena through meanings brought to them by people, as interpreted by the researcher (Groat & Wang, 2013, pp. 218–222).

In Articles III-IV, in which the analysis was likewise qualitative and inductive, the analysis was guided by concepts of tectonics and architectonic quality. The analysis in Articles III-IV was targeted at finding connections between tectonics of logs and architectonic quality. As described in the previous sections 1.4.3 and 1.4.4, literature on tectonics informed the recognizing of aspects related to tectonics of logs, whereas aspects of architectonic quality were recognized through the definition provided by the interviewees themselves. Even though the interview questions in Articles III and IV addressed mainly aspects of tangible properties and requirements of log material and construction, the intangible aspects, such as associations, experiences and mental images brought forth by the material constructions were considered as well in analysing the interviews.

Among others, Brinkman and Kvale (2018, p. 116) have noted that in qualitative interviewing, the first steps of analysis are taken already during the interview. Thus, the initial impressions of the meanings in the participants' answers arose ad hoc during the interviews. Similarly, prior to the actual analysis, I went through the recordings of those interviews that were not conducted by me, to get the initial impressions and made notes of them.

The interviews were transcribed, as was described in detail in the previous three sub-sections. For the breakdown of the total interview data, see Table 6. Transcribing is common when a substantive content of talk is the focus of analysis (Roulston, 2014). After that, the transcriptions were organized so that they could be read as single narratives, i.e., horizontally, but also question per question, i.e., vertically. With Article II, this was done by arranging all the transcriptions in a table format. In the other articles, I used Nvivo computer software. Through several close readings of the material, both horizontally and vertically, codes were gradually formed and further categorized. For this process, Nvivo software was

utilized for Articles I, III and IV; for article II, the table format was utilized to highlight words and excerpts of accounts. Then, through writing up the articles, the final categories and themes of perceptions were finalized.

Table 6. The amount of interview data in the articles.

Article	Amount of audio (h)	Amount of transcriptions (pages)
I	9	120
II	8	146
III	2.5	20
IV	10	115
(Total)	29.5	401

The interviews were conducted and transcribed in Finnish. The Finnish language was preserved when reducing, reorganizing, classifying, and categorizing the data. When moving to writing up the findings, the language was switched to the language of the eventual publication, English. This type of process has been described by Roulston (2014) as practical steps of analysing and representing qualitative interview data.

The results are presented as rich, in-depth descriptions of perceptions of the participants, which is a feature that distinguishes qualitative interviews (Guest et al., 2013a; Roulston & Choi, 2018). While some of the aspects brought forth in the analysis were recurring, some of the aspects were pointed out only by a few or even a single respondent. This is why qualitative inquiry was considered so useful regarding this research topic: it is a fruitful way of 'establishing the *range* of attributes associated with the phenomena of interest', not how common something is (Guest et al., 2013b).

1.5 Dissertation structure

This doctoral dissertation is based on four original journal articles. This compiling part of the dissertation, in which the contributions of the articles are combined, is divided into four chapters.

In this first Chapter, 1 Introduction, I have presented the background, objectives and scope along with the research questions, research approach, as well as research methods and materials of this doctoral dissertation.

In the second Chapter, 2 Theoretical background, I will elaborate the viewpoint of tectonics as a central theoretical perspective of this dissertation. Another central notion for this research is architectonic quality, which is addressed as well. In addition, current literature on experiencing wood in the context of buildings, and log building from cultural and technical standpoints are reviewed, in order to attach this dissertation to existing knowledge.

In Chapter 3, Results, I will present the results from original Articles I-IV, divided into three sections, also answering the three research questions respectively. The first section deals holistically with logs as a phenomenon, and within the framework of tectonics, is related to the experiential level. The second section focuses on the connection between tectonics of logs and architectonic quality. Within the framework of tectonics, the constructional level is addressed. Finally, in the third section I will form a synthesis of the results in the first two sections of results.

The final Chapter 4, Discussion, is divided into four sections. In theoretical implications, I will discuss this research and its results in the light of existing literature from aspects of architectonic quality, experiencing wood in the context of buildings, and logs as part of Finnish culture, along with the theoretical contribution of the overall approach informed by the perspective of tectonics. In practical implications, then, I will discuss the findings in the light of practice, that is, how the findings could be seen to inform and support the development of log architecture and logs, from viewpoints of architects and the log industry. The theoretical and practical implications are followed by a discussion of the reliability and validity of this research. Finally, I will make recommendations for further research that arise from this dissertation.

2 Theoretical background

The theoretical background of this dissertation is composed of three main aspects – 1) architectural theory on a) tectonics and b) architectonic quality, 2) studies on experiencing wood in the context of buildings, from both laypersons' and professionals' viewpoints, and 3) logs in the Finnish context from cultural and technical standpoints.

In this dissertation, tectonics is a fundamental theoretical viewpoint that provides the basis for the theoretical background for the entity that Articles I-IV form, as was shown in Figure 1. In addition, regarding the articles, tectonics served as the theoretical background in Articles III and IV, especially on the constructional level, which I will explain thoroughly in the next section.

Studies on experiencing wood as a building material was reviewed in Articles I and II. This review in a comprehensive form is presented here too, to attach this dissertation to current knowledge. Regarding the framework of tectonics, this, and Articles I-II, are related to the experiential level – that is, how logs and log building are perceived. I will view the experiential level of tectonics as well in detail in the next section along with the above-mentioned constructional level.

Lastly, I will present log building from cultural and technical standpoints in the light of literature and current practice. These constitute the Finnish context in which the interviewees and I as the researcher inevitably view log building currently. The cultural standpoint especially affects how logs are perceived and is thus of relevance within the experiential level of tectonics, while the technical standpoint has more to do with the constructional level of tectonics.

In the next three sections, the three above-mentioned aspects are viewed in detail. These are followed by a section, in which I will form a synthesis of the three aspects, outlining how the aspects are connected as the overall focus within the theoretical background of this dissertation.

2.1 Framework of architectural theory

2.1.1 Tectonics

Kenneth Frampton's Studies in Tectonic culture (1995) is widely held as a seminal work in bringing tectonics back to architectural discourse (Foged & Hvejsel, 2018, p. 144; Huuhka, 2018). According to Frampton (1995, pp. 4–6, 13), the term tectonic was introduced to architectural theory in connection with the archaeological studies of ancient Greece in 1830 by Karl Otfried Müller, and was further developed in the mid-19th century by Karl Bötticher, addressing the core form and art form of the Greek temple; and Gottfried Semper, drawing from vernacular building and thus also from the emerging science of ethnography, addressing the four basic elements of a building: the earthwork, the hearth, the framework, including the roof and, the lighter enclosing membrane. Semper used the term tectonics to describe the procedure of assembling the frame with linear lightweight components to form a spatial entity, whereas he used stereotomics to refer to masonry and earthwork (Frampton, 1995, p. 5). In the extensive introduction to the opus, Frampton draws from the work of abovementioned theorists and several other renowned architects and philosophers when outlining his thorough outlook on the tectonic that he fundamentally views as being the 'poetics of construction', an art that is neither figurative nor abstract and pertaining quintessentially to building (1995, p. 2). Frampton (1995, pp. 1–2) addresses the tectonic from the viewpoint of architectonic space, which he sees – referring to the writings by Cornelis van de Ven – as 'spatio-plastic unity of interior and exterior space'. Frampton highlights that there is

expressive potential in constructional techniques, techniques that necessarily must be applied when forming physical architectural spaces (1995, p. 2).

Frampton goes into great depth when describing how the material architectonic space is experienced bodily by the building occupant, including naturally the visual aspects, but also the acoustic and tactile characteristics of the space, with various other 'nonretinal sensations', and how meanings and values are associated with architecture through experiencing the space (1995, pp. 8–12). Besides materials themselves, the techniques and crafts, primarily weaving, are argued as conveying symbolic meanings (Frampton, 1995, pp. 13–16). In addition, throughout the delineation of the tectonic, Frampton makes several references to architectural implications of aspects such as topography and cultural context in general, and referring to Heidegger's thoughts, also technology's impact on culture (1995, pp. 1–27).

In the scope of tectonics, symbolic aspect is also referred to in connection with constructional logic and how to express it. Frampton makes a distinction between the ontological (constructional) tectonic form, which refers to the fundamental load-bearing structure of a building, and the representational (symbolic) tectonic form, which is a covering, that symbolically elaborates the underlying structure (1995, p. 16). Thus, tectonic portrays the constructional logic and derives its expressivity from constructional details and joints and 'from the statical resistance of constructional form', whereas atectonic masks or does not otherwise visually express the constructional logic (Frampton, 1995, pp. 16–21). It should be noted that interestingly, within the context of log structures, the representational and the ontological can be, and often are, merged.

According to Richard Weston, Frampton's approach is a 'return to reality', following the era of abstract, dematerialized space of early Modernism, Deconstructivism and Postmodernism, and Weston describes tectonic expression to emphasize architecture 'as a material practice grounded in the particular conditions of site, construction and materials.' (Weston, 2008, pp. 186, 190) Thus, even though the viewpoint of tectonics is quite well defined, it is very broad, when focusing on a building as a whole. However, this holistic view is in this dissertation narrowed considerably by focusing on the tectonics of the log construction – not on log building as a whole – and thus excluding other parts of the building from consideration.

When an examination from a tectonic viewpoint is directed to a singular material, as is the case in this dissertation, a closely reminiscent approach is presented in an earlier dissertation. In that earlier work, the central part is in developing a theoretical model for analysing materials in architecture, namely the materiality of another form of solid engineered wood, cross-laminated timber (CLT) (Bejder, 2012, pp. 69–91). Stating that a thorough theoretical model does not exist for the purpose in question, Bejder (2012, pp. 73–75) builds on a thorough review of literature, citing Frampton's above-discussed opus of 1995, some of the same architectural theorists as Frampton and several additional more recent authors.

Bejder's model is divided into three aspects of *technology, material*, and *materiality* (Bejder, 2012, pp. 76–85). The first two cover the tangible aspects of the material – *technology*, the features related to the material's processing; *material*, its inherent properties; and *materiality*, which is related to how the material is perceived (Bejder, 2012, pp. 76–84). There are many similarities in Bejder's (2012, p. 43) aim to clarify the architectural potential of CLT – in terms of 'applicability, spatiality, experiences, perceptions and aesthetics in general' – and the aims of this dissertation regarding understanding contemporary industrial logs as architectural material from the viewpoint of tectonics.

However, while Bejder's research and theoretical model are targeted primarily towards the scientific community and only secondarily towards practice in the architectural field and CLT industry (Bejder, 2012, p. 51), I expect the new knowledge in my dissertation to be of relevance firstly for architectural design, theoretical implications being secondary. While Bejder's model is undoubtedly appropriate considering theoretical needs, for my dissertation I deemed the tectonics as a more open framework focused on tangible aspects and thus is more suitable considering the expected interests of architectural design.

The current research related to tectonics in architecture is based largely in Danish architecture schools, where the background for interest in tectonics is in integrating architectural and engineering

knowledge (Foged & Hvejsel, 2018, p. ix). Danish scholars Foged and Hvejsel, the editors of a comprehensive reader on tectonics, view the notion of tectonics to imply a 'context-dependent bringing together of aesthetics and technique' (2018, p. xi). Recent topics on tectonics in architecture deal with, e.g., sustainability and ecological issues (Bech-Danielsen et al., 2012; Madsen, 2016), emergence of digital design tools (Nilsson, 2013; Reiser & Umemoto, 2006), architectural quality in general (Kristensen, 2016), and contemporary everyday constructions (Beim & Hvejsel, 2016). As in these studies, tectonics is often seen from a theoretical standpoint, but it can refer to a practical approach, as means or a method, as well (Beim, 2004, p. 6; Hvejsel, 2018).

Log constructions are not covered from the viewpoint of tectonics in the current literature. It has been also rare so far that a singular architectural material is studied from the viewpoint of tectonics. However, Huuhka's study of tectonic use of reclaimed timber provides an example of such an approach (Huuhka, 2018). Huuhka has encapsulated Frampton's viewpoint of tectonics aptly in stating that symbolic meanings in architecture, which is a technical craft, 'derive from the way buildings are made, their structural expression and the bodily experience of the material space.' (Huuhka, 2018) Huuhka (2018) highlights the 'nature' of materials, from the viewpoint of tectonics, as it influences the structures that create the architectonic space, which will then be experienced, and lead to symbolic associations. The way in which the material properties affect the physical form of construction is conceived as the practical level of tectonics, while the symbolic level is related to what kind of symbolic associations the material architectonic space evokes (Huuhka, 2018).

Informed by the theoretical background on tectonics as a whole, I make a presumption in this dissertation that constructional technique and its expressive potential have implications for architectonic space and form. I will thus use the viewpoint of tectonics here to limit the scrutiny to concern this interplay. Analogously to Huuhka (2018), I have recognized the implications to occur on two levels, that is, on the practical level, that is in this dissertation referred to as the *constructional level*, and on the symbolic level, that is here referred to as the *experiential level*. The constructional level focuses on recognizing how the use of log construction – material, structure, joints, details, etc. – influences the physical architectonic space. Referring to Bejder's abovementioned work, the aspects of technology and material are considered in this level. The experiential level, on the other hand, focuses on recognizing how the use of log construction influences the holistic experience of material architectonic space, i.e., the perception of log construction, including stated sensations and associations alike. In Bejder's theoretical model, the aspect of materiality can be considered somewhat analogous to the experiential level.

2.1.2 Architectonic quality

As stated previously in 1.2 Aims and scope, it is presupposed in this dissertation that the notion of architectonic[4] quality is a central constituent when forming an understanding of logs as architectural material. Rönn (2017) has argued this type of quality is a key concept in architectural design in a Scandinavian context. Also in the larger European context, European Union member states were urged to promote architectural quality on a political level by the Council Resolution on Architectural Quality in Urban and Rural Environments, that has been adopted by the EU Council (Bento, 2012, pp. 6–9). Moreover, a viewpoint that might reflect the broader understanding of architectural quality as a notion of fundamental importance for architectural design in the Finnish context is the doctoral dissertation by renowned Finnish architect Hennu Kjisik, in which it is argued that the aspect of utmost importance to consider in the design of important public buildings, such as hospitals, is their architectural quality (Kjisik, 2009, p. 12).

However, architectonic, or architectural quality, as it seems to be more commonly referred to in English, is a complex subject, as the stakeholders' preferences and perceptions regarding quality in architecture vary between the public, architects, and

[4] For clarification of the use of the synonyms architectonic and architectural in this dissertation, see 1.2 Objectives and scope.

other professionals (Dewulf & van Meel, 2004; Rönn, 2017). Indeed, the slogan 'all good architecture leaks' pointedly demonstrates that good and poor quality can co-exist in constructions (Hardarson, 2005). Related to this, interestingly, the preconscious evaluative strategies regarding architecture have been found by a study employing fMRI (functional Magnetic Resonance Imaging) of study participants' brain activity to be convergent within a group of architect subjects, but differed from a subject group of non-architects (Nygaard, 2006). Regarding studies on quality in architecture, another issue is that the existing studies are usually 'positivistic', failing to address immaterial, more 'soft' quality aspects, such as beauty and delight, while measuring aspects related to, for example, indoor climate or ergonomics, which might be important, but only narrow variables of quality (Dewulf & van Meel, 2004). This is also recognized by Kjisik, as he views a lot of research touching upon the subject of evidence-based design (EBD) – dealing with 'materials, colours, finishes, furniture, fittings, appliances and decoration, all of them cosmetic aspects that have a lifecycle of a few years at most' – to have 'precious little to do with architectural quality *per se*.' (Kjisik, 2009, p. 104)

What is, then, this concept of architectonic quality, in the sense that it is understood as a key concept of architectural design in the Finnish and Scandinavian context? It is perhaps an indication of a besetting sin in the architectural discipline of not verbalizing its key concepts, that even though 'architectural quality' is mentioned some 30 times throughout Kjisik's 2009 dissertation, its meaning is not once defined. However, Kjisik discusses aspects that define a good building, and perhaps the meaning of architectonic quality is alluded to indirectly:

> *The most important decisions in the physical design of a hospital, as in any other building, are made very early on in the design process. The choice of the site, the urban context, the relationship with the surrounding buildings, structures and landscape, the orientation, the traffic arrangements, the massing of the building parts, the articulation of solids and voids, the interface between the exterior and the interior, the spatial qualities of the interior – are all fundamental aspects that define a good building and determine its potential lifecycle.* (Kjisik, 2009, p. 110)

This might reflect the understanding of architectonic quality by architects more generally, as according to Rönn (2017), architectural professionals in the Nordic countries typically view architectural quality, especially in the early design stages, as an entity of various aspects of functionality, aesthetics, technology, environment and social qualities, united by a holistic architectural idea. Kjisik also admits that 'quantifying' architectural quality is difficult, but perhaps also unnecessary, since he believes that such an 'evidence base that would nail down the absolute truth about architectural quality would be fatal to the development of our culture. If mankind had always based its design decisions on existing evidence only, we would still be living in caves.' (Kjisik, 2009, pp. 110–111) Rönn (2017) too has suggested that architectural quality should be understood as an open concept, needing to be continuously revised through architectural design and research. Nygaard (2006) as well points out that conceptual fixation and semantic precision are not possible for architectonic quality, because as being identified as an 'empty signifier', it can obtain basically any number of meanings, depending on the context and communicative intention.

However, the institutional concept of architectonic quality has proven one suitable definition for research purposes, and it is also used in this dissertation as one definition of architectonic quality, as described in 1.4 Research methods and materials. In short, based on George Dickie's institutional theory of art, Pihlajaniemi (2014, pp. 63–66) has explained the concept as follows: the projects selected and presented in architectural publications are appraised by professional actors in the field of architecture, and thus those projects express quality by institutional conception. The importance of this kind of architectonic quality was evidenced by Pihlajaniemi (2014) by showing that the consumers' appreciation and willingness to pay higher prices for apartments correlated with architectonic quality of apartment buildings.

Lastly, the connection between tectonics and architectonic quality is also evident, as Hvjesel (2018,

p. 396) has pointed out, when describing the development of tectonic theory in architecture:

> *Hence, throughout history, tectonic theory has revolved around the question of outlining the meaningful development of architecture in relation to its physical, technological, and societal context, necessarily also addressing the more general – yet very delicate – question of architectural quality.*

To conclude, then, considering the abovementioned challenges related to the use of the concept of architectonic quality in the academic context, this dissertation delineates the concept of architectonic quality in the specific context of log construction, from the architects' viewpoint, utilizing the perceptions of the study participants. I will address this delineation in the results chapter's section 3.2.

2.2 Studies on experiencing wood in the context of buildings

As I have sought in this dissertation to understand logs as architectural material from the viewpoint of tectonics, as explained in the previous section, the existing perception studies concerning other wood products or wood in general offer relevant perspectives and starting points into logs as well, since logs are a specific subset of wooden construction materials in which the perceptual qualities of wood are well exposed.

While existing studies do not deal with logs specifically, there is an emerging body of literature that deals with the experiential effects of wood and seeks to understand how wooden materials and products are perceived and experienced in the context of buildings, indicating toward some qualities and aspects that logs might possess. Thus, this body of knowledge served as the background for Articles I and II, in which perceptions regarding logs and log building in general were mapped. Regarding the framework of tectonics, this body of knowledge is related to the experiential level. As Article I dealt with laypersons' perceptions, and Article II addressed professional perceptions, the review of the perception studies regarding wood and wooden products that I will present next uses the same division.

2.2.1 Laypersons' views

According to Nyrud et al. (2008), the forest industry can achieve competitive advantages and higher consumer satisfaction if product development is informed by knowledge of consumers' aesthetic and functional requirements. However, the motivation of perception studies regarding wood material is often related to design paradigms that seek to bring health benefits of nature into buildings, such as the restorative environmental design (RED) paradigm. These studies strive to provide information for building designers to make evidence-based design decisions in creating healthful indoor environments (e.g., Burnard & Kutnar, 2015).

One important area of research within the field is the potential psychological benefits of interior wood use, of which Nyrud and Bringslimark (2010) have conducted an extensive review of existing studies. The starting point of their research is in previous research that shows that nature and natural elements are beneficial for human health and well-being when experienced, which is why they see it as relevant to ask whether wood, as a natural material, might have similar effects when used in building interiors' context (Nyrud & Bringslimark, 2010). Possible explanations for this phenomenon include cultural learning (Altman & Chemers, 1984; Tuan, 1990); evolutionary perspectives (Appleton, 1996; Orians, 1986); the biophilia hypothesis, which in this case would mean that humans desire elements of nature, such as wood, in their living environments (Kellert, 2005, 2018; Wilson, 1984); and attention restoration theory (Kaplan & Kaplan, 1989) and psychoevolutionary theory (Ulrich, 1983), both of which assume elements of nature to be something that captures the involuntary attention of humans effortlessly, allowing the capacity of directed attention to rest, leading one to be refreshed by nature (Nyrud & Bringslimark, 2010).

In their review, it is summarized that the outcomes of the reviewed studies can be divided into the following three types of closely related psychological responses; '1) perception of wood, including both visual perception and tactile sensation; 2) attitudes and preferences (aesthetic evaluation) of various wood products; and 3) psychophysiological responses toward wood' (Nyrud & Bringslimark, 2010). As conclusions, it was noted that due to a large

incoherence in the studies' outcome measures, no clear conclusions could be made regarding whether interior wood use is psychologically beneficial, but other similarities were identified, such as that wood materials differ in terms of how they are perceived depending on tree species and physical properties of wood like knottiness, and that wood is perceived as natural and therefore often preferred by laypersons over other materials (Nyrud & Bringslimark, 2010).

In general, Europeans associate wood use especially with interiors and furniture, and consider wood to be natural, healthy, environmentally friendly and to create a cosy and warm atmosphere (Rametsteiner et al., 2007, pp. 11, 18). Strobel et al. (2017) have linked European user perceptions to physical properties of wood, and noticed that colour, grain, and thermal conductivity were the properties that made wood appear cosy and warm. Similar findings have been presented earlier by Masuda (2004), who argued that the long-wavelength light reflected by wood appears as yellow to red hues to humans giving a warm impression and that the more wood surfaces there were in a room, the warmer it was perceived.

Regarding perceived naturalness, its indicators are the wood's grain and scent, and thus engineered wood products with a higher degree of transformation, such as fibreboard, are not perceived as natural due to the absence of grain (Strobel et al., 2017). Similar results have been presented also by Burnard et al. (2017), as solid wood was in their study perceived as more natural compared to specimens of wood-based composites such as oriented strand board (OSB). In terms of industrial lamella logs, these results offer an important viewpoint, as logs' perceived naturalness might be compromised as they are a composite of wood and adhesives, even though the level of processing of logs is much lower than that of OSB or fibreboard.

Even though naturalness is a desired attribute, wood can appear also as excessively natural. According to Nakamura and Kondo (2008), knots as a reminiscence of branches in a tree are evidence of the material's biological origin, but by combining sensory evaluation with tracking of the participants' eye movement, they concluded that many noticeable knots on wood surfaces can provoke negative perceptions. However, it was also found in the same study that noticeable grooves between wall panels to some extent reduce the impact of knotty wood, and thus a desirable natural impression could be achieved by means of design of details, such as appropriate grooves between the wood panels. This too is an interesting link to log construction, as a log wall usually consists of separate logs with visible seams in between.

Decking materials, along with treated or modified wood products are one important focus area within this scope of perception studies about wood products among laypersons (e.g., Fell et al., 2006; Gamache et al., 2017; Vlosky & Shupe, 2002, 2004), as are wooden flooring materials (e.g., Jiménez et al., 2015; Jonsson, 2005; Manuel et al., 2015; Spetic et al., 2007). Here also, Nyrud et al. (2008) found that untreated natural wood characterized by moderate colour intensity and a visually homogenous surface that was defined by attributes of fractures, colour, and size, shape, density, and patterns of knots, was preferred by consumers over decking samples that were chemically modified or were made of wood that was too visually heterogenous. However, it should be noted that as aesthetic experience is affected also by the values embodied in the target of evaluation (e.g., Carlson, 1994), it is possible that, for instance, knottier wood could become more popular in the future, if it was considered to entail some other positive aspects, such as sustainability, as wood of inferior quality is taken into useful purpose.

