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Thesis Title

Development of mid-rise Residential Timber-based Architecture – Barriers and Opportunities in Kosovo

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"Wood is universally beautiful to man. It is the most humanly intimate of all [building] materials."

Frank Lloyd Wright, 1975

I dedicate this work to my beloved mother

ABSTRACT

This research explores the progress and the state of the art of timber-based architecture, focusing on residential construction industry towards a sustainable urban and economical development. Residential construction in Kosovo is an important sector, due to its large share as a result of post-conflict rapid growth of urban settlements. Mid-storey timber-based residential buildings are the prime focus of this dissertation, with the aim to identify main barriers that limit the increase of timber use in residential construction industry, hence the opportunities for sustainable development in Kosovo.

Theoretical part addresses multi-storey timber development, main building systems and methods, the acknowledged advantages as well as perceived technical disadvantages such as fire safety, acoustics and thermal properties. The following chapter provides an overview on Kosovo background with the aim to better understanding of the local context of the research topic. It is divided into four main sections: the first section presents the actual situation in historical, geographical, demographical, economy and spatial development perspective; the second section elaborates the wood-based residential architecture in Kosovo. Several categorized buildings are explained and evaluated based on the building technology and architectural features; the last two sections discuss the present state of Kosovo forestry as local potential, and wood industry.

Methodology approved to achieve the objectives of this research is based on mixed methods, integrating both quantitative and qualitative approaches. Surveys were conducted to the chosen communities - architects and civil engineers as professionals, and random inhabitants with no engineering background, which have provided a comprehensible view on their role and perception towards the use of timber in residential sector in the context of Kosovo, and its main attributes. Afterwards, semi-structured interviews enabled a further and deeper qualitatively analysis of the revealed findings. The sample has targeted the wood industry, residential construction companies - the business sector, architects, engineers and forestry governmental institutions. The discussed findings have enabled to conceptualize the topics under the study, which have been categorized, consequently generalized the conclusion.

The main barriers and motivation revealed have enabled to establish a strategic model for the identified key actors to address the issues, hence acknowledge opportunities for future sustainable timber-based mid-rise residential construction in Kosovo.

ABSTRAKT

Ky hulumtim eksploron progresin dhe gjendjen aktuale të arkitekturës me bazë druri, duke u fokusuar në industrinë e ndërtimit të banimit drejt një zhvillimi të qëndrueshëm urban dhe ekonomik. Ndërtimi i banimit në Kosovë është sektor i rëndësishëm, për shkak të shtrirjes së gjerë si rezultat i zgjerimit së shpejtë të vendbanimeve urbane. Fokusi kryesor i këtij studimi bie mbi ndërtimin e banesave me bazë druri që i takojnë etazhitetit të mesëm, me qëllim përfundimtar që të identifikoj pengesat kryesore të cilat ndikojnë në rritjen e përdorimit të drurit në sektorin e banimit të industrisë së ndërtimit, si dhe mundësitë për zhvillim të qëndrueshëm në Kosovë.

Pjesa teorike trajton zhvillimin e ndërtimit shumëkatësh nga drurit, sistemet dhe metodat kryesore të ndërtimit, aspektet pozitive si dhe mangësitë teknike siç janë siguria nga zjarri, karakteristikat akustike dhe termike. Kapitulli në vijim ofron një pasqyrë mbi situatën aktuale të Kosovës me qëllim të të kuptuarit më të mirë të kontekstit lokal të temës së hulumtimit. Kapitulli është i ndarë në katër seksione kryesore: seksioni i parë paraqet situatën aktuale nga perspektiva historike, gjeografike, demografike, socio-ekonomike dhe e zhvillimit hapësinor; seksioni i dytë shtjellon arkitekturën e banimit me bazë nga druri në Kosovë. Disa ndërtesa të kategorizuara janë shpjeguar dhe vlerësuar sipas teknologjisë së ndërtimit dhe tipareve arkitektonike; dy seksionet e fundit diskutojnë gjendjen aktuale të pylltarisë së Kosovës si potencial vendor, dhe industrinë e drurit.

Metodologjia e miratuar për të arritur objektivat e këtij hulumtimi bazohet në metodën e kombinuar, duke e integruar qasjen sasiore (quantitative method) me atë cilësore (qualitative method). Janë zhvilluar anketa në komunitetet e përzgjedhura – atë profesional duke përfshirë arkitektët dhe inxhinierët e ndërtimtarisë, si dhe banorët pa shkollim profesional në lëmin e inxhinierisë, që kanë ofruar një pikëpamje të qartë mbi rolin dhe perceptimin e tyre ndaj përdorimit të drurit në sektorin e banimit në kontekstin e Kosovës si dhe atributet kryesore të drurit si material ndërtimor. Më pas, intervistat të gjysmë strukturuara kanë mundësuar një analizë më të thellë dhe cilësore mbi gjetjet paraprake dhe ato të zhvilluara gjatë procesit. Mostra ka pasur shënjestër industrinë e drurit, sektorin e biznesit – kompanitë ndërtimore të banesave, arkitektët, inxhinierët e ndërtimtarisë dhe institucionet qeveritare. Gjetjet e diskutuara kanë mundësuar konceptimin e temave të studiuara, të cilat janë kategorizuar dhe si rrjedhojë kanë mundësuar përgjithësimin e konkluzionit. Pengesat kryesore si dhe aspektet shtytëse kanë mundësuar zhvillimin e një modeli strategjik për aktorët kryesor të identifikuar për t'i adresuar çështjet relevante, që këtej të njoh potencialet e së ardhmes për zhvillimin e qëndrueshëm të ndërtimit banesor me bazë druri të etazhitetit të mesëm në Kosovë.

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Prishtina, October 2017

Arta Januzi-Cana

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Chapter 1
INTRODUCTION

abstract:

The first chapter provides the background, therefore the problem statement of the topic explicated in this thesis and the motivation for undertaking this process. It follows with describing the aim and main objectives of the study, the stated research question(s), the organization of the thesis and the methodology applied.

1 INTRODUCTION

1.1 Background of the study

This research explores the progress and the state of the art of timber-based architecture, focusing on residential construction industry towards a sustainable urban and economical development. Residential construction is an important sector, due to its large share of expansion as a result of rapid growth of urban settlements. Multi-storey timber-based residential buildings are the prime focus of this dissertation, providing an overview on construction typologies and structural performance, construction products and methods, architectural expression and detailed solutions for sensitive issues, like fire safety, acoustics and thermal properties. Support groups involved and other interdependent factors which determine the level of utilizing timber as main structural material are described. The other part of the research investigates the potential of timber-based residential application in Kosovo, from different standpoints (the perception and the role of different actors from the building community, government institutions, professional education and academy, timber industry and forestry). Subsequently, it will focus on several questions regarding the use of timber in architecture, such as: Why is timber architecture getting an attention more than ever? Who supports it? Why and how? What is the role of government, industry, forest management institutions, R&D developers? Answers will provide an overview of the overall process and obstacles different countries face, which will be compared with the situation of Kosovo.

The aim is to introduce a strategic platform that would support development of timber architecture, therefore achieve national economical benefits for Kosovo, with regards to architectural expression, sustainable urban development, forestry management, wood industry and national economy.

Wood is widely considered to be one of the most used friendly materials all over the humankind. It has had a significant application from varieties of tools to a large range of products for construction. In our century, special attention has been paid toward wood manufacturing and large usage in construction as Konrad Wachsmann in 1930 indicated,

"Wood or timber as a manufacturing material to be processed all the way through by machines, technically and economically is of the same importance as any other

construction material. A new look will have to come into existence".[1] With the development technology, compounded with other construction materials, wood has found new manners of contemporary application in the field of construction and everyday shows its promissory abilities in residential sector as well.

Architectural buildings are no longer determined only by aesthetical, functional and economical features, but also in terms of ecological impact. Sustainable design is described as a philosophical approach to design that seeks to maximize the quality of the built environment while minimizing or eliminating the negative impact to the environment.[2]

Wood is the only naturally renewable and recyclable building material that is able to store carbon and as long as it is utilized the longer it stores carbon within, providing the environment with oxygen. Several analyses have shown that woods renewability, relatively low energy consumption during manufacture, carbon storage capability, and recyclability offers considerable long-term environmental advantages compared to other structural materials.[3,4] Aesthetic architecture and economical efficiency are enabled due to construction systems that use a relatively small amount of timber, composing high strength products like plywood, sawn timber, glulam, laminated veneer lumber etc. In residential sector wood-based construction is continuously expanding its application on multi-storey buildings, providing its technical capability according to approved construction norms and regulations. Therefore different structural and non-structural systems are being developed to reach the satisfactory solution for both residential and non-residential multi-storey sector.

[1] Claudia Klinkenbusch, *Holzbauten der Moderne / Timber Houses of the Modern Age: Architekturführer Holzbauten in Niesky* (Niesky: Museum Niesky, 2006), 8.
[2] Jason F. McLennan, *The Philosophy of Sustainable Desing* (Kansas City: ECO tone, 2004), 4.
[3] Andy Buchanan, " Energy and CO_2 Advantages of Wood for Sustainable Buildings," *NZ Timber Design Journal* 15, no. 1 (2000): 11-21. http://www.timberdesign.org.nz/files/Energy_CO2_Advantages_of_Wood.pdf (accessed September 10, 2014).
[4] John Perez-Garcia, David Briggs and James B. Wilson, "The Environmental Performance of Renewable Building Materials in the Context of Residential Construction," *Wood and Fiber Science* 37, special issue (2005): 3-17 https://wfs.swst.org/index.php/wfs/article/view/2071 (accessed September 10, 2014).

European countries are developing strategies to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.[5] Wood-based buildings use renewable energy and are made from renewable materials, therefore have major advantaged in comparison to other building materials for new opportunities and benefits. In order to fully take the advantage of the potential of timber construction and increase the efficiency of, an increased theoretical and practical understanding of the business and the process development is required.[6]

Some aspects on global benefits by using wood-based material in building construction could be listed as following:

- **Pace of construction / cost of construction** – construction time is significantly shorter in comparison to concrete constructions due to fast erection of the structure and non-relevance to weather conditions;
- **Lightweight structure** - enables lower cost for foundation, therefore overall lower cost;
- **Higher productivity** - due to construction speed, with less labor work in a shorter time period;
- **Photosynthesis process** enables absorbing of CO_2 from the atmosphere by storing the carbon during growth and releasing the oxygen;

The use of natural resources for supporting local timber construction industry should be considered as a great opportunity for the national economy, to be achieved with new strategies of forest management. Forest area in Kosovo is considered fairly stable at approximately 481 000 ha (44.7% of total area).[7] The Government's objective is to support the sector of forestry through institutional framework and regulatory, therefore enhance its

[5] European Parliament and the Council of the EU, *Decision No. 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020: (Official Journal of the European Union, 2009), 136-145.* http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009D0406&from=EN (accessed September 10, 2014).

[6] Ylva Sarden, "Complexity and learning in timber frame housing - the case of a solid wood pilot project." (PhD diss., Lulea University of Technology, Dept. of Civil and Environmental Engineering, Sweeden, 2005), 1.

[7] Stein M. Tomter et al., *Kosovo National Forest Inventory 2012* (Prishtina: Minstry of Agriculture, Forestry and Rural Development, 2013), 8. http://www.nfg.no/userfiles/file/kosovo/kosovo%20national%20forest%20inventory%202012.pdf (accessed September 12, 2014).

contribution to the national economy through sustainable use of forest resources, taking into consideration the multi-functional role of forestry.[8]

In Kosovo, wood was considerably used in traditional urban and rural houses as a main structure or as reinforcement in mixed typology. The artistic work of popular art inside the houses is very rich in wood. Different hand-crafted functional and decorative amenities are composed of floral and geometrical symbols. With the development of construction industry and the availability of clay brick and concrete as modern materials, the use of wood has declined significantly. Today, very few contemporary low rise non-residential buildings that apply traditional building know-how can be found in different urban and rural areas. Thus, significant tendency toward wood-based application is noticed.

Rapid expansion of urbanized areas is evident; therefore alternatives on efficient construction methods and material selections will be beneficial. At once time, this expansion visibly prepossesses higher construction material resources consumption. In this context, the use of environmentally-friendly, low energy consumption as well as reusable materials are vital regarding economical, ecological and social benefits in Kosovo. The main reasons or obstacles are considered to be the lack of expertise in timber construction, gaps in building law regarding the structural requirements, fire safety, acoustics and similar, the lack of support from the government and other institutions etc.

[8] Ministry of Agriculture, Forestry and Rural Development, *Policy and Strategy Paper on Forestry Sector Development* (Prishtina, 2009).
http://kosovoforests.org/wp-content/uploads/2013/04/291687_Strategy_for_Forestry_in_Kosovo_2010_2020.pdf (accessed September 12, 2014).

1.2 Motivation

Why mid-rise timber-based residential construction?

Construction industry is one of the main sectors of the Kosovo economy. Its largest share resides in multi-storey residential buildings construction, albeit with dominance of heavy building materials (concrete and clay bricks). In response to global climate challenges, the European market of wood-based multi-storey residential building design and construction, as sustainable alternative to traditional heavy materials construction, has distinctively gained the attention. Given that multi-storey residential sector dominates in Kosovo construction industry, timber-based construction application shows a potential to increase its share. The process of globalization is bringing changes in every aspect of the economy world, and market in Kosovo will have to adapt with it in order to develop and to join the free world and EU market.

The majority of construction material and products in Kosovo is estimated to be imported,[9] which is an indicator that a shift towards environmentally friendly locally based construction materials is advisable. By utilizing locally produced construction material from local forests new local employment opportunities can be generated. Sustainable development of timber-based mid-rise residential construction encourages local manufacturers to extend varieties of engineered wood products, hence the national forest economy and quality.

Social structure need to be considered with regards to future construction alternatives. The average population growth in Kosovo is stable; Kosovo population is relatively young, which is an indicator that the demand for dwellings will be stable.

Post-conflict situation in Kosovo has resulted with rapid urban sprawl from the urge for reconstruction and lack of authorities' impact which lead to low quality urban development consisted of solid, rough and lifeless construction. Tendencies toward rebuilding the quality of urban identity through development of mid-rise residential buildings with improved urban standards and applying more natural and ecological material in our urban space would improve the environment and living conditions.

[9] Strategy Development Consulting, Vlerësim i tregut per sektorin e ndërtimit: Raport 2015, *Perspektivat e punësimit për të rinjtë,* 6. http://www.helvetas-ks.org/eye/wp-content/uploads/2017/03/Vler%C3%ABsim-i-tregut-p%C3%ABr-sektorin-e-nd%C3%ABrtimit-ALB.pdf (accessed September 20, 2017).

The topic of the research evaluates from my latest study on wood construction trends on multistory buildings and its evident role on sustainable urban development, as well as personal further interest on the possibility of such application. An evident incitement is the two semester Master thesis research developed in TU Vienna, Department of Architectural Sciences, Structural Design and Timber Engineering, which was a comparative study on economical feasibility of multi-storey residential building construction to conventional construction in Kosovo. The study conducted on four typologies has evidenced the probability of wood-based application, the frame structure system in particular, in terms of cost efficiency as well as material supply and professional expertise. However, in order to produce short-term and long-term national benefits through the increase use of timber in construction industry, a multidimensional approach is indispensable. Numerous key factors are determinative: starting from the standpoint of national governmental strategies to promoting and supporting environmental friendly construction technology, sustainable management of national resource and their potential in national timber industry, to the role and interest of building community, industry and academy.

Targeted beneficiaries, to whom the research will contribute, are listed below:

Table 1.1 Targeted beneficiaries

Government	- Ministry of Agriculture Forestry and Rural Development: *Department of Forestry and Kosovo Forestry Agency* - Ministry of Environment and Spatial Planning *Department of Housing and Construction* *Department for European Integration and Policy Coordination* - Ministry of Trade and Industry
Education	- Vocational education - Academic education *Faculties of architecture, civil engineering and applied science*
Industry	- Wood Industry - Kosovo Association of Wood Production - Construction Industry
Organizations	- Regional/International and Local Governmental Organizations - Regional/International and Local Non-gov. Organizations

The well coordinated activities in establishing common strategies by the three targeted groups: government, academy and timber industry would support the future perspective to achieve progress in developing of timber construction. This study will endeavor to identify the motivations and barriers of key role players towards the increase of timber use, therefore developing a theory that will indicate and promote its potential for the national long-term benefits.

1.3 Aim and Objectives

The Aim of the study is to identify the motivations and barriers that support / limit sustainable development of timber architecture, respectively multi-storey residential buildings, in order to achieve short-term and long-term benefits for Kosovo, with regards to architectural expression, urban development, environment impact, forestry, national economics, and construction expertise.

Research objectives can be summarized as follows:

- To analyze and introduce, by reviewing the literature, the progress of contemporary residential timber-based architecture in Europe: the motivations, therefore benefits in terms of environmental impact, lifecycle assessment and renewability from material perspective;
- To provide an overview on main building typologies applied in multi-storey residential construction;
- To explicate advantages of timber buildings and technical disadvantages with solutions to overcome them in order to achieve the required building performances;
- To investigate motivations and barriers in Kosovo in relation to timber architecture in general and residential sector specifically. Respected target groups will be subjected to the approved methodology to identify their role and perception towards the aim of the study;
- To provide recommendations towards new opportunities in development of mid-rise multi-storey timber-based buildings;

1.4 Research questions

The overall question that concerns the study is:

"How could the involvement of the main actors strengthen, to overcome the barriers that affect sustainable development of multi-storey timber-based residential architecture in Kosovo?"

The following sub-questions however refine the focus:

- What is the significance of multi-storey residential timber architecture (MRTA) development in Kosovo?
- Which barriers affect sustainable development MRTA in Kosovo?
- How could MRTA be developed in Kosovo?

1.5 Research methodology

This study is conducted in mixed inquiry, based on quantitative and qualitative research approaches, analyzing the information in an interpretative, explorative and diagnostic method. Certain approach for specific topics of study is carried out with the purpose of obtaining the best overview on each issue explored.

- Literature review is the initial source for the study. Publications such as research papers, official reports and dissertation related to timber architecture progress in the context of sustainability, environmental impact, timber industry and forestry are utilized. A great part of the study consists of the applied typologies for mid-rise residential buildings in Europe, using timber as the main construction material.

- Traditional wooden architecture is a valuable heritage of Kosovo, developed in relation to local climate, geographical position, political circumstances, diversity of cultural influences, material accessibility and local skills in construction techniques. Building typologies are investigated in two terms: traditional building systems and applied contemporary structures, by analyzing and classifying their structural elements as well as interpreting the architectural values. Technical details of construction methods are presented based on literature review and field survey of both historical and contemporary timber architecture in Kosovo.

- Kosovo forests are identified by multiple factors, therefore strategies of forest management that would provide benefits need to be developed in the national conditions. Kosovo forestry covers around 45% of the country's area, however only 6% consists of coniferous species.[10] Such indicators point out the potential and challenge of Kosovo Forestry Institutions toward utilization of national resource as an alternative in construction industry that would provide national economical benefits. Official reports are reviewed and interviews are conducted in two institutions within the frame of Ministry of Agriculture, Forestry and Rural Development,[11] in charge of developing policy and regulatory framework, administering and managing of the forestlands. The aim is identifying responsibilities, strategies, challenges and potentials in supporting timber industry from the respective of construction.

- Wooden Industry in Kosovo is one of the important sectors considering the number of businesses and employment. Information is gained from related official reports and conducted interviews / surveys with enterprises.

- A detailed investigation is carried out on the law on construction related to building regulations and standards, with focus on timber-based construction.

- Surveys and interviews are carried out within extended building community in Kosovo, especially architects and engineers, investors, officials from different institutions (research, forestry, education and industry) and random inhabitants.

The applied methodology provided a clear overview on the present situation in Kosovo, barriers and challenges, motivations and opportunities towards development of mid-rise timber-based residential architecture.

[10] Tomter et al., *Kosovo National Forest Inventory 2012*, 26.
[11] Ministry of Agriculture, Forestry and Rural Development http://www.mbpzhr-ks.net/en/home (accessed August 17, 2014).

1.6 Organization of the thesis

The study is structured into six chapters.

Chapter 1: Introduction

The first chapter provides the background, therefore the problem statement of the topic explicated in this thesis and the motivation for undertaking this process. It follows with describing the aim and main objectives of the study, the stated research question(s), the organization of the thesis and the methodology applied.

Chapter 2: Theoretical background

This chapter gives an overview on the progress of multi-storey timber-based buildings in Europe. Several question of interest will be raised, such as: Why is timber construction everyday more present? Which are the main factors and motivations that support timber-based construction?

The second part of this chapter deals with timber-based residential building systems, based on literature review and personal survey of during different study visits. Through exploratory approach main timber building systems will be described. The third part explains advantages of timber buildings in several aspects as well as technical disadvantages with the measures to overcome them in order to achieve the required building performances. Technical issues like: building code, quality control, fire safety, sound and thermal insulation, durability and comfort are discussed.

Chapter 3: KOSOVO – The setting of the research topic

The third chapter provides a background on Kosovo: historical perspective of wood-based housing and the latest application. Several categorized buildings will be explained and evaluated based on the building technology and architectural features. Legislation – building's performance quality requirements and key players (forestry, construction industry, related government institutions and academy) are explicated.

Chapter 4: Methodology applied

The fourth chapter outlines the approved methodology to achieve the objectives of the research. The process of adopting the most appropriate methodology for caring out the research is elaborated.

Chapter 5: Results and discussions

This chapter consists of a range of processed collected data on understanding of the current role and perception of targeted actors toward timber-based residential architecture. Results will be analyzed and identified categories will be afterwards separately discussed.

Chapter 6: Recommendations and overall conclusions

The final chapter provides the overall conclusions of the study and future proposals with regards to the topic.

Last of all, the list of appendixes, consisting of published research papers, collected material during the implementation of adopted methodology, other relevant materials and the bibliography with the list of the sources and literature exploited in the thesis, are attached.

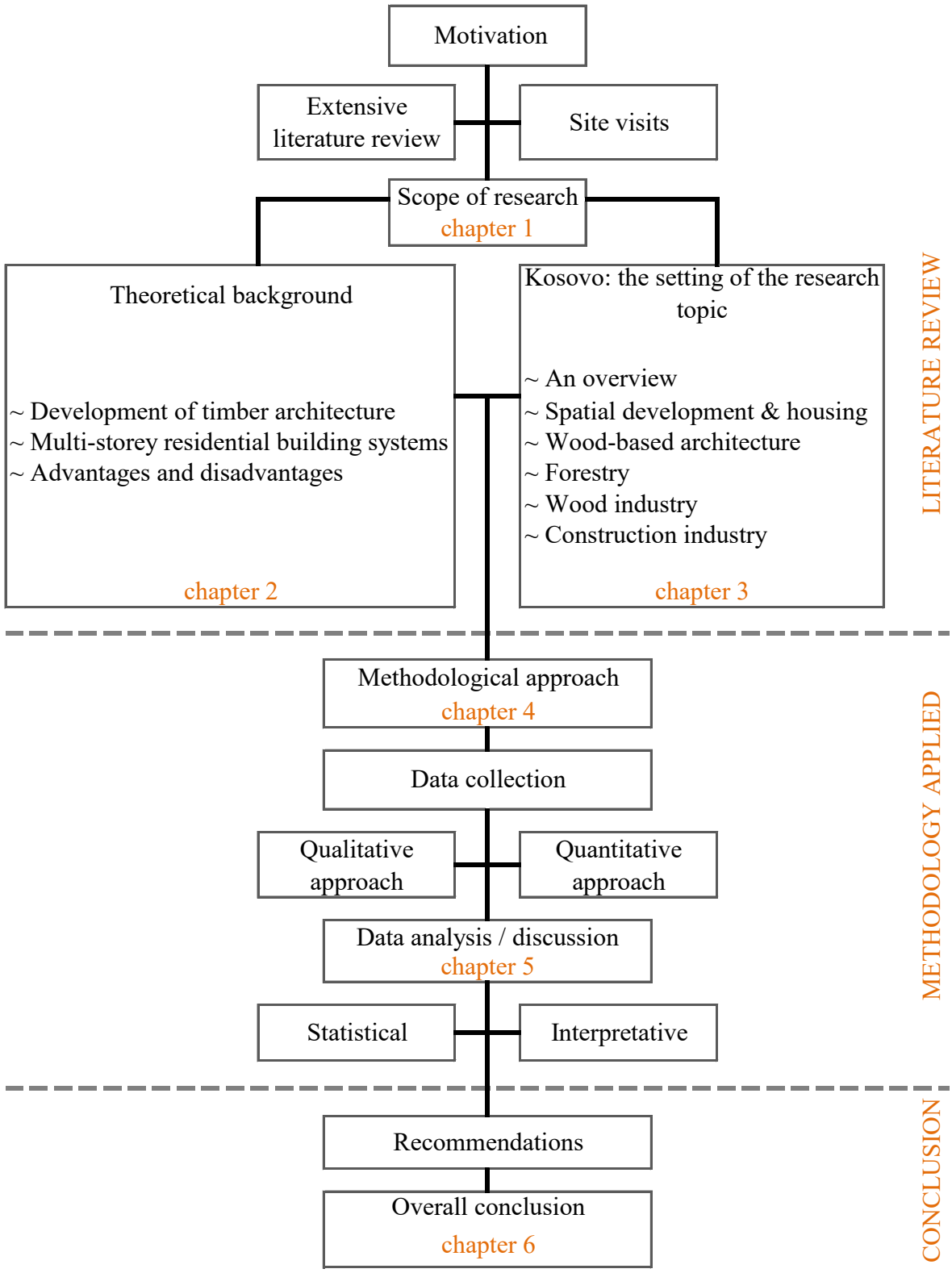

Figure 1.1 The structure of the thesis

Chapter 2 – THEORETICAL BACKGROUND

abstract:

The second chapter examines the development of timber architecture, with focus on progress of residential multi-storey timber buildings. On the second section is an overview from three main structural systems, exemplified with respective case studies, and the principle differences between construction methods in regards to multi-storey wood structures. Advantages of multi-storey residential timber buildings in terms of environmental effect of timber buildings, life cycle assessment, renewability, sustainability from material perspective and time and cost effectiveness are elaborated, also indicating the disadvantages and measures for overcoming them in terms of fire safety, sound insulation, durability and seismic resistance.

2 THEORETICAL BACKGROUND

2.1 Development of timber Architecture

Wood as a natural resource has always been fundamental and indispensible to architecture as a regenerative construction material.
Timber has been one of the primary materials for providing shelter. In all probability, among the earliest building methods is the simple post-and-beam construction.

The origins of Architecture seem to appear in a primitive timber construction, a circular erection made of curved poles. The fact that is surprising in the light of the timber manufacturing`s efforts to work up the linear characteristics of the tree trunks, as well as its development of glue laminated trusses to improve dimensional stability and spans through the standardization of dimensional lumber.[12]

Historically, the variety in application and expression of wood in multi-storey constructs is best exemplified in Japan, (Horyu-ji temple and Hime-ji castle as presented in figures 2.1 and 2.2) where the amalgamation of different oriental influences that evolved parallel with introduction of Buddhism played a large part.[13]

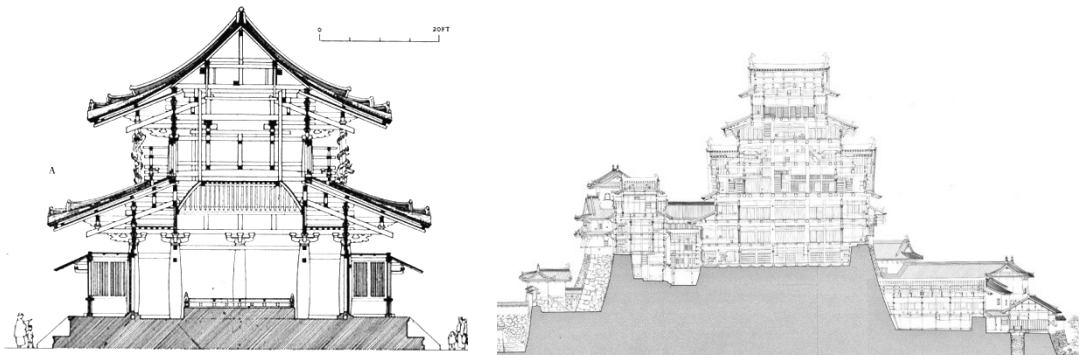

Figure 2.1 Section drawing of Horyu-Ji late 7th century timber structure
Source: Bonnie Cheng Approaches to Chinese and Japanese Art
http://www2.oberlin.edu/images/Art251/eas143a.html
Figure 2.2 Section drawing of Hime-Ji late 16th century seven storey timber structure
Source: Agency for Cultural Affairs, Government of Japan
http://bunka.nii.ac.jp/suisensyo/himeji/APPENDIX-7/appendix7-5.html

[12] Frank Kaltenbach, "Primitive hut of the future?", in *Holz-Wood best of Detail*, ed. Christian Schittich (Germany: Institut for internationale Architektur - Dokumentation Gmbh and Co. KG, Munchen, 2014), 17c.
[13] Roland Schweitzer, "Wood as a building material- from the beginnings of 19th century" in *Timber Construction Manual,* ed. Friedmann Zeitler (Germany: Birkhauser publishers for Architecture, 2004), 27.

Up till the start of 19th century wood was the utmost employed building material, a strong vernacular comprehension of building methods with wood has been established through hundreds of years.[14] But amid the industrial revolution timber somehow lost its prominence when novel possibilities of construction emerged with the expansion of materials like cast iron, steel, and concrete. In the European modernist movement of the early twentieth century, glass, steel, and concrete materials were flagged as the mark materials of the most of twentieth century architecture.[15]

From the mid nineteenth century onwards, development in timber constructions steadily started to arise with application of lightweight frame constructions like platform framing and various forms of panel constructions (examples shown below in Figure 2.3). The largest part of the production of these structural elements takes place off-site in protected environments at the factory.[16]

Figure 2.3 Left - Four storey timber building in Seatle, constructed in 1913, still in use; right - three storey timber building in Seatle, constructed in 1917, still in use
Source: Joseph Mayo Hans-Erik Blomgren, Wood: concrete of the 21st century

The trend towards an increasing use of wood in architecture is clear although the development and utilization of timber constructions in residential multi-storey buildings in European countries is on a diverse level. The main reasons are that wood used for building

[14] Joseph Mayo, Solid Wood: Case Studies in Mass Timber Architecture, Technology and Design (US:Routledge 2015), 3.
[15] Anne Kirkegaard Bejder, "Aesthetic Qualities of Cross Laminated Timber" (DCE Thesis, Aalborg University - Alborg, 2012), 15.
[16] Ibid., 16.

is renewable and locally available; it is aesthetically attractive, and has excellent technical characteristics.[17]

2.1.1 Progress in multi-storey residential construction

> *The 17th century was the age of stone. The 18th century was the peak of brick. The 19th century was the era of iron. The 20th century was the century of concrete. The 21st century will be the time for timber.*[18]

In response to global climate challenges in recent times awareness and interest in design and construction of residential mid-rise timber structures as a sustainable alternative to more traditional construction materials has increased worldwide. Various studies have been pursued to expand on new contemporary mid-rise timber-based structural systems with corresponding design and construction tools.

Figure 2.4 Evolvement of multi-storey wood buildings from 1995 to 2015
Source: Manja Kitek Kuzman and Dick Sandberg, Development of multi-storey timber buildings and future trends

Recent demonstration of multi-storey projects throughout Europe especially shows that using timber as a sustainable construction and ecological material can produce outcomes that are both architecturally intricate and cost-effective. Moreover, studies and solutions for dealing with issues related to previously considered disadvantages for building multi-storey timber structures such as fire safety, sound transmission and durability are being conducted and developed, and the aforementioned disadvantages no longer constitute the

[17] Manja Kitek Kuzman and Dick Sandberg, "Development of multi-storey timber buildings and future trends", *II Latin American Congress on Timber Structures*, (2017): 4. http://clem-cimad2017.unnoba.edu.ar/papers/T7-11.pdf (accessed July 20, 2017).
[18] Alex de Rijke, quoted in Amy Frearson, "Architects embrace "the beginning of the timber age"." *dezeen*, November 9, 2015. https://www.dezeen.com/2015/11/09/cross-laminated-timber-construction-architecture-timber-age/ (accessed August 26, 2017).

same obstacle for development of multi-storey residential construction. The contemporary evolvement of multi-storey buildings from 1995 to 2015 is illustrated in figure 2.4. Contemporary approaches in timber construction manufacture in Central Europe have undergone innovative transformation. Traditional approaches, such as block and half timber constructions, the balloon- frame and platform frame, have been succeeded by contemporary frame skeleton and solid constructions.
These constructions are distinguished by the assembly method of the prefabricated structural elements and the structure of covering.[19]

2.2 Multi-storey timber residential building systems

In multi-storey timber residential buildings, three mostly used construction methods are recognized: timber frame construction, massive solid-timber construction and panel composite construction. The first method is based on light frames made from timber in order to create structural stability, the second method is based on solid panels that are made from glued planks to become a solid timber unit while with panel structure, the loads are transferred through bracing elements consisted of composite panels.

While in multi-storey timber based buildings post-and-beam and platform frame construction can be considered as traditional and original forms of construction, the most significant innovation is the utilization of lighter prefabricated and standardized wood panel construction components. Solid panel constructions unlike the conventional linear timber elements have the ability to withstand loads in surface as well as perpendicular to it thus offer superior strength and stiffness properties in both directions. New trends are moving toward prefabricated box units that form sections of the building and can be stacked and rapidly assembled. The system is proven as cost effective and the quality is ensured in preproduction, however due to transportation restrictions the span and volume of the units is limited.

The main differences between the aforementioned wood based construction systems relate to the range of building methods, structural span, volume of timber used and the number of storey's that can be built.[20] Load-bearing requirements are fundamental in choosing the

[19] Frank Lattke and Steffen Lehmann, "Multi-storey residential timber construction: current developments in Europe," *Journal of Green Building* 2, no.1 (2007): 119.
http://nova.newcastle.edu.au/vital/access/manager/Repository/uon:5790 (accessed August 3, 2017).
[20] Tzofit Shmuelly-Kagami, "A study on multi-storey timber residential building in Japan" (Ph.D.diss., The University of Tokyo - Tokyo, 2010), 33.

most suitable structural building design. Further essential criteria are function and space requirements, location, design and material preferences. The manufacture of advance wood products requires dependable models for envisioning the load bearing performance under mechanical, thermal and hygroscopic loadings. the sub sequential requirement is innovative and optimal design, which should be done correctly with manufacturing.[21]

2.2.1 Light timber frame construction

Timber-frame construction consists of a stiff framework of quadrangle sections for both interior and external walls. Alternatively named as, the post-and-beam construction that refers to several construction principles for which the load-bearing structure is similar to a skeleton composed of vertical and horizontal members.[22] Timber frame construction as shown in figure 2.5, uses timber studs and rails, jointly with a structural sheathing board, in order to form a structural frame that transmits the entirety of vertical and horizontal loads towards the foundations.