The appreciation of naturalness is not limited to visual evaluation. In an Austrian study regarding parquet flooring, roughly three quarters of study participants, after touching the samples of oiled parquet, lacquered parquet and laminate flooring with their hand and feet, eyes blindfolded, preferred the oiled parquet due to its natural surface (Berger et al., 2006).

Along with the abovementioned RED paradigm that aims toward very detailed outcomes that could be used in evidence-based design and that focuses mainly on interior use of wood, another related aspect is studies related to perceptions of wood as a construction material more generally (Harju, 2022; Lähtinen et al., 2021; Viholainen et al., 2020). Here also, laypersons' – often referred to as consumers or end-users – views are seen as valuable for professionals to understand and consider when

making decisions about construction materials (Høibø et al., 2015; Viholainen et al., 2021).

In a large study mapping general perceptions of wood as a construction material among citizens of Austria, Denmark, Finland, Germany, Norway, Sweden and the United Kingdom (UK), wood was perceived mostly approvingly, as being aesthetic, natural, warm and associated with indoor environmental quality, tradition and trendiness, but durability-related concerns were also reported, especially in outdoor uses (Viholainen et al., 2021). What is noteworthy is that the differing geographical cultures in the use of wood between the countries noticeably impacted responses, as views from Finland, Norway and Sweden were more positive overall about wood, while responses from other countries were, for example, more worried about deforestation and other negative environmental impacts of exploiting timber resources (Viholainen et al., 2021). Viholainen et al. (2021) suspected some of the differences in perceptions of wood between citizens of different countries could be explained by limited personal experiences of living in wooden houses in other than Nordic countries.

Regarding the impact of building culture background, Høibø et al. (2018) found that there were only minor differences between native and immigrant Norwegians in their preferences for urban building materials, as concrete and steel were preferred over wood, which was not expected given the fact that Norwegians in the study were more used to wooden houses outside cities than immigrants. As an explanation they present material tradition, which means that people tend to prefer materials in the urban environment that they are familiar with in that context.

To sum up, logs seem to be a previously unexamined application of wood in recent studies dealing with layperson perceptions, both in the category of psychological benefits or other implications of interior wood use, as well as in general perceptions regarding wood as a construction material. In this latter category, the studies do not usually separate the exact method of timber construction applied, but often address perceptions toward multi-story wooden buildings (MSWB) (e.g., Karjalainen & Ilgın, 2021, 2022; Lähtinen et al., 2019). It has been suggested by Harju (2022), after conducting a systematic literature review on the perceived quality of wooden building materials, that to improve the accuracy and generalizability of the results, future empirical research could concentrate more on specific wood product categories, especially with load-bearing structures. Similarly, the existing studies in the former category of the RED paradigm do not deal with logs. Instead, they seem to concentrate primarily on aspects of quality of wooden surfaces in general (e.g., Jonsson et al., 2008; Nyrud et al., 2008), and especially as an interior material, whereas logs are a structural material, often visible both inside and outside of a building. Therefore, it has been proposed that future studies could delve into how context and application impact perceptions (Jonsson et al., 2008) as majority of the existing studies are conducted in laboratories, creating a need for field settings as well (Nyrud & Bringslimark, 2010).

All in all, the existing studies indicate that there are many factors that can affect how wood is perceived, and thus it is very context dependent. In addition, one illustrious example of the impact of various associations and beliefs related to wood is that there are discrepancies between the evaluation of different wood species when done by mere name in contrast to physical samples (e.g., Bowe & Bumgardner, 2004; Bumgardner & Bowe, 2002). These aspects are important reasons for the study setting in Articles I and II, where a 1:1 scale log pavilion was exploited in mapping the perceptions holistically, taking into account the effect of culture, field setting, wood material's specific application as well as exterior and structural use, as discussed previously in 1.4 Research methods and materials.

2.2.2 Professionals' views

Laypersons' perceptions seem to be the predominant viewpoint in the studies within the RED paradigm, but according to Viholainen (2021), professionals' views are emphasized in the existing body of research dealing with perceptions of wood as a construction material in general, due to professionals' direct impact on the construction material choice. This is understandable, as a recurring motivation for these studies is for sustainability reasons to identify ways to enhance the acceptance and the adoption of wood in the notoriously path-dependent construction sector that continues to favour the carbon-intensive, but

familiar materials such as concrete and steel (e.g., Hemström et al., 2011; Viholainen et al., 2021). Contrary to this, the motivation in this dissertation for examining logs holistically as a phenomenon in the Finnish context through perceptions among laypersons and professionals, addressed in Articles I-II, is to gain insight into logs as an architectural material, from the viewpoint of the experiential level of tectonics.

As was the case with laypersons, here too the perception studies of wood as a construction material deal to a large extent with residential and other types of MSWB, or in other words, use of wood in multistory construction (WMC) (e.g., Franzini et al., 2018; Gosselin et al., 2017; Hemström et al., 2011; Ilgın et al., 2021), which could be explained by the fact that policy initiatives in various states of European Union, Canada and the United States focus on the development of such larger wooden constructions (Franzini et al., 2018).

The research in this area is also active in the Finnish context. Municipal civil servants in Finland perceived WMC and related building technologies as interesting solutions that could improve urban citizen lifestyles and support local and, more generally, Finnish enterprises and economies (Franzini et al., 2018). However, downsides were also reported, such as the WMC sector's weakness that creates project risks, lack of personal knowledge of WMC and some material limitations of engineered wood products (EWPs), which are utilized in WMC (Franzini et al., 2018). Interestingly, no appearance-related issues were brought up, while these have been previously reported as an issue with log buildings in town areas (Heikkilä, 2002, p. 17; Saarelainen, 1999, p. 10).

In addition to MSWB / WMC, perception studies of wood among architectural and other building industry professionals deal often with EWPs in general (Kuzman et al., 2018; Markström et al., 2018). As EWPs are mostly structural building materials, it seems that while the use of wood as a surface material that has no structural function was a predominant focus in the perception studies among laypersons, the structural use is highlighted among professionals.

Ilgin et al. (2021) have reviewed current literature on perceptions of wood as a structural material in residential buildings from the architects' perspective. They found that in the existing studies from the last 20 years, the most -reported perceived benefits were low environmental impact, aesthetic properties and ease of use and buildings' erection. In addition, structural performance and cost-related issues were considered both as a benefit and hindrance, depending on the study, while properties related to fire and sound insulation along with durability issues and lack of knowledge were considered mainly as limitations of wood (Ilgın et al., 2021).

They also noted that such studies had not been conducted in the Finnish context, and based on the literature review, Ilgin et al. (2021) formed a survey to find out Finnish architects' perceptions of wood's benefits and hindrances compared to concrete in the context of residential WMCs. They concluded that there were no major differences in the Finnish perceptions compared to the reviewed studies in other countries, and that wood's benefits over concrete were its light weight, ecological benefits, localness and low climatical impact, whereas as clear benefits of concrete over wood were highlighted as its familiarity, cost-competitiveness, and fire-safety performance. In addition, the study participants viewed over eight-story residential buildings negatively, regardless of the construction material, but the general attitudes were positive toward residential WMCs up to eight stories (Ilgın et al., 2021).

As was the case with the perception studies about wood among laypersons, logs seem to be a mostly unexamined area among professionals too. In addition, Viholainen et al. (2021) have noted that regarding perceptions of wood, professionals usually highlight economic, environmental, or structural performance, along with other technical qualities, while laypersons' concerns are focused more on wood construction's social aspects, such as tradition, trendiness and indoor environmental quality and occupant health promoted by wood materials. However, while this observation seems to be correct based on the literature review presented here also, it might be that the motivations and research strategies of these studies among laypersons and professionals differ so that it limits the professionals to highlight social aspects and vice versa.

Even though the reviewed literature here served as a theoretical background in Articles I and II, the motivations of these studies and this dissertation are different. While the primary motivation of mapping the general perceptions of logs among laypersons and

professionals in Articles I and II is, in the light of this dissertation, to gain insight into logs as architectural material in terms of the experiential level of tectonics, the wood studies related to the RED paradigm seek to inform building designers in creating healthy indoor environments. The perception studies of wood among architectural and other building industry professionals, on the other hand, aim to find ways to increase the adoption of timber constructions for sustainability reasons.

While the motivation in this dissertation is different, this reviewed research in wood has apparent implications for logs as a specific subset of wood too. Moreover, supporting occupant well-being as well as using solutions with low environmental impact are possible motivations for using logs in architectural design. The review also highlights knowledge gaps and research needs for studies that a) deal with logs particularly, outside the laboratory setting, among both laypersons and professionals, b) map perceptions of laypersons concerning also structural and exterior wood use, and c) map perceptions of professionals so that also other than technical aspects are allowed to emerge.

Next, I will present an overview of mainly Finnish literature dealing with log building, from cultural and technical viewpoints.

2.3 Logs in the Finnish context

As I have discussed earlier in this chapter, the tectonic viewpoint comprehends both the symbolic, experiential level, and tangible, constructional level impacts that construction technique and material have on the architectonic space. In the previous section dealing with studies on experiencing wood material in the context of buildings, it became clear that cultural differences and aspects of material tradition affect how wood is perceived. Thus, the existing literature dealing with log building that is of relevance for this research concerns the cultural aspects related to log building, which in part affect how log building is currently perceived, as well as basic technical principles of log building, the understanding of which forms the basis for the abovementioned constructional level of tectonics. These are presented next.

2.3.1 Cultural significance of log construction in Finland

Wood is said to be one of the oldest building materials, having had an omnipresent relationship with people in various parts of the world from the dawn of humankind to the start of industrialization (Herzog et al., 2012, p. 24). As Herzog et al. point out, prehistoric wood structures were adapted regionally to fit diverse circumstances. In boreal areas of the world and the mountain ranges of Central Europe this led to the development of log building (Vuolle-Apiala, 2012, p. 52). As this research delves into perceptions of logs among Finns, it is relevant to briefly summarize the historical developments of log building from the Finnish viewpoint. This is presented to help in understanding the cultural context through which all the interviewees and I as the researcher responsible of this dissertation, as Finnish individuals inevitably perceive contemporary log building in Finland.

According to Vuolle-Apiala (2012, pp. 6–8), it is assumed that log building in Finland became the primary way of building around 600 CE, but based on archaeological findings, logs had been used in building in Finland already during the Stone Age, first as a low basement for primitive huts, providing shelter and enabling permanent settlement in harsh conditions. In these earliest huts utilizing a rectangular base of a couple of logs high, the roof made of assumably birch bark and split logs reached almost to the ground and was thus the characteristic element in the shape of the building (Kaila, 1996, p. 158). The primitive log structured huts had earth floors and they could have been partly dug inside the ground (Siikanen, 1996, p. 17). Joining of the logs was primitive, done with stone axes, and there was a gap between the overlapping logs, which needed to be filled (Sirelius, 1921, pp. 154–155).

As people started to form more permanent settlement along with development of agriculture, circumstances for the development of buildings enhanced as well (Lindberg, 1940, p. 15). The primitive hut gradually evolved, through pit dwelling and a primitive log cabin used for drying grain, to a chimneyless log cabin, *pirtti* in Finnish (Sirelius, 1921, pp. 168–180). In this building type, the underside of the log in a wall was hewn to match the shape of the

log below, making the log wall more robust and weathertight (Kaila, 1996, p. 158).

According to Kaila (1996, p. 158), Finnish words *pirtti* and *tupa*, both denoting cabin or living room, are linguistically of Slavonic and Germanic origin, respectively, originally meaning 'living spaces with high, joined log walls.' Both this and the fact that the chimneyless log cabin survived as a utilized building typology in the remote areas of Finland until the 19th century (Kaila, 1996, p. 158) are illustrative examples of how closely intertwined the development of log building has been with the development of Finnish culture. This kind of traditional way of house-like log building in Finland in which horizontal logs are fitted and stacked on top of the other and interlocked in the corners with special notching to form simple rectangular rooms, was influenced from its arrival in 7th century onward by building cultures and traditions of several European countries and Russia (Gardberg, 2003). The abovementioned primitive huts as well had been used in Mediterranean countries possibly already when Finland was still under the ice during the Ice Age (Kaila, 1996, p. 158).

The earliest Finnish log structures remaining to this date are from the 15th and 16th centuries; these old constructions can be found in numerous museums covering local history as well as in the countryside in general, where most of the Finnish population have lived traditionally (Vuolle-Apiala, 2012, pp. 8–24).

Jokelainen (2005, pp. 18–33) recognizes three distinct periods in history of Finnish log building, noting that attitudes towards log building have varied between these periods, which also affects the current attitudes towards log building. These three main periods are the period of vernacular builders from arrival of the notching technique in the 7th century until the middle of the 19th century, the turning point of industrialization at the turn of the 19th and 20th centuries and, industrial manufacturing of log buildings from the 1950s onward.

During the period of vernacular builders, log building was viewed approbatively (Jokelainen, 2005, p. 26), which is understandable, as it was the building method used for almost all buildings (Soikkeli & Koiso-Kanttila, 2006). Along with the spread of Christianity to Finland in the 12th century, also churches started to be built out of logs by professional vernacular craftsmen, a development that continued to the 19th century and led to technically sophisticated solutions of markedly large buildings, some of which today are listed as UNESCO world heritage sites (Soikkeli & Koiso-Kanttila, 2006). Kaila (1996, pp. 158–159), on the other hand, divides this period into two phases, making a distinction between the early tradition of chimneyless huts and wooden churches from the 17th century onwards. The example of technical and stylistic features of the latter began then to show in most important buildings of towns, and gradually as the wealth increased, in the buildings of the countryside as well (Vuolle-Apiala, 2012, p. 24).

During the second period described by Jokelainen, the industrialization era, logs began to be considered as outdated, and more "rational" – cheaper, faster and modern – ways of building with less material consumption were favoured, apparently at least from the architectural and building industry professionals' perspective (Kaila, 1996, p. 160). However, Jokelainen (2005, pp. 28–30) notes that during this era, the status of log building was two-fold, due to the architectural stylistic period of national romanticism, which had a notable impact on how log building today is perceived. In the context of national romanticism, log building was appreciated and used to build several wilderness ateliers for famous Finnish artists, such as Pekka Halonen, Akseli Gallen-Kallela and Jean Sibelius, which later have served as museums. What is noteworthy, is that the overhang corners used in many vernacular buildings and buildings of national romanticism were considered rustic, and therefore even forbidden in many towns already in the 19th century, while flush corners, resembling those of brick buildings, were considered appropriate for town houses (Kaila, 1996, pp. 159–160).

The use of logs as primary building material in Finland faded away along with the rise of industrialization by the 1930s (Heikkilä, 2006). In the 1940s, logs were used to build mainly secondary buildings, such as sauna huts (Heikkilä, 2002, p. 15). According to Jokelainen (2005, p. 12), in these buildings the notching and other structural solutions have been rudimentary and simplified, and based on these practices, the industrial production of log houses was born in the 1950s. Industrial production has since marginalized hand-hewn log houses.

Over the next decades, the manufacturing techniques evolved, and by the end of the millennium,

industrial logs had become a high-quality product of engineered wood that is precise in dimensions (Heikkilä, 2002, pp. 15–17). During these decades, however, it could be said that the appearance of industrial log buildings did not evolve to a same degree as the technical aspects did. Heikkilä (2002, p. 15) describes that the appearance of the log houses of this period was influenced by the ideals of national romanticism, but flattened to match the requirements of manufacturing and other business-related demands. Professional designers were rarely used, and the industrial log houses served predominantly as holiday homes or single-family houses in sparsely populated areas (Heikkilä, 2002, p. 17). The fact that log building did not end completely, and rather evolved to an industrial practice, indicates that as part of Finnish culture, log construction has had also economic significance for Finns.

In the 1990s, the commercial demand for industrial log houses expanded to single-family houses in detailed planned areas with genuineness, cosiness, and healthiness as the main drivers for customers (Heikkilä, 2002, p. 17). However, due to the status of log building at the time, builders faced difficulties on behalf of the planning authority, who deemed log buildings unsuitable, by their appearance, for towns and other detailed planned areas (Heikkilä, 2002, p. 17; Saarelainen, 1999, p. 10). According to Heikkilä (2002, p. 17), architectural and other design professionals in general disliked the use of logs and the quality of architectural design of log houses had therefore fallen behind compared to contemporary wood architecture in general. Thus, in the end of the 1990s, log house manufacturers started to develop house models that would be approved for the town milieus as well (Heikkilä, 2002, p. 17). Architectural development of such house models was at the time also the objective in the University of Oulu's project, Log in the Urban Milieu (Heikkilä, 2001, p. 5). One solution offered by the industry at the time was house models that resembled regular clad timber houses. Heikkilä contemplates whether the right direction would instead be to develop houses suitable for a townscape that utilize an unclad log structure (2002, p. 17). This reveals illustratively the dilemma that log building in detailed planned areas poses, at least from the viewpoint of professionals of architectural design: there is a desire for genuine unclad log architecture, but at the same time, unclad log structures have historically led to associations of wilderness romanticism and rustic appearance considered unsuitable for such areas.

Now, after two decades, it seems that log building was indeed then on the verge of a renaissance, as Heikkilä (2002, p. 17) anticipated. In the final report of the Modern Log City research project, Heikkilä evaluates the current situation of log building, in the light of the conclusions of the abovementioned, earlier project Log in the Urban Milieu, and notes that regarding single-family houses suitable for detailed planned areas, today, log house manufacturers offer a variety of options (Lakkala & Pihlajaniemi, 2019, pp. 17–20). Heikkilä continues however, that the use of log construction in the first two decades of 2000s has focused mainly on single-family houses. The use of logs in larger-scale residential and public buildings is today desired as well. As there are few examples of such log buildings in the contemporary context, architectural professionals and the log industry are faced with questions like those two decades ago concerning the single-family houses – that is: How should log architecture for these novel contexts and uses be developed? As I pointed out in the introduction of this dissertation, this is a discussion that constitutes an important part of the motivation for this dissertation.

Next, I will outline the basic principles and recent developments of logs and log building in Finland from the technical viewpoint.

2.3.2 Log construction from a technical perspective

Jokelainen (2005, p. 20) notes, in the beginning of the 2000s, that log building in its current form is understood generally as horizontal log construction, *lamasalvostekniikka* in Finnish, characterized by notching, that is, the corner joints, and long groove or long notch on the underside of logs, through which the parallel logs on top of each other are tightly fitted together. Parallel logs are joined together with wooden pegs or steel screws (Heikkilä, 2002, pp. 21–23; Siikanen, 1996, p. 232). This way log walls form rigid plates so that they can be used as shear walls (Herzog et al., 2012, p. 127). By joining logs together by doweling, it is also possible to form higher beam

structures out of logs in buildings (Rakennustieto, 2014).

The corner joints are the most important part of a log building regarding its structural strength, and these joints can be either extending or flush on the exterior. Round notching, pictured in Figure 5, in which the log ends are extended in the exteriors, is the most primitive type of corner joint. Over the centuries, corner joints evolved to overcome problems related to, for example, longevity and tightness, which led to development of the flush corners. Examples of these are shown in Figure 5 as well. Although the purpose of corner joints is primarily structural, cornering also became a distinctive decorative motif in log buildings. (Phleps, 1982, pp. 52, 60; Siikanen, 1996, pp. 229–230)

Through advancements in building traditions and practices, the cross-section shapes of logs evolved a great deal from original round to rectangular, with various others in between (Phleps, 1982, pp. 55–56). Hewing or sawing the exterior of a log wall flush makes it more durable against the weather by exposing the more weather resistant heartwood (Heikkilä, 2002, p. 11). Naturally this has implications for the looks of a log building as well, as Kaila (1996, p. 158) notes, stating that the practice of hewing the exteriors of log walls became common throughout Finland only in the 18th century. Historically, flush log walls have also been covered with paper in the interiors and with siding on the facades, both to embellish the building and to make it more draughtproof (Kaila, 1996, pp. 158–159).

As for these age-old characteristics of log building, they have remained relevant for today's log building as well. Renowned Swiss architect Peter Zumthor describes how in his home region – which was assumably among the origins of the influences for log building in Finland as well – log houses are called 'strickbauten', meaning knitted houses in English (Zumthor, 2006, p. 10). As the expression connotes, in log buildings the beams of wood are knitted, put together by notching in corners, to make a whole. Zumthor also notes that for the log walls to retain their function as structural elements of construction, the sizes of the openings are limited. In addition, the shrinking of the horizontal logs, causing the log walls to lose height over time, that is, settling, is highlighted

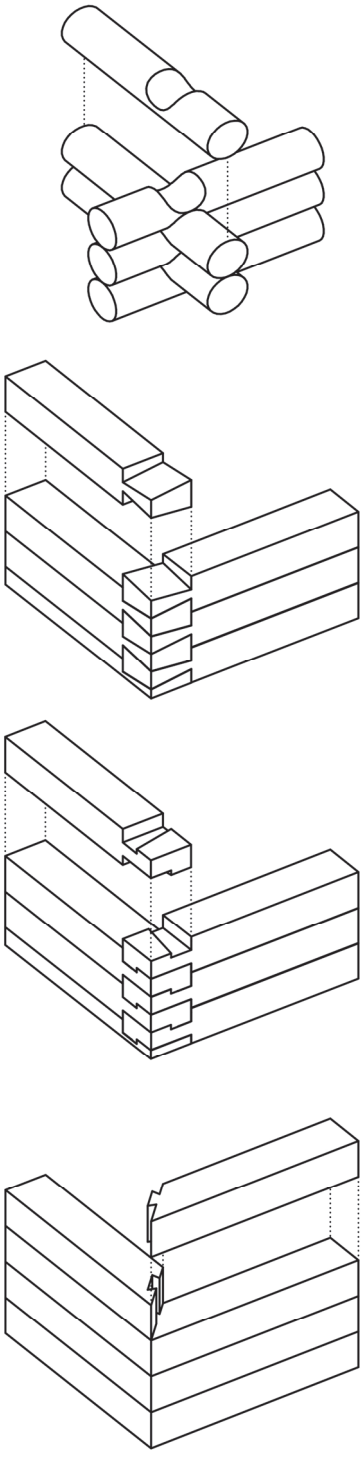

Fig. 5. Schematic drawings of different types of corner joints. The first one from the top is the oldest type of round notching. Turned upside down, it becomes more durable against the weather. Second from the top is a dovetail corner, of which there exists also industrial adaptations. The third one from the top is one form of a cogged notch, which is another example of flush notching that creates a decorative motif. On the bottom there is a mitre-cut corner joint, a development of industrial production of the 2000s.

by Zumthor (2006, p. 11). [5] When adding the 'elemental and expressive' effect of the log walls' corner joints, and that the length of the available timber generates a scale of intimacy for the architectonic space, Zumthor (2006, p. 11) illustratively analyses the technical aspects of log building that have been traditionally and still are considered fundamental from an architect's perspective.

However, industrial manufacturing of logs has made some of these aspects ambiguous. Today's industrial logs consist typically of multiple parallel or cross lamellas of kiln dried wood, pine or spruce, joined together by glue (Sinkko et al., 2019). The gluing means that the size of the logs is not dependent on the available natural timber, but rather on the capacity of the production lines and limitations of transportation. In addition, the fact that logs today consist also of cross lamellas of wood means that houses built with such logs lose height only a fraction compared to what log buildings have done until recently due to settling. These logs that are made by gluing crossing lamellas of wood are typically called non-settling logs (see Figure 6) and they closely resemble CLT by composition. In Figure 6 it is also illustrated that in industrial logs there are tongues and grooves to make the log wall airtight. Non-settling log structure can, however, consist of only horizontal wood as well. A recent standard states that a non-settling log structure should lose height a maximum of two millimetres per metre (Finnish Standards Association SFS, 2022), while traditionally settling means that the change in the vertical dimension of a log wall is one to five centimetres per metre (Siikanen, 1996, pp. 234–235).

The gluing of logs is a relatively recent development, which became common in the 1980s in Finland (Saarelainen, 1993, p. 48). However, the non-settling logs were not introduced in Finland until the beginning of the 2000s. When interviewed about the current situation of the Finnish log industry, managing directors of the companies stated that the fact that non-settling logs have become common has been one of the biggest changes in the industry during the last three years (Lakkala & Pihlajaniemi, 2019, p. 184).