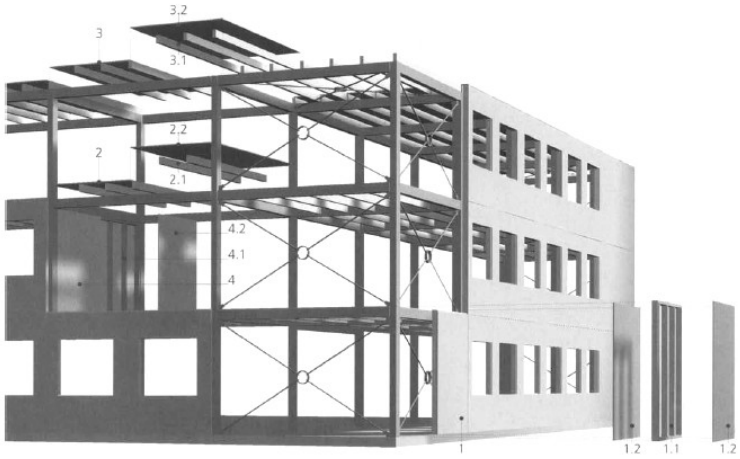

Figure 2.5 Timber-frame construction system.
Source: Josef Kolb, *Systems in Timber Engineering*, (Switzerland: Birkhauser, 2008), 88.

Timber frame construction can be considered as the actual earliest form of construction, by using fallen trees or tree limbs and lashing them together to form overhead structure. In modern time the evolution of industrial tools made the components for the timber frame easier to refine. In multi-storey timber frame structure designs, the load-bearing structure is arranged in a pattern that allows any type of facade and partition wall construction. Higher

[21] Heikki Martikka and Erkki Taitokari. "Design of composite elements of wood and reinforced-plastic based on micro structural and FEM modeling," *International symposium on advanced timber-composite elements for buildings COST E29* (2004): 60. http://www.enmadera.info/cost/e29/wsh/1%20FLORENCIA/COSTE29-Florence-Proceedings2004.pdf (accessed May 7, 2017).
[22] Bejder, "Aesthetic Qualities of Cross Laminated Timber", 20.

design freedom is ensured due to the walls not bearing the vertical load.[23] Usually the frames are not assembled one piece at a time, but rather as site prefabricated structural assemblies called bents. Above or between the primary elements, secondary load-bearing elements are placed.

The structure most commonly is visible (especially as part of interior design) in order to accentuate the type of construction. There is a wide range of possibilities when it comes to the overall footprint, exterior profile and interior complexity of a timber frame building.

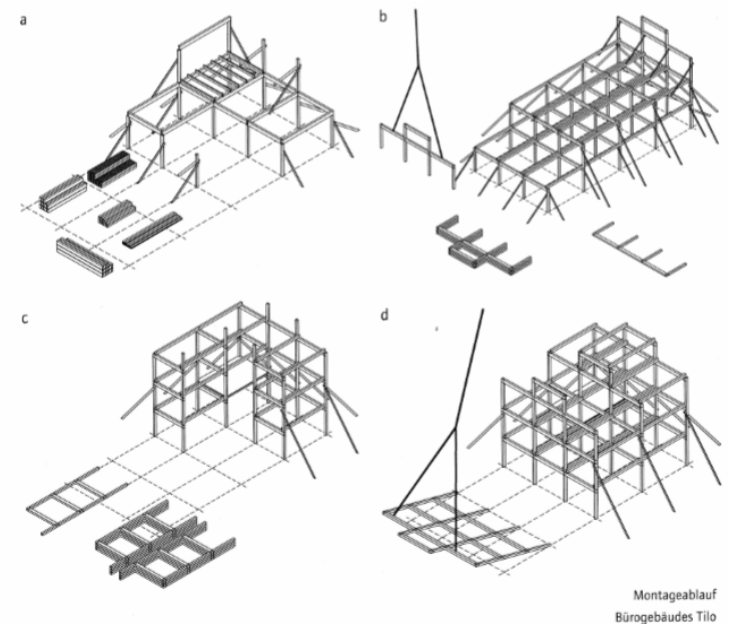

Figure 2.6 Isometrical view examples of timber skeleton engineering in multi-storey construction *Source*: Mehrgeschossiger holzbau - Einleitung; Institut für Architekturwissenschaften Tragwerksplanung und Ingenieurholzbau, 35. https://www.iti.tuwien.ac.at/ (accessed March 2, 2017).

Depending on the column/beam configuration and the types of connection we differentiate amid various forms of frame construction in timber (fig. 2.6). It is therefore best to opt for the grid initially and set up preliminary dimensions for the structure and then decide on the resulting frame construction form.[24]

While utilizing the timber frame structural construction the key points to bear in mind are:

- Selection of the ideal type of wood, surface texture.
- Choose the framing style to best suit your design vision, site and economic efficiency.

[23] Manja Kitek Kuzman and Andreja Kutnar, *Contemporary Slovenian Timber Architecture for Sustainability*, Switzerland: Springer International Publishing, 2014, 43.
[24] Josef Kolb, *Systems in Timber Engineering*, (Switzerland: Birkhauser, 2008), 93.

- Structural engineering that ensures the proper load bearing and durability of multitude of structural systems.
- Joinery methods, detailing and finish.
- Craftsmanship and detailing, methodical assembly and raising process

When opting for timber frame building system of a multi-storey buildings three different conditions that need to be taken in to consideration by the structural

engineering designer[25]: Strength and stiffness design for individual framing elements, robustness design of the framing and connections and disproportionate collapse design.

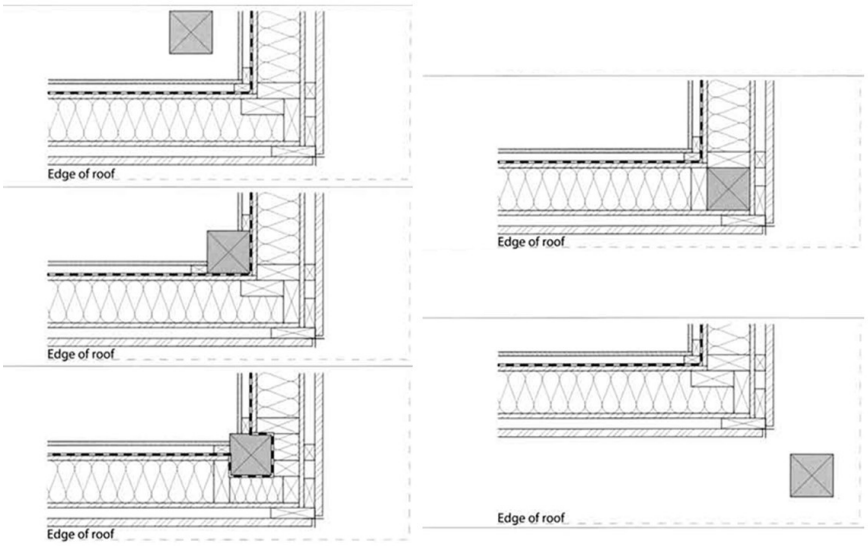

Figure 2.7 Positioning possibilities of envelope walls
Source: Josef Kolb, *Systems in Timber Engineering*, (Switzerland: Birkhauser, 2008), 109.

In multi-storey timber frame system envelope walls have the convenience can be positioned in various forms, in front of, between, or behind the load bearing members, since they do not carry any loads from the suspended floor of the upper stories, they can basically take on any form. examples of positioning of envelope walls in timber frame structures are shown in figure 2.7.

The principle advantage of the timber-frame construction system in multi-storey residential buildings is that the supporting structure is separated from the space-enclosing and separation functions, light weight of the structure and rapid and dry assembly.

[25] Structural Timber Association. "Timber frame structures –platform frame construction (part 3)." *Structural timber Engineering bulletin*, 2014, 1.
http://www.structuraltimber.co.uk/assets/InformationCentre/eb5.pdf

Case No: 1

Genesis Apartments in Los Angeles, CA,

Building Information:

Designation:	Apartment housing
Year of construction:	2012
Designed by:	Killefer Flammang Architects
Stories:	7
Gross area:	5,200 m²

Figure 2.8 Case 1-Exterior view; Genesis Apartments in Los Angeles, CA
Source: https://continuingeducation.bnpmedia.com/courses/rethink-wood/midrise-wood-construction/7/ (accessed March 12, 2017).

Structure type:	Timber frame construction
Primary material:	Prefabricated Timber Frame
Secondary material:	Block Concrete base

Mixed seven storey residential social building is comprised of repetitive wood framing structure attached with numerous fasteners and connectors. The specific structure provides numerous and often superfluous load paths for wind force resistance.[26]

The LEED - Platinum certified New Genesis affordable housing as a cost-effective and sustainable choice for high-performance achievement.

In this respective case the load-bearing structure of the building consists of posts and beams arranged in a pattern. Traditional platform framing is used due requirement of one-hour fire-resistance rating of exterior walls. Because the walls do not bear the vertical load, timber frame construction enables more design freedom. Secondary load-bearing elements are placed above or between the primary elements. The load is transferred exclusively through beams onto the vertical columns.

Figure 2.9 Case 1- Exterior view during construction phase
Source: https://engineeringcenter.bnpmedia.com/article_print.php?C=1205&L=312 (accessed March 12, 2017).

[26] Jeffrey B. Stone, "Wind-Resistive Design of Wood Buildings," Continuing Education, http://www.awc.org/pdf/education/des/ReThinkMag-DES420A-WindResistive-140611.pdf (accessed March 12, 2017).

Case No: 2

Paris housing by Tectône Architectes

Building Information:

Designation:	Apartment housing
Year of construction:	2014
Designed by:	Tectône Architectes
Stories:	4
Gross area:	3200 m²

Figure 2.10 Case 2- Exterior views; Paris housing blocks by Tectône Architectes
Source: https://www.archdaily.com/769163/housing-in-auvry-barbusse-tectone

Structure type:	Timber frame construction
Primary material:	Prefabricated Timber Frame
Secondary material:	Block Concrete base

The building structure is assorted of concrete and wood. The ground floor, the stairs and lifts cores are made out of concrete. The construction of the two-storey residences is utterly prefabricated timber frames, which have been clad in thin slats of untreated pine. Wood frames of the facade are pre-produced in factory. They are given natural finish cladded with a no-treatment pine. The twofold covering has a protective role: light shading and maintaining a comfortable summer time temperature as well as ensure privacy. The wooden shutters slide into the gap of the double skin, in order to protect the shutters from bad weather. The load-bearing structure consists of columns and beams arranged in a pattern that allow any type of facade and partition wall construction. Timber frame construction enables more design freedom since the walls do not bear the vertical load.

Figure 2.11 Case 2- Ground floor and typical floor layout
Source: https://www.dezeen.com/2015/07/02/tectone-architectes-housing-encased-timber-cage-rue-auvry-paris/ (accessed March 10, 2017).

Figure 2.12 Case 2- Paris housing blocks by Tectône Architectes
Source: https://www.dezeen.com/2015/07/02/tectone-architectes-housing-encased-timber-cage-rue-auvry-paris/ (accessed March 10, 2017).

2.2.2 Solid timber construction

There are two types of structures differentiated in regards of solid timber construction: structure with solid log walls constructs and structures made from adhesively bonded wood elements.[27]

The later is most commonly achieved through the utilizing of cross-laminated timber and essentially is a large format solid wood panel. It is consisting of several layers adhesive bonded lumber boards stacked and pressed in to a rectangular solid panel. The CLT panels boast exceptional strength, dimensional stability, and rigidity. While sizes vary by manufacturer and are usually limited by transportation restrictions, panels can be manufactured according to customized dimensional requirements.

CLT is a well suited material for mid-rise to high-rise construction and has a lighter environmental footprint than traditional construction systems.[28] CLT as a system can be used in hybrid applications or interchangeably with other wood products. This mass timber product due to its structural properties and stability is well suited to floors, walls and roofs used in mid-rise construction.

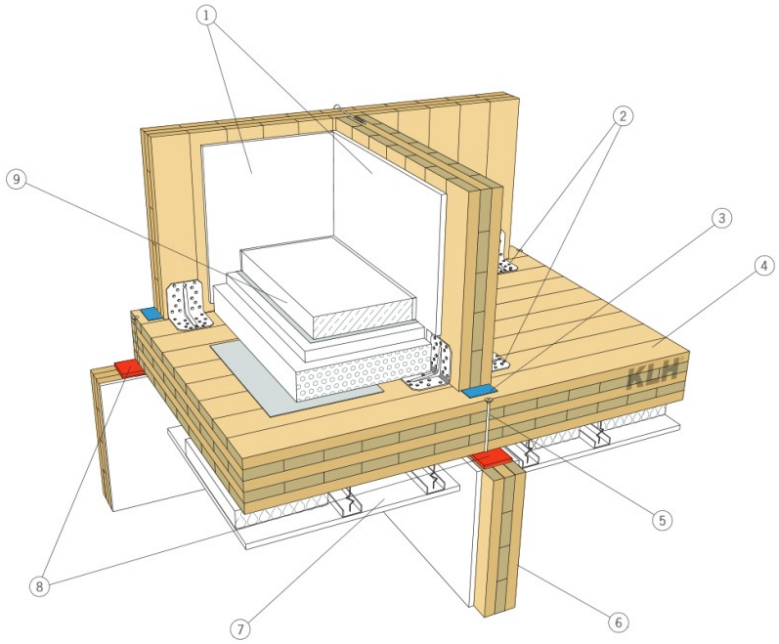

Figure 2.13 CLT External wall and flat separating ceiling detail
Source: Massivholz Gmbh KLH, *Construction Component Catalogue*, 2011, 17.

[27] Kuzman and Kutnar, *Contemporary Slovenian Timber Architecture for Sustainability*, 43.
[28] MAHLUM, Walsh Construction Co., Coughlin Porter Lundeen, CLT Feasibility Report 2014, *A Study Of Alternative Construction Methods In The Pacific Northwest*, 3.
http://www.mahlum.com/pdf/pnwcltfeasibilityreport.pdf (accessed June 7, 2017).

Main advantages include shorter construction time frame, safer work environment, reduced number of skilled laborers. Also by using pre-assembly systems and Precise manufacturing process minimizes material waste, on-site time and energy waste and optimizing material value by utilizing lower quality timber in higher value application.[29]

The wall and floor panels may be left exposed in the interior which provides additional aesthetic attributes. The panels are used as prefabricated building components which can speed up construction practices or allow for off-site construction.

Cross-laminated timber products have a larger volume of wood usage and are more expensive than traditional wood framing. Therefore, an important design constraint is the value engineering of the product to the minimal structurally required amount. In many instances, the thinnest panels available have the capacity to support the required loads with reasonable resistance to deflection and vibration.[30]

Elements of walls and floors by using the similar panels, have an overall performance of a massive solid timber panel and are very rigid and strong, with much less energy dissipation and flexibleness characteristic in comparison to other traditional wood-frame constructions system.[31]

The massive board is highly resistant in each of its dimensions, this system is suitable for extremely high modern timber constructions.

The system is not constrained by module or grid dimensions. In comparison to other structural systems, the number of layers can be minimized.

Beyond the innovations in construction techniques, the new developments that employ planar, non- directional building components are accompanied by a profound transformation of tectonics.[32]

[29] Ryan E. Smith, Gentry Griffin and Talbot Rice, *Solid timber construction-process practice performance*, (Utah: University of Utah, Integrated Technology in Architecture Center, 2015), 5.
[30] MAHLUM, *CLT Feasibility Report 2014*, 5.
[31] Ario Ceccotti et al., "Cyclic Tests on Cross-Laminated Wooden Panels", in *9th Wood Conference on Timber Engineering - WCTE 2006* (Portland, USA *2006), 8.* http://support.sbcindustry.com/Archive/2006/aug/Paper_112.pdf (accessed June 24, 2017).
[32] Peter Cheret and Arnim Seidel, "New timber construction", in *Holz-Wood best of Detail*, ed. Christian Schittich (Germany: Institut for internationale Architektur - Dokumentation Gmbh and Co. KG, Munchen, 2014), 46.

Case No: 3

Neubau eines Mehrfamilienhauses- Esmarchstraße 3, 10407 Berlin, Germany

Building Information:

Designation:	Apartment housing
Year of construction:	2014
Designed by:	Kaden + Klingbeil
Stories:	6
Gross area:	940 m²

Figure 2.14 Case 3 - Exterior views; Neubau eines Mehrfamilienhauses- Esmarchstraße
Source: https://divisare.com/projects/239891-kaden-klingbeil-architekten-bernd-borchardt-e3

Structure type:	Massive wood construction
Primary material:	Cross Laminated Timber
Secondary material:	Steel as the post-and-beam joint

This multi-storey timber construction project corresponds to the “Efficiency house” standard 55. It is a prototype for a novel approach in urban planning and structural engineering. Due to high industrial prefabrication of mullions, bars and felling elements the construction was concluded in only nine months of construction time. The wooden construction is invisible from the exterior perspective. The insulated, plastered and white painted façade plays the role of classic solid construction. Particular attention was paid to the interaction of architectural attractiveness, maximum environmental protection an sustainability.

Figure 2.15 Case 3 - Layout designs and section of Neubau eines Mehrfamilienhauses
Source: https://divisare.com/projects/239891-kaden-klingbeil-architekten-bernd-borchardt-e3

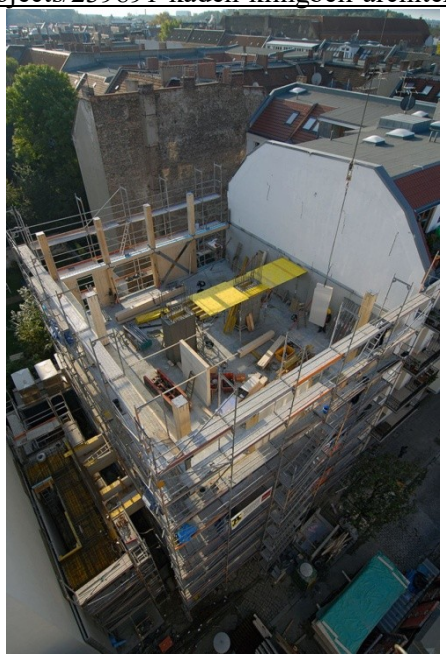

Figure 2.16 Case 3 - Exterior view during construction
Source: https://divisare.com/projects/239891-kaden-klingbeil-architekten-bernd-borchardt-e3

Case No: 4

Välle broar – Limnologen 8- storey timber building

Building Information:

Designation:	Apartment housing
Year of construction:	2014
Designed by:	Arkitektbolaget Kronoberg
Stories:	6
Gross area:	10.700 m ²

Figure 2.17 Case 4 - Exterior view; Välle broar – Limnologen 8
Source: http://www.europeanwood.org.cn/cms/page/en/residential-case-studies/29

Structure type:	Wood Hybrid Construction
Primary material:	Cross Laminated Timber
Secondary material:	Reinforced concrete sub base

The supporting structure used in mutually in walls and floors is comprised of CLT-elements. Additionally, conventional timber framed separation walls are installed. The substructure is made of concrete as an anchoring for the upper storey's.

The load bearing is ensured by all exterior stockade, while vertical loads are transmitted through interior walls. In order to reduce the deformations, in some areas the load bearing system is improved with glue-lam columns and beams. The moderately intricate geometry of the Limnologen buildings, means that beyond optimal for the building system used.[33]

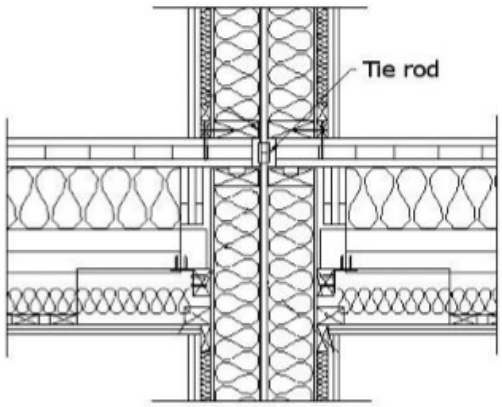

Figure 2.18 Connection between interior wall and floor
Source: http://www.forum-holzbau.ch/pdf/%20ihf09_Serrano.pdf (accessed March 12, 2016)

Of special interest is the investigation on the life cycle primary energy use and carbon emissions, the results of which show that the timber option chosen at Limnologen, taking into account the energy used in a 50 years life cycle, does not only reduce carbon emissions, but actually can create a net uptake of CO2. [34]

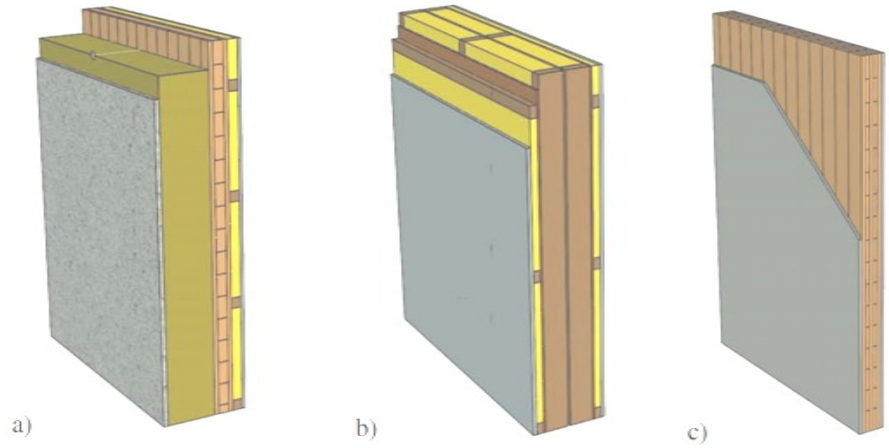

Figure 2.19 Case 4 - a) Exterior wall, b) Separating timber framed wall, c) Interior partition wall
Source: http://www.forum-holzbau.ch/pdf/%20ihf09_Serrano.pdf

[33] Eric Serrano "Limnologen–Experiences from an 8-storey timber building." *Internationales Holzbau-Forum,* (2009): 4.
[34] Ibid., 11.

Case No: 5

Residential Building in Wagramer Strasse, Vienna | Austria

Building Information:

Designation:	Apartment housing
Year of construction:	2014
Designed by:	Schluder Architektur, Hagmüller Architekten
Stories:	4
Gross area:	7,097 m²

Figure 2.20 Case 5 - Exterior view
Source: https://www.binderholz.com/it/soluzioni-edili/edilizia-residenziale/edilzia-residenziale-di-wagramer-strasse-vienna-austria/

Structure type:	Massive wood construction
Primary material:	Cross Laminated Timber
Secondary material:	BBS external wall

The envelope of the three storey residential building are entirely fabricated with timber construction, accomplished through stable cross laminated timber BBS sustaining structure and moderately short ceiling span. The convenience of wood construction technology in its prefabrication and the precise onsite fitting of pre-assembled solid wood panels are evident. Larger degree of prefabrication has been made feasible with employment of load-

bearing partition consisting of laminated BBS timber walls, as well as external wall elements that are non-load bearing. Elements entirely composed of concrete are the three stairwell cores which enable additional structural stability to the building and are utilized as fire protection zones.

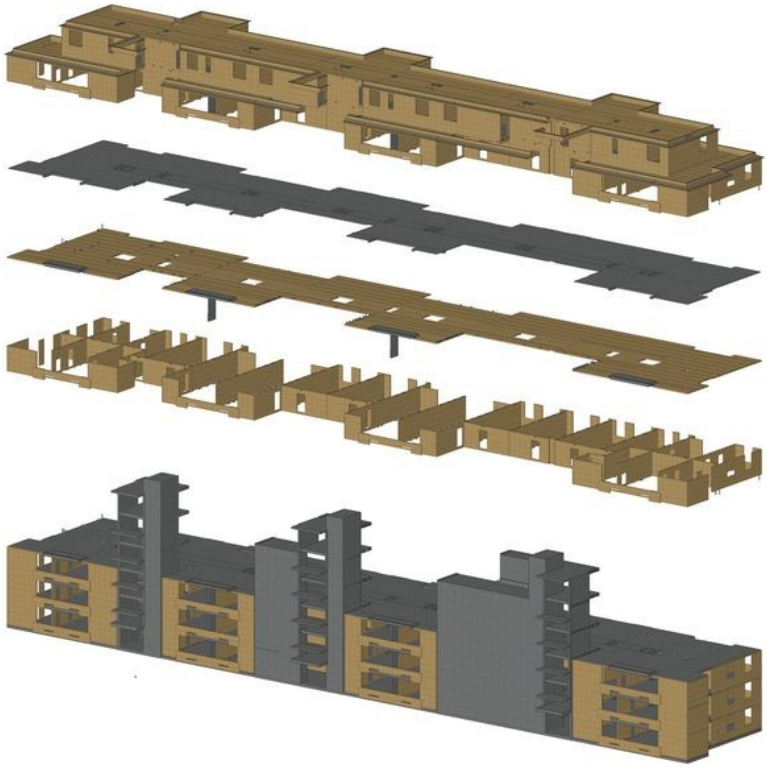

Figure 2.21 Case 5 - Construction sketch
Source: https://www.binderholz.com/it/soluzioni-edili/edilizia-residenziale/edilzia-residenziale-di-wagramer-strasse-vienna-austria/ (accessed March 12, 2017)

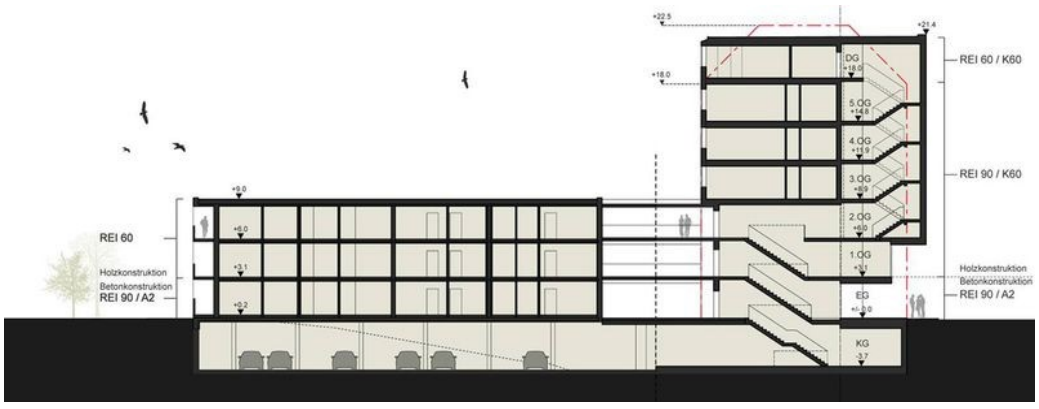

Figure 2.22 Case 5 - Section drawing
Source: https://www.binderholz.com/it/soluzioni-edili/edilizia-residenziale/edilzia-residenziale-di-wagramer-strasse-vienna-austria/ (accessed March 12, 2017)

Case No: 6

3xGruen apartments, Berlin

Building Information:

Designation:	Apartment housing
Year of construction:	2010-2012
Designed by:	Atelier PK
Stories:	4
Gross area:	1.850 m²

Figure 2.23 Case 6 - Exterior view; 3xGruen apartments, Berlin
Source: http://www.ifuh.org/template1.php?pid=14&sid=&uid=30 (accessed March 17, 2017)

Structure type:	Massive wood construction
Primary material:	Prefabricated CLT panels
Secondary material:	Block Concrete base

In contrast to "lightweight" wood frame construction method, the structure consists of solid construction components made of stacked and accurate cross sections that are joined in to a even , planar elements using dissimilar fabrication process.[35]

The foundations, basement, the fire walls and the ceiling above the EC are constructed in reinforced concrete, as all other components are of timber constructions. The load bearings are sustained by wooden supports. All extrusions and balconies are cantilevered solid wood ceilings. In the interior ceilings the wood construction is visible and is covered with colorless fire protection coating. Because the building is mainly made of prefabricated components In the production hall, a short construction time and a high accuracy in the manufacture were achieved. The horizontal loads are conveyed by the floors acting as rigid plates.

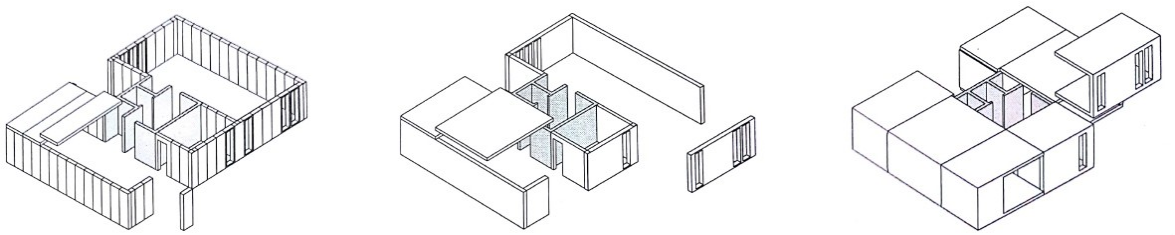

Figure 2.24 Case 6 - Apartments construction assembly scheme; 3xGruen apartments
Source: Peter Cheret, Arnim Seidel, "New timber construction", in Holz- Wood best of Detail, ed. Christian Schittich (Germany: Institut for internationale Architektur - Dokumentation Gmbh and Co. KG, Munchen, 2014), 46

Figure 2.25 Case 6 - Apartments floor layout; 3xGruen
Source: http://www.ifuh.org/template1.php?pid=14&sid=&uid=30 (accessed March 17, 2017).

[35] Cheret and Seidel, New Timber Construction, 46.

2.2.3 Panel construction

The structure is the load sustaining element for vertical and horizontal loads that run into bracing elements comprised of large sized composite boards (OSB, veneer boards etc.) or diagonal cladding of sawed board. The advantage of the respective construction system lies on its lightweight structure. The plane elements consist of boards (glued, nailed or pined) and can be used as structural elements vertical or horizontal, that offer efficient load bearing system.[36]

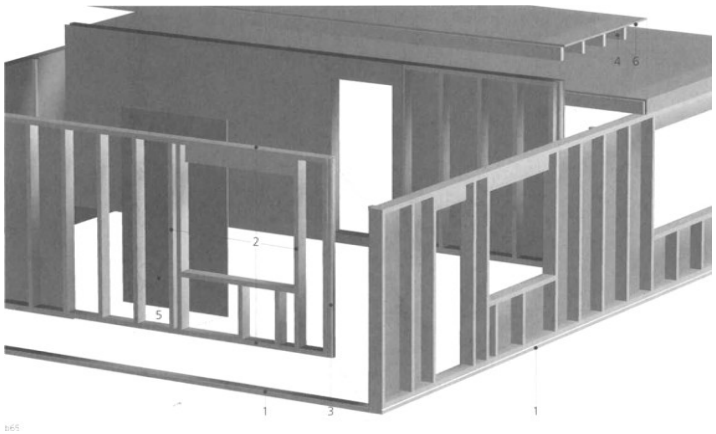

Figure 2.26 Platform frame and balloon timber frame construction system examples
Source: Josef Kolb, *Systems in Timber Engineering*, (Switzerland: Birkhauser, 2008), 93.

The board system originally was based on a similar structural mechanism to the post-and beam and frame building system, however unlike those constructions, the board system refers to prefabricated industrial products. Generally cross-laminated timber and stack-of-plank are used for pre casting the plates.[37] The board panel system in spite of its unadorned appearance embodies multiple structural and constructional concepts. Various panels may be used for the exterior and interior faces; usually thermal insulation (mineral, glass or rock wool, cellulose etc.) is placed as a filling material between panels.

The structural arrangement of the layout in panel construction is based on modular grid of smaller modular dimensions, in comparison with the frame construction where the layout of the load bearing structure is based on a large grid. There is a entirely free choice of plan layout and modular dimensions, however the type of construction and the manufacture of elements should play a role in selection.[38]

[36] Lattke and Lehmann, *Multi-storey residential timber construction: current developments in Europe*, 122.
[37] Yu-hsiang Yeh, "Comparative life cycle assessment of multi-storey timber buildings" (Ph.D. diss., Technischen Universität Dresden - Germany, 2014), 16.
[38] Josef Kolb, Systems in Timber Engineering, (Switzerland: Birkhauser, 2008), 75.

One of the more common forms of wood panel based structure in multi-storey buildings is the platform frame construction which is built one story at a time. Each story is assembled horizontally, raised and then closed by a horizontal division after which the process is repeated on the next storey these construction principles require less skilled labor in comparison to conventional timber constructions. [39]

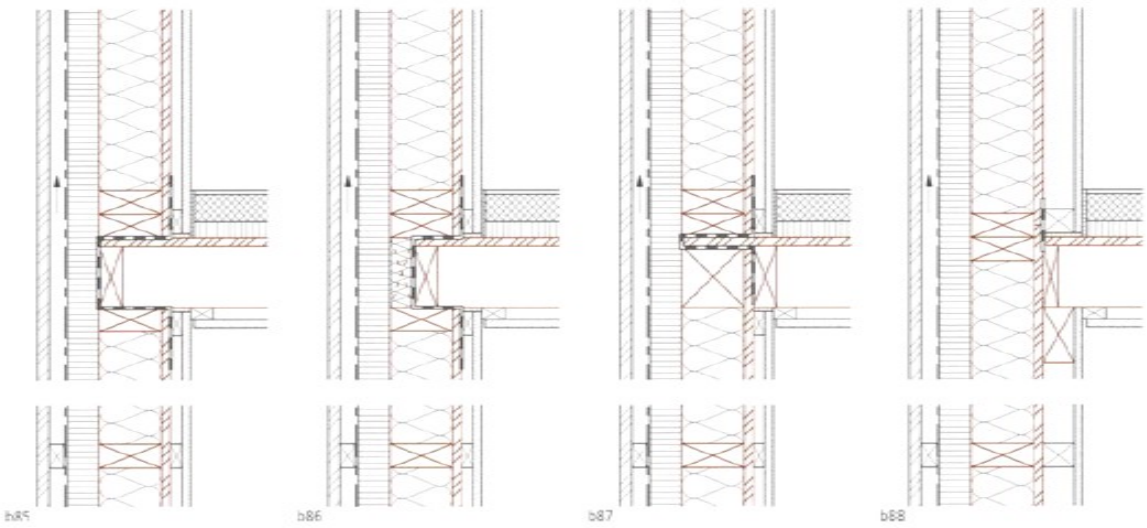

Figure 2.27 Illustration of four options for the junction between a suspended floor and an external wall, with particular reference to the load bearing construction.
Source: Josef Kolb, *Systems in Timber Engineering*, (Switzerland: Birkhauser, 2008), 93.

The choice in selection in wall construction largely depends on the requirements for thermal performance on the building envelope, functional use and the building physics (figure 2.27). In more contemporary panel construction buildings insulation is preferably arranged in two layers, the first in the plane of the load bearing wall element and the second fastened to the outside face of the load bearing elements. This allows for diminution of the thermal bridges, caused by the position of the timber sections within the load bearing element.[40]

In multi-storey wood panel construction higher attention must be given to the bracing. Structure must be considered as a whole, and appropriate anchorage of the subsequent construction must also be taken into account. In case of heavy loads, larger window openings, a structural analysis is necessary to determine dimensioning requirement of stud sections.

[39] Anne Kirkegaard Bejder, "Aesthetic Qualities of Cross Laminated Timber" (DCE Thesis, Aalborg University - Alborg, 2012), 22.
[40] Kolb, Systems in Timber Engineering, (Switzerland: Birkhauser, 2008), 93.