Fig. 6. Cross-sections (275mm x 205mm) of a traditional, settling lamella log (left) and a non-settling log. Logs become "non-settling", when they are glued together from crossing lamellas, since inside the log, there is vertical wood, which nearly eliminates the shrinkage of the log in a vertical direction. Image: Kontio Log Houses. (Published with permission)

It is clear that the technical viewpoint is intertwined with the cultural viewpoint. Technical developments are often motivated by changes in culture. Indeed, Heikkilä (2001, pp. 53–57), for instance, highlights elegant junction details on how to join windows and other non-settling structures to a settling log structure, as means to develop log architecture. The non-settling log naturally solves these issues by eliminating the settling.

Besides the manufacturing process and the composition of single logs, also the shape of a log's cross-section has evolved. According to 18th century standards, six-inch-wide logs were considered adequate, and the caulking gap between the logs to make the seam tight needed to be four inches wide (Kaila, 1996, p. 158). This caused a visible bevel of approximately one inch on both sides of the logs' seams. Before the industrial production and gluing, a log's height had been predetermined by the trees' diameter. At the turn of the 2000s, Heikkilä (2001, p. 55) noted that the cross-section profile of single logs had not been developed, and the visible seam between the logs could be made smaller, to make log constructions more suitable for town milieus. Based on the illustrations, around that time, industrial logs had a quite large bevel of just about one inch in size, perhaps because of the examples of the past centuries. This need for development mentioned by Heikkilä has

[5] Wood is a hygroscopic material. This means that it will gain or lose moisture from and to the air. When the wood dries, it also shrinks. (Meier, 2016) Wood is also an anisotropic material, which causes the shrinkage of wood to be considerably stronger in the direction perpendicular to the grain (Thibaut et al., 2001). The shrinkage together with tightening of seams causes settling.

also been fulfilled today, as the log industry in Finland has started to offer logs with minimal bevels.

Another development idea presented by Heikkilä (2001, p. 55) was an industrial corner type that is flush, a feature that was required in many towns in Finland already in the 19th century, as mentioned earlier. This aspect is also resolved today, with industrial dovetail and mitre-cut corners as shown in Figure 5 on the previous page. The mitre-cut corner is fundamentally different compared to all the earlier corner types since with it, the courses of logs are even, instead of the traditional offset of half a log. Moreover, the corner joint is not visible in the finished wall structure.

Next, I will outline a synthesis of the theoretical background presented in this chapter.

2.4 Synthesis of the aspects of theoretical background

Based on the three aspects of theoretical background of this dissertation presented above, I will here form a synthesis of these, outlining how the aspects are connected as the overall focus of this research within the theoretical background. This is illustrated in Figure 7 on the following page, and further elaborated below.

The aim of this dissertation, which is to form a current, in-depth understanding of contemporary industrial logs as architectural material from the viewpoint of tectonics, necessitates obviously the theoretical background to address the concept of tectonics in architecture, which also connects the other aspects of existing literature that I have discussed in this chapter. All three aspects of the theoretical background of this dissertation are 1) architectural theory dealing with tectonics, and architectonic quality; 2) studies on experiencing wood in the context of building, entailing viewpoints of laypersons and professionals; and 3) logs in the Finnish context, viewed from cultural and technical standpoints.

Based on existing literature, tectonics is in this dissertation seen to deal with the impacts of constructional technique and its expressive potential for architectonic space, an entity of interior and exterior space constituting a form. The impacts are understood to take place a) on an *experiential level*, focusing on recognizing how the use of log construction influences the holistic experience of material architectonic space, i.e., the perception of log construction, including stated sensations and associations alike, and b) on a *constructional level*, which focuses on recognizing how the use of log construction – material, structure, joints, details, etc. – influences the physical architectonic space. Throughout this dissertation, I condense this holistic interplay between logs and the resulting architectonic space as tectonics of logs.

The other aspect of architectural theory, that is, architectonic quality, is considered in this dissertation as a fundamentally important aspect of architectural design, and it is thus needed when forming an understanding of logs as architectural material, to understand how logs could be utilized in architecture to achieve this overall aim of architectonic quality. As central notions in architectural theory, tectonics and architectonic quality are intertwined, which is another reason why this dissertation examines how the tectonics of logs contribute to architectonic quality.

The existing literature on experiencing wood in the context of buildings constitutes the starting point for understanding logs as architectural material from the viewpoint of tectonics on the experiential level, by indicating toward some qualities and aspects logs might possess, even though the existing literature does not deal specifically with logs. In addition, as the bodily experience of architectonic space is in a central role in tectonics, the literature on experiencing wood offers explanations for why wood is experienced in certain ways.

Delving into the aspect of log building from a cultural viewpoint is motivated also by the background of tectonics, in terms of the experiential level, as well as by the abovementioned literature on experiencing wood in the context of buildings, which both highlight the impact of cultural background for the perception of a material. Thus, historical developments of log building from the Finnish viewpoint are explored, to understand the cultural context through which all the interviewees and I as the researcher of this dissertation, as Finnish individuals, inevitably perceive contemporary log building in Finland. The aspect of log building from the technical viewpoint, on the other hand, presents the basic technical principles of log building, as well as the technical developments of log construction in Finland.

These form the basis for understanding logs as an architectural material from the viewpoint of tectonics, on the constructional level.

In the following Chapter 3, I will present the results from the original Articles I-IV. In the final section of the chapter, I will form an understanding of contemporary industrial logs as architectural material, based on the synthesis of the results in all the articles, from the viewpoint of tectonics, as outlined in this section.

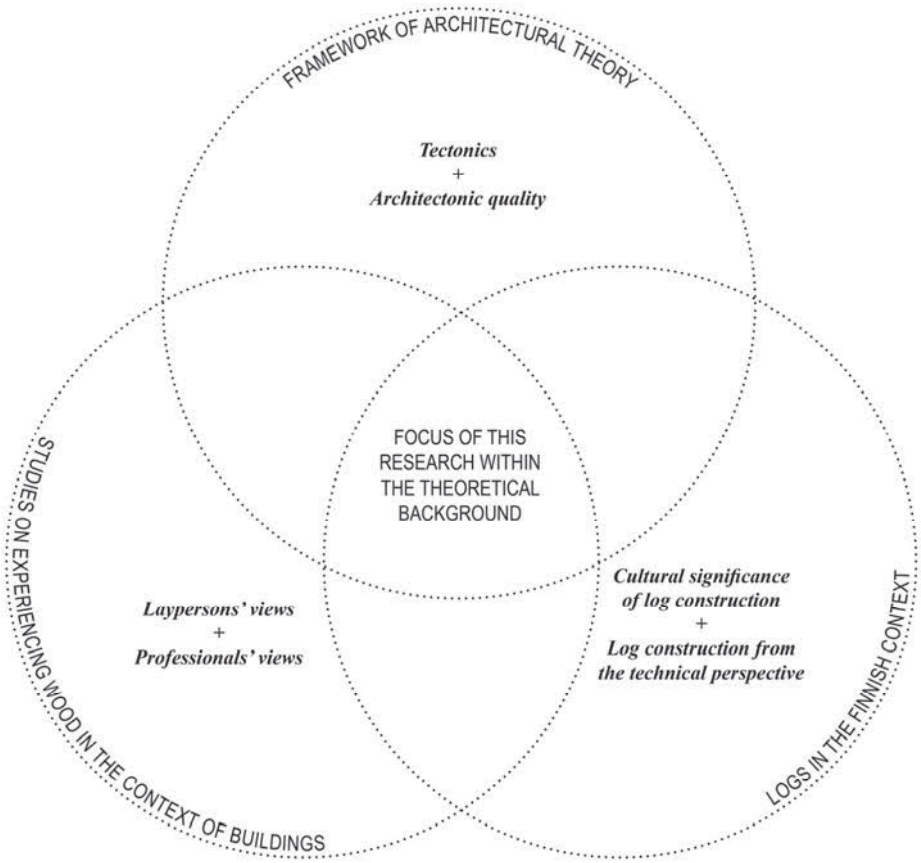

Fig. 7. The three main aspects of the theoretical background in this dissertation are combined in the focus of this research within the theoretical background.

3 Results

In this chapter, I will present the research results from original Articles I-IV. In the following three sections, I will answer the corresponding three research questions of my dissertation. The first two sections are divided into two sub-sections, each one describing the findings in Articles I-IV accordingly. The third research question is answered in the third section, in which I will form a synthesis of the results of the first two sections.

3.1 Logs as a phenomenon

In this first section of the results, I will address the Finnish perceptions of the log as an architectural material, and as a phenomenon in general, describing the results for research question Q1, a and b: *What kind of perceptions of the log as a material currently exist among individual Finnish laypersons (a) and architectural and construction professionals (b)?* Regarding the framework of tectonics, this section is related to the experiential level (See sub-sections 1.2 Objectives and scope, and 2.1.1 Tectonics).

3.1.1 Laypersons' perceptions

Article I provides the answer for Q1a. Next, I will present these perceptions among individual Finnish laypersons, divided into three thematical categories, followed by a summarizing paragraph of the results. The thematical categories are:

- *Emerging, topical, and trendy*
- *Traditional in the rural, novel in the urban context*
- *The "log-ness" of (glued) logs.*

Emerging, topical, and trendy

The interviewees in Article I viewed the current image of log building to be very positive in general. Log was described as currently highly topical, emerging, and trendy. An important reason for the trendiness and positive image was the perceived health benefits. In earlier studies, health benefits associated with the use of wood in construction were often related to perception of wood as a natural material, which then caused a positive psychological response among building occupants (Nyrud & Bringslimark, 2010). However, the perceived health benefits of log construction were mostly related to respondents considering log buildings to be safe against indoor air problems. Many of the respondents referred to the Finnish public discussion related to indoor air problems of various buildings and logs' reputation as a solution for these problems.

However, few of the participants were able to elaborate on why log would be a good solution for indoor air problems. As one explanation for the healthiness, logs' "ability to breathe" was brought up several times. In Finnish discourse, this popular term is often connected with log buildings. A common misconception of this term – which appeared in the participants' responses as well – is that the log wall is not airtight, and thus "breathes". In fact, breathability refers to the hygroscopic properties of wood, which means that a log wall has the ability to absorb and release moisture, and thus regulate the indoor humidity (e.g., Herzog et al., 2012, p. 33; Ojanen, 2016).

Participants' views related both to the healthiness and trendiness of log were many times connected with novel Finnish examples of public log buildings, such as the log school campus of Pudasjärvi (see e.g., Dejtiar, 2017). The campus, which is arguably the most famous instance of recent public log buildings in Finland, was highlighted repeatedly as a positive

example by the participants. In Pudasjärvi, the indoor air problems in existing school buildings resulted in demolishing the old schools and erection of the new log-structured school (Lukkaroinen, 2016). Thus, a connection between the sense of trendiness, perceived healthiness and recent public log buildings might currently exist. One interviewee was even under the impression that nowadays a log-structured alternative is always considered when a new school building is needed.

Participants viewed log also as a long-lasting and robust material. It was considered as durable in general and against the weather. These aspects were mentioned intuitively by many respondents when asked to describe logs in general. In the participants' views, the positive image of log consisted also of the perceived traditionality and association of the log with the 'good old days' (S6).

Log was perceived as a renewable material, and therefore sustainable. However, the perceived sustainability was not unconditional. Many of the respondents pointed out the importance of the correct management of forests:

> *I guess we cannot fell all of our forests and make something of them (SM6).*

Additionally, in the Finnish context, log was viewed as a local material. The locality aspect was connected with the perceived sustainability as well, as it was noted by one participant that shipping of the Finnish logs to remote locations might represent a sustainability issue.

Along with the renewability, the recyclability of logs was also mentioned. The respondents had personal experience with the traditional procedure of moving log buildings by dissembling and rebuilding the log structure. These views serve as a demonstration that cultural history affects how logs are perceived currently.

In addition, the positively perceived image was fostered by the participants' views of logs as a valuable and elegant subset of wooden construction materials. Further positive qualities that the participants cited when describing logs included fragrant, beautiful in general and a good acoustic environment that is created using logs. Some participants believed that often a sense of uniqueness is sought when building with logs, and that log itself can be actually seen as fostering a certain image, due to the values that logs currently express.

Besides being local and therefore sustainable, log was viewed as an especially Finnish material. In the light of the Finnish cultural history of log building, it is not surprising that log was associated closely with the Finnish forest and nature in general, as well as stated to belong to the Finnish national imagery.

Nature and naturalness were connected with log building in a positive manner. One view that was related to the concept of biophilia (see e.g., Kellert, 2018) was that log walls could satisfy a longing for nature and the forest, which might be experienced by Finns as their environment becomes more urban. Contrary to some other materials, such as concrete, log was seen as a biological, not human-made material, that is not living but nevertheless has a sense of livingness in it, even when used in a building.

Warmth was an attribute that was repeatedly associated with logs. Although physical warmth and good insulation were mentioned too, the concept of warmth appeared mainly in connection with a warm atmosphere and cosiness, that is, an experience of "psychological warmth". The experience of cosiness was explained also with positive memories of log cottages during childhood.

Overall, log was viewed as a soothing material, which was encapsulated well in a participant's description of the experience when visiting the Pudasjärvi log campus:

> *It is a totally fantastic feeling to be inside the building [Pudasjärvi log campus]. The atmosphere somehow exudes the ability to breathe and warmth. I felt very peaceful there (SM6).*

For the sake of these attributes that were viewed as pleasant, a respondent portrayed log as a particularly 'humane material' (SM1).

Traditional in the rural, novel in the urban context

Log building was associated strongly with various types of rural environments, as building with logs was perceived to have long traditions in such environments. Log buildings were seen as especially suitable in several non-urban milieus, where the

participants viewed log buildings to be typically located. In addition to a rural village or farmland, the desired surroundings for a Finn's summer cottage, such as forests and lakeshores, were seen as especially suitable places for log buildings.

The conception of log as a rural material by tradition was related also to the fact that participants had few experiences of log buildings in the urban context. Thus, the ruralness of log could be seen also as a prevalent mental image, as one participant noted that his life had so far occurred in an urban area, and that he could not describe what a log building in the countryside looks like.

Although the study participants were unanimous in their perception of the rarity of log buildings in the urban context, some of them had observed log-structured detached houses under construction in their neighbourhoods. In addition, many of the participants were familiar with the Pudasjärvi log campus, which was portrayed in a positive light as a contemporary log building in an environment atypical for log buildings situated somewhere in between urban and rural.

The large scale of urban buildings was also one reason why log buildings were stated to better suit less densely built rural areas. Log buildings were associated with a relatively small scale, while urban buildings, such as blocks of flats, were contrasted with a large scale. The main reason that some participants expressed scepticism towards large-scale log buildings and the density in cities, was the combustibility of wood.

In general, the study participants were doubtful of log buildings' suitability in the city. Log buildings were stated to look odd among existing stone and concrete buildings. A few participants contemplated that if an entire block of log buildings would be constructed, the suitability would be better. Some were of the opinion that they would prefer some natural surroundings for log buildings even in the urban context. When visiting the Timber-Tetris pavilion during the interviews, many of the participants deemed the elements of forest, such as brushes and pines that surround the pavilion, amusing even though the amount of these elements was quite small.

Based on the interviews, it was evident that estimating the suitability of log buildings in the urban context was very difficult because of the lack of examples. This challenge was encapsulated aptly by one participant, who stated that she would wish to see log buildings in cities, but:

> *I do not know if Valkea[6], for example, was built out of logs – what would it be like then (SM3)?*

The presumption in this dissertation is that currently, forming an answer to this highly relevant question would be difficult even for experts in the field of built environments, such as architects, which highlights the importance of this research.

Despite the abovementioned challenges related to the use of logs in the urban context, several participants expressed a desire to see more log buildings in such an environment. It was seen as something novel to use log in the urban environment. Log buildings were expected to look distinctive compared to existing buildings and thus the increase of log buildings was stated to be refreshing in general, from the cityscape viewpoint. Even though the participants felt that log would be perceived as a rather odd material in urban settings, the public would welcome log buildings there, due to the reputation of log as a healthy and ecological material. In addition, one participant stated that values like naturalness and sustainability are disclosed visually by using log and suspected that log would distinguish itself in the urban context, due to its current rareness.

When discussing the suitability of log in buildings with different public uses, schools were often mentioned as a good fit. Additionally, day care centres, nursing homes and buildings for assisted living were perceived as well-suited applications for log building. A participant felt that log is especially suitable for buildings that emphasize humaneness, and asked:

> *What better material would there be for building for example a library than log (SM10)?*

It could be that the appearance of precisely these building types in the participants' responses is related to seen examples. There are recent examples of especially log-structured schools and day care centres in Finland, but also of the other abovementioned types, excluding the library.

[6] A large shopping centre in the city centre of Oulu.

Compared to picturing logs in the urban environment in general, picturing a log surface in public indoor spaces seemed to be easier for the participants. Thus, it would be relevant to ask whether log buildings should even look like log buildings on the exteriors. It was noted by a participant who deemed log buildings as potentially suitable for cities, that log buildings could, for example, have brick facades if the suitability for the milieu required it. Additionally, one participant was aware that the exterior appearance of some contemporary log houses can be actually quite similar to houses with mere wooden cladding. This referred to log houses where the log building technique is not revealed due to the cross-section profiles of logs resembling façade boards, and hidden corner joints enabling the layers of logs to be even, instead of half-lapping, as traditionally.

The "log-ness" of (glued) logs

The concept of log building and log as a term were very familiar among the interviewees, as they most likely are among Finns in general. The interviewees initially described log as a sturdy, thick piece of natural wood. Additionally, log was described as a very little processed, cut down tree to be used in building. Thus, the interviewees' initial associations of logs were closer to the traditional log consisting of a single tree trunk than industrial glued logs, despite the fact that almost all contemporary log buildings are built with glued logs. This is an indication that traditional log building is a well-known part of the history of Finnish culture, as the current prevalent practice of log building was less familiar for the interviewees. Some participants recognized the current dichotomy in log building, stating that along with the old buildings and traditional logs, also a separate mental image of current buildings with industrial logs arose related to logs in general.

The two-part interview enabled a closer scrutiny of the abovementioned dichotomy, as the first part of the interview focused on mental images, while the industrial glued logs were discussed in detail when evaluating the pavilion in the second part. The aim was to understand the differences between these two: the somewhat idealised mental image and current practice of log building; and additionally, what are the defining attributes that justify the contemporary glued logs to be still perceived as log – a material associated with so many benefits?

Participants noted that logs are used in walls, forming a robust wooden structure, and that with logs an entire house can be built, logs being therefore something other than a mere surface material with no structural function. Thus, the construction method, the way of building, was one definitive attribute of logs and log building for the participants. The log construction was stated to resemble a puzzle or Lego block building. The fact that log building seems to be assembled without fasteners, holding together because of corner joints, was also mentioned as a characteristic feature. The participants stated that corner joints are pleasant and interesting in general, since the corner joints showcase the technique of log building, in which the structure is built log by log. These views were first taken up in the first part of the interview, but they reappeared as more nuanced when evaluating the pavilion construct (see Figure 8 on the following page).

When it comes to individual logs, thickness emerged as an important attribute of the log-ness. When evaluating the logs of the pavilion, several participants described the logs as being thicker in their minds. In general, the participants still deemed the utilized wooden beams as logs. However, according to the participants, if they had been thinner, they could no longer be referred to as logs as they would resemble more timber planks. Additionally, a participant perceived the structure to be solid and firm as it is but noted that it could feel too shaky and weak to be log if the log walls were thinner.

The cross-section profile used in the logs of the pavilion was perceived as positive in general. It was noted that different shapes of the cross-section profile also exist, such as round or square. However, one participant felt that log should be a more natural round log. Additionally, another interviewee felt that the logs used in the pavilion were totally unnatural and therefore unacceptable for him to be regarded as logs:

> *Their shape is unnatural, the proportions are unnatural, it is ridiculously planed (SM2)*

On the contrary, some participants would have preferred an even smoother surface for the logs.

For the participants, the adhesive was the most crucial attribute separating the traditional log and the glued industrial log. A few participants did not consider glued logs to be real logs. The main concern towards the adhesive was its effect on the logs' breathability and healthiness in general, which were perceived earlier to be positive attributes affecting logs' desirability. Indeed, the glue and its potentially negative impact on indoor air was formed as a decisive attribute for the log-ness of glued logs:

> *If the lamella-log house is as risk-free as a natural log house, then it can be called log building (SM10).*

One respondent brought up experiences with a plastic mat where the glue had reacted with the moist concrete slab resulting in indoor air problems and wondered if similar issues could occur with glued logs as well.

However, also opposite views emerged. One respondent reasoned this based on the actual composition of the logs:

> *Ninety-nine point something is after all wood, so I still consider it as log, even though it is composed of multiple pieces of wood (SM5).*

Some participants considered the glued logs as the result of natural, inevitable, and even desirable development of logs. This view was aptly encapsulated by one participant when describing glued log an ancient building material that has been modernized.

Summarizing the results from Article I

The first observation that should be highlighted from the results in Article I is the connection between desirability and trendiness of log and its perceived healthiness. Healthiness was even perceived as a definitive attribute for the log-ness of glued log, as described previously. This connection is also visible in some of the recent public log buildings. In the case of Pudasjärvi, existing school buildings were replaced by log-structured school buildings, since it was deemed by the municipality as a good solution to overcome the indoor air problems in the existing schools (Lukkaroinen, 2016). Thus, the perceived healthiness seems to be crucial for the desirability of log. In addition, among participants, the perceived trendiness of log was associated with recently built public log buildings, such as the Pudasjärvi log school

Fig. 8. The aspects of the Timber Tetris pavilion in Oulu brought up in this thematical category, such as the log construction method, corner joints and details of single logs are here well illustrated. Photo by the author.

campus. As the log school campus was repeatedly highlighted in a positive manner in the participants' responses, it could be also argued that the seminal example of public buildings has efficiently disseminated log's reputation as a healthy material for the public. The second observation is that there are existing and emerging positive aspects, or even stereotypes, related to log building, which are challenging the rather negative ones, such as ruralness. Also, some stereotypes that have been negative before are turning into positive ones. For example, in the beginning of industrialization, logs were abandoned due to their overly traditional image, as pointed out in the theoretical background chapter. However, traditionality and "good old days" were now associated positively with logs – although contemporary log is technically quite a different material compared to "traditional" logs. In addition, the perceived sustainability, because of the renewability of wood, was one positive aspect, but possibly a stereotype as well if it is accepted unconditionally. Healthiness is also a crucial stereotype related to logs, which is fostered by the public buildings, as described above. Regarding the laypersons' perceptions, the results indicated that these current aspects and stereotypes are possibly able to overcome the established understanding of logs as a material of old and rural buildings.

A final summarizing observation is that the visibility of the log structure was considered meaningful in various ways by the participants. The defining attributes of logs among the participants were mostly wooden, solid composition, longitudinal shape, and the construction method itself. It was interesting, pleasant, and soothing for the participants that the log construction technique is a transparent, understandable way of building, which one can approve at one glance. It was stated that the key values related to logs, such as healthiness and sustainability, are disclosed visually with the visible log structure. The understandability of log structures is thus in a key role in the perceived healthiness.

3.1.2 Architectural and construction professionals' perceptions

Next, I will present the results of Article II, answering Q1b. Like in the previous sub-section answering Q1a, also here I have divided the results, dealing with perceptions of log among individual Finnish architectural and construction professionals, into thematical categories. There are four of these categories:

- *Both traditional and contemporary*
- *Predominantly rural, but potential for urbanity*
- *Purity and non-purity*
- *Both natural and industrial*

After these, a summarizing paragraph of the results in these thematical categories is presented.

Overall, the materials gathered with the semi-structured interviews demonstrated that studying the perceptions of logs and log buildings among these professionals is relevant. This was evident since the mental images these professionals had were very strong, yet they had relatively little experience with log building, excluding the log industry representatives.