Case No: 7

Viikki wooden apartment buildings Von Daehninkatu Finland

Building Information:

Designation:	Apartment housing
Year of construction:	2012
Designed by:	HMV Architects
Stories:	4
Gross area:	6300 m²

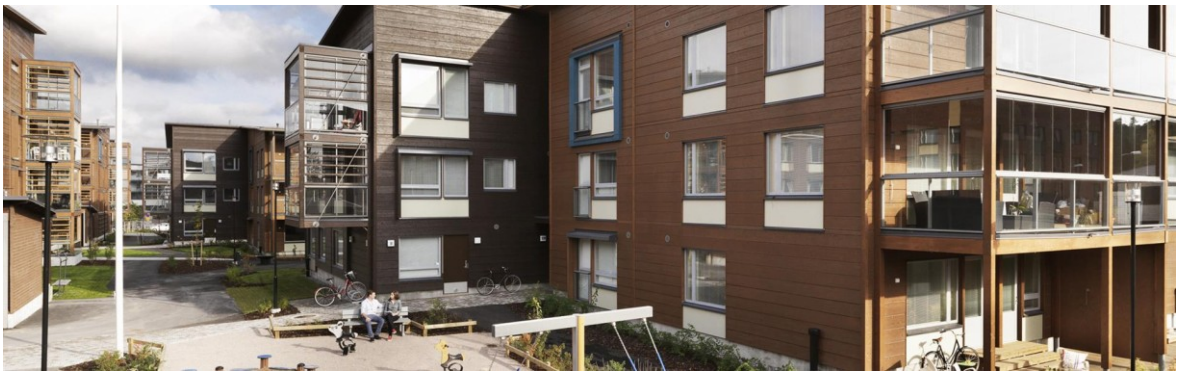

Figure 2.28 Case 7 - Exterior view; Viikki wooden apartment buildings
Source: http://www.metsawood.com/global/news-media/references/Pages/Viikki.aspx (accessed March 12, 2017).

Structure type:	Wood panel construction
Primary material:	Prefabricated panels
Secondary material:	Block Concrete base

The starting point for the design of the residential four-storey building complex was the economically viable urban structure and human wooden habitation environment structure.

The construction system of the multi storey residential building consist of a multi-faceted post and beam frame, flooring, roof elements and exterior walls executed as wooden elements. The advantage of this structural design is the flexibility of conversion. Given that the building is absent of load-bearing interior walls, various sizes of dwellings were enabled. This also made it easy to combine and detach dwellings afterwards.

Figure 2.29 Case 7 - Panel wall assembly.
Source: http://www.structuraltimber.co.uk/assets/InformationCentre/timberframeeb3.pdf (accessed March 12, 2017).

Figure 2.30 Case 7 - Layout drawing
Source: http://www.woodarchitecture.fi/projects/housing-developments-helsingin-rauduskoivu-ja-helsingin-manty (accessed March 12, 2017).

Case No: 8

Student Housing - University of Washington

Building Information:

Designation:	Apartment housing
Year of construction:	2012
Designed by:	Mahlum Architects
Stories:	4
Gross area:	62,130 m²

Figure 2.31 Case 8 - Exterior view; Student Housing - University of Washington
Source: http://www.woodworks.org/design-and-tools/ (accessed March 12, 2017)

Structure type:	Wood panel construction
Primary material:	Prefabricated panels
Secondary material:	Block Concrete base

Continuous wood structural panel sheathing is used as part of an air barrier system for exterior walls. The details how panel joints and openings are sealed with sealant

specifically selected for use on plywood or oriented strand board (OSB). Using uninterrupted structural sheathing as part of the air barrier system also provided a solid sustaining base for exterior cladding systems while ensuring the structure's earthquake and wind resistance.

Figure 2.32 Case 8 - Exterior view; Student Housing - University of Washington
Source: http://www.woodworks.org/design-and-tools/ (accessed March 12, 2017)

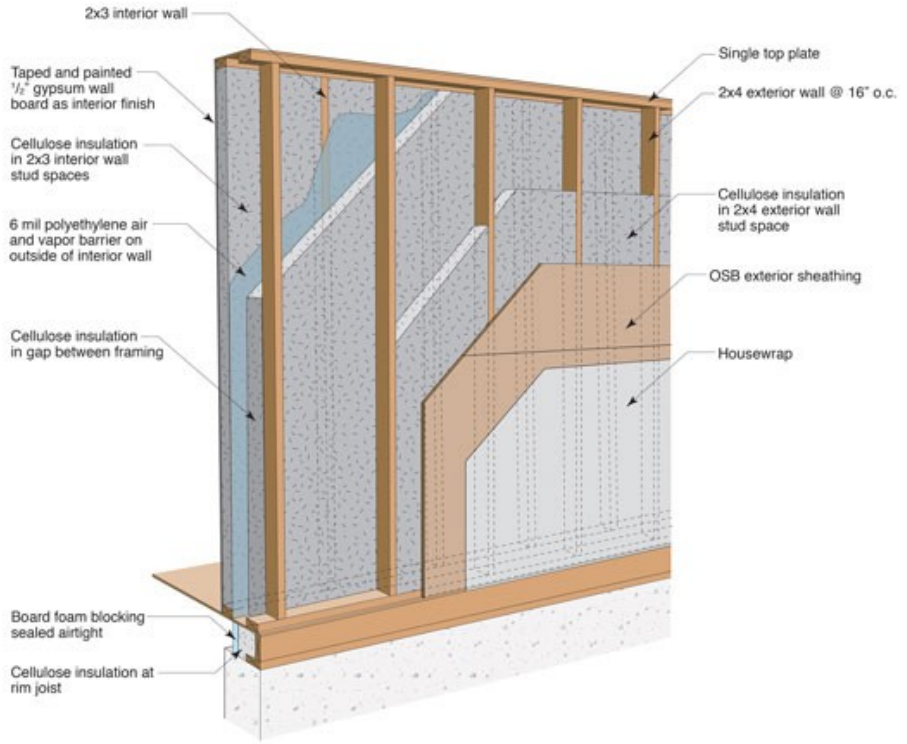

Figure 2.33 Case 8 - Panel construction detail, Student housing
Source: https://buildingscience.com/documents/enclosures-that-work/high-r-value-wall-assemblies/high-r-wall-exterior-insulation-finish-systems-eifs-wall-construction (accessed March 12, 2017)

2.3 Advantages and disadvantages of multi-storey residential timber buildings

2.3.1 Advantages of timber buildings

Wood owing to its structural capabilities and its aesthetic value is an exceedingly enduring construction material and if designed and utilized properly has very few structural limitations. It is sturdy building material with light load, whose hollow cells provide thermal insulation and absorb and discharge moisture, insuring a healthy interior environment.

The use of wood reduces the consumption of non renewable resource products and fuels. Usage of wood instead of non renewable material or fossil relieves the environment and contributes to protect the climate.[41]

Wood construction elements offer a higher ratio of strength-to-weight over the structures built with concrete or steel. In multi-storey wood-based construction, a larger number of walls are often used, which reduces the collective loads by each wall. Structural walls and floors transmit lateral loads induced by winds or seismic activities.[42]

Timber construction materials generally have lesser energy and carbon dioxide balances than alternative materials in analogue applications.

2.3.1.1 The environmental effect of timber buildings and CO2 emission

Nowadays architectural buildings are no longer determined only by aesthetical, functional and economical features, but also in terms of ecological impact. There is an increasing awareness and many efforts to manage global warming and reduce greenhouse gas (GHG) emissions throughout the world. Wood is gradually becoming acknowledged as the most suitable construction material to be included for addressing climate change. An increased use of wood frames from sustainable forestry in multi-storey building will consequently help to reduce the primary energy use and greenhouse gas emissions in construction.

[41] Gerd Wegner and Bernhard Zimmer, "Building with wood is building for the future." in *Timber construction manual,* ed. Friedmann Zeitler (Germany: Birkhauser publishers for Architecture, 2004), 49.
[42] Kevin C. K Cheung, "Case Studies of Multi-Storey Wood-Frame Construction in USA," *Structural Engineering International* 18, no.2 (2008): 2.

Wood is a global carbon store. Forest and timber products make an valuable contribution to protecting the climate. The employ of wood reduces the consumption of non renewable fuels and products made from non renewable resources.[43]

In the case where instead of wood frames concrete frames are used, the increase in CO2 emission will be larger than the increase in energy use as CO2 is released, from the fossil fuel used in the manufacture of concrete as well as from the chemical process from the production of cement.[44]

2.3.1.2 Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) of timber evaluates and compares environmental impact of building materials, products and complete structures; Starting from resource extraction through manufacturing, transportation, installation, building operation, decommissioning and eventual disposal. LCA allows designers to compare building designs based on their true environmental impacts and make educated choices about the materials they utilize. The LCA process is governed under series of international standards addressing environmental management. Environmental impacts of building materials, as reported by Green Building Rating System Guides, are indicated by: material usage; embodied energy; global warming potential (GWP); air pollution; solid waste generation; water consumption; water pollution: the effluent deposited into water bodies.

Different LCA studies have shown that wood-based buildings are better for the environment than either steel or concrete in terms of embodied energy, air and water pollution, and carbon footprint. A very specialty of wood is its life-long production cycling indicating its large potential in different fields of use, as showed in following Figure 2.34.

[43] Wegner and Zimmer, Building with wood is building for the future, 47.

[44] Pal Börjesson and Leif Gustavsson, "Greenhouse Gas Emission from Building Construction in a Life-Cycle Perspective", *ACEE Summer Study on Energy Efficiency in Buildings Conference* (Pacific Grove California, 1998), 5. http://aceee.org/files/proceedings/1998/data/papers/0901.PDF (accessed July 9, 2017).

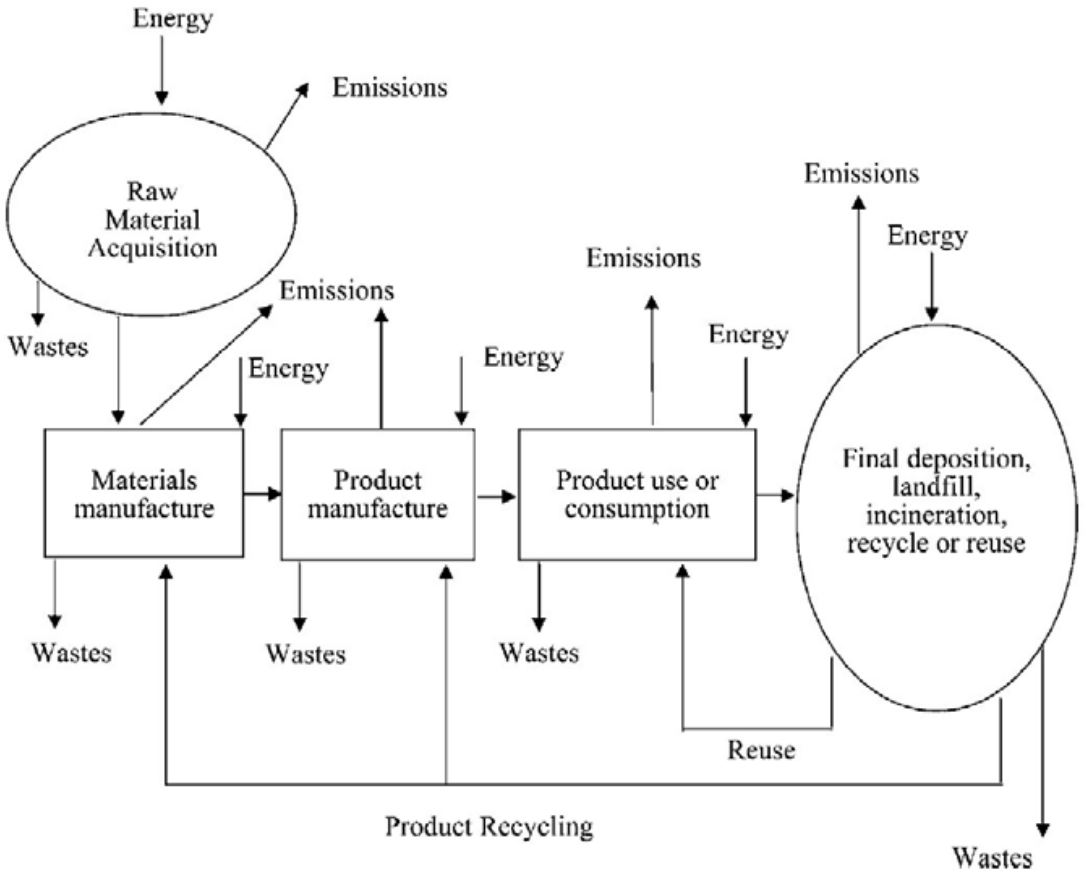

Figure 2.34 Product life cycling, LCA system
Source: FRANKLIN ASSOCIATES, How wood products help slow Global Warming,1990, http://www.roadmap2010.eu/wisd/pdfs/30-45.pdf. (Accessed: August 2008).

2.3.1.3. Renewability

A material is only considered a renewable or sustainable resource if it can be grown at a pace that meets or surpasses the rate of human consumption. Wood is the sole naturally renewable and ecological building material. It is able to accumulate carbon and as long as it is utilized the longer it stores carbon within, providing the environment with oxygen.
"Several analyses have shown that woods renewability, relatively low energy consumption during manufacture, carbon storage capability, and recyclability offers considerable potential long-term environmental advantages compared with other structural materials. Although aesthetic and economic considerations are usually the major factors influencing material selection, the environmental advantages of using wood may have an increasingly important effect on material selection."[45]

[45] Russell C. Moody and Roland Hernandez, "Glued-Laminated Timber" in *Engineered Wood Products-A guide for specifiers, designers and users*, ed. Stephen Smulski (US: Pfs Research Foundation, 1997), 9.

Wood as a renewable building material, boasts an important role in mitigating the environmental impact, nonetheless this idea must be reflected on in terms of sustainable forestry. Wood is not an infinite resource but flow of wood products, with proper forest management can be maintained for a very long period.[46]

2.3.1.4. Building sustainability from material perspective

"Sustainable design is described as a philosophical approach to design that seeks to maximize the quality of the built environment while minimizing or eliminating the negative impact to the environment".[47]

Wood-based construction is becoming everyday more and more popular due to sustainability advantages that it embraces as well as the new technological innovations which develop high technical performances and new ways of application of timber in architecture. With the technology development, in combination with other construction materials, wood has found new manners of contemporary application in the field of construction.

In residential sector, wood-based construction is incessantly expanding its application on multi-storey buildings, attesting its technical capability according to construction norms and regulations for such constructions. Therefore different structural and non-structural systems are being used and developed to reach the satisfactory solution.

Also a good potential is the prospect of reusability/recycling of post-use timber in reasonably large dimensioned products in recovered wood from the demolition of buildings, provided that the material is structurally sound and has adequate dimensions, an application through reprocessing into smaller dimension, such as batten or stud may be assumed at a reasonable price.[48]

2.3.1.5. Time and cost of construction

Mid-rise wood construction is a cost-effective and sustainable choice for achieving high-performance goals.

[46] Atsushi Takano, "Wood in sustainable construction - a material perspective " (Ph.D. diss., Aalto University - Finland, 2015), 30.
[47] Jason F. McLennan, *The Philosophy of Sustainable Design* (US: ECO tone Publishing 2004), 4.
[48] Takano, *Wood in sustainable construction - a material perspective*, 37.

The advantage of wood as a construction material is that in terms of weight is relatively light. In the case of multi-story timber buildings the structural elements can be hoisted using rudimentary lifting equipment at heights of several stories and requires a reasonably small number of specialized labors involved on site. This significantly accelerates the construction timeframe and comprehensively reduces the building cost.

Wood based construction and particularly in multi-storey buildings to a great extent allow off-site prefabrication. The advantage of the technique is that the greater part of the building work takes place in an industrial plant in a well-controlled environment with approved quality assurance and the actual assembly of the building takes less time to be completed.

The subject of construction cost should be addressed in two aspects the cost of material and technical solutions. The majority of expenditure being the material itself, timber material in structures should be used based on sensible engineering solutions and cost.

However the factor of uncertainty in cost estimation is higher in prefabricated elements. The prefabricated structural elements represent the greatest uncertainty in the quotation as it is difficult to predict the 'in place' cost of any new system which has not yet been built in large quantities.[49]

Another rational way for constructing multi-storey timber buildings is by combining timber and other materials in structural elements.

2.3.2 Disadvantages of timber buildings

On this chapter several disadvantages of timber as a construction material with a focus on multi-storey construction are indicated. General overcoming technical solutions are also indicated in order to express that high building performances can achieved on multi-storey residential timber buildings.

2.3.2.1. Fire safety

Timber is essentially a combustible material; hence fire safety concern is one of the most important obstacles in exploitation growth of wood in mid-rise multi-storey construction.

[49] Tobias James Smith, et al., "Construction time and cost for post-tensioned timber buildings," *Proceedings of the Institution of Civil Engineers - Construction Materials* 162, no.4 (2009): 148. http://www.icevirtuallibrary.com/doi/pdf/10.1680/coma.2009.162.4.141 (accessed July 3, 2017).

Therefore number of storey's on timber based structures, respectively in residential buildings is limited by building fire safety codes.
For achieving fire resistance of timber elements the most convenient method is casing the exposed structural elements with non-combustible boards to avoid direct combustive contact of timber. Another method is by allowing the wood element to form a charring layer that eventually self-extinguishes the fire by reducing accumulated heat.[50]

Other than the active safety precautions and measures that are taken in to consideration (fire alarms, extinguishers and evacuation measures) passive fire protection system also should be calculated. Designing passive fire protection system relies on specific use of materials, building elements and construction features that convene well-defined fire safety performance requirements. These safety measures are inherently considered into the building architecture and structure and to detain fire and smoke to designated zones.[51]

By applying timber-based products in multi-layer composite elements, certain fire resistance can be achieved.[52] However, with new industrial advancements of wood processing, many countries have started to revise their fire regulations, leading to greater use of timber.[53]

2.3.2.2. Sound insulation

For multi-story multiple family residential buildings sound transmission is a especially important non-structural design consideration.
Timber material in comparison with other materials has its shortcoming in noise diminution performance of buildings. Being that the density of material strongly effects sound conduction in buildings, the insulation properties of the building can be significantly improved by increasing the mass of certain elements. For instance, using a floating surface concrete cast on the surface above a flexible layer on the upper floor plane.