Both traditional and contemporary

Log was evidently viewed as a very traditional material by the participants. This view was also expressed when describing what kind of log would ideally be desirable for them, in statements like:

> *Ideally, I would like it to be traditional log, solid wood (O1).*

> *A hand carved log is a genuine log to me, it's one piece of wood and made by hand (O2).*

On the contrary, instead of the composition of logs, rather the longitudinal shape was emphasized by the participants within the log industry. This seems understandable as the glued log is the prevailing product of the log industry, and thus this definition matches their experiences in real life. The perceptions of the participants other than those representing the log industry can be interpreted as being more idealized, since, as mentioned above, experience with professional log use was rare among them. Along with the composition and shape, some of the participants highlighted the stacking of the logs, one on top of the other, in log walls. Thus, there were three

requirements for log to be perceived as log: material composition, and distinctive shape and usage.

Log was also viewed as a 'tried and tested' (D2) material that has been used for millennia in vernacular building. The homogeneity of logs was connected with this reliability, as it was seen both as a healthy and topical, even trendy attribute. It was very clear for one of the interviewed officials that the primary reason for the topicality of log is that people desire 'buildings they can understand' (O4). This link between the trends of contemporary architecture and ancient building techniques might very well be beneficial for the current status of log among architectural and construction professionals.

Even though logs' traditionality and trustworthiness were viewed explicitly as positive attributes, the round cross-section profile of logs, which was seen as being the most traditional one, was not regarded as something desirable among the participants. Thus, there was a contradictory principle. According to this logic, there is a desire for material to be traditional, whereas its shape and architectonic use is contemporary and novel. A contrary combination was viewed as undesirable, as the participants felt that the reputation of log as an architectural material had experienced severe damage during past decades, when non-traditional, industrially produced round or square logs were used to build houses and cottages with a traditional, or at least non-contemporary overall appearance. Overall, the participants' statements could be encapsulated into two combinations to which positive associations were related, i.e., traditional material – contemporary architecture, and contemporary material – contemporary architecture. Consequently, the negatively associated combination was contemporary material – traditional architecture. The combination where both the material and architecture were traditional was not addressed by the participants.

All in all, the professionals viewed log currently as a very contemporary and relevant material. The abovementioned appreciation of homogenous materials in current architecture clearly fostered this perception. Regarding current preferences in architectonic appearance, the detailing of log building appeared as a meaningful aspect. Analogously to the traditional round shape of logs, the most traditional long-ended corners in intersecting log walls were viewed as undesirable, whereas different types of flush, and thus more novel corners, were regarded in a positive light. The corner type was definitely one aspect that seemed to determine the suitability of a log house in the built environment, and whether the architectonic appearance is novel enough to be contemporary.

Regarding the significance of detailing in the contemporary architectonic use of logs, the bevel creating the visible seams between the logs in a log wall, was viewed as important. The unconventional small and round-shaped bevel of the pavilion was mostly viewed in a positive light by the participants. However, several participants also suggested that sharp-cornered and smaller bevels resulting in the pavilion's even more minimalist appearance could be even more preferable for them. The general logic was that in order for the building to express its contemporality, the bevel needed, in one way or another, to differ from a conventional bevel. The bevels and corner joints of the Timber Tetris pavilion in Helsinki are illustrated below in Figure 9.

Fig. 9. Corner joints of the Timber Tetris pavilion in Helsinki. Photo: Aki Markkanen. (Published with permission)

Log was also viewed emphatically as a material of the future by some participants. Environmental and health factors, along with developing Finnish regulations, were connected with these perceptions. The fact that wood is not only a renewable material, but also local in the Finnish context, was well recognized among the participants, as was log buildings' reputation as "healthy" buildings. According to the participants, due to regulations related to appearance and combustibility it had been difficult to get a construction permit for log buildings in the urban environment. Various participants expected the current fire safety regulations to be updated or "optimized" as they put it, as these regulations were even today viewed as presenting challenges for the realization of wooden buildings of a larger scale. The appearance-related concern on the other hand, was related mostly to smaller buildings, such as detached houses, and moreover, was regarded as an outdated view by the planning and building officials. Most of the participants were eager to believe that it is possible to use log in ways that are pleasing by appearance.

Predominantly rural, but potential for urbanity

Despite the fact mentioned only by a few participants, that until the 20th century log was the principal structural material of buildings in Finnish cities – albeit usually covered – all the participants viewed log primarily as a rural building material and not self-evidently suitable for the urban environment.

However, the participants saw that the nature of log as a material principally for the rural environment is currently subject to some changes. Indeed, a great deal of the current concerns among the participants were largely connected to the contemplation that is here termed as the "urban question" of log: Can it be an urban material? While the identity of logs was viewed as rural per se, most of the participants believed the answer to the question comes down to the architectonic use of logs. Regarding this, the discussion revolved a great deal around the detailing of the corners. The traditional, so-called long corner, *pitkänurkka* in Finnish, was generally deemed as not fit to be used in urban buildings. Short corners, such as dovetail joints – *lohenpyrstönurkka* in Finnish – and their variations were considered more desirable. A senior designer participant considered visible corner joints pleasant, alluding to the fact that they reveal the composition of the walls to be indeed massive wood.

All in all, for the designer participants, the novelty of the corner design was its most important attribute. Several participants liked the peculiar corner joint of the Timber Tetris pavilion and viewed its not totally traditional appearance as a good thing (See Figure 9 above). Besides the aforementioned desire for the architectonic use of logs to be novel or even avant-garde, among the architect participants – students, officials and designers – the discussion in general stemmed largely from the desire to use materials architecturally in a manner that was described as "honest". This was mostly related to the idea that "one sees what one gets". Regarding the corner joints, the urban question has been addressed by the Finnish log industry as well by introducing the so-called mitre-cut corner. Contrary to the traditional corners, in this type of corner the ends of the logs are hidden.

Purity and non-purity

The word "pure" appeared in the participants comments frequently, in various contexts. The state of being pure was always seen as something desirable, but coupled with log as a material, it was found to encompass distinct meanings.

Naturally, the word pure was used to refer to hygienic purity. Within this scope, log was viewed as having positive qualities. As a natural material, log was considered as being pure and healthy. Purity and healthiness appeared also in connection with the solid and simple composition of the wall, as it was seen to be superior compared to layered wall structures when considering moisture-related problems. This attribute was also seen as a soothing attribute due to its understandability for both professionals and others. Studies in which indoor air quality had been better in log houses than in houses with other materials were stated to exist. However, some of the participants were suspicious towards the use of log walls in hospitals, since they considered log as an unhygienic material there. Thus, views of both purity and impurity of logs in the hygienic sense emerged among the participants, depending on the context of the building's occupation.

In addition, an aspect of purity in a visual sense emerged from the materials as well and was more

complex. Log material and wooden surfaces in general were considered as beautiful among the participants. However, some participants remarked that interior spaces with too much wooden surfaces were undesirable for them, because it would not be "visually pure" then. These visually impure, overly wooden interiors were associated with summer cottages, in which, intriguingly, they were deemed appropriate. Surfaces of logs obviously are characterized by some features, such as knots and horizontal lines created by bevels, due to which these surfaces are indeed "busy" in a visual sense – and thus "less pure" in architectural vocabulary. However, it does not serve as an explanation for why this busyness is tolerated in the leisure home context, which is a beloved place of rest for Finns.

One way of explaining this is through Mary Douglas' idea of cultural purity. It is argued by Douglas (1966) that any matter that is considered to be out of place in a given context or even in a society, referring to cultural categories, is regarded as impure or dirty. Thus, cleaning, for example, could be seen as a method for organizing our environment. Regarding this, one participant self-reflected repeatedly by stating:

> *I guess I just want things to be in clear categories (O1).*

According to the argument of Douglas, when current cultural boundaries are transgressed by something, it is then closely associated with undesirability and dirtiness; these things not in line with the existing categories can be viewed as even morally corrupt, disgusting or dangerous (Douglas, 1966).

All this results in some tensions regarding the architectonic use of logs. Among the participants, the association between rural settings, including summer cottages, and log building was very strong indeed, even though the participants were professionals and aware of the technical and architectural developments that the material has been recently undergoing. Thus, a relevant threat for logs, a way of building that the participants viewed as essentially healthy, time-honoured, natural and beautiful, is that it is viewed as something undesirable when used in a "wrong" context. A way to avoid log from becoming culturally impure, especially in a visual sense as a façade or interior material, is through a transformation of some sort. This explains the urge among the participants for the novel, non-traditional detailing, which could be seen as one manifestation of such alteration.

Both natural and industrial

As initial perceptions of log among the participants, most described logs as natural, massive, and having also a sense of craftsmanship in them. The naturalness, strengthened by ecological aspects related to it, seemed to be the most compelling attribute of logs among the participants.

However, during the more elaborate discussion, it became clear that the participants were aware of the composition of lamella logs, which, besides solid wood, contain adhesive as well. In this matter, the opinions of industry representatives differed greatly compared to architects regarding the implications that adhesives have for logs. While the former highlighted the stability and preciseness enabled by lamella logs, the latter were concerned about the decline of some of the qualities that were initially deemed the most compelling, namely naturalness and "genuineness".

Despite this concern, the architect participants acknowledged the benefits of glued composition of logs as well. Indeed, the novel opportunities provided by the industrial production aroused even interest. In addition, when queried about the "genuineness" of the logs used in the Timber Tetris pavilion, almost all the participants deemed the logs in the pavilion as "genuine" logs, despite the presence of adhesives. For the participants, then, lamella logs seem to be located on the border of the categories of natural and artificial. All in all, the resulting compromise is perceived as not fully desirable, yet acceptable overall. Thus, there are elements of both low-tech and high-tech products present in logs at the same time.

Summarizing the results from Article II

It was strikingly clear that log is a material that is currently mired in heavy contradictions in terms of perceptions of the architectural and other professionals in the field. In their views log was seen, on the other hand, as a highly traditional but also even a contemporary material of the future. The perception of contemporariness was intertwined with aspects of sustainability, occupant health and current

architectural trends toward simplicity. In addition, log was viewed simultaneously as being pure and impure, both hygienically and culturally. Many notions to limit and control its use in both regards were stated. As a third aspect, log was seen both as an industrial and thus high-tech, and a natural and thus low-tech material. In the light of these three aspects of heavy contradictions (traditional vs. contemporary; pure vs. impure; industrial/high-tech vs. natural/low-tech), it should not be surprising that most of the study participants, excluding the ones representing the log industry, had no professional experience with logs.

The second finding that should be highlighted here is related to the defining parameters of log compared to other industrial products of solid wood, such as CLT that arose from the materials. The main finding was that log is not merely a raw material, but a piece of massive wood that is longitudinal by shape and stacked horizontally, one on top of the other. The addition of glue into this assemblage provokes ambivalence but does not manage to make it unrecognizable. Thus, the "log-ness" and aspects that are culturally related to it were valid regarding lamella logs as well – they were still logs to the participants.

The final observation to be highlighted here is related to the fact that the strong images associated with logs reflect the Finnish historical and cultural context, which was also presented as part of the theoretical background of this dissertation. Despite this history, acknowledged also by the participants – that log in the previous decades has been stigmatized as an overly traditional material with only narrow potential in terms of architecture, especially outside the summer cottage context – the traditionality seems to be currently turning in to a positive attribute of logs. Thus, according to the participants, the desirability of logs in the end depends on the architectural design and architectonic appearance of log buildings, which ought to be contemporary. The importance of the contemporary architectonic appearance characteristic of logs was highlighted in nearly all the thematical categories above.

Log is currently undergoing rapid changes in perceptions, caused by the novel technical possibilities of logs, as well as changes in culture more broadly, which both have an effect on how to achieve the desired contemporary architectonic appearance. The technical aspect results in curiosity about what is possible with logs these days in terms of architectonic appearance. The cultural aspect has a somewhat negative effect on what is considered as a suitable use for logs, particularly in the urban context. On the other hand, the growing interest towards wood as a sustainable material affected the participants' perceptions of logs as well, but as something positive.

3.2 Tectonics of logs and architectonic quality – architects' perceptions

In this second section of the results, the focus shifts from the viewpoint of the symbolic, experiential level of tectonics in the first section of results to the viewpoint of a more tangible, constructional level of tectonics (See sub-section 2.1.1 Tectonics). In this second section of results, light is shed on the relation between the tectonics of logs[7], on the constructional level, and architectonic quality, as defined by the interviewed architects. This naturally touches upon the aspect of the architectonic appearance of log architecture, which was found in Articles I and II to be central in making log a suitable alternative in contemporary contexts.

The results that I will present next provide answers to research question Q2a and b: *Regarding the constructional level, how does the tectonics of logs contribute to the architectonic quality of log architecture, as perceived by individual Finnish architects in general (a) in the context of architectural competitions and (b) in the context of published log architecture?*

3.2.1 Learning from architectural competition

Here I will present the results from Article III, giving an answer to the Q2a. In general, it was clear based on the interviews that the context and culture-related preconceptions affect the potentiality of the architectonic use of log construction. As a rule of thumb, it was stated by the interviewees that log seems

[7] As was described in sections 1.2, 2.1.1 and 2.4, *tectonics of logs* refers to the holistic interplay between logs and the architectonic space.

to be more suitable to be used in rural or provincial areas, than in the urban context. It was noted, however, that this is also a question of how the material is used. I have divided the results into three thematical categories, which are followed again by a summarizing paragraph of the results in this sub-section. The three thematical categories are:

- *Desire for revealing the log structures*
- *Designing by preconditions of log structure*
- *The importance of further design solutions characteristic for log*

Before these, I will present a description of the aspects that the interviewees brought up as attributes of architectonic quality.

Definitions of architectonic quality by the participants

For the respondents in this context of architectural competitions, the notion of architectonic quality consisted of various attributes that they consider when designing or evaluating architecture. One was the site. It was seen as important to recognize the unique conditions of each place. In addition, the suitability of the building in relation to the place and the environment was brought up. Regarding the building itself, the overall scale and the proportions of the building volumes were mentioned as belonging to the notion of architectonic quality. The selection and use of visible materials were stated to be one key element. Additionally, one term that was connected with architectonic quality, was spatiality. As manifestations of this, the merging of spaces in terms of outdoor and indoor, as well as public and private, were mentioned. One aspect of spatiality that was emphasized was the functionality of the spaces, regarding the intended use of the building. However, even more abstract features of architectonic quality were mentioned, such as the image of the building, or its overall "spirit" or atmosphere. In the following three thematical categories, the recognized connections between the tectonics of logs and the abovementioned attributes of architectonic quality are described.

Desire for revealing the log structures

The interviewees were strongly of the opinion that log is a material that should self-evidently be left visible in a building. The revealing of the log structure of the building was considered as a natural starting point for designing log architecture. In general, the reason for the desire for the log structures to be visible was that

Fig. 10. View to the main entrance of the Monio competition's winning proposal, "Monikko". Image: AOR Architects Ltd. (Published with permission)

then the "log-ness" becomes evident, which was seen as important per se. The jury members also pointed out that log building had been seen to entail image factors desired by City of Tuusula representatives.

However, more direct connections between the visible log structure and architectonic quality emerged as well. The author of the proposal "Monikko" (see Figure 10 on the previous page) believed that architectonic quality in general originates from the construction materials utilized and from using them in appropriate locations within the building. By this the interviewee meant that for the sake of architectonic quality, it is important to make visible how the building is constructed. It was added by the respondent that with logs, which he referred to as a 'tectonic material', it is possible. Indeed, the fact that with logs the bearing structure can serve as the façade material and the visible interior surface was regarded as the most prominent asset of the material in terms of architectonic quality by the interviewee. It was added that as a positive consequence of this, the plain materiality goes on from the exteriors to the interiors.

The members of the jury had analogous views regarding the significance of this aspect for the architectonic quality of Monikko. The extensive use of log, visible throughout the building, was stated to create the specific identity for the building in question. Another positive aspect of this homogenous materiality that was brought up was that the use of a single visible material makes the building an architecturally coherent whole, even though it consists of a complexity of spaces for various functions.

Designing by preconditions of log structure

Regarding Monikko, another key factor for its architectonic quality was related to taking notice of the perceived preconditions brought forth by the use of log structures. The limited length in spans of log structures was mentioned as one precondition. Another was an observation that log walls do not just end but instead they either turn or make a crossing in order to retain their stability. Thus, according to the interviewees, it is structurally distinctive for log walls to form rectangular units. Compared to other materials, these features of log structures were viewed as constraints or deficiencies. However, a somewhat contradictory observation was that, in fact, the

Fig. 11. A view from the central interior space of Monikko, "main street". Image: AOR Architects Ltd. (Published with permission)

attributes of architectonic quality in Monikko largely stemmed from designing according to these recognized constraints.

All this is related generally to the relevance of bearing structures in terms of architectonic quality. Overall, the participants believed a positive feature in a building was that the bearing structures form an integral part of the architectonic whole. Indeed, the architect of Monikko described that it had been theirbasic starting point to design the whole building, as of from the overall layout, according to the characteristic structural preconditions of log structure. According to the interviewee, the overall layout forms the basis of the structural solution and the spatial entity – a three-dimensional maze – which are adapted to reasonable spans and structure heights for a log structure. In addition, it had been important to them that the log walls form the bearing structure in both the interiors and the exteriors (See Figure 11 on the previous page).

The jury member participants took notice of this aspect as well. They felt that by distributing the spaces into smaller "houses" inside the building Monikko (See Figure 12), the architects had turned the limitations of log structure into a strength. The jury members felt that besides being a distinctive and natural usage for logs, the large scale of the building was managed this way, and dividing the building volume also made it connect better with the place and surrounding buildings. Like the architect, the members of the jury viewed the "main street" as the fundamental spatial concept of the building creating a very rich spatial weave, which was seen to be a consequence of the characteristic use of log structure. In terms of architectonic quality, it was viewed as an important merit of the proposal that the required spaces had been fitted to the requirements of log building by the architects. The members of the jury felt that the bearing structures have a crucial role in Monikko's architectonic quality, exactly due to the skilful consideration of the characteristics of the log structure.

The importance of further design solutions characteristic for log

Taking advantage of the characteristics of log structure in smaller-scale architectonic solutions as

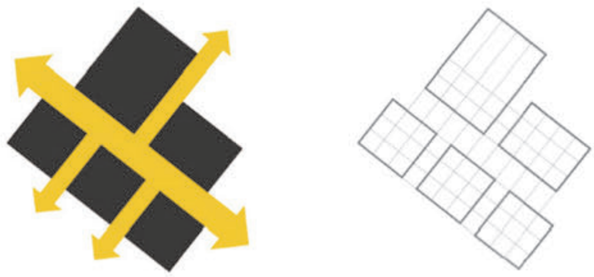

Fig. 12. Schematic floor plans of Monikko. The building volume is divided into smaller "houses". Image: AOR Architects Ltd. (Published with permission)

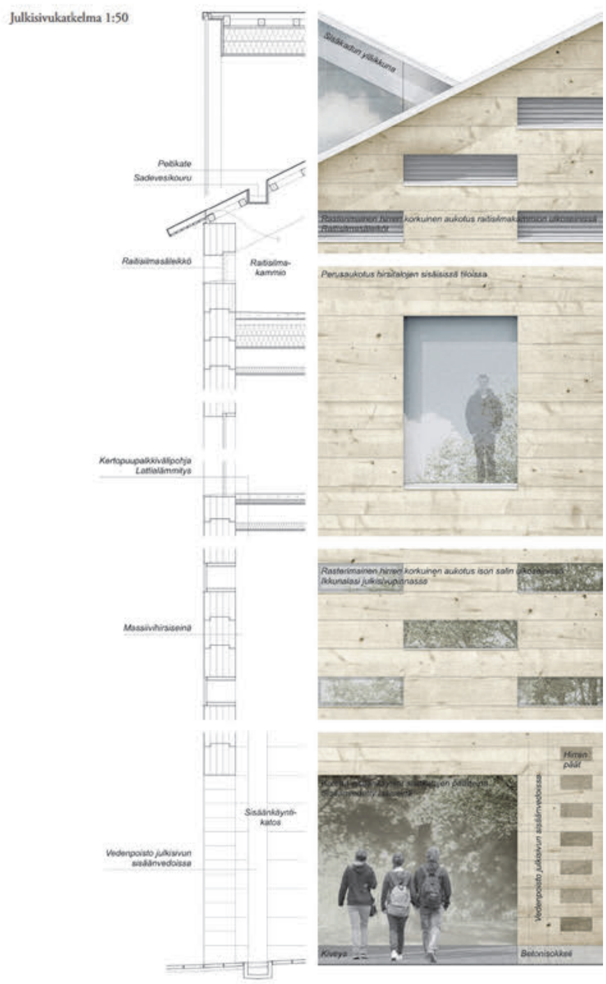

Fig. 13. Façade excerpt showing the detailing of *Monikko.* Image: AOR Architects Ltd. (Published with permission)

well appeared to have an influence on architectonic quality. However, it was clear that in the context of architectural competitions, the proposed details were affected not only by the preferences of the architects but also by the visual requirements for the presentation. Regarding the selection of the detailed features of a single log, one participant noted that it should be seen as a similar task to, for example choosing bricks, when contemplating these detailed features. In general, the visible corner joints were viewed as beautiful. Short corners and sleek log walls were also preferable, instead of long corners and log walls of round logs or walls with large grooves between the logs.

According to Monikko's architect, the openings, ornamentation and other motifs in the façades were considered through the characteristics of log structure, as seen in Figure 13. An illustrative example of the influence of the presentational requirements was the interviewee's description of how the details such as bevels of the logs and corner joints were presented as 'plain enough' for a competition proposal.

Here again, the jury members brought forth these same aspects. As an essential factor of Monikko's architectonic quality, the beauty of the façades was mentioned. By this, the participants referred to the grid of openings that were the height of a single log. In addition, according to the interviewed jury members, the details related to log structure were beautifully presented in the proposal.

Summarizing the results from Article III

In the context of architectural competitions, the respondents perceived tectonics of logs to greatly contribute to architectonic quality. Architectonic quality was described to consist of a number of attributes.

A distinctive feature of logs related to tectonics that appeared central in the results was that a visible bearing structure can be created with logs. This was also regarded as the most prominent feature of logs in terms of architectonic quality. Consequently, it is no wonder that a visible log structure was seen as a natural starting point of log architecture.

In addition, taking into account the structural preconditions of a log structure was perceived to have a crucial role in the architectonic quality of log architecture. It was seen that the design should be made in logs' terms. The recognized structural constraints of log structures were seen as deficiencies when compared to other materials. However, the architectonic whole of Monikko was viewed to be based on these constraints, which was again considered as a very positive feature for architectonic quality. A general perception was that by taking into account logs' constraints, these constraints were turned into strengths from the viewpoint of architectonic quality.

The more detailed-level architectonic solutions of logs and log structure were also considered to have an impact on architectonic quality. Creating openings that were the same dimensions as the logs was seen as important, and visible corner joints were considered desirable. However, the participants themselves noted that especially the details related to corners and properties of single logs were affected by the requirements of presentation in the competition context.

Additionally, as competition proposals are not architecture per se, but rather should be seen as presentations of architecture, it should be noted that the participants' views might have been somewhat idealized. For example, reasons for covering the log structure such as fire or weather protection might exist in the case of the eventual realization of a competition proposal, along with other aspects that are not necessarily yet considered in the competition phase. Thus, in Article IV, the results of which I will present in the next sub-section, the context shifts from architectural competitions to built architecture to complement the understanding provided by the results presented in the current sub-section.

3.2.2 Published log architecture

Article IV provides the answer for Q2b; I will present this next. As in the previous sub-section of results, here too a description of participants' perceptions of architectonic quality is followed by their views of the connection between the tectonics of logs and the perceived architectonic quality, divided into six thematical categories. These are:

- *Log construction plays a major role in the architectonic solution as a whole*

- *Rules of log structure – limitations or qualities?*
- *Expressing the unique qualities of log in architecture is fundamental*
- *Logs form a modular system*
- *Corner joints are important symbols of log construction technique*
- *Significance of the detail-level solutions of the logs*

These are then followed by a summarizing paragraph of the results in the thematical categories.

However, before delving deeper into the results in this sub-section, I will give a brief overview of the various types of logs that are utilized in the listed buildings (See Table 4 for the numbering that follow). In buildings 9 and 11, non-glued hand-hewn logs are utilized, while building 8 is made utilizing non-glued sawn logs that have industrially tooled tongues and grooves. Industrial glued lamella logs are used in the rest of the buildings, as a settling structure in buildings 2-4, 7 and 10, and as a non-settling structure in buildings 1, 5, 6 and 12. Different log types are presented in Figures 14-17.

All the listed buildings are defined as log buildings. In this sense, the composition of different logs, as well as the actual construction technique of these buildings have a lot in common. However, according to the participants, there are also major differences between the various types, since glued industrial logs and non-glued hand-hewn logs were stated to be 'practically two different materials' (CA6).

According to the participants that had experience with the larger listed buildings, using non-glued hand-hewn logs is not an option in such large buildings due to higher costs. In addition to the feasibility aspect, the stated differences were related to technical qualities of different log types, as well as logs' appearance, having an effect on the atmosphere of the architectonic space of a log building.

Next, after the paragraph describing the participants' perceptions of architectonic quality, I will present the participants' perceptions of the

Fig. 14. (Top right) In the Smoke Sauna in the Inkoo Archipelago (listed as building 11) by Architect's office Livady, non-glued hand-hewn logs are utilized. Photo: Livady. (Published with permission)

Fig. 15. Sauna Asikkala (listed as building 8) by Architect's office Tuomo Siitonen Ltd, utilizes non-glued sawn logs with industrially tooled tongues and grooves. Photo: Rauno Träskelin. (Published with permission)

Fig. 16. (Top) In Pikku-Paavali Day-care Centre (listed as building 3) by Architects m3 Ltd, industrial glued lamella logs are utilized. Photo: Jussi Tiainen. (Published with permission)

Fig. 17. In the housing co-op Vuoreksen Tiera (listed as building 10) by HIMLA Architects,industrial glued lamella logs with very small bevels are utilized. Photo: Okko Sorma. (Published with permission)

connection between the tectonics of logs and the perceived architectonic quality, divided into thematical categories. In the results, I will bring up the differences between log types described here, when relevant based on the participants' accounts.

Definitions of architectonic quality by the participants

The participants viewed architectonic quality generally as a positive key concept of architectural design. The given definitions for architectonic quality were largely in line with the general architectonic goals that the participants stated to guide their design work. Striving to fit several preconditions into a coherent whole was a recurring goal among the participants:

> *With a large public building, the role of the building in the cityscape needs to be considered and complex functional demands is an equation that needs to be solved. Then of course the tangible construction must be considered; how it is realized, and how this all becomes an entity that speaks the same narrative all the way from the cityscape to functional and structural solutions (CA1).*

Thus, architectonic quality was commonly viewed as a hypernym, and aspects such as coherent whole, functionality, surroundings, spaces, construction and atmospheres were seen as hyponyms that it entails:

> *What it consists of is a very manifold entity. Architectonic quality is usually achieved by ensuring that nothing is disturbing in the big picture. Rather, things have been worked out considering all aspects, preserving the coherence of the whole in the end (CA1).*

Additionally, architectonic quality was seen to be about making the building adequate in general, considering the multitude of building codes, fulfilling the client's wishes as well as local building and planning authorities' demands, but on top of that creating 'good architecture' (CA8).

Finding a balance between structure, material and architectonic appearance was also stated to be a key goal concerning a coherent whole of construction. Regarding the concept of a coherent whole, another mentioned way of approaching it was to strive towards a pleasing appearance of the building. This was seen to be an important overall goal in terms of architectonic quality. However, focusing on visual appearance was also viewed as a practical means for reducing the overwhelming amount of aims of architectural design. The experience of one of the participants was that on the level of 'floor plan, façade, view, detail or whatever' (CA4), it often turns out that what looks good is also functional and economically efficient. The same respondent added, however, that goals related to pleasing appearance as such cannot supersede other aspects such as functionality and economic efficiency.

According to the participants, each design task entails individual possibilities that the architect must take advantage of so that the building as a whole is more pleasing by appearance and functionally better than could be expected, which is essential in architectonic quality. Thus, it was stated that achieving architectonic quality does not depend on qualities such as scale or so-called significance of the project. The positive experiences of the building occupants were often regarded as the main indication of architectonic quality by the participants:

> *In every piece of work exists great opportunities and somehow, with good architectural practice, or by good design, they are unearthed. Often it means that when a neutral person arrives on the site and enters the structure and looks outside, the person experiences a sense of great ease. Nothing is bothersome, nothing is, so to say, incorrect (CA3).*

According to the same participant, such architectonic quality is usually experienced by people quite similarly, in general:

> *This means that somehow the building can fulfil the specific requirements of this exact place and task – the best features have been found. People quite easily sense intuitively that now the house works on this level as well, and not merely on the functional level (CA3).*

Indeed, it was stated that there seems to be even something mystical in architectonic quality, as it is about the occupants' experience, to which such a multitude of attributes can contribute. Thus, the

participants viewed this sort of architectonic quality, which might be termed as "anthropocentric", as perhaps the most fascinating feature of the architectural design of buildings.

Additionally, also very tangible aspects such as longevity of the building was highlighted in defining architectonic quality:

> *For me, architectonic quality is about when you look at a house, it looks like it was built well, and it will be durable (CA2).*

Regarding the viewpoint of tectonics, a direct link between the architectonic use of construction material and the architectonic space itself emerged, as one participant stated that an important goal is to compose the design in such a way that it pays attention to constructability and executability, especially in the case of log building.

However, a negative connotation of architectonic quality was recognized as well by some of the participants. This was defined as something that is pursued to impress primarily colleagues, or to create a superficial "wow" effect. These participants believed that there is a possibility of overlooking some crucial aspects of building if architectonic quality in this negative sense is emphasized in a design.

A few participants also believed that architectural competitions foster a biased type of architectonic quality. It was said that in competitions, the most renowned judge's personal preferences are what the competitors are trying to fulfil with their proposals. Architectonic quality was thus described merely as a stylistic feature that varies from time to time and not something that considers the actual demands of the task and context.

A participant also reminded that the client's significance seems to be sometimes forgotten when pursuing architectonic quality:

> *Even the world's greatest architect will not realize a single house without a client. The client is the most important component (CA2).*

When it comes to this negative connotation of architectonic quality, achieving it was understandably not seen as something worth pursuing.

All things considered; architectonic quality was understood as a key element of "good architecture", and defined holistically as a coherent architectonic whole in which various different demands are fitted insightfully together. This understanding, as perceived by the participants in the positive sense to be something desirable, has been utilized when the found connections between tectonics and architectonic quality are described next.

Log construction plays a major role in the architectonic solution as a whole

It was stated by many that the overall architectonic solution of a building is guided by the choice of construction materials, and that 'the starting point is always to design the building out of some construction material, not whatever material' (CA6). This view was emphasized by one of the participants, stating: 'we will not design anything, unless it is decided already at the beginning, how the building will be constructed' (CA2).

Analogously, the overall architectonic solution was generally perceived to be heavily influenced by log construction:

> *For me, log building is an entity, and the entire building project should be designed with the requirements of log construction in mind, not just superimposing log as an exterior wall material on a normal building (CA10).*

Monio, seen in Figure 18, is an illustrative example of this, as according to the corresponding architect, the spatial and architectonic solution in general were guided by the structural principles of log building.

Utilizing logs as a bearing structure was viewed generally as a basis for architectural design, which was clearly one reason for the central role of log construction. It was even questioned by one participant, if it is reasonable at all to use logs, if not as a bearing structure:

> *It is difficult to see why log would be used as a non-bearing structure, but of course in this world there could be situations, for the sake of carbon footprint for example, where it would make sense, but then one could ask if it would be more reasonable to use CLT, for example (CA6).*

Fig. 18. The central space of Monio (listed as building 12), which was developed further based on the proposal ”Monikko” after the architectural competition. Image: AOR Architects. (Published with permission)

However, even though logs' utilization as bearing structures was viewed as ideal regarding architectonic quality and being characteristic in terms of architectonic appearance, participants had experienced situations where this ideal did not transfer into practice. For example, in a log cottage that was not included in the listed buildings, according to one participant, a large bay window was realized with a secondary bearing structure for feasibility reasons. Additionally, steel reinforcements are typically used when needed, especially with non-settling logs, according to the participants. A few participants brought up also the possibility to use other large wooden structures alongside and supporting the log structure.

Rules of log structure – limitations or qualities?

According to the participants, several features of log construction, when utilized as a bearing structure, limit the architectonic appearance of log buildings. Log construction was viewed to be constrained in its application to be used as structural units with four corners, which was said to be a traditional, common understanding. Additionally, limitations in span-lengths of walls, as well as dimensions and amount of wall openings, were mentioned. One interviewee described the interplay of these limitations and architecture as follows:

> *If these factors are not considered and the design is not done accordingly, then the outcome is usually also technically quite weak (CA5).*

Especially larger-scale non-glued hand-hewn logs were associated with the limitations by some:

> *I would not dare to design a larger building out of massive log because of settling, unless it was realized entirely in terms of the log construction – then it could work (CA10).*

As one limitation, settling was mentioned. It was understood by the participants that settling needs to be considered with both non-glued logs and glued logs with parallel lamellas. As gluing enhances the technical properties of logs, overall stability of logs was viewed as the main technical difference between glued and non-glued logs. Thus, one participant believed that the level of airtightness required for buildings for year-round occupation could be difficult to achieve with non-glued logs.

Even though defined primarily as limitations or restrictions, these features of log construction were not perceived as something negative in terms of architectonic quality:

> *The limitations of log should not be considered as limitations, but they are just natural starting points for the architecture (CA5).*

According to a participant, architects are often at their best when having to work according to many limitations. In this spirit, limitations of logs were perceived as something important for architectonic quality, as an asset rather than a burden:

> *In smaller-scale projects, I do not think that something would restrain the appearance or the making of log architecture. Often such limitations that logs present, are what could be called positive limitations (CA3).*

However, also a few opposite views were expressed. Some believed that by using non-settling logs, such limitations belong to the past. One participant was especially strict in his opinion that the traditional idea of a "log cottage" restrains architecture from the structural viewpoint:

> *Large, glazed walls cannot be executed, all cantilevers are out of the question, spans need to be very short; it is more like traditional log building then (CA7).*

Regarding the non-settling logs, many participants believed that in terms of architectonic appearance, they offer novel possibilities compared to other log types, since reinforcements of steel are easier to integrate into the log structure, as for example in Custom Home II (Figure 19 on the following page).

Expressing the unique qualities of log in architecture is fundamental

Construction materials were viewed by the participants as having characteristic or natural ways of being employed in architecture:

> *Each construction material and method possess a way of constructing that is characteristic, distinctive, and perhaps reasonable for that specific material and structure. If it is not achieved, and one tries to use log structure in a way that is natural, for instance with concrete or steel, it will not work out (CA4).*

This architectonically characteristic and natural utilization of logs was related to the limitations described under the previous sub-heading, but also to other aspects. Log was deemed to have some intrinsic qualities that were perceived as fascinating. Utilizing these was viewed to be crucial from the viewpoint of architectonic quality:

> *The excellent benefit that the same substance bears and insulates is the great thing about log building, and the architect should be able to take a great deal of enjoyment from that thing (CA5).*

This advantageous quality was considered to be a shared one for all the log types, including non-settling logs:

> *Buildings with non-settling logs can be more slender, eloquent, and dashing compared to the so-called stone houses in Finland, because insulation and thermal breaks can be achieved with wood (CA7).*

From the viewpoint of the desire for a coherent architectonic whole formed by materials and structure,

Fig. 19. Custom Home II (listed as building 1) by M.A.R.K. Architect's office Mäntylä, utilizes non-settling logs, to which steel reinforcements can be integrated, according to the respondents. Photo: Honkatalot. (Published with permission)

logs and other massive materials, such as bricks or CLT, were considered especially delightful since they 'are so tangible in the way that they form structure and surface simultaneously' (CA6). In terms of architectonic quality, one participant described the logs' most important qualities followingly:

> *Their strength is that they form the façade, interior and structure, all of one substance, and leave the composition of the building visible. So, the sensation of the material and this certain honesty are definitely the most important properties (CA1).*

The participants frequently associated logs with honesty as one of their important aspects. One of the participants believed this type of honesty to be especially something that intrigues architects:

> *Log is an incredible material in the sense that it is true, it is a material of solid composition, which is what it looks like, inside out. Le Corbusier spoke about truthfulness and a certain honesty, among many other things. But those white boxes are not "for real"; despite the beautiful white plastered surface, the composition of the wall could be just about anything. Whereas log is actually for real, it is what it looks like (CA7).*

Related to this honesty or "realness", it was said that a visible log structure is required to make the best architectonic use of logs:

> *A log structure should be visible as much as possible, both inside and outside. If it is covered, it is precisely the main advantage of log – the solid composition and homogeneity – that is lost (CA4).*

Additionally, honesty was described also as being understandable. It was perceived as generally pleasant and important in terms of architectonic quality, that with log construction, what one sees is what one gets:

> *The fact that it is the same substance inside out, and one understands and sees it when moving through the building; that is important (CA4).*

The desire for visible log structure was reasoned also by wood being naturally beautiful; thus, its visibility

should be maximized. Indeed, speaking of architectonic quality, the most important features of log were described followingly by a participant:

> *It is the genuineness and naturalness of the material and the trace of handcraft or industrial manufacturing, which usually persists because it does not have to be covered. The surface is inherently beautiful and pleasant to touch, the way of processing can be left visible. Very few materials possess this potential (CA5).*

Thus, showcasing the almost unique properties of logs by a visible log structure was perceived crucial, because log is one of the few materials to allow this. Additionally, visibility was desired because it was perceived to represent certain values:

> *People often want it to be visible since log has such a good reputation (CA3).*

Indeed, the solid, homogenous composition of logs was perceived fascinating for the sake of technical benefits as well. It was stated that a log-structured outer wall is superior to modern, layered wall structures in terms of longevity and reliability against moisture-related problems. Besides the structure as a whole, also the bare wooden surface of a log wall was seen desirable for the technical benefits it entails:

> *Regarding technical properties, a log surface is great in balancing indoor humidity and temperature, so we preferably leave it as such in the interiors, at least in a majority of the spaces (CA2).*

Then, also views on covering the logs, especially in the exteriors, emerged. In these, the reasons were technical in nature, or related to appearance-related demands of the cityscape:

> *In cities, especially with hand-hewn buildings, we have preferred the exterior cladding. But it is a good thing in terms of longevity that it has a raincoat on (CA2).*

Lonna's public sauna serves as a good example of a partly clad log structure (Figure 20). In addition, when it comes to interiors, participants stated that some people might find excessive log surfaces undesirable.

Fig. 20. The log structure of Lonna's sauna by OOPEAA Office for Peripheral Architecture is clad with a wooden board exterior. Photo: Jussi Tiainen. (Published with permission)

Logs form a modular system

The characteristic composition of log walls was stated to be something natural or inherent in terms of the architectonic appearance of a log building. This fact that a log wall consists of horizontal wooden elements laid on top of each other was viewed to form an advantage for logs compared to CLT plates, by making logs easier to handle. More importantly, regarding the architectonic appearance, the repeating heights of the stacked logs were viewed to form a modular system:

> *It is perhaps one major advantage of industrial log, that it creates a certain modular system. And it is pleasing from the aspects of both appearance and practice, to make use of this modular system, which exists there anyhow (CA3).*

Due to this modularity and its implications, it was seen important to decide the size of the logs at an early stage of the design process. An illustrative example of the relationship between the modularity and architectonic appearance can be seen in Monio (Figures 10-13, 18), where the window heights will be decided according to the logs' heights.

The modular system formed by log construction itself, along with its benefits, was interestingly juxtaposed by one participant with systems that Frank Lloyd Wright and Le Corbusier had developed and used:

> *It is a bit similar to Wright, who had his own modular system in many works. ... There are some similarities with Le Corbusier's argument for using his Modulor – it makes the good easy and the bad difficult (CA3).*

Corner joints are important symbols of log construction technique

Regarding the architectonic appearance, the visible cornering of log walls was viewed as something crucial by the participants:

> *Corner joints are really pleasant, and especially with a smaller contractor, there can be various different joints in a single building, which is interesting. I like to operate with corner joints, and they are obviously part of the architecture (CA2).*

One explanation for why the visible corner joints were perceived as pleasant was that as an inherent part of structure, they generate "real" ornamentation. Of the listed buildings in this section, Villa Valtanen (Figure

Fig. 21. In Villa Valtanen (listed as building 2) by Architect's office Louekari, the visible corner joints create ornamentation to the façades. Photo: Lauri Louekari. (Published with permission)

21) offers a great example of this. The participants' shared desire for visible corner joints was also clearly connected with the general desire to showcase the unclad log structure, as described above.

Different types of corner joints were described to be needed for different contexts. According to the participants, corner joints need to be selected according to specific demands, which can be spatial, visual, or technical. For example, the traditional long corners were stated to be forbidden in urban areas, while in some other, more natural milieus, such corners might be even preferable due to appearance-related expectations:

> *In our building projects in Lapland for example, we have applied the long corner (CA8).*

However, the short corners seem to be more common in contemporary architecture. In only one of the listed buildings, Naava Chalet, a variant of a long corner is utilized (Figure 22).

Besides visible corners, such corner types that do not showcase structural logic were stated to exists. An example of this are the so-called mitre-cut corners, which stirred up very contradictory views among the participants:

> *Without the ornamentation of the joints it [the log] looks like a large board. It can no longer be perceived quite as log (CA9).*

Indeed, some participants even considered the visible corner joints to be a prerequisite for the genuineness of log building:

> *This is significant for architectonic quality in the sense that it [the visible corners] seems to make the log building more genuine, and these city-corners [mitre-cut corners], not to mention that the corners would be clad, well that is a completely different kind of case (CA4).*

The significance of corner joints was definitely considered as high, as something inextricably characteristic:

> *I consider it [the meaning of corner joints for architectonic quality] crucial because the joinery is what makes log building what it is, and the distressing thing about the mitre-cut corner is that it diminishes the technique used to build the structure. It might as well be log-wallpaper (CA1).*

Fig. 22. Long corners are used in Naava Chalet (listed as building 6) by architect Janne Kantee in order to achieve the desired architectonic appearance seen fit for the surroundings by the corresponding architect. Photo: Honkatalot. (Published with permission)

In addition, the tradition of log building played a role in the perception of the importance of the visible corners:

> *The mitre-cut corner is a bit boring for the material, considering the heritage that we have in these corner joints, which have after all been the place to showcase the skills of the craftsman (CA6)*

The novel mitre-cut corners were stated to be commonly used especially with non-settling logs. Mitre-cut corners were also advocated:

> *They [visible corners] are undoubtedly fancy, but their durability is an issue, and then again, is it the 2000s? Why use those joints if we have this kind of modern solution? (CA10).*

Unlike with the majority of the corner joints which are so-called half-lapping joints, with mitre-cut corners logs are usually stacked on the same level throughout the building. Some participants believed this affected the architectonic appearance so that it becomes more contemporary as well as urban. Suitability in the urban environment was indeed the main argument for using the mitre-cut corner. Some participants viewed the mitre-cut corners' role as crucial in modernizing log building.

The ends of non-settling logs were stated to be especially weather sensitive, which came up as a technical reason for the preferability of mitre-cut corners in that context. The vulnerability of log ends was acknowledged by the advocates of the visible joints too. As a compromise solution for this contradiction, one participant pointed out that even though exterior corners are preferably hidden, visible corners can be exploited as part of the interiors. Especially in the larger buildings, corner joints can be found in the interiors as well, for example in the Pudasjärvi log campus (Figure 23).

Significance of the detail-level solutions of the logs

In general, detail-level solutions were viewed to affect architectonic quality, in large public buildings in particular:

> *I guess these log public buildings, which are now erected all over Finland – schools, day-care*

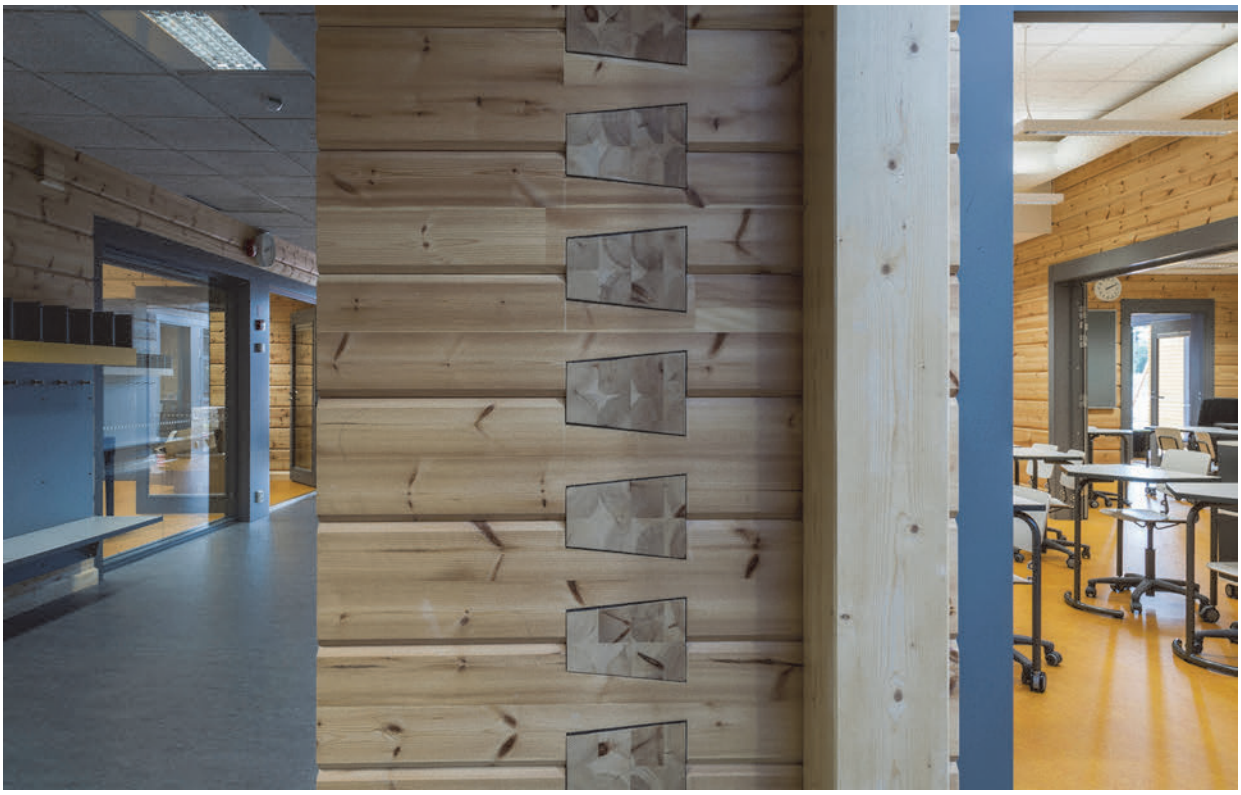

Fig. 23. Interior view of the Log campus in Pudasjärvi (listed as building 7) by Lukkaroinen architects. Photo: Raimo Ahonen. (Published with permission)

centres – are still troubled by the fact that the details, which have been adopted from catalogue houses, have not been developed to meet the level of the dignity required for public buildings. This is one of log's current weaknesses (CA1).

Especially the details of window junctions in log walls were considered in the quote above. Elegantly and plainly detailed window junctions were viewed to be more easily reached with non-settling logs.

The architectonic appearance was viewed to be affected by details of single logs as well, such as shape and size of the bevel and surface texture of the logs. As an example, there is a quite large bevel in the logs of Pikku-Paavali day care centre (see Figure 16). On the contrary, in Vuoreksen Tiera (see Figure 17) for example, the bevel in the logs is minimal. The factors affecting the selection of the suitable log type was viewed to include context, use, scale as well as a desired building atmosphere. An illustrative example of this is that all the three listed buildings in this section in which non-glued logs are utilized are saunas. It was stated by the corresponding architects of these buildings that it felt like a natural choice to utilize non-glued logs from the viewpoint of use and context. Regarding the impact of surface texture, hand-hewn surface was seen in one of the listed buildings as a memorable, "strong" material that 'would surely inspire people's emotion' (CA6). For the same building, industrial log was considered to having been 'too cold and precise for that context' (CA6). The non-glued logs, especially hand-hewn ones, were considered to entail a very distinctive and lifelike atmosphere compared to glued logs, which were considered to be more or less an industrial product. The feeling of wood material and massiveness were nevertheless stated to be present in glued logs as well.