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[50] Kagami, *A study on multi-storey timber residential building in Japan*, 42.
[51] Robert Gerard and David Barber, Fire research report 2013, *Fire Safety Challenges of Tall Wood Buildings*, 7. http://sustainable-fire-engineering.sustainable-design.ie/wp-content/uploads/2015/08/NFPA-FPRF_Tall-Wood-Buildings-Fire-Safety-Challenges_2013.pdf (accessed July 3, 2017).
[52] Alireza Fadai, Wolfgang Winter and Michaela Gruber, "Wood based construction for multi-storey buildings. The potential of cement bonded wood composites as structural sandwich panels," *Auckland World Conference of Timber Engineering 2012* (Auckland, New Zeland 2012), 7. http://www.timberdesign.org.nz/files/00446%20Wolfgang%20Winter.pdf (accessed March 2, 2017).
[53] Birgit Östman and Bo Källsner, Växjö University report, *National Building Regulations in Relation to Multi-storey Wooden Buildings in Europe*, 9. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.477.4813&rep=rep1&type=pdf (accessed March 2, 2017).

In multi-storey timber buildings, the means of calculating sound insulation (separate frames, sound breaks) are challenging, because they are opposing to how structural rigidity is achieved. When designing to minimize sound transmission the selection of structural wood component is often not as essential as the choice of a system.[54]

The firm assemblies required to resist earthquakes and high wind loads as they are pathways for sound vibrations largely hinder noise control. On the other hand, penetration sealing for spread of fire resistance also blocks movement of certain sounds.[55]

2.3.2.3 Durability

While wood is inherently a sustainable building material, it is also vulnerable to fungal decay and multitude of wood destroying insects, as well as susceptible to deterioration from weathering, dampness and aridity. Durability is perceived as the ability of a timber structure to perform the required functions in its particular environment over a period of time without unpredicted cost for maintenance or repair. However there are great array of measures for protecting, and maintaining and ensuring durability of the wood based structures.

2.3.2.3.1. Dampness, humidity and heat

Perhaps the most imperative characteristic of working with timber structures deals with the rapport between wood and moisture. One of disadvantages is that wood is hygroscopic material which means that based upon surrounding environment it will absorb or lose moisture from the atmosphere. Humidity changes of the surrounding air will cause amassed changes, often manifested in dimensional changes in timber elements.
Due to timbers anisotropic nature (it has a different value when measured in different directions), different directional changes in dimensions can happen as a result of alteration in relative air humidity. As a cause of aeration the shrinkage of lumber occurs, however after lumber reaches the equilibrium in moisture content dimensional changes would be minimal. These changes in parallel to wood grain are often negligible, but perpendicular to

[54] Cheung, *Case Studies of Multi-Storey Wood-Frame Construction in USA*, 4.
[55] John Burrows and Barry Craig, *Sound control in multi-family Wood-frame buildings*, (Canada: Manitoba association of architects, 2005), 2. http://www.soundivide.com/uploads/content_file/multi-family_sound-control-en-277.pdf (accessed March 2, 2017).

the grain is not so insignificant.[56] The cumulative effects of multi-story shrinkage can cause large expanses of interior and exterior drywall, paneling and siding to buckle.[57]

Consideration for shrinkage is necessary required for wood-framed buildings more than three stories. The most important measure is to limit the condensation to harmless quantities and generally avoid gradual increase.

2.3.2.3.2. Living environment

Belligerent hazards for timber based structures are fungi and insects, for which reliable protection has to be provided. Fungi that can grow where free moisture is available in cell cavities can discolor or destroy the wood. In case of extensive humid conditions usually from condensation or precipitation, fungi can spread, causing the timber to decay and ultimately it will be unable to sustain loads any longer.

Consequently protecting the wood against fungi in the first place is done through selection of the appropriate type of construction and by limiting the moisture content in the structure.[58]

The risk for organic decline must always be considered when the construction is exposed to elevated moisture conditions. Damage from rot is disastrous failure and a slow process and can be avoided by uncovering before this happens. Though, in some instances this type of deterioration remains undetected as it takes place in non ventilated and hidden locations.[59]

2.3.2.3.3. Achieving durability in multi storey timber framed buildings

The issue of protecting wood must be integrated from the start of the planning. It is imperative to choose a variety of wood that is resistant to the particular function and a wood product class to suit the particular application.[60]

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[56] Enjily R. Grantham, Multi-story Timber Frame Buildings, A Design Guide, BRE *Center for Timber Technology and Construction, TRADA Technology,* 2005, 20. quoted in Kagami, *A study on multi-storey timber residential building in Japan*, 49.

[57] Cheung, *Case Studies of Multi-Storey Wood-Frame Construction in USA*, 3.

[58] Michael Volz, "Protecting Wood." in *Timber Construction Manual,* ed. Friedmann Zeitler (Germany: Birkhauser publishers for Architecture, 2004), 60.

[59] Eva Frühwald Hansson et al., *Design of safe timber structures - How can we learn from structural failures in concrete, steel and timber?* (Sweden: Division of Structural Engineering, Lund University, 2007), 18. http://portal.research.lu.se/portal/en/publications/design-of-safe-timber-structures--how-can-we-learn-from-structural-failures-in-concrete-steel-and-timber(e1e5771a-6e3e-4581-87c5-f7e6cb601e3a).html (accessed August 2, 2017).

[60] Volz, *Timber Construction Manual*, 60.

The multi-story timber buildings are designed for the structure to be durable for at least one hundred years providing that parts other than skeleton such as cladding, wiring and ventilation be maintained, repaired or replaced as needed.

In order to ensure durability of timber based structures the influence of moisture on wood and wood-based materials as the most critical elements in the detail design, must be minimized.

Most commonly practiced precaution actions involve: Minimizing moisture ingress into the material, choosing dimensions and section profiles that are tolerant to any dimensional changes that may still occur, giving special attention to end grain, providing shelter or covering parts, selecting appropriate surface coatings or other treatments, priming with oils and using adequate sealants or paint, avoiding narrow gaps at joints etc.

The general recommendation is to continue the development on performance based durability design of timber buildings in order to make it more equivalent to other performance requirements for building design.[61]

2.3.2.4. Seismic, technical resistance

Provided the quality of materials and the construction are adequate, the seismic resistance of wood-frame structures is relatively high especially due to its lighter weight and good dynamic properties. Wooden buildings in general have a good reputation when subjected to seismic events and experience shows that wooden buildings can resist disastrous earthquakes, while sustaining only minimal damage.[62] However, under the action of natural hazards, such as earthquake and hurricane events, integrity of the structure of wood-frame constructions in multi-storey buildings is not necessarily guaranteed.[63]

A critical issue for all types of wood structures is their connection of the building to its foundation. During a seismic event structural damage can occur if the buildings structure is not properly fastened to its foundation.

[61] Östman and Källsner, *National building regulations in relation to multi-storey wooden buildings in Europe*, 21.
[62] Ibid., 19.
[63] Ming He, Frank Lam and Ricardo O. Foschi, "Modeling Three-Dimensional Timber Light-Frame Buildings," *Journal of Structural Engineering* (2001), 901. https://www.researchgate.net/publication/245304737_Modeling_Three-Dimensional_Timber_Light-Frame_Buildings (accessed March 3, 2017).

Several research reports have specified that under lateral loads the malfunction of the fasteners or the nails is the main failure mechanism of the wood-frame connections.[64]
In multi-story residential wooden buildings, an efficient way to plan for lateral loads, including seismic loads, is the use of plywood panels in shear walls. These shear walls have a high lateral force-resisting capacity and the joints are in general very ductile. However, a appropriate design of timber structures would diminish the damage and failure in the event of seismic activities and other damaging force majeure.

2.4 Conclusion

The rationale in this chapter was to discuss the development of wood architecture focusing on residential multi-storey construction. Focus on three predominant structural construction systems in regards to multi-storey timber residential buildings as a conceptual planning of the building structure in the light of the load supporting structure for appropriate transfer of the loads, and considerations regarding the choice of the optional timber construction system.
Discussion on encouraging aspects of wood as a structural material include its exceeding endurance, aesthetic value, ecological congeniality, and suitability for industrial use. Timber has very few structural limitations if planned and employed appropriately. However timber as a construction material admittedly is not the ideal construction material as it has its disadvantages. It is foremost combustible, it is anisotropic and as an organic material it can decay, and due to its low density and low ductility can cause earthquake resistance problems.
The deficiency in awareness and comprehension gaps of the material's properties and the contemporary technical construction solutions significantly hinder the larger expanse of opting for wood base structure in multi-storey residential development. However the research on appropriate building techniques and continuous innovations of wood processing industry in timber durability and quality achievements can assure on high building performances in residential multi-storey timber construction.

[64] Hossein Mostafaei et al., Research Report, National Research Council Canada. Construction 2013, *Seismic Performance of Wood Mid-Rise Structures*, 13. http://nparc.cisti-icist.nrc-cnrc.gc.ca/eng/view/fulltext/?id=43c1ab8e-2a36-4f01-b15e-2935c131a665 (accessed July 3, 2017).

Chapter 3
KOSOVO – THE SETTING OF THE RESEARCH TOPIC

abstract:

The third chapter provides an overview on Kosovo background with the aim to better understanding of the local context of the research topic. It is divided into four main sections: the first section presents the actual situation in historical, geographical, demographical, economy and spatial development perspective; the second section elaborates the wood-based residential architecture in Kosovo (both traditional and contemporary). Several categorized buildings will be explained and evaluated based on the building technology and architectural features; the last two sections discusses the present state of Kosovo forestry as local potential and wood industry.

3 KOSOVO: THE SETTING OF THE RESEARCH TOPIC

The following section provides a general overview on the profile of Kosovo with the aim towards a better understanding of the historical/political context, geographical and social structure of the population. The next section is focused on the profile of spatial development in Kosovo, especially the occurrence after the last conflict of 1999 with regard to urban sprawl reflected on the development of certain typologies for multi-storey residential buildings in urban areas of the cities. An overview on the wood-based architecture: both traditional and contemporary follows the chapter, to be enclosed with a profile regarding the forestry sector and wood industry.

3.1 An overview

3.1.1 Historical | Political context

The Albanian-Serbian conflict roots back from the Conference of Ambassadors in London, 1912. Following the WWII, Kosovo became an autonomous region of Serbia within the Socialistic Federal Republic of Yugoslavia.[65] In Yugoslavian 1974 Constitution, a broad autonomy was granted to Kosovo,[66] to be followed by student protests in'81-'86. In 1990, without the approval of YU Federal Parliament, the Serbian Assembly adopted a new Serbian Constitution, therefore stripped Kosovo of its autonomous status, establishing direct regime in Kosovo.[67] Hence, the '90s would be the beginning of the isolation of the Albanian community from the rest of the Yugoslavian republics. During early '90s ethnic Albanians engaged nonviolent resistance to be escalated in 1997,[68] consequently resulting with the last war in 1998/1999.

Kosovo has declared its independence on February 17, 2008 following a historical struggle for freedom, the last war in 1998/1999 and international intervention by NATO, UN. The open conflict has resulted in over 1,500 deaths of Kosovo Albanians and forced around

[65] ConstitutionNet: Supporting Constitution Builders Globally, http://www.constitutionnet.org/country/constitutional-history-kosovo (accessed June 22, 2017).
[66] Momčilo Pavlović et al., *Kosovo under Autonomy, 1974-1990*, 2005:7, https://www.cla.purdue.edu/si/Team1Reporte.pdf (accessed June 22, 2017).
[67] Ibid. 3
[68] ConstitutionNet: Supporting Constitution Builders Globally.

400,000 people from their homeland.[69] NATO's major objectives were to assist on achieving a peaceful resolution and promote stability and security.[70] Subsequent to the declaration of independence, Kosovo statehood is formally recognized by all neighbouring countries (except Serbia) and the vast majority of UN member states, respectively by 114 countries so far (June, 2017), fulfilling the initial aim of obtaining more than 100 recognitions.[71]

As stated in the declaration, Kosovo is declared a democratic republic secular and multiethnic, accepting full obligations contained in the Ahtisaari Plan[72] – obligations to be incorporated in the constitution.[73] Thereof, obligations include those achieved by the Mission Interim Administration of the United Nations in Kosovo (UNMIK) and other obligations of the former Socialist Federal Republic of Yugoslavia, including the Vienna Conventions of Diplomatic and Consular relations.[74] Since Febriary 2008 EULEX (the European Union Rule of Law Mission in Kosovo) is the largest civilian mission working under the general framework of United Nations Security Resolution 1244 with the aim to assist and support the Kosovo authorities in the rule of law area, specifically in the police, judiciary and customs area.[75] Its mandate in Kosovo is extended until 14 June 2018.[76] The strong cooperation with the EULEX and other EU institutions is crucial for Kosovo, with the aim of building a stable and fully functional state and fulfilling standards and recommendations by the European Union.

3.1.2 Geography

The Republic of Kosovo is located in South-Eastern Europe (Figure 3.1), being characterized by its central position in the Balkan Peninsula. It shares the boarders with:

[69] NATO Official Page, http://www.nato.int/kosovo/history.htm (accessed June 20, 2017).
[70] Ibid.
[71] MFA Official Page, http://www.mfa-ks.net/?page=1,224 (accessed June 20, 2017).
[72] Ahtisaari Plan refers to the constitution foreseeing Kosovo as multiethnic society, who will govern itself democratically and in full respect for the rule of law, human rights and fundamental freedoms, while promoting peace and prosperity for all its inhabitants. It was a project of a team of the Special Envoy of the United Nations for Kosovo engaged with the negotiating teams from Belgrade, Prishtina and international partners. The team was led by Martti Ahtisaari, the former Finnish president appointed from UN Secretary General, in 2006.
[73] Enis Rexhepi, "Shtetndërtimi Kosovar: Rast i veçantë në praktikat politike ndërkombëtare." (Postdipl. Diss., South East European University, Faculty of Public Administration and Political Sciences, Macedonia, 2011), 95.
[74] Enis Rexhepi, "Kosovo's State-building: Exceptional Case in International Political Practices" *Journal of European Social Research*, 1, no. 2 (2016):75, http://ejs.epoka.edu.al/index.php/jesr/article/view/155 (accessed June 20, 2017).
[75] EULEX official page http://www.eulex-kosovo.eu/ (accessed June 20, 2017).
[76] Ibid.

Albania (length of the border - 112 km), Montenegro (77 km), Serbia (352 km) and Macedonia (161 km).[77] The total area of the territory covers 10,908 km^2 and it is located in the northern geographic hemisphere with width ranging from 41° 50' 58" to 43° 15' 42", and eastern geographic height ranging from 20° 01' 02" to 21° 48' 02".[78] Kosovo is specific area by its geographic characteristics. It has an important strategic position of south-eastern Europe, as important roads which link Central Europe with the coast along the Mediterranean pass through its territory.[79]

Figure 3.1 Kosovo geographical position in European map
Source: https://upload.wikimedia.org/wikipedia/commons/1/18/Europe-Republic_of_Kosovo.svg

Prishtina (42º40N 21º10E / 42.667, 21.167) is the capital city of Kosovo, whereas Mitrovica, Prizren, Peja, Gjakova, Gjilan and Ferizaj are the other larger cities, [80] as shown below in Figure 3.2. The local administration is consisted of 38 municipalities.[81]

[77] UNDP, *Human Development Report- Kosovo* 2002 (Prishtina, 2002): 15. www.ks.undp.org (accessed April 23, 2017).
[78] MESP-DSP, Report 2002, Prishtina, p.8. cited in Institute for Spatial Planning, *Kosovo Profile* (Prishtina, 2004): 9
[79] Institute for Spatial Planning, *Kosovo Profile* (Prishtina, 2004): 10
[80] Ministry of Environment and Spatial Planning, *Spatial Plan of Kosovo: Spatial Development Strategy 2010-2020+* (Prishtina, 2010): 20
[81] http://kk.rks-gov.net/ (accessed June 20, 2017).

Figure 3.2 Map of Kosovo
Source: http://www.worldatlas.com

Climate

The climate of Kosovo is predominantly continental, which results in warm summers and cold winters with Mediterranean and Alpine influences (average temperature within the country range from +30 ºC during summer to -10 ºC during winter).[82] Three climatic areas are recognized: (1) Climatic Area of Kosovo with colder winters down to -26, and hot summers up to 37 ºC and characterized by a dry climate and a total annual precipitation of 600 mm per year, approximately; (2) Climatic Area of Dukagjini which is influenced by the hot air masses, that cross the Adriatic sea. Medium temperatures during winter range from 0.5 to 22.8 during summer. The average annual precipitation of this climatic area is about 700 mm per year. The winter is characterised by heavy snowfalls; (3) The climatic area of the mountains and forest parts is characterised by a typical forest clime, that is associated with heavy rain falls (from 900 to 1,300 mm per year), and summers that are very short and cold, and winters that are cold and with a lot of snow.[83]

[82] Independent Commission for Mines and Minerals, 2014. https://web.archive.org/web/20140527212027/https://www.kosovo-mining.org/kosovoweb/en/kosovo/climate.html (accessed April 23, 2017).
[83] Ibid.