As atmospheric implications the log type choice has, several participants believed that because the mark of human labour is visible in the hand-hewn logs, as seen in Figure 24 on the following page, by using them an atmosphere that is "stronger" in character is created into an architectonic space:

It is an important part of the architecture and the whole [in Lonna's sauna], that the material is present, it is right next to you, you can experience it, you see the blows of the axe, feel the texture and it gives colour to the overall space. In fact, it would be nothing without it (CA6).

Another interviewee described the same difference followingly:

Surfaces which have been hand-hewn with an axe are kind of the highest standard, and if the craftsmanship is good, it is definitely exquisite. The planed surface is a bit more of an affordable solution, and it also looks like it, and feels like it. It does not offer the same experience (CA2).

However, according to the participants, many alternatives are applicable regarding the details of individual logs. In fact, some viewed these details to be a matter that is more related to, for example, personal preferences of the client than directly to architectonic quality. Anyhow, these details were considered to be things that have to be designed regarding the case-specific aims.

Summarizing the results from Article IV

Several features related to tectonics of logs in the listed buildings in Article IV were perceived to contribute to the architectonic quality of the buildings. In general, the participants viewed architectonic quality to be about creating a coherent architectonic whole, which fulfils all the pragmatic requirements as well. The tectonic features of logs, considered as crucial attributes of architectonic quality of the listed buildings included: logs' ability to serve as a bearing, insulating and visual material, spatial implications of characteristic structural use of log construction, and the expressivity of log wall surfaces.

The primary reason why tectonics of logs appeared to contribute highly to the architectonic quality of the listed examples of log architecture, is that there was clearly an intuitive desire among the participants to highlight log structure's role in the architectonic whole. This desire, on the other hand, can be reasoned as follows: Firstly, the static aspects of log construction were stated to guide the creation of the architectonic whole, as the bearing structures of log buildings were preferred to be of logs per se. Secondly, logs' ability to bear, insulate and form the visual surface too was seen as the unique quality of logs – a central strength to be exploited in the architectonic appearance. This uniqueness was

Fig. 24. The hand-hewn log surface in Lonna's sauna by OOPEAA Office for Peripheral Architecture. Photo: Jussi Tiainen. (Published with permission)

viewed to enable log buildings to be “honest”, which was deemed as an eminently fascinating possibility related to log architecture. The fact that a building’s composition can be understood with one glance was perceived to be generally pleasant for architects and building occupants. A primary prerequisite for all this is to reveal the log structure, which was seen to be important for other reasons as well: besides some technical benefits, bare surfaces of logs were also considered inherently beautiful and particularly with hand-hewn logs, to express their making. Thus,the way that log structure is composed was deemed crucial for the architectonic whole and therefore contributes highly also to the architectonic quality.

The final aspect of the results that should be highlighted in this summary, is that the central matter of characteristic structural use of logs was viewed to differ between log types. Especially the glued, non-settling logs were considered to enable a crucially different architectonic appearance compared to settling logs, especially to the ones that are not glued. As the non-settling logs are a novel solution in the scope of the tradition of log building, some uncertainty about how to react to this new situation emerged among the participants.

3.3 Results synthesis

In this final section of the results chapter, I will answer the third research question: *Based on the synthesis of the results of Articles I-IV, what kind of understanding of contemporary industrial logs as an architectural material is formed from the viewpoint of tectonics?*

In the previous two sections of the results chapter, to explore the tectonics of contemporary industrial logs on experiential and constructional levels, very detailed descriptions were presented as answers for the research questions, divided into thematical categories. On the following spread, in Figure 25, I have compiled all these thematical categories together to support the synthesis of the results presented in this section. Along with the headings, there are summaries of the key results in each of the thematical categories, listed under the corresponding heading. The layout of Figure 25 is analogous to Figure 1, introduced in section 1.2 Objectives and scope, used to illustrate the way in which the original Articles I-IV form the whole in this dissertation, in relation to the overall aim, framework of tectonics and the research questions. Thus, Figure 25 shows how Articles I-II pertain to the experiential level of tectonics and research questions Q1, a and b; Articles III-IV to the constructional level of tectonics and research questions Q2, a and b; and how these two are combined in answering research question Q3 in this section.

In this section, compared to the detailed descriptions in the earlier sections of the results chapter, my aim is to outline a broader understanding of contemporary industrial logs as architectural material from the viewpoint of tectonics, based on the synthesis of the contributions in all the articles in this dissertation. This overall understanding is comprised by combining aspects from the articles, around the central themes. Aspects related to the themes brought up in this synthesis emerge in more than one of the articles, and I have thus regarded those themes as particularly meaningful regarding the aim of this dissertation.

I have divided the themes under the sub-sections of experiential and constructional levels of tectonics. In addition, a description of definitive features of contemporary industrial logs is presented.

3.3.1 Definitive features of contemporary industrial logs

Log is not a mere raw material

It was emphasized in all the articles that logs are not just a raw building material. Instead, logs encompass a reference to the way of building as well. In Articles I and II, logs were defined as elongated pieces of solid wood that are stacked horizontally on top of each other. In Articles III and IV as well, it was evident that the use of logs entails preconditions related to the way of building that ought to be considered when conceiving the architectonic whole.

Differences of glued and non-glued logs

The focus of this dissertation is on contemporary, industrial logs. Logs, that are used today in buildings for year-round occupation, are practically all industrial glued lamella logs. Non-glued industrial and hand-hewn logs are used for new buildings as well, but their share is marginal.

Even though the focus is on the industrial glued logs that are currently the most common, they pertain to the cultural continuum of log building in general, and thus cannot be considered out of this context. Hence, the research has been devised so that perceptions of industrial logs are scrutinized in the context of log building in general. Especially in Articles I, II and IV, the perceived differences and similarities between industrial glued logs and more traditional non-glued logs were revealed.

In all the above-mentioned articles, the glue in the industrial logs was noted somehow by the participants. The participants in Article I, consisting of people who had no professional relationship to log, had perhaps the strongest opinions regarding the glue, as it raised suspicions about whether it might affect the healthiness of logs. This was seen also as a prerequisite for the "log-ness" of glued logs: if glued logs are as safe regarding healthiness as non-glued logs, they then can be accepted as being logs. Architectural professionals in Article II had their suspicions as well towards the glue, but glued logs were nevertheless regarded as "real" logs. On the other hand, the professionals were aware of the technical benefits that the gluing enables and were excited by the novel possibilities. In Article IV, the interviewed architects felt that, regarding technical qualities and atmospheric implications, glued and non-glued logs are practically two different materials. However, despite the suspicions, all these articles also pointed out that the glued log is considered to be a natural result of product development of logs as well.

Thus, according to current Finnish perceptions, logs are a combination of three factors: shape and composition of single logs, and the way of connecting the logs. Changing the composition by adding the glue does alter the logs' architectonic possibilities and people's attitudes towards logs, but not to the extent where they would not be recognized as logs anymore.

3.3.2 Logs and the experiential level of tectonics

The experiential level of tectonics of logs is used in this dissertation to refer to the connection between construction material and technique, and the resulting architectonic space on a symbolic, experiential level, that is, what log represents. The experiential level was covered mainly in Articles I and II, dealing with general perceptions of log building as a phenomenon. Aspects related to the experiential level were touched upon also in Articles III and IV, but usually more indirectly.

Culture and stereotypes

It was clear based on Articles I-II that log building is a concept that has a well-known role in the Finnish culture. All the respondents had at least mental images of logs and almost everyone also had tangible experiences of log building. An indication of the well-known and strong cultural role was also that both the professionals and non-professionals in Articles I-II had strong opinions related to log building, even though few of them had had any professional experience with it.

The most obvious theme that recurred especially in Articles I-II, and also emerged indirectly in Articles III and IV, was that log building was seen as a rural way of building per se. Log building often connoted a summer cottage. This connotation was not positive at all in the urban context, even though in the summer cottage context it might be even desired. In Article II, this dissonance was explained through Mary Douglas' (1966) concept of cultural purity.

However, both professionals and non-professionals also associated numerous positive aspects with logs, such as healthiness, environmental friendliness, trendiness and traditionality as a positive feature, along with many other qualities as described in detail earlier in the results. Especially from the non-professionals' perspective, the different positive features and associations of log construction prevailed over any negative ones. The professionals' perceptions of logs, on the other hand, entailed similar positive aspects, but the overall attitude was characterized by more contradictory views. Perceived contrasts like traditional but contemporary, pure but impure, industrial but natural and "high-tech" but "low-tech" made logs appear as a very difficult material from the viewpoint of architectural professionals. This difference between the perceptions of professionals and non-professionals is mainly explicable due to professionals' stronger experiences or mental images of qualityless architectonic appearance of past examples of industrial log building,

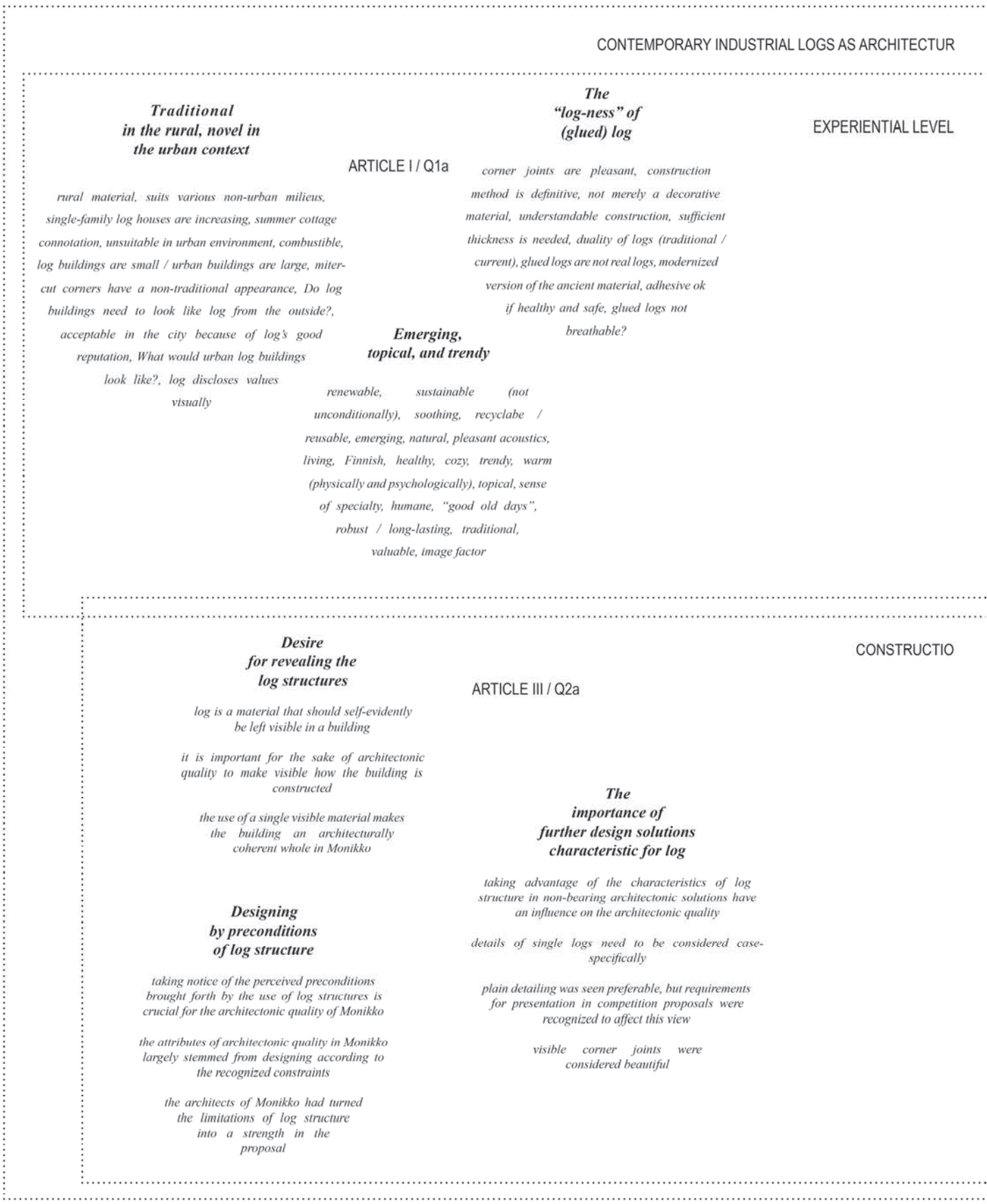

Fig. 25. Compilation of the thematical categories and corresponding summaries of key results in them, placed on the framework of tectoni

AL MATERIAL FROM THE VIEWPOINT OF TECTONICS / Q3

OF TECTONICS

Both natural and industrial

massive, natural, ecological, sense of craftsmanship, awareness of the adhesives, adhesive reduces "realness" and "naturalness", lamella logs technically advantageous, novel opportunities are exciting, log is both low-tech and hi-tech

ARTICLE II / Q1b

Purity and non-purity

healthy material, pure and natural material, unhygienic in some uses (e.g. hospitals), safe and reassuring regarding moisture-related problems, summer cottage connotation, extensive log surfaces are tolerated only in summer cottages, beautiful but visually impure, "culturally impure" (Douglas)

Both traditional and contemporary

"tried and tested", architects: hand-hewn log is genuine, industry: the shape of the material is central for logness, three requirements for log in general: material / shape / use context, traditional materials with contemporary architecture is desired, novel detailing is needed to create contemporary appearance, homogenous and thus understandable for the public, healthy and environmentally friendly reputation, material of the future

Predominantly rural, but potential for urbanity

rural material, Can log be an urban material?, used previously in urban buildings but clad, architectonic use of logs decides the urban suitability, corner joints are central for architectonic appearance, mitre-cut corners: industry's answer to the "urban question", "honesty" of log construction (visible corners) is pleasant, short corners preferable (novelty important), long corners out of the question

NAL LEVEL OF TECTONICS

Rules of log structure – limitations or qualities?

structural factors of log construction limit the architectonic appearance (four-cornered structural units, limited span lengths, amount and size of openings, settling)

limitations of log are natural starting points, or "positive limitations"

non-settling logs enable novel possibilities compared to settling logs

ARTICLE IV / Q2b

Logs form a modular system

stacking of logs creates a natural and controlled division for the wooden elements

it is advisable to fix the exact cross-section size of the log at the earliest stage possible

Expressing the unique qualities of log in architecture is fundamental

construction materials possess their own characteristic or natural architectonic ways of being used

log is a simultaneously bearing, insulating and visual material

the "honesty" and homogeneity of log structure is pleasant and thus it is desirable to reveal the structure

Log construction plays a major role in the architectonic solution as a whole

selected construction material always guides the overall architectonic solution

log construction as a bearing structure is a natural starting point for architecture

Corner joints are important symbols of log construction technique

corner joints are natural part of the structure, forming "real" ornamentation

various corner types are needed to fulfil spatial, aesthetical and technical demands

mitre-cut corners conceal the log building technique (negative perception)

mitre-cut corners modernize log building and are durable (positive perception)

Significance of the detail-level solutions of the logs

non-settling logs enable elegant, plain detailing in junctions of openings

the shape and size of the bevel and surface-texture of logs are important for architectonic appearance

hand-hewn surface creates an exquisite atmosphere compared to planed surface

the details of logs need to be designed according to the demands of the context

cs, as understood in this dissertation.

mainly summer cottages and single-family houses in provincial areas.

In general, cultural changes are continuously affecting how log is perceived and the values it represents. For stereotypes regarding logs this signifies that the meaning of some existing stereotypes is shifting from negative into positive and new stereotypes are formed. For example, while log building in an urban context might seem culturally dubious, the growing interest in sustainability aspects can make attitudes towards renewable materials – logs included – more positive in novel uses as well. In addition, healthiness of logs appeared as a strong new stereotype that seems to have the ability to overcome existing negative ones, such as ruralness. The seminal example given by recent public buildings was found to have affected the healthiness of logs to become a strong new stereotype.

"Urban question"

As stated above, the summer cottage connotation was an overarching theme in all the articles. Thus, much of the discussion revolved around the "urban question", that is, can log be an urban material?

Among the non-professionals, it was clearly difficult to picture what urban log buildings would look like. Non-professionals were confident, however, that urban log buildings would be accepted due to the positive values logs currently represent.

Among professionals as well, there appeared to exist a consensus that log is not categorically out of the question in urban contexts. Professionals believed that the way to transform log buildings to fit novel contexts and uses and to overcome the cottage connotation is through architectural design and contemporary architectonic appearance.

3.3.3 Logs and the constructional level of tectonics

While the experiential level of tectonics addressed aspects of what log represents, the constructional level focuses on the practical, tangible implications that the use of logs has for the architectonic space. The constructional level of tectonics was covered mainly in Articles III-IV, focusing on the relation between tectonics of logs and architectonic quality. However, some of the ways in which the interviewed architects use logs in order to achieve architectonic quality were clearly intertwined with aspects that emerged in Articles I-II and on the experiential level as well.

Load-bearing log structure as a starting point

An aspect of log building that was found to affect the architectonic whole in a very tangible way was the log construction itself as a load-bearing structure. In both the contexts of competition (Article III) and realized buildings (Article IV), the use of logs as a bearing structure was seen to be a natural starting point for architecture.

In Articles III and IV, perceived structural factors of log construction, such as four-cornered structural units, limited spans, limited amount and sizes of openings and settling were found to limit the architectonic appearance of log buildings. Surprisingly though, these limitations were for the most part considered as "positive limitations" since as a natural starting point, when taken into account, these limitations were considered to form a crucial attribute of architectonic quality. Thus, the log structure had very tangible implications for architectonic space.

However, in Article IV, also differing aspects emerged. It was found that in the context of built architecture, situations may occur when a secondary load-bearing structure is needed, even though the ideal would have been a load-bearing log structure. In addition, in connection with non-settling logs, the structural preconditions of logs were also seen only as limitations, and as such, a thing of the past. Non-settling logs were seen to enable novel possibilities for the architectonic appearance of log buildings. It could be argued that Article III represents views that are very "pure" from the perspective of architecture, but those views may be also somewhat idealised, as not all the practical demands of a construction project are not necessarily known in the competition phase. In this sense, Article IV provided more detailed but also richer results regarding the tectonics of logs and their contribution to architectonic quality.

The understandability of visible log structure

The above-mentioned statics-related aspects were not the only reasons why architects were found to have an

intuitive desire to emphasize the role of log structure in log architecture. It was found in Articles III and IV that log is a material that is almost self-evidently wanted to be visible, which obviously has a big effect on the architectonic space. It was seen fundamental in architectural appearance to express the logs' almost unique quality that the same material serves as a load-bearing, insulating and visual material, which requires the log structure to be visible. This uniqueness was seen to make it possible for log buildings to be "honest". These articles showed that architects find it generally pleasant that a building's composition can be understood with one glance, and they suspect it will be pleasant for building occupants as well.

Indeed, understandability was a crucial feature associated with log building directly or indirectly in all articles. For both professionals and non-professionals in Articles I-II, log building represented an understandable way of building. The solid composition of log walls was viewed superior to layered wall structures from the viewpoint of healthiness. In this sense, the log building appeared as a transparent construction technique, that is soothing since it can be understood just with one glance, also by non-professionals. Thus, the perceived healthiness of logs regarding moisture-related issues due to the simplicity of solid wooden structure was intertwined with the understandability of log construction, as it was highlighted as a positive quality in all the Articles I-IV. Logs appeared as being almost "fool proof" structures that are also "tried and tested".

In all the articles, the corner joints were viewed as important symbols of log building, which also emphasize visually the composition of log structure. The key values that log building represents were found to be disclosed very efficiently with the visible, "readable" log construction. However, in Article IV, opposing views emerged regarding mitre-cut corner joints that are commonly used with non-settling logs due to durability reasons. While others felt that these corners made log constructions less genuine and reduce the understandability of the log structure, mitre-cut corners were, on the other hand, viewed also as something that modernizes log construction and makes it more suitable to urban environments.

Tectonics of logs contribute considerably to the architectonic quality

All in all, tectonics of logs were found to considerably contribute to the architectonic quality through its impacts on architectonic space. Along with the previously mentioned spatial implications of characteristic structural use of log construction and logs' ability to form "honest" constructions, also the expressivity of surfaces of log walls were found to have an effect. Considering these aspects, as well as the experiential level of tectonics, the intuitive desire to highlight the role of log construction in the architectonic whole by architects in Articles III and IV seems to be truly justifiable.

4 Discussion

In this final chapter, I will discuss the findings of this dissertation as a whole, along with their meaning more generally. The Discussion is divided into four sections. First, in theoretical implications, I will discuss the findings in the light of relevant literature, and how the findings contribute to current scientific knowledge. In addition, I will discuss a theoretical contribution of this dissertation, related to tectonics as a viewpoint in materials-related research in architecture. In the second section, I will discuss the practical implications of the findings with respect to the expected audiences of this dissertation, that is, in the light of practice of architectural design. Moreover, I will highlight aspects related to logs that might be of interest from manufacturers' viewpoints. In the third section, I will assess the trustworthiness of this research. Finally, in the last section of this chapter, I will give recommendations for further research based on the findings of this dissertation.

4.1 Theoretical implications

As this research has been devised considering the scope of architectural design – that is, aiming to create new knowledge that would inform and support the development of log architecture and logs by architects and the log industry – the theoretical implications of this dissertation are focused on this new knowledge. However, it could be argued that there is also a theoretical contribution in the holistic way that I have utilized the perspective of tectonics in this dissertation to scrutinize a single material, combining the experiential and the constructional levels of tectonics, also entailing the aspect of architectonic quality, and framing the perspective by existing perception studies of wood and the cultural context.

Due to the novelty of the abovementioned tectonic viewpoint in current literature, it is naturally not possible to make direct comparisons between existing scientific knowledge and the new knowledge provided in this dissertation. Thus, I will discuss the findings of this dissertation in the light of relevant literature divided into areas that follow the logic of the theoretical background chapter. These areas of relevant literature are architectonic quality, experiential qualities of wood in the context of building, and the Finnish cultural context of log building. Before going into discussion of these aspects, I will first discuss the theoretical contribution related to the tectonic perspective.

4.1.1 The tectonic perspective and logs as architectural material

Since logs as architectural material from the viewpoint of tectonics is an aspect that is virtually uncovered in current literature, the knowledge that this dissertation produces contributes significantly to the existing scientific knowledge on the matter. In addition, this type of approach is something novel within the scope of materials research in architecture. In general, the review of the perception studies regarding professionals' views on wood (see 2.2.2) showed that the primary aim among these studies often is to recognize barriers and benefits of using wood, motivated by finding ways to increase the adoption of timber constructions for sustainability reasons. The literature review did not reveal previous work on mapping perceptions of professionals to gain insight that would be helpful from an architect's perspective on the issue of how to use wood, let alone logs, as is the case in this dissertation. I will discuss this overall approach next.

In a study regarding architects' considerations while selecting materials during the design process, Wastiels & Wouters (2012) state that in research and other sources that provide information about material aspects to support architects' and designers' material

selection, an engineering approach is prevalent. This provides comprehensive information on the technical properties of materials, whereas there continues to be a need regarding knowledge on experience aspects of materials (Wastiels & Wouters, 2012). According to the authors, in the field of architecture and design more generally, the importance of non-technical aspects related to experience have only recently started to gain interest, leading to the introduction of approaches like '*design for experience* or *multi-sensory design*' (Wastiels & Wouters, 2012). In the practice of architectural design, the issue that is caused by the lack of such information is traditionally tackled by counting on intuition, perhaps complemented with browsing a physical material library. Wastiels & Wouters found however, that these intuitively assessed experience-related aspects are difficult to identify and name for architects, and thus there is a 'need for more systematic descriptions and information on material experience.' (Wastiels & Wouters, 2012)

It is challenging, however, to produce such experience-related information about materials that could be easily exploited in architectural design. Wastiels & Wouters (2012) themselves found that when compared to industrial design, the material selection process in architectural design is differently context-driven, since a building exists in a physical and cultural context. Another challenge is that material experiences are generated in interaction between the material and the user, and with buildings, their users are very heterogenous by age, cultural background and gender, among other aspects (Wastiels & Wouters, 2012).