Seismicity

Kosovo, from the seismological view, presents a region with high seismic activity, characterized by the occurrence of earthquakes within its territory but also being subject to strong motion from the earthquakes, with epicentre out of the territory of Kosovo (in Macedonia, Albania, Montenegro and Serbia).[84] Several powerful zones of seismic sources are:[85]

- Ferizaj earthquake, on February 26 1755; 9 degree MSK-64 and magnitude 6.1 Richter scale
- Ferizaj – Viti earthquake, on August 10 1921; 9 degree MSK-64 and magnitude 6.1 Richter scale
- Kopaonik earthquake, on May 18 1980; 8 degree MSK-64 and magnitude 6.0 Richter scale
- Gjilan earthquake, on April 24 2002; 8 degree MSK-64 and magnitude 5.2 Richter scale

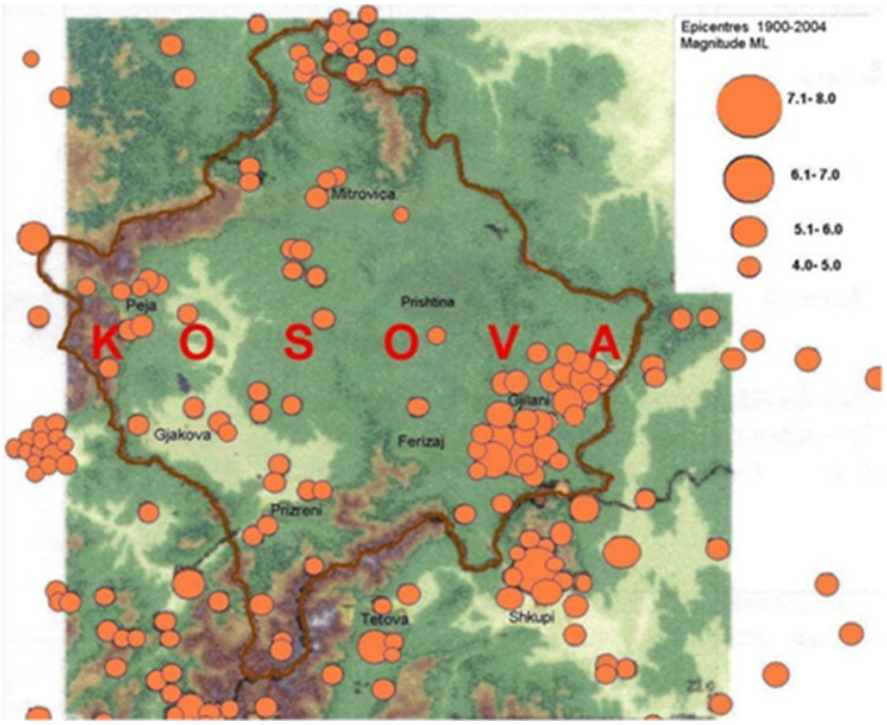

Figure 3.3 Earthquake epicenters and magnitude in Kosovo 1900-2004
Source: Institute of Spatial Planning, Spatial Plan of Kosova 2010-2020+, 57

Elezaj, states that according to Eurocode 8 for calculation of seismic constructions, Kosovo can be subjected to seismic hazards in the specified future foreseen, based on the maps of maximal intensity and maximal acceleration. He suggests that in seismic zone of IX scale

[84] Zenun Elezaj, "Seismotectonic Settings of Kosova" *Journal of International Environmental Application & Science,* 4, no. 2 (2009): 167
[85] GoK, Institute of Spatial Planning, *Spatial Plan of Kosova 2010-2020+,* 57 http://www.kryeministri-ks.net/repository/docs/Spatial_Plan_of_Kosova_2010-2020.pdf (accessed November 12, 2016).

MSK-64 with critical belts of periods of 0.4s-0.8s, constructed objects should be lower than 4 floors, respectively higher than 8 floors with the aim to avoid destruction of buildings as a consequence of resonance effect of earthquake.[86]

3.1.3 Demography

The firs census of population and housing after the 2008 declaration of independence was conducted in 2011, in accordance to the international criteria and standards for censuses with the main goal to enumerate the resident population. According to the conducted census, the total number of enumerated residents in Kosovo was 1,739,825, excluding northern municipalities which boycotted the census.[87] The estimated population including the northern part of Kosovo for 2014 is 1,804,944 inhabitants.[88] As population density concerns, Kosovo is classified as one of the densest in the region of Balkan.[89] The estimated number of inhabitants in 1 km^2 for 2015 is 162.41 residents.[90] Cities with the highest assessed density are Prishtina, Fushe Kosova and Ferizaj (more than 300 persons per km^2).[91] The total number of households according to Labour Force Survey conducted in 2014 was 322,612 with the average size of 5.62 people in an economy.[92]

As shown below in Table 3.1 and Figure 3.4, the Albanian ethnicity dominates with high growth, while the Serbian ethnicity as a general percentage declines from '60s; other ethnic groups (Turks, Bosnians, Romani, Ashkali, Egyptian, Gorani) remain within a constant level of percentage dominance.

Table 3.1 Kosovo's population by Ethnicity from population censuses 1953-2011

Ethnicity	**1953**	**1961**	**1971**	**1981**	**2011**
Albanian	64.3%	67.1%	73.7%	77.4%	91%
Serbian	24.1%	23.5%	18.4%	13.2%	3.4%
Others	11.6%	9.4%	8%	9.4%	5.6%
Total in No.	**815,908**	**963,988**	**1,243,693**	**1,584,440**	**1,780,021**

Source: Adopted from: Statistical Yearbook 2015 *of the Republic of Kosovo*: 35, Tab.2.2

[86] Elezaj, *Seismotectonic Settings of Kosova*, 175.
[87] GoK, SOK, *Estimation of Kosovo population* 2011
[88] GoK, SOK *Statistical Yearbook of the Republic of Kosovo: 2015*, 31 http://ask.rks-gov.net/media/1303/statistical-yearbook-of-the-republic-of-kosovo-2015-08102015.pdf (accessed June 22, 2017).
[89] Hivzi Islami, *Demographic Studies: 100 Years of Kosova Demographic Development*, 2nd ed. (Prishtina: Kosova Academy of Sciences and Arts, 2008), 222
[90] GoK, SOK *Statistical Yearbook of the Republic of Kosovo: 2016*, 29 http://ask.rks-gov.net/media/2577/statistical-yearbook-2016-ang.pdf (accessed June 25, 2017).
[91] Ibid
[92] Ibid. 12

Table 3.1 shows the population growth by 964,113 in total, from the residents enumerated in 1953 till the last census conducted in 2011. According to the projected Kosovo population by 2061[93] (the medium variant), the estimated total population number is 1,743,470, dominated by the 65+ age group (around 500,000).

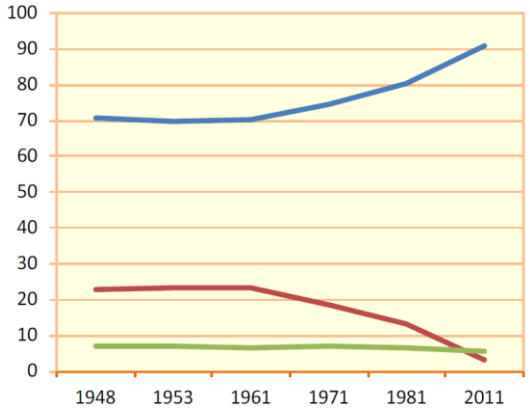

Figure 3.4 Ethnic composition by censuses 1948-2011
Source: Adopted from: Statistical Yearbook 2015 *of the Republic of Kosovo*: 35, Fig.2.6

Table 3.2 Population by age group in censuses of 1953-2011

Age group / Year	1953	1961	1971	1981	2011
0 - 19	51%	51%	53%	52%	**38%**
20 - 34	21%	23%	21%	22%	**25%**
35 - 49	14%	10%	13%	14%	19%
50 - 64	9%	10%	8%	8%	11%
65+	5%	5%	5%	5%	7%
Total in No.	**815.908**	**963.988**	**1.243.693**	**1.584.440**	**1.780.021**

Source: Adopted from: GoK, SOK Statistical Yearbook of the Republic of Kosovo: 35, Tab.2.4

It is evident that the population is quite young, respectively 38% are represented by the youngest age group (0–19) and 25% of the population represents the '20-34' age group. Otherwise, 28 percent of the population is younger than 15; half of the population is younger than 28.2 and the average age of the population (Aprill 2011) is equal to 30.2.[94] Natural growth of the population of Kosovo is approximately 16‰ a year, still remaining as one of the fastest in the region as well as wider (Figure 3.5), which is a result of the slow rate of birth rate reduction and rapid rate of mortality reduction.[95]

[93] GoK, SOK, *Kosovo Population Projection 2011-2061,* 2013, 34-35 http://ask.rks-gov.net/media/1611/kosovo-population-projection-2011-2061.pdf (accessed June 22, 2017).
[94] GoK, SOK, *Kosovo Population Projection 2011-2061,* 2013, 26
[95] GoK, Institute of Spatial Planning, *Spatial Plan of Kosova 2010-2020+,* 21

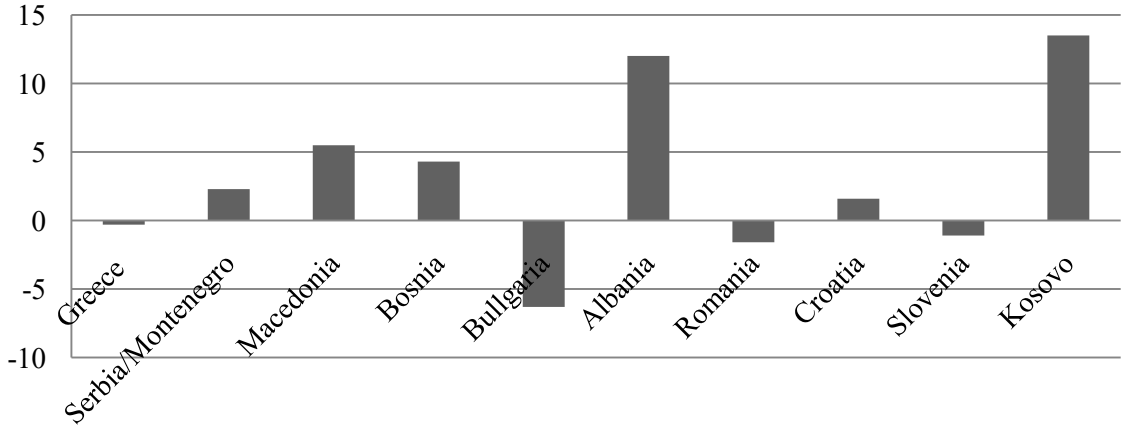

Figure 3.5 Population growth in Kosovo and the region (in ‰)
Source: Institute of Spatial Planning, Spatial Plan of Kosova 2010-2020+, 21

3.1.4 Socioeconomic characteristics

After the declaration of independence in 2008, the migration from Kosovo has been evident. According to the conducted population census, the migration from Kosovo has been driven mainly by the economic reasons (37.9 percent) to an even greater extent for purposes of family reunification, respectively 48.8 percent (Figure3.5).[96] The education purposes are also evident which influence the reason to emigrate.

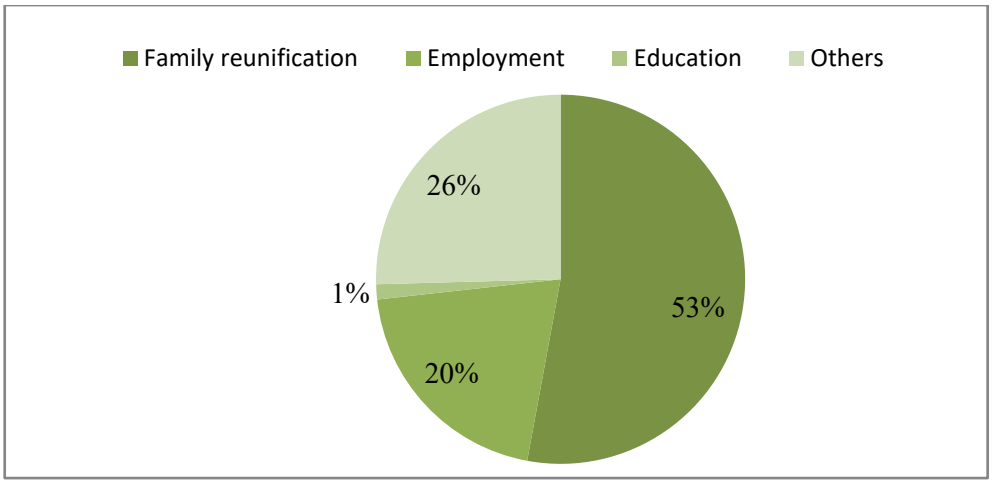

Figure 3.6 Emigration motives of Kosovan asylum seekers in EU member states, 2008-2012
Source: UNDP, Kosovo Human Development Report 2014, 25, Fig. 2.6

[96] UNDP, Kosovo Human Development Report 2014, *Migration as a Force for Development*, 26 http://hdr.undp.org/sites/default/files/khdr2014english.pdf (accessed June 23, 2017).

As reported by a number of studies and surveys conducted during 2008-2012 with regards to the geographic dispersion of Kosovo Diaspora, the majority live in Germany (32.8%), Switzerland (24.8%), followed by Slovenia (6.10%), Italy (7.6%), Austria (5.9%) and United States (4.3).[97]

According to Key labour market indicators for the year 2015, the total employment of the working age population estimated is 25.2 percent, where the employment rate for man was considerably higher than for women (3.7% of working age men was employed compared to 11.3% of working aged women).[98] The majority of employed persons were employees (71.1%), 6.2% were self-employed with employees, 14.8% are self-employed without employees and 7.9% were family workers.[99]

The main sector of the employed workers is Trade and Services with 70% of the employment share, following by Industry (15%), Construction (8%), Agriculture (4%) and other (3%).[100]

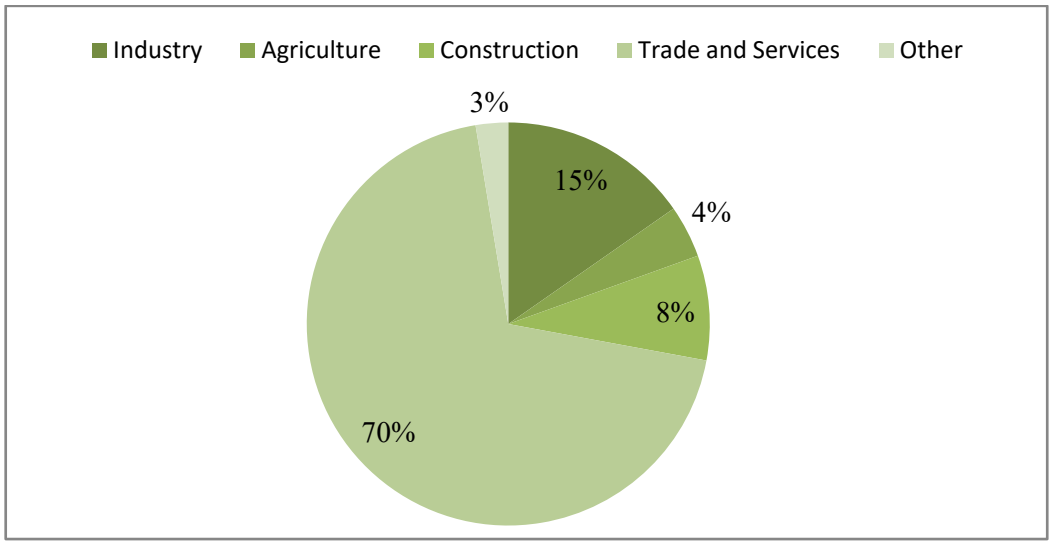

Figure 3.7 Employment by sector
Source: Adopted from Kosovo Census Atlas, 2013: 52-53

The unemployment rate from the 145, 776 people aged 15-64 years old, is 32.9 percent; 60% of the youth population is unemployed, where the majority are age between 15-34 years old, accounting for 62% of the unemployment.[101]

[97] UNDP, *Migration as a Force for Development*, 28.
[98] Kosovo Agency of Statistics, *Results of the Kosovo 2015 Labour Force Survey*, 2016, 11 www.ask.rks-gov.net (accessed June 23, 2017).
[99] Ibid., 12
[100] Kosovo Agency of Statistics, *Kosovo Census Atlas,* 2013:52-53 http://ask.rks-gov.net/media/2005/atllasi-i-regjistrimit-te-popullsise-2011.pdf (accessed June 25, 2017).

Taking into account the relatively young average age of 29.5 years in Kosovo, while the average age in the European Union in 2010 was 40.9 years, the trend of migration from Kosovo may continue for some time to come.[102]

3.1.5 Spatial development and housing

Urban development frameworks in Kosovo have been initiated after the Second World War as a result of industrialization and urbanization processes of the YU socialist system of the time. The regime was characterized by visionary planning of large industrial and social projects that had to embody progress and prosperity.[103] The first urbanization document is the "Regulative Plan of Prishtina" (1937) – designed for the surface of 192.72 ha, for a demographic projection of 16,000 inhabitants.[104] In contrast, the latest "Urban Strategic Plan 2004-2010" of Prishtina was drafted for a population of 420,000 inhabitants.[105] Affected by the political directives, the old traditional structures of the main cities have been subjected to the new modern urban plans, causing a constant 'threat' of losing the original identity of the old cores of the cities built throughout history, especially inherited from the ottoman era.

Two main tracks of development are recognized: the first track is identified by the major industrial, commercial and social housing projects, shaped by social-realist architecture; the second development track refers to the private initiative, the share of private dwellings in housing developments, which lacked of proper implementation of official urban development plans.[106]

By the end of '80s the number of cities has grown to 30 cities and towns, in contrast to only 5 cities counted during 1948; a process identified by a constant trend of demographic expansion in main large cities, especially in the capital of Kosovo, Prishtina.[107] The 10 year period, from the census of 1981 up to 1991 has had no significant differences as

[101] Kosovo Agency of Statistics, *Kosovo Census Atlas,* 21.
[102] UNDP, Kosovo Human Development Report 2014, *Migration as a Force for Development*, 25
[103] Andrej Pogačnik, "Yugoslav experience in the decentralization of urban and regional planning systems" *Landscape and Urban Planning*, 14, No. 1(1987):442
[104] Municipal Assembly of Prishtina, *Strategic Plan: Prishtina Urban Development 2004-2020*, 2004, 33
[105] Ibid.
[106] Kobe Boussauw, "Challenges, threats and opportunities in post-conflict urban development in Kosovo" *Habitat International*, 36, No. 1 (2012):143 https://biblio.ugent.be/publication/1843809 (accessed July 22, 2017).
[107] Besim Gollopeni, "Socio-Urban Developments in Kosovo: Study case Pristina" *International Scientific Journal: Micro Macro & Mezzo Geo Information*, No. 6 (2016): 83-84, http://mmm-gi.geo-see.org/wp-content/uploads/MMM-GI_6/MMM-GI%206-2016.pdf (accessed July 22, 2017).

regards the rate of urbanization, with the exception of Prishtina, whilst the urban demographic increase has been marked between 10%-20%.[108] Urban plans were applied mainly to certain parts of city centres leaving the surrounding areas under no control of urbanization directives. These areas were mainly inhabited by the migrants in search of new economic opportunities from the surrounding rural zones who built their private individual houses. A new way of planned housing is commenced within large-scale residential blocks. Typical traditional Albanian detached housing (as shown in section 3.2) is now replaced by modern mid-rise and high-rise residential buildings (Figure 3.8, 3.9, 3.10).