As I depicted in the theoretical background chapter of this dissertation, a growing body of research exists concerning the experiential effects of various wood materials and products for building occupants. Many of these studies also aim to produce knowledge to benefit designers, but for the abovementioned reasons, utilizing this type of knowledge is problematic. These issues, among others, have been recognized in the studies themselves as well, as it has been suggested that focusing on specific wood product categories would improve the accuracy of the results (e.g., Harju, 2022). Moreover, whether the material is used as a load-bearing or insulating structure, or merely a surface material might generate different experiences. In the findings of this study, for instance, logs as an understandable way of construction were perceived as soothing, safe, and healthy, due to log's solid composition. Thus, it could be argued that a wall with a wooden covering would not have the same effect. Another aspect in this discussion is that even if the selection of a material itself in the architectural design process was based on experience-related information in order to reach desirable outcomes, information provided in the current research among building occupants – as was the case with building professionals, such as designers – does not give insight on *how* to use wood either.

The knowledge resulting from the approach that I have devised for this dissertation might be of aid in the material selection process as well, but it should also be helpful regarding the question posed above. As I brought up in the theoretical background chapter, there are correspondences between this approach and Bejder's (2012) assessment of the aesthetic qualities of CLT or Huuhka's (2018) scrutiny on the potential tectonic uses of reclaimed timber. However, Bejder (2012, pp. 69–91) focused mainly on developing a theoretical model for analysing materials in architecture, primarily CLT, for academic use, while the aim in my dissertation has been to produce knowledge that would be applicable in the practice of architectural design. In this sense, Huuhka's (2018) research had a more similar aim, but only the aspects that I have in this dissertation labelled as pertaining to the constructional level of tectonics were included in Huuhka's scrutiny, excluding the consideration of aspects on the experiential level, that is also included in this dissertation.

In the effort to overcome these abovementioned shortages in previous studies, the approach that I have utilized in this dissertation focuses on a single material in real-life applications, in a definite cultural context. The qualities of logs are addressed by perceptions of various people, in order to entail a broad spectrum of aspects that might exist. When I have formed the overall understanding of logs as architectural material, findings related to tectonics on constructional and the experiential level have been combined. To shed light on the issue of how to use logs in architecture, the exploitation of the concept of architectonic quality as a general objective of architectural design is central.

However novel the type of approach that is presented here may be in the context of materials-related research in architecture, it is not anything novel in architectural design per se. As Weston (2008, p. 186) pointed out, already Frampton's Studies in Tectonic Culture from 1995 marked *a return* to reality, after modernistic eras that put less emphasis on material space. Moreover, Wastiels & Wouters (2012) note that as the choice of materials determines the structural possibilities, but also the character of the buildings, architects during their design processes consider also 'aspects that concern user experience or sensory stimulation, such as colour or texture', besides performance-related aspects of materials. And this is what architects have arguably been doing "for centuries" now.

This inconsistency that something is novel in terms of research, but almost self-evident in architectural design, has led to criticism towards how useful these research results can be for architectural design. For instance, Kjisik (2009, pp. 214–216) has been highly critical towards EBD in the context of architectural design of hospitals, noting that many of the studies that provide "evidence" to be utilized in design, are highly context-dependent, and some of the "evidence-base" that research has produced, such as the importance of paying attention to a room's daylight conditions or exploiting views from indoors to outdoors in an optimized way, have actually for ages been fundamental principles of good architectural design and cornerstones in the teaching of architecture, however novel those results may seem in the field of research.

To sum up, I have used the tectonic perspective in this dissertation in order to approach logs as architectural material through research in a way that would resemble how architects would approach logs in architectural design. In this sense, the depiction, 'return to reality', of Weston (2008, p. 186) is incisive, as the tectonic perspective highlights the meaning of construction and materials, which are, after all, a necessity in all buildings, as experienced by people, who are, in the form of building occupants, another integral part related to buildings. I hope that utilizing this perspective, which is arguably a novel one in the scope of materials research in architecture, has resulted in knowledge that is both relevant and understandably presented in a textual format, so that it can be easily obtained and exploited by architects who take the time to explore this work.

4.1.2 Architectonic quality and Finnish architects' perceptions

As architectonic quality is such a central part in the overall approach of this dissertation, as I have highlighted throughout this dissertation, almost as a by-product of the actual aim of this dissertation, it also contributes to the scientific literature concerning how architects perceive architectonic quality.

Overall, as it was elicited from participants in Articles III-IV, the participants' definition of architectonic quality as a coherent architectonic whole that holistically unites the multiple demands set for a building project was well in line with the understanding of architectonic quality by Nordic architects in general, as depicted in the literature review (see section 2.1.2). The complexity of the notion of architectonic quality was recognized in literature, as well as by the participants, who felt that there is even something mystical about how architectonic quality is created so that people intuitively experience it. Architectonic quality was recognized in the literature and by participants as an ideal objective, but difficult to define exhaustively. In the participants' accounts, the role of fulfilling the pragmatic demands were emphasized, perhaps because they were something that could be verbalized more easily than the "mystical" aspects of "anthropocentric" architectonic quality. However, the participants also believed it to be critical to fulfil the practical requirements in a way resulting in the architectonic whole to be coherent.

A sort of "elitist" connotation of architectonic quality was also brought up by some participants. In this view, the artistic, even avant-garde architectural appearance, aimed to impress colleagues, predominates over the pragmatic demands such as client's wishes, feasibility or durability. These types of contradictions have been recognized in the literature as well (e.g., Hardarson, 2005; Troiani, 2007).

It is contradictory that, despite the significance of architectonic quality as a general aim in architectural design, it is possible to perceive it so dichotomously. On the other hand, the dichotomous perception is also understandable, as both the artistic expression and

fulfilling the pragmatic demands are present in both the abovementioned negative and positive connotations of architectonic quality. In the negative connotation, the artistic expression is highlighted to the detriment of other demands, while in the positive connotation, artistic expression exists in balance with other demands. Ideally, according to the findings in this dissertation, architectonic quality is created when a building is a coherent architectonic whole that unites the multiple other demands in a satisfactory manner.

In addition to these rather universally applicable definitions of architectonic quality, in this study, they were linked to tangible aspects of architectonic constructions, namely of logs. Quite surprisingly, it seems that this is something novel in terms of current literature regarding architectonic quality. Rönn (2017), for example, addresses architectural quality on a general level without making direct references to tangible constructions. Pihlajaniemi (2014), on the other hand, evidenced a correlation between architectonic quality of apartment buildings and consumers' appreciation and willingness to pay higher prices for those apartments. However, as the architectonic quality in that study was defined simply through buildings being published in selected architectural publications (see 2.1.2), the quantitative study could not – and was not supposed to – elaborate what were the tangible aspects of architectonic quality in these buildings.

In this dissertation, however, many important attributes of architectonic quality were connected to tectonic aspects of log construction in the results. Among these, logs' nature as a concurrently load-bearing, insulating and visible material, expressivity of log constructions, as well as the overall spatial matrix created by log structures were brought up as such aspects of tectonics of logs that contribute to architectonic quality.

This dissertation did not address the importance of aspects related to tectonics of logs in terms of architectonic quality, when compared to other features of buildings. However, the results suggest that log construction and how it is arranged can have a very central role in contributing to architectonic quality in log architecture.

4.1.3 Logs' experiential qualities and wood in general

In general, many of the experiential qualities of logs found in this dissertation corresponded with what can be found from current literature concerning wood in general, as reviewed in 2.2. Aspects related to wood in general, such as soothing sensations of cosiness and warmth, among others, were found to be aroused by logs too. In addition, in reviewed literature, naturalness was stated to be one of the main reasons why wood is preferred over other materials (e.g., Nyrud & Bringslimark, 2010), and natural elements were stated to have the possibility to produce positive experiences for building occupants (Burnard et al., 2017). However, it was also found in the reviewed literature, that the level of processing in EWPs alters the perception of naturalness too, so that composite wood products with a greater amount of apparent transformation were considered less natural compared to totally wooden samples. Logs too were perceived as natural per se, but the presence of adhesives was seen to lower the level of naturalness. In the case of industrial logs, the amount of transformation was considered generally relatively low and thus industrial logs also were considered mainly as something natural, and still as logs per se.

Along with naturalness, another, perhaps even more important positive attribute of logs was perceived healthiness and potential health benefits that are achieved by using logs. The main perceived health benefits recognized in current literature related to wood in general were related to psychophysiological effects of wood, mainly as an interior material, inducing positive feelings as an element of nature (e.g., Burnard & Kutnar, 2015). Wooden surfaces have also been found to moderate humidity fluctuations of indoor air, leading to a positive experience for occupants (Alapieti et al., 2020). This phenomenon is known as breathability of wood, based on wood's hygroscopic properties, as I have discussed earlier in this dissertation. Breathability was among the perceived positive attributes of logs as well. However, in the context of logs, the breathability aspect was intertwined with healthiness of the structure, in the sense that log structure is a safe and healthy choice considering

moisture-related problems, that were perceived to be more common in other type of outer wall structures.

In the light of the literature review of this dissertation, this type of perception, characteristic for log structures, is not found connected to other wooden products or wood in general. It is possible that this type of conception of log walls as a healthy structure is characteristic for the Finnish cultural context and the strong existing understanding of traditional log building, in which logs are utilized without additional insulation, as a sole material for exterior walls. This continues to be the current practice in Finland with contemporary log buildings as well. In other countries, such log walls of solid wood seem to be rarer. While other reasons for not using walls of solid wood might exist elsewhere, such as climatic reasons, practice has shown that also due to energy efficiency regulations, massive log walls can be even prohibited in some other European countries. Thus, due to the rarity of massive wall structures of wood, it is quite understandable that this type of perception of healthiness regarding wood does not emerge in those contexts.

Another aspect of perceptions of logs that was not emphasized in the literature concerning perceptions of wood more generally, was a downside, namely the rural and cottage-like stigma when logs were brought into the urban context. Perceived downsides related to wood that were reported in current literature were concerns about durability or negative environmental impacts such as deforestation from the laypersons' perspective (e.g., Viholainen et al., 2021), while downsides from related professionals' perspectives included material properties such as fire and sound insulation and durability, along with structural performance and cost, which, on the other hand, were seen as benefits of wood in some studies (e.g., Franzini et al., 2018; Ilgın et al., 2021).

In the results, the notion of cultural purity (Douglas, 1966) was proposed as an explanation for why logs are tolerated in rural or summer cottage context but not in the urban context. It was also reasoned that a possible way to overcome the threat that logs are considered as "culturally impure" and thus undesirable when used in the "wrong" places is through a transformation that could be achieved through contemporary architectural design of log buildings. It might be that the other types of EWPs used in contemporary construction more generally have gone through such a transformation that they are more readily considered to be culturally "pure" even in the urban environment.

To sum up, it seems that many of the general experiential and perceptual qualities that wood entails, recognized in the literature, are valid for logs too. However, logs seem to possess also features characteristic only for log construction, most notably the perception of logs as safe materials to protect against moisture-related issues, which was considered directly beneficial for occupant health, but also as something soothing in general, due to the understandability of the structure. As researching and justifying the application of wood in construction are often reasoned citing potential health benefits, this finding seems significant. It also merits an interesting topic of further research on other types of massive wooden structures, such as CLT: Is this same perception of positive health impacts valid in massive wooden structures as well and under what circumstances?

These novel findings regarding log structures might have been enabled by the overall aims and scope in this dissertation. As was highlighted in the literature review, current research has tended to exclude some aspects that are present in this dissertation, such as addressing a particular wooden construction material in a real-life setting, dealing with architectural use of wood as a whole, including the structural and exterior use, and focusing also on other than technical aspects in mapping professionals' perceptions. It could be argued that allowing these aspects into consideration has enabled the novel findings I have discussed above.

4.1.4 Current situation of logs in Finland through a cultural lens

As the final part of the theoretical implications I will discuss here, the findings in this dissertation contribute to the existing body of literature dealing with logs and log building as a phenomenon in Finnish culture, especially from an expert viewpoint; I reviewed these previous works in the theoretical background chapter.

Within this viewpoint, scrutiny of log building is framed with the holistic portrayal of the Finnish

cultural context, containing a delineation of historical developments as well as references to overall "climate" regarding log building, that is, how it is generally perceived by the public or different groups of professionals, such as architects or building and planning control authorities. These are complemented with very comprehensive descriptions of technical aspects of log building, so far focusing primarily on log building that utilizes settling log types. (e.g., Heikkilä, 2001; Saarelainen, 1993, 1999; Vuolle-Apiala, 2012)

In his doctoral dissertation, which can be also seen to fall into the category of this type of scrutiny from a professional viewpoint, Jokelainen (2005, pp. 18–33) presented an interesting delineation of three historical periods of log building in respect to Finnish culture, each period characterised by a distinctive general attitude towards log building. The three main periods, which I described in more detail in the theoretical background chapter of this dissertation, were the period of vernacular builders from the 7th century until the middle of the 19th century, the turning point of industrialization in the turn of the 19th and 20th centuries and industrial manufacturing of log buildings from the 1950s onward.

Based on the overall understanding that I have formed through compiling the findings in this dissertation and comparing them with the theoretical background, a fourth era of log building in Finnish culture can be proposed here to be added to Jokelainen's above-mentioned periodization. This has been previously anticipated in the literature as well, as after the turn of the millennium, Heikkilä (2002, p. 17) suspected that a new renaissance for log construction would be beginning. The new period, proposed here to have started approximately from the 2010s, is characterized by a significant rise in the market share of single-family log houses, supposedly fostered by changes in culture that highlight values of sustainability and healthiness, along with the overall pleasing appearance of wood (Jussila, 2020). In this dissertation as well, these attributes were associated with logs by the study participants. These factors are also often mentioned among the drivers behind the currently ongoing, more general, global increase towards interest in using novel construction techniques of massive timber (e.g., Gosselin et al., 2017).

According to Jokelainen (2005, pp. 32–33), it was characteristic of the last period of log building, during industrial manufacturing from 1950s onwards, that development was directed towards technical aspects and the manufacturing process alone, and no professional designers, such as architects, were used. In addition, Heikkilä (2002, p. 17) has noted that until the end of the 1990s, the architectural profession showed little interest in using logs. On the contrary, however, a tangible aspect that is definitive for the current period proposed here is related to the architectural appearance of log houses, towards which a new emphasis has been directed on behalf of the log industry, so that a variety of options for single-family houses suitable for detailed planned areas exist today (e.g, Lakkala & Pihlajaniemi, 2019, pp. 17–20). Moreover, in the results of this dissertation, it was found that architects are excited by the novel possibilities that the current industrial production offers. These views are also undoubtedly linked to the overall image of logs, which was found to be very positive indeed.

Overall, this new period is also characterized by the definitive generalizing of industrial logs that gradually marginalized hand-hewn logs, compared to the earlier period, when industrial manufacturing was only starting. At the turn of the millennium, some 30% of Finnish log products were still hand-hewn (Heikkilä, 2002, p. 17). In addition, the strong generalizing of non-settling logs has been recognized as one of the biggest changes in the industry during recent years (Lakkala & Pihlajaniemi, 2019, p. 184). In the findings of this dissertation as well, the introduction of non-settling logs was found to enable novel possibilities for the architectonic appearance of log buildings.

However, due to the novelty of non-settling logs when compared to the tradition of log building, which proved to have a well-known role in the Finnish culture, the results indicated that there is some uncertainty among architects about how this novel development should be dealt with. Moreover, despite the fact that logs were found here to evoke positive perceptions among the public, and arouse much interest in architects as well, the current period is also somewhat characterized by uncertainty about logs more generally. Besides the generalizing of the non-settling logs, the uncertainties are caused mainly by

what was dubbed as the "urban question": Can log be an urban material or does it become "culturally impure" when used in novel contexts? In addition, uncertainties are caused also by technical properties, namely the glue, which stirs up doubts regarding healthiness and questions about the "genuineness" of logs. In general, among the layperson participants in this dissertation the various positive perceptions regarding logs seemed to have the ability to overcome the negative perceptions. On the other hand, architects' views were more contradictory, which made log appear currently as quite a difficult material professionally.

This uncertainty that characterizes the current period could be seen as an important indication of the importance of the new knowledge and understanding that this dissertation provides. Harari (2016, pp. 59–65) has used the term 'cultural cargo' to explain why people expect to have lawns in the yards of their houses. According to Harari, neat lawns as something non-productive, but laborious and expensive, were originally considered as status symbols of the French and English nobles in the late Middle Ages. Through later use of lawn in, for example, important administrative buildings and soccer fields, people started to associate them with political power, social status, and prosperity. Then, due to the industrial revolution, the lawnmower and irrigator, lawns turned from a luxury of the rich to a necessity of the middle-class in American suburbs, and their condition in this new context too served as a signal of the general situation of the lawn's owner. Harari uses this example to illustrate the relevance of historical knowledge, which is obtained not to repeat history or predict future, but to be liberated from the grasp of the past. When one is aware of the cultural cargo behind the desire to have a lawn, a conscious decision can be made to either have a lawn anyhow, or to have something totally different. (Harari, 2016, pp. 59–65)

It could be stated that quite similarly, even though contemporary logs as architectural material are associated with a multitude of positive features both from professionals' and laypersons' viewpoints, log's well-known history has created log's "cultural cargo". For instance, log is seen primarily as a rural material, due to the cultural cargo created by logs' extensive use in rural buildings. Log is also seen as a healthy, natural, and unprocessed material, so when it is developed and produced industrially including glue, suspicions and contradictions are raised. These contradictions are among the things that currently make contemporary logs such a difficult material from the viewpoint of architectural design. On the other hand, cultural cargo can turn into something positive as well. Traditionality, for example, appeared currently as a positive attribute associated with logs in the results, while the overly traditional image of logs was among the reasons why they were replaced by other materials in the beginning of the industrialization era (Jokelainen, 2005, pp. 18–33).

Even though my dissertation does not represent historical research, the relevance of this new knowledge can be reasoned somewhat analogously to Harari's reasoning. In this research, I have described and clarified the current situation of log as an architectural material through participants' views, framed by relevant literature. Through this research, the target audience, namely architects and the log industry, can understand the current situation, what kind of development has led to it and, through this new understanding, be as free as possible to decide how to continue from the current situation. Logs as an architectural material bears cultural cargo, but becoming aware of this cargo, it can be shaken off.

What log is and aspects that are culturally related to it change over time. Jokelainen (2005, p. 179), for example, has stated that mimicking the traditional way of log building in the context of industrial log building is something that hinders the development in that context, but the eventual developed way of building should not be called log building anymore, but rather massive wood construction. Regardless of this view, industrial log manufacturers have preferred to continue to define their products as logs despite the altered properties, mainly because of the positive associations the term evokes in their customers(Lakkala & Pihlajaniemi, 2019, p. 185). However, manufacturers have added additional attributes to the word log, such as lamella log or non-settling log (Lakkala & Pihlajaniemi, 2019, p. 185). In this dissertation as well, through participants' perceptions, log has been defined as a longitudinal piece of massive wood – with or without glue and manufactured industrially or hewn by hand – that are stacked horizontally on top of each other.

To sum up, the current period of log building in respect to Finnish culture, starting from the beginning of the 2010s', is characterized by an increase in overall popularity fostered by cultural changes, new emphasis on architectural appearance of log houses, new interest towards log on behalf of architects, definitive marginalizing of hand-hewn logs, strong generalizing of non-settling logs and overall uncertainty, especially on behalf of related professionals, created by these relatively rapid changes. In addition, currently the hand-hewing of logs and industrial manufacturing of logs coexist as two clearly separate traditions of log construction, although there are some definitive features that are common for both traditions. The large masses of log buildings are, however, produced industrially. Thus, this period could be dubbed as the *rebirth of log building*.

4.2 Practical implications

As stated previously, the new knowledge regarding logs as architectural material from the viewpoint of tectonics that I have produced in this dissertation is intended to inform and support the development of log architecture and logs especially by architects and secondly the log industry. In this section of practical implications, I will discuss the findings of this dissertation in the light of the practice of architectural design, that is, how these findings could be seen to inform and support the development of log architecture and logs. This discussion is divided into two sub-sections: architectural considerations, and implications of logs' desired qualities for manufacturing – I will present these next.

4.2.1 Architectural considerations

The way and extent to which the knowledge produced in this dissertation can inform architects is far from straightforward, as I already discussed in 4.1.1. This is a context-dependent question, but also a question of subjective preferences for how architects want to interpret these findings in their work. Regarding this, however, I will discuss next the main points that have emerged during the research process, from the viewpoint of architectural design, for me as an architect having conducted this research.

Overall, utilizing logs as architectural material can be seen as justifiable due to the positive experiences that it can offer for building occupants, let alone the aspects related to potential sustainability that apply to wood architecture. On the other hand, the persisting negative stereotypes associated with logs, such as their rural or cottage-like reputation and doubts raised by the use of glue, make architectural design of contemporary log buildings for urban milieus complicated. These incoherencies, however, are expected to be fitted together by architects. Thus, architects who take on this challenge in Finland should be aware of the variety of perceptions that are currently connected with logs. This is one way to exploit the findings of this research in practice – to consider the various perceptions related to logs to support the intended outcome of an architectural project. These aspects were mainly addressed in Articles I-II (see 3.1 and 3.3).

Additionally, in Articles I-II, the novel architectonic appearance of new log buildings was found to have a crucial role in making them acceptable to new use contexts in urban milieus. Thus, another way to exploit the results is to use the experiences of interviewed architects, addressed in Articles III-IV (see 3.2 and 3.3), as an inspiration and guidelines for future log architecture. In the results, a multitude of aspects were described to highlight how log constructions can be utilized as a way to promote architectonic quality. These aspects ranged from the scale of architectonic whole to the scale of details in corner joints and single logs.

The third way of exploiting the findings of this dissertation is connected to the discussion on cultural cargo, presented above in 4.1.4. Following the line of thinking of Harari on cultural cargo (2016, pp. 59–66), when architects, through the knowledge provided by this dissertation, begin to understand thoroughly the current situation of using logs as architectural material, and the cultural cargo that has been gathered along the way, they can liberate themselves from it. Then they can choose more freely how to proceed with this ancient material and technique, that has become topical again in a changed form and cultural context. While the above-mentioned other two ways of exploiting the findings can be accomplished by focusing on the results chapter, this third way needs further explanation, especially when thinking about

the future of logs from a professional perspective. Thus, I will discuss this third way of exploiting the findings here more thoroughly, regarding the cultural cargo and what it could mean to be liberated from it.

In the Finnish cultural context, the role of logs in terms of appreciation has varied from a prevalent, very sophisticated handcraft construction technique to an abandoned and outdated material of the past, then from a basic industrial material used to build summer cottages to its current "reborn" position described in 4.1.4. Due to this evolution, currently two divergent traditions of log building coexist, which are the marginal hand-hewing technique and the industrial production. What is noteworthy, as seen also in this dissertation, is that interesting contemporary architecture is created within both these directions.

In terms of architectural design, however, based on the findings of this dissertation, logs used in these two directions have major differences as architectural materials from the viewpoint of tectonics. These differences are related to the atmosphere of the resulting architectonic space, as well as to technical properties – particularly with non-settling logs – and thus architectonic possibilities. Now, as the general perception among participants in Articles III-IV was that, in terms of architectonic quality, it is crucial that the architectonic solution is characteristic or natural for the materials and construction technique, understanding the current duality is significant for architectural design. Currently, it is clear that characteristic use of logs in general is ambiguous, due to the co-existing two directions that logs have.

This ambiguity was also especially present in the responses of participants in Article IV. Regarding the connection between architectonic quality and tectonics of logs, the perceptions of architects were influenced by the older hand-hewing tradition of log building, accompanied by its characteristic limitations, which led to some inconsistencies in the responses. On the one hand, structural factors of log construction were seen to limit the architectonic possibilities, and these limitations were seen as important starting points for log architecture. Then again, non-settling logs were seen to enable novel possibilities. Thus, with non-settling logs, the earlier starting points for architectural design in this sense would not seem to apply anymore.

In the light of the scope of this dissertation, the main differences between the two traditions can be highlighted with consideration of two sets of three aspects that were found to be characteristic for logs. The first set, associated with logs in all Articles I-IV, was the longitudinal shape, solid wooden composition, and a distinctive way of building, that is, the stacking of logs on top of each other. Another distinctive set of three aspects of logs was found to be that it is a simultaneously bearing, insulating and visual material, and it is thus possible to make "transparent" constructions with it that are understandable with a single glance, basically through corner joints, which emerged as important symbols of log building. Regarding architectonic quality, the greatest benefit of using logs was found to be related to this understandability, or "honesty", and making the most of it in the architecture. This understandability fascinated architects but was also important for the perception of log as a healthy material, as I have pointed out earlier in this dissertation.

However, currently within the direction of industrial logs, these two sets of three aspects are changing. Firstly, non-settling logs were stated to enable novel ways of using logs since additional structures can be integrated with it more easily than with settling log structures. Thus, it can lead to situations that logs are simultaneously visual and an insulating material, but not structurally bearing. Indeed, there are now several examples in Finland of large buildings in the 2020s – public, commercial, and residential – that have a concrete structural skeleton and outer walls of non-settling logs. This was something that was precisely opposed in the results – "superimposing" logs on an otherwise regular building and disregarding the traditional "rules" of log structure as an overall starting point for log building. Secondly, the non-settling logs were stated to require mitre-cut corners. The perceived challenge of these hidden joints was that the understandability of log construction is compromised.

Thus, the current issue with non-settling logs seems to be that while the addition of glue to logs already made them appear less natural and genuine, glued logs continued to be perceived as logs per se, due to the above-mentioned definitive two sets of three aspects. However, eliminating the visible corner joints made log construction feel like "log-wallpaper"

for some participants, and some of the genuineness of log construction was lost. Moreover, losing the bearing function of logs made some of the participants ponder whether it would be more "reasonable" to replace logs with CLT plates in these types of situations. The aspect of understandability appeared as an important argument for the use of log as a bearing structure with visible cornering. However, it seems likely that it is also one form of cultural cargo that due to past examples and the tradition of log building, logs' use as a bearing structure appeared as the primary starting point for architects and that without visible corner joints, log construction felt less genuine.

One possible way to respond to this pondering concerning contemporary logs and CLT – and at the same time try to shake off the cultural cargo – is that non-settling logs can actually be seen as longitudinal construction elements of solid, cross-laminated wood, just as CLT plates. However, their shape is, at least commonly, different than CLT, which are usually used as plates. Moreover, these longitudinal elements are joined together with horizontal seams that have tongues and grooves in them to make them air and weather tight. The current log industry in Finland is specialized in manufacturing these elements at an industrial scale. Practice has shown that beyond shape, there are also other differences between the two. For example, logs are ordinarily used as a façade material, whereas CLT is more commonly covered with a cladding. As the size and shape of the commonly used elements are different between the two, also other feasibility-related aspects might separate them, such as material or transport efficiency. The differences between these two very similar materials would most definitely serve as an interesting topic of future research, from these multiple practice-oriented viewpoints, including also the perception-related differences brought up earlier in 4.1.3, concerning whether or not solid CLT-structures would be perceived similarly understandable, and thus healthy, as log structures.

Regarding the discussion on cultural cargo and being liberated from it, I believe it is illustrative to return to the abovementioned "hybrid" log buildings. These buildings should not be considered as part of the research material of this dissertation. However, during this dissertation process I have followed and learned about these projects out of professional interest. Thus, I want to discuss how hybrid log buildings appear in the light of the knowledge provided by this dissertation from my own perspective. In the end, also the Monio building, which was part of this dissertation's research data during its design phase is now, as erected, one of these hybrid log buildings.

As pointed out above, through the lenses coloured by cultural cargo, these log buildings could be considered less genuine and even their reasonability in general can be questioned, due to the separate load-bearing structure, mitre-cut corners, and comparisons with CLT.

However, these buildings can be viewed from another angle as well. If we think that these buildings do not utilize logs, but longitudinal construction elements of solid, cross-laminated wood, like I proposed above, the construction can appear differently. Overall, in Monio for example, this element is used in a way that creates a very coherent architectonic whole, which was viewed as a crucial attribute of architectonic quality in this dissertation.

In addition, when the exterior walls are made of this log-shaped element, virtually all the best features of log construction are applied. When logs were used extensively in Finnish building, prior to the industrialization era, they were used as a wall structure that is clad both in interiors and exteriors (Kaila, 1996). Currently, however, most of the aspects related to log that are perceived as its positive qualities, requires an unclad log structure. Logs along with wood in general can have restorative effects for building occupants when such surfaces are exposed in the interiors, as shown in the reviewed literature in section 2.2. Indeed, many of the most important desirability aspects related to logs can be achieved with an exposed log wall *interior* surface. Basically, a wooden interior cladding could provide those benefits that logs entail as a natural wood material, but for the perceived healthiness that is characteristic for logs, the walls need to be solid wood. Thus, for these benefits, log building does not necessarily have to utilize visible corner joints and disclose its "log-ness" to the outside.

On the other hand, mitre-cut corners and the resultant even courses of logs were also found to make the log construction appear more contemporary as well as urban for some participants. However, log buildings of characteristic looks were also desired by

laypersons in the urban environment, as they were viewed as generally refreshing and to disclose visually the positive values that logs currently represent, such as naturalness, healthiness, and ecological aspects. It remains also a topic for further research how the new types of log buildings, in which the corner joints do not reveal the composition of the construction, are perceived among building occupants. However, it might also very well be so that the other visible characteristics of logs, i.e., the shape of the wooden element and stacking them up one on top of the other, is enough to make the structure be perceived as a soothing, understandable and healthy structure of solid wood.

Still, in order to promote the aspect of understandability, with future buildings utilizing contemporary logs, architects may need to come up with strategies and architectonic solutions that – despite the lack of visible corner joints – somehow make the solid composition of the walls visible. One option is to use visible corner joints in the interiors where the log ends are not exposed to weather, as was brought up in the results as well. This is also the case in the Monio's "main street". It needs to be said, though, that the ends of non-settling logs do not look the same as settling logs' ends due to the crossing lamellas, like illustrated in Figure 6. It might be that the level of processing appears higher with this type of logs, decreasing their perceived naturalness. Since in this dissertation the logs used in the Timber Tetris pavilion were glued but consisted of parallel lamellas of wood, it is unclear how these different looking log ends would have affected the participants' views. Thus, further research would be needed regarding general perceptions of non-settling logs.

What about the interior walls of logs then, that do not have a bearing function? One could ask if it is "reasonable" to make them out of this very robust log-like wooden element, as they do not have an insulating function like exterior walls, which virtually represent all the best features of log construction. A possible response is that, reasonable or not, these structures that limit the interior space need to be made somehow, and using these elements of massive wood is one option. Using these can contribute to architectonic quality through the resulting coherent architectonic whole, as in Monio, for example. Thus, instead of questioning the justification of using contemporary logs in this way, it can be seen also as an example of the diversity of their novel architectural use.

To sum up, then, these hybrid log buildings of the 2020s can be viewed to be characterized by an entity made of horizontal elements of solid wood. This could be one way to look at contemporary industrial logs as architectural material in the future. If the cultural cargo can be shaken off and logs are understood as these massive wooden elements that are not restrained by the tradition of log building, the architectural design of novel buildings of mass timber can be developed into interesting directions. Future log constructions utilizing industrial logs do not have to look like traditional log buildings necessarily. In fact, it might be even preferable that logs and their use is somehow altered as was proposed in the results of this dissertation, for them to be better accepted for novel uses and contexts in urban environments. The task for architectural design is, then, to alter the appearance of logs and log buildings to shake the rural stigma, but not to the extent that the positive qualities associated with only logs would be lost. It would seem to be important to think of novel strategies regarding the architectural solutions of log constructions through which the benefits of massive timber, brought up in this dissertation, can be fully exploited, as such log constructions might possess unused architectural potential.

4.2.2 Logs' desired qualities and implications for manufacturing

Throughout the results of this dissertation, several aspects emerged, which indicated some tangible detail-level aspects of logs that could be taken into consideration as log manufacturers further develop the qualities of logs in the future. In this second sub-section of practical implications, I will focus primarily on these detail-level aspects of logs.

Overall, many accounts indicated that there should be a variety of options regarding these detail-level solutions. In Article I, when evaluating the Timber-Tetris pavilion in Oulu, layperson participants preferred varying detail-level qualities of logs. For instance, more natural, even very traditional round logs were desired by some participants. In addition, some participants would have wanted the surface texture of the logs to be rougher compared to the

planed surface of lamella logs, whereas others would have preferred an even smoother surface. The interviewed professionals in Article II, on the other hand, urged novelty regarding the details of the logs, such as corner joints and bevels of single logs. Bevels as small as possible were desired. Article II proposed that through novel detailing, logs are transformed so that they no longer appear as a "cottage-like" material in novel contexts and are thus regarded as culturally pure and ca be accepted also outside the summer cottage context.

In Articles III-IV, the interviewed architects highlighted the significance of detail-level solutions of logs as well, which were viewed to affect architectonic quality, particularly in large public buildings, in which the detailing was viewed to be currently adopted from regular catalogue houses, and thus did not reach the level required for public buildings. Details such as window junctions, logs' surface texture and bevels, corner type, and shape of the log's cross-section profile were brought up. As an example, a log surface hand-hewn with an axe was viewed as a strong memorable material, resulting in a totally different atmosphere compared to a planed industrial surface, in which the appearance is more precise and "colder". In general, choosing the correct type of log was contrasted with choosing the correct type of brick. With bricks, an abundance of options exist regarding the shape, size, colour, surface texture, etc. Also, various types of corner joints were stated to be needed to fulfil the different spatial, visual or technical needs. All in all, all these details were seen to be dependent on the context, and thus should be considered separately in each project, based on case-specific aims. Naturally, a balance between a feasible industrial process and sufficient variety in product attributes needs to be settled.

Thus, as logs are developing into a contemporary industrial material that can be used in diverse contexts from rural to urban milieus and from small-scale residential to large public buildings, a multitude of options regarding the detailing of logs need to be provided by the manufacturers in order to fulfil the needs of architects when solving architectural problems utilizing logs. The results indicate that there is a need for, e.g., alternatives in cross-section profiles with various types of bevels; options for corner joints that are "long" and "flush"; alternative industrial solutions regarding surface textures, in addition to different quality classes characterized by, for instance, the knottiness and colour variations of wood. Regarding all these aspects, options for interior use and exterior use might differ, as different demands affect the log surfaces in interior and exterior uses that can be visual, tactile, or related to durability by nature. This also leads to a conclusion that there might be a need for such logs whose qualities are different between the outside and the inside. The current composition of logs consisting of core lamellas and visible lamellas of wood should be quite flexible in this sense. Regarding exact needs and expectations concerning the above-mentioned qualities, more research is needed, both from architects' as well as building occupants' viewpoints. As there were no surface treatments in the logs in the Timber Tetris pavilion, nor were they particularly weathered, these aspects should be also considered in the future studies proposed above.

Another aspect that should be highlighted here is the glue in logs and how it was perceived by the study participants as somewhat problematic, especially in Articles I-II, that is, on the experiential level of tectonics. The layperson participants were concerned about the breathability of glued logs and whether they release harmful emissions into indoor air. The architectural professionals in Article II feared the glue caused a decline in logs' naturalness and "genuineness", which were also some of the logs' most compellingly perceived qualities. However, among participants that had professional experience with logs, mainly in Articles III-IV, the glued logs were rather accepted as part of everyday practice, and the necessity of manufacturing logs this way to produce them at an industrial scale was acknowledged. Also, the technical benefits of glued logs – their efficient production, technical stability, and overall homogenous quality – were understood among these participants.

Thus, as among architectural professionals with less experience with contemporary logs, and layperson participants too, the preoccupation towards glue was somewhat negative, the communication of the potential adverse effects of glue, or lack thereof, should be very open. This way, the benefits of glue can be likewise disclosed openly. Another way to tackle this issue would be to follow the lead of CLT and its

glue-free alternatives and develop lamella logs without glue. The potentiality of this type of log and perceptions related to it would require further research; as such these logs were not addressed in this research. As plastic-based glues are used currently in log industry, it would be also interesting to examine whether a bio-based glue would cause lamella logs to be perceived, for example, as more natural.

Before delving into the complete range of recommendations for further research, I will present a consideration of the trustworthiness of this research next.

4.3 Consideration of the trustworthiness of the research

Ascertaining the quality of qualitative research is an ongoing, not yet concluded discussion that has been done since the beginning of qualitative research (Flick, 2018, p. 16). With qualitative interviews no generic ways exist to judge quality, so the criteria must be 'considered in relation to various theoretical conceptualizations of interviews and disciplinary conventions.' (Roulston, 2014, p. 308) Thus, I will discuss the aspects of the trustworthiness of this research mainly in the light of what Groat & Wang (2013, pp. 79–99) have raised concerning the subject in their opus of field-specific to architectural research.

Groat & Wang (2013, pp. 79–80) recognize as a potential threat that a work of architectural research is not evaluated according to the standards of quality concerning a correct paradigm, as the field of architectural research is inherently an interdisciplinary one and research is conducted within multiple paradigms from objective, positivist, to more subjective, constructivist systems of inquiry. I have depicted the research approach of this dissertation in section 1.3, and in terms of paradigm, it could be described as constructivist, but situated in between the radically subjectivist constructivism and the intersubjective paradigms.

For this type of research paradigm, four aspects of quality standards are presented, which are credibility, transferability, dependability, and confirmability (Groat & Wang, 2013, pp. 80–86). To assess these aspects, it might be useful to recall the overall aim of this dissertation: to form a current, in-depth understanding of contemporary industrial logs as architectural material from the viewpoint of tectonics. The new knowledge is supposed to inform and support the development of log architecture and logs especially by architects and secondly the log industry.

The first aspect of quality standards is credibility. This aspect deals with the truth value of the research data especially, and the ability of this data to take into account the natural complexities of a situation under study. Important measures of this are triangulation – meaning multiple data sources, investigators and/or data collection techniques – and member checks (Groat & Wang, 2013, p. 84), which mean the continuous testing of data and derived interpretations with study participants from which the data are solicited (Guba, 1981).

Before going into the forms of triangulation in this research, the overall justification of the primary way of acquiring research data in this research is briefly considered. Section 1.3 Research approach depicts how the chosen research paradigm frames the choice of methodology and eventually data collection tactics, that is, interviews. In qualitative research, interviews are a very common and useful method, as was described in 1.4 Research methods and materials. Thus, the selection of methods and materials should be seen as a natural consequence of the overall aim and research problem of this dissertation.

Even though the primary way of acquiring research data in this dissertation was through interviews, the empirical data from which the findings are written consist also of the architectural presentations of the projects, as well as the actual pavilion construct of Timber Tetris that were discussed with the interview participants. In addition, regular interviews, as well as go-along style interviews were used. Regarding study participants, a wide range of individuals were involved, including laypersons with varying backgrounds as well as current and future architectural and constructional professionals with and without professional experience with logs. The architectural professionals also had varying backgrounds from design practitioners to local planning and building authorities' office holders. Moreover, the holistic perceptions of log building were mapped in two locations, and the connection between the tectonics of logs and architectonic quality was examined within two different contexts. The theoretical perspective also

included the experiential and constructional levels of tectonics. In addition, there were altogether 2-3 investigators working together on all the articles. Thus, triangulation on different levels took place in this research. However, it could have been fruitful to conduct interviews also in actual log buildings. This could be covered in future studies. In addition, as the interviewed group of laypersons consisted of university staff and students, acquiring layperson interviewees without any such common denominator could have produced a different spectrum of perceptions.

Guba (1981) proposes that member checks should be done both during and after the completion of the study. In this dissertation, these were not executed. With layperson participants especially, the truth value of the data might have been improved by member checks. However, there is also disagreement regarding the use of member checks, as they can also become an ethical problem, especially when vulnerable groups of people are confronted with what the researcher has found when analysing their statements (Flick, 2018, p. 11). Even though the interviewed people in this dissertation were not interviewed about a sensitive topic per se, other types of ethical issues might have emerged. Especially the fact that the interviewed professionals were mostly very busy and taking time out their schedules for a single interview with no compensation was already a big thing to ask. Going through their accounts and derived interpretations with them could have been too much. Moreover, it would be interesting to contemplate the authorship of such findings co-created with the participants. All in all, with member checks, the truth value of data might have been improved regarding professionals' accounts as well. However, it must be noted that the significance of member checks might be greater in more traditional anthropological circumstances that the quality criteria of Guba (1981) essentially reflects. In these circumstances, for example, the lifestyles of people previously unknown to the researcher are under scrutiny.

Transferability, which is the second aspect of quality standards discussed here, is an approach toward "generalizability" of research findings, but in the case of qualitative research it is rather a consideration of 'the extent to which the conclusions of one study can be applied to another setting or circumstance.' (Groat & Wang, 2013, p. 85) Needless to say, this research is not striving for any kind of statistical generalizations. Transferability has also been called 'reader generalizability', as no discovery of general conditions under which the results are valid is required, but instead, 'it involves a transfer of knowledge from a study to a specific new situation.' (Maxwell & Chmiel, 2014, p. 541) A prerequisite of transferability is "thick" description that enables the reader to decide whether the results are applicable elsewhere (Groat & Wang, 2013, p. 85; Maxwell & Chmiel, 2014, p. 541).

As this dissertation has aimed to produce such knowledge that could be exploited in architectural design, it is important that this type of transferability would exist, since architectural design is highly contextual; the ways in which the findings of this dissertation could be applied was discussed particularly in 4.2.1 Architectural considerations. Regarding the aspect of transferability, I have strived to provide sufficient details in this dissertation regarding the particularities of the settings studied.

The third aspect of quality standards of qualitative research within this paradigm is dependability. A primary means to achieve this is through an audit trail, in which the process of data collection, analysis and interpretation are transparently presented (Groat & Wang, 2013, p. 85), which enables the reader to assess the consistency of the generation of findings from the data. Overall, all the aspects of this research from how the participants were selected to how the analysis was conducted is disclosed very openly in section 1.4 Research methods and materials. In addition to descriptive parts in this and other sections explaining the overall research approach, also reasons behind the choices made throughout this research are highlighted, in order to enhance dependability. In discussing the findings as well, the raised aspects have been openly linked with the results and thus, also consistently to interview data.

The final aspect of quality standards is confirmability. It is related to previous aspects, as triangulation and reflexivity on the part of the researcher are needed to ensure confirmability (Groat & Wang, 2013, p. 86). Reflexivity is about revealing the epistemological assumptions and their impact on framing of the research problem (Groat & Wang, 2013, p. 86). In this dissertation, the research approach along

with ontological and epistemological assumptions is openly disclosed. My own position and experience as an architect have been discussed, as well as how they have influenced the scope and viewpoint of this dissertation, along with the formation of research questions.

Beyond these four aspects, Groat & Wang (2013, pp. 86–97) disclose some additional quality standards among selected schools of thought and disciplines, one of which is constructivist. The addition to the above-discussed is the focus of constructivism for studying phenomena in their natural settings. Indeed, it has been seen important in this research that all the interviews were directly related to actual architectural projects, in addition to abstract issues and mental images, which clearly enhances the quality of this research. This was highlighted also in 1.4.1.

Even though the research devised for this dissertation strives to respond to the research problem as well as possible, one must remember that no single interpretation represents 'an all-encompassing portrayal of a phenomenon.' (Roulston, 2014) Thus, I will present next potential topics of further research on contemporary logs as architectural material from the viewpoint of tectonics.

4.4 Recommendations for further research

Throughout the discussion on theoretical and practical implications of log, I have identified potential areas of further research that are justified by the findings in this dissertation. In this final sub-section of the Discussion chapter, I will recapitulate these recommendations for further research, along with some more general ones.

One obvious theme of further research was related to the fact that contemporary, non-settling logs, which have recently been generalizing rapidly, seem to be very close to CLT, at least by material composition. In addition, the findings of this dissertation suggest, to some extent through interviewed architects' perceptions, that CLT is often contrasted with non-settling logs as an architectural material. Consequently, the two materials might even be considered, to some extent, as competing novel massive timber products. Thus, the differences and similarities that non-settling logs and CLT have as architectural materials from the viewpoint of tectonics would be important to clarify. The important topics would contain at least viewpoints of structural performance, and product qualities such as overall appearance and durability against the weather more generally, accompanied by other topics that are of relevance from the viewpoint of practice, such as feasibility aspects of material and transport efficiency that might separate the two.

Along with these rather technical viewpoints, perception studies focusing on the differences and similarities between the non-settling logs and CLT regarding their healthiness should be conducted. As was described in 3.3.3, the perceived healthiness of logs was intertwined with the understandability of log construction. Thus, it would be interesting to examine, whether this type of perception exists in connection to CLT as well, especially if CLT is used as a solid wall structure without any insulation; buildings have been constructed in this way in Finland at least. This topic would be an important one, as potential health benefits for building occupants are often brought up as important motivators for the use of wood, not to mention researching it.

In addition to this comparison, further research needs are related to the perception of contemporary logs themselves. As this dissertation was the first attempt to clarify contemporary logs as an architectural material from the viewpoint of tectonics, a considerable effort was made to position the contemporary logs into the cultural continuum of logs in Finland in general. In addition, even during the dissertation process, beginning from 2017, the situation around contemporary logs kept on evolving rapidly. Thus, it was not possible to cover the perceptions of non-settling logs exhaustively, and delving deeper into them is needed. For one, it would be important to examine how the new types of log buildings, in which the corner joints do not reveal the composition of the construction, are perceived among building occupants. Are they still perceived as log buildings and does the construction appear as understandable? Moreover, perceptions of the "hybrid" log buildings, in which the logs are used as a material of exterior walls along with a structural skeleton of some other material, is an important topic of further research as well, to investigate whether these types of buildings are still perceived as log buildings. In addition, as the appearance of the log ends of non-settling logs is somewhat different to the log ends of

lamella logs with parallel lamellas, they might be perceived as being more processed and thus less natural. This aspect should be explored in further studies. There are some recently executed, architecturally interesting buildings that could be exploited in these studies.

In addition to a research need regarding comparison of CLT and non-settling logs and general perception studies regarding non-settling logs, research is needed in order to inform the product development of logs. This dissertation found that logs have developed into a contemporary industrial material that could be used in diverse contexts from rural to urban milieus and from small-scale residential to large public buildings. However, this development sets diverse needs for the appearance of logs that are not currently entirely fulfilled. Thus, the findings in this dissertation merit research regarding the desired and preferred detailed qualities of logs that could inform product development of logs; the exact proposed aspects were specified in 4.2.2. In addition, research related to product development of glue-free alternatives for lamella logs – of which there are already examples with CLT – could be fruitful, as glue seemed to cause logs to be perceived as less natural.

As for architectonic quality, this dissertation produced new knowledge on how this concept is perceived by architects and how tectonics of logs contribute to it. In the light of the findings, the building's occupants' experiences are an important indicator of architectonic quality. Thus, regarding architectonic quality, it would be important to look into perceptions of laypersons as well, as architects' perceptions were the focus in this dissertation. This could strengthen the understanding of architectonic quality as a concept and indicate also whether the ideas of architectonic quality between laypersons and architects share common ground. This type of investigation could be done, for example, by exploiting some of the public log buildings that have been addressed in this dissertation, such as Monio.

The final aspect that I will here raise as a potential topic of future research is related to the geographical scope of this research. As this dissertation addressed the Finnish context, similar research could be conducted with a different geographical scope in countries or areas in which log building has a historical role in culture, such as other Nordic countries or German-speaking Europe. However, it might also be that, regarding the development of logs, the Finnish context is so unique that there is no need for identical studies in other countries. Nevertheless, such studies might be beneficial for the Finnish log industry in developing the export potential of their products. In addition, the abovementioned studies regarding the understandability aspect of CLT might be relevant in other countries as well, as this theme is an important one and possibly valid with other materials in addition to logs.

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Figures and tables

The figures and tables are by the author, unless indicated otherwise in the captions.

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I Lakkala, M., Luusua, A., & Pihlajaniemi, J. (2020). Finnish perceptions of log and log architecture. *Scandinavian Journal of Forest Research, 35*(5-6), 296-307.

II Luusua, A., Lakkala, M., & Pihlajaniemi, J. (2019). Perceptions of Log and Log Buildings among Finnish Architectural and Building Industry Professionals. *Architectural Research in Finland, 3*(1), 133-147.

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Original publications are not included in the electronic version of the dissertation.

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