Figure 3.8 High-rise residential block in Mitrovica
Source: https://www.slobodnaevropa.org/a/1497445.html

Figure 3.9 High-rise residential blocks in Prishtina
Source: http://wikimapia.org/12462434/sq/Dardania

[108] Gollopeni, *Socio-Urban Developments in Kosovo: Study case Pristina*, 85.

Figure 3.10 Mid-rise residential blocks in Prishtina
Source: http://wikimapia.org/12808667/sq/Ulpiana (upper image); the author (lower image)

High-rise urban blocks dominated in Prishtina and partially in the main cities, while the mid-rise buildings secured the highest share in planed urban areas, building the new identity of urban habitat. This new typology of collective residence was welcomed as a result of economic development, hence rapid urban population growth.

Two main structural typologies of mid-rise buildings are present: the load bearing masonry structure and later, the reinforced concrete frame structure. Both typologies were composed of one or two basement levels offering storage and risk shelter for the residents, the ground floor used for commercial, residential or administrative purposes, and two to four residential floors, covered by a pitched or flat roof.

The load bearing masonry structure (Fig. 3.11 and 3.12) is composed of 50cm thick load bearing brick walls, the secondary 20cm walls and 12 cm non-structural walls. The floor height is usually three meter composed of lightweight montage or semi-montage flooring systems.

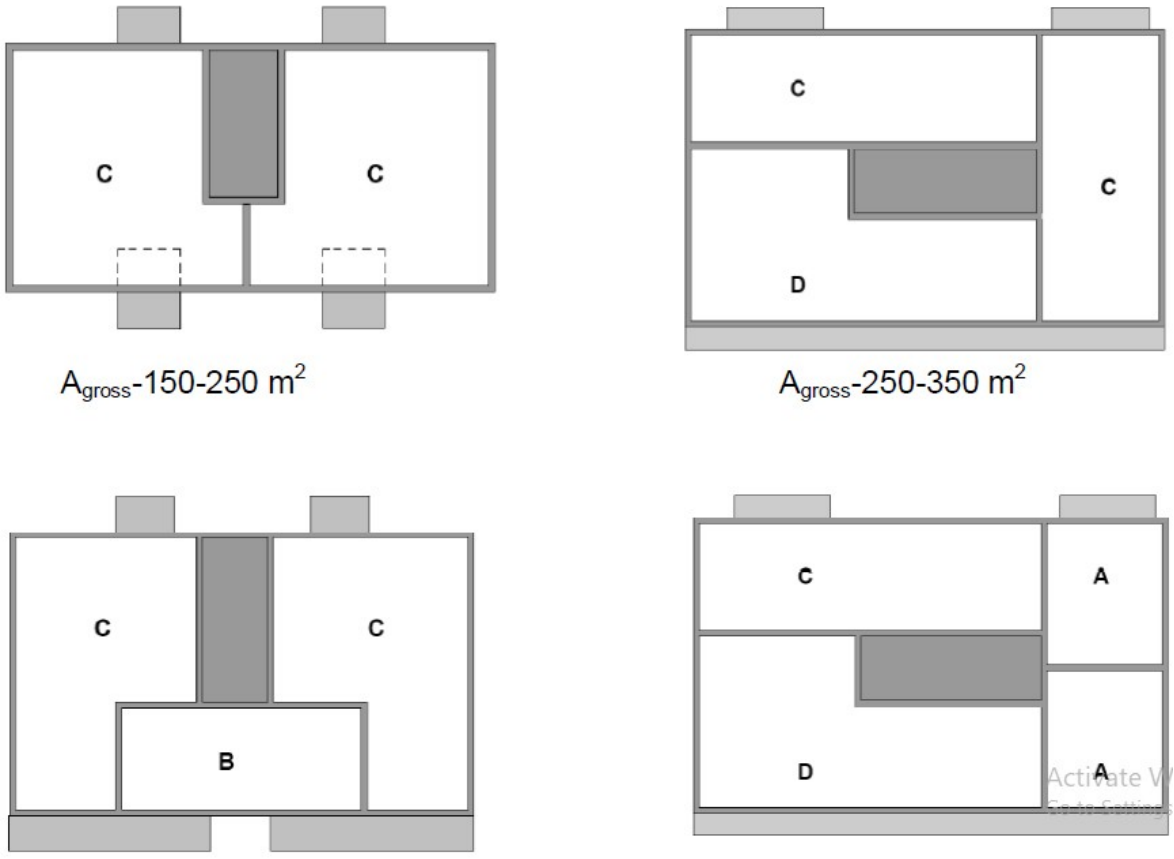

Figure 3.11 Load bearing masonry structure - typical layouts of residential units

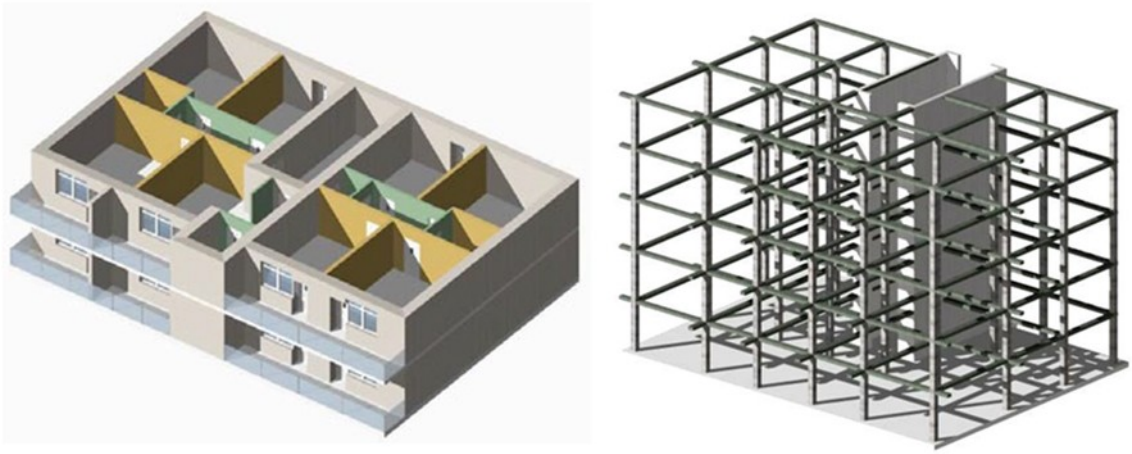

Figure 3.12 Load bearing masonry structure (left); reinforced concrete frame structure (right)

From the late '70s reinforced concrete frame structures were approved, maintaining the layouts of masonry mid-rise buildings' units but also introducing new plans with bigger and more flexible spaces within the unit. The outer walls are replaced by 25cm thick cement mortar bond hollow clay blocks, the inner walls of 20 and 12cm blocks. Floors are constructed by lightweight structure or reinforced concrete slab. Clay bricks were used in facades, bringing a new image of the residential blocks.

Significant economic developments reflected in spatial development and construction industry occurred until the end of '80 – up 1990, where due to the political situation in the region the stagnation of development occurred.[109] Many capital investments partially implemented would remain unfinished for the whole decade of '90s.

3.1.5.1 Post-conflict urban sprawl

Urban sprawl is a recognized process of rapid urbanization faced in most of the cities today which is caused by many factors defined by different causes and consequences. The unimpeded growth, unsystematic landscape development, increased demands for living and inexpensive building lots are some of the causes of urban sprawl, whilst some of the consequences include the diminution of landscape quality, loss of arable soil, a lack of clearly defined open spaces, the dysfunction of built areas for people and large numbers of commuters.[110] Post-conflict countries are most prone to urban sprawling in many dimensions with rapid, sometimes brutal consequences to the society and urban environment.

The last war in 1998/1999 is a point in time of drastically changes in Kosovo. The transition period has been distinctly manifested in spatial developments, by uncontrolled horizontal sprawl from construction sector in both, urban areas - invading the 'available' space, and rural areas which has caused a great loss of agricultural land.

In the beginning of 2000 the population of Kosovo found itself in a state of emergency. High need for shelter and reconstruction from the damages of war were evident. Population initiative and international organizations' support through donations for house reconstruction have had no plan or legislative framework to be directed from. At the same time, as the migration towards cities was increasing and the presence of international

[109] Gollopeni, *Socio-Urban Developments in Kosovo: Study case Pristina,* 85
[110] European Environment Agency- EEA & Federal Offices for the Environment- FOEN, *Urban sprawl in Europe* (Luxembourg: Publications Office of the European Union, 2016), 20, https://www.eea.europa.eu/publications/urban-sprawl-in-europe (accessed July 18, 2017).

community was dominant, this euphoric situation has been an opportunity for potential investors to realize their construction projects for residential and commercial use. In a post conflict city, the main actors identified as urban developers are: 1) The Planning Institutions, 2) The Residents, and 3) The International Organizations.[111] The local and planning national authorities were not able to manage the growing demand for housing, infrastructure, and services since, as Narang and Reutesward state: *the development was always to be a few steps ahead of the plan – thus continuing to be chaotic and unsustainable*.[112] The 'absence' of local authorities facing the transition with difficulties due to the lack of urban regulating plans and the high request for reconstruction has led the population to take the situation under its 'control' which caused a pressure on the existing infrastructure. The influx of people from rural areas towards cities, especially the capital has placed a great pressure on the existing infrastructure, public services and accommodation (Figure 3.13).[113]

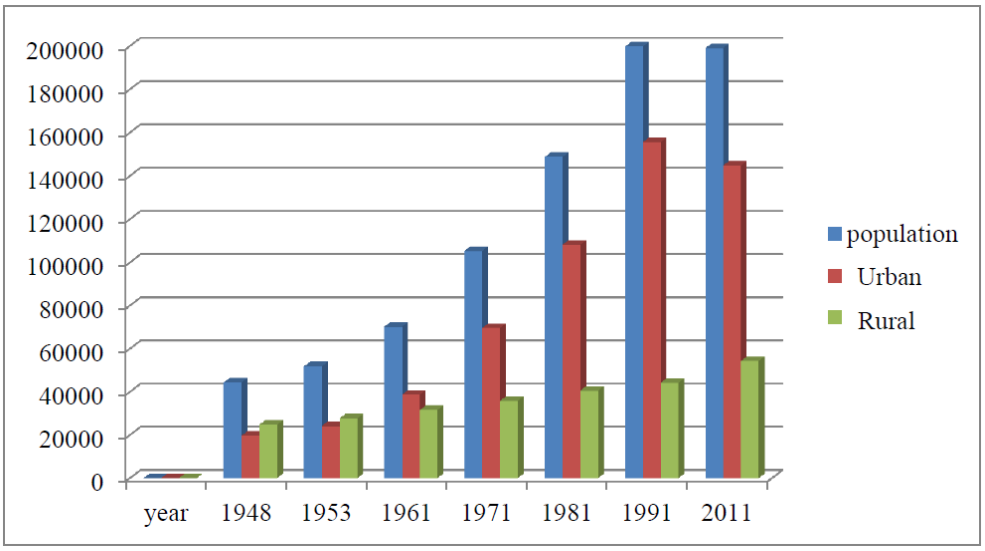

Figure 3.13 Prishtina urban/rural population structure in five decades
Source: Ferhat Bejtullahu[49],11, Table 3

The city expansion of Prishtina between 1993 and 2014 into the surrounding, mainly agricultural land as well as its densification is shown in the figure below (Figure 3. 14).[114] The spontaneous trend from the private sector has resulted the unplanned illegal individual

[111] Arta Jakupi, "The Effect of the International Community Presence in the Urban Development of Post Conflict City – Case Study: Kosova."(PhD. Diss., Bauhaus University Weimar, Germany, 2012). 78
[112] Shipra Narang and Lars Reutward, "Improved governance and sustainable urban development, Strategic planning holds the key", European Journal of Spatial Development, 2006 in Ibid. 81
[113] Ferhat Bejtullahu, "Demand for housing quality and urban livability, potential for establishing a new identity of city (Prishtina)." (PhD. Diss., University of Pecs, Hungary, 20155). 11
[114] Ibid. 10

residential/commercial building construction at the beginning, and later mid-rise, especially high rise constructions arouse suffocating the 'available' urban spaces and challenging, therefore causing the loss of the urban identity.

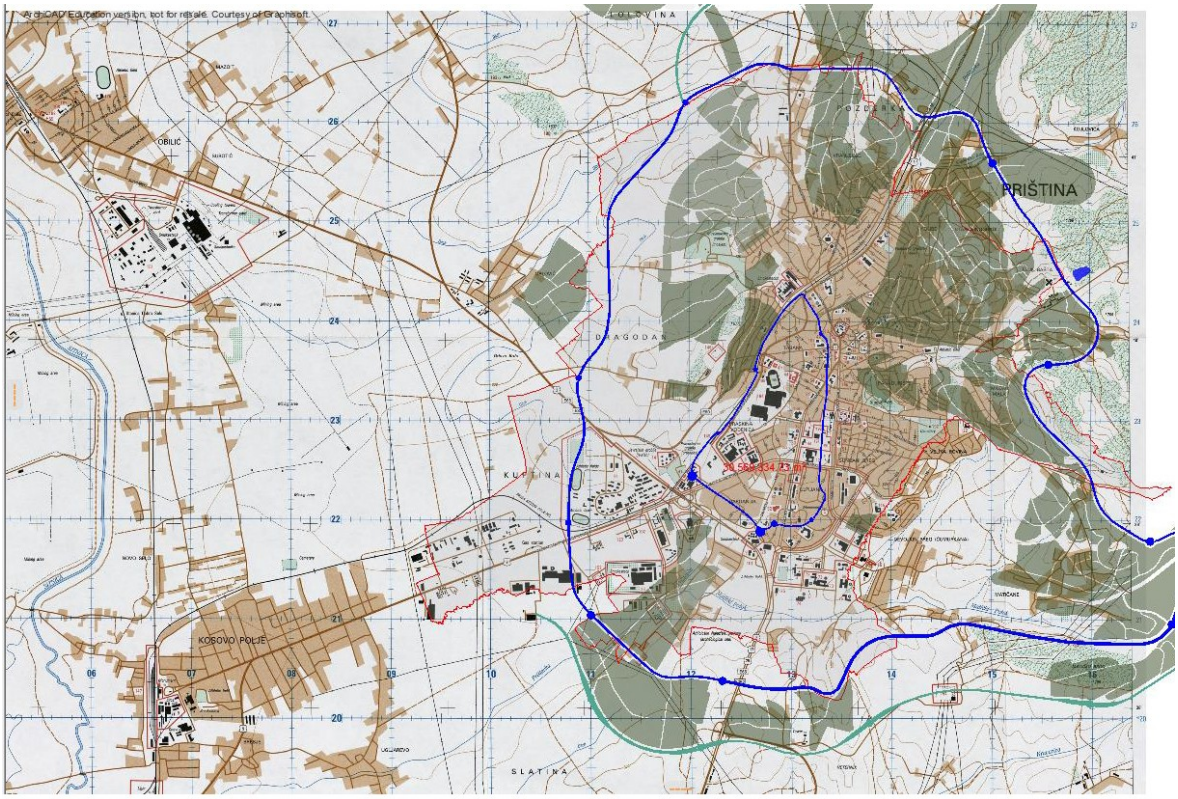

Figure 3.14 Digital map of 1993 (brown color) and urban sprawl in Prishtina until 2014 (dark green color)
Source: Ferhat Bejtullahu[49],11, Fig.1

Figure 3.15 Typical post -war collective residential development, surrounding of Prishtina
Source: http://lajmi.net/ndertimtaret-te-lodhur-nga-procedurat-per-leje-video/

Figure 3.16: Post -war collective residential development, surrounding of Prishtina; previously agricultural land with individual housing
Source: Internet

The international community presence has played a great role on the cities' development. At the beginning of 1999 KFOR troops and international organizations were placed in Kosovo under the control of a provisional international administration. As part of international organizations they were able to pay high rent price and settle in new buildings. This opportunity stimulated massive constructions without permits, offering various services around international organizations' settlements.[115]

The collective residential sector in the post conflict Kosovo has been developed without appropriate construction standards and urban regulative plans, providing high storey chaotic residential blocks with maximum use of space, therefore lack of collective open spaces. The many identified causes of post conflict urban sprawl have made a great effect to the wellbeing and image of the cities. Today, through regulative plans, efforts are given toward the balance between the height of buildings and distance between in order to improve the quality of life inside residential complexes. Residential blocks consisting of mid-rise residential buildings with improved urban standards are being integrated in the new plans with the aim to rebuilding the quality of urban identity.

[115] Kai Vockler, *Prishtina is Everywhere- Turbo Urbanism: the Aftermath of a Crisis* (Germany: Messedruck Leipzig GmbH, 2008), 39.

3.2 Wood-based architecture

Wood, as the oldest construction material, is one of the foremost used materials throughout the world, likewise in Kosovo up till the beginning of industrialized era. Kosovo is located in South-East Europe, in the centre of Balkan Peninsula,[116] therefore its architectural heritage shares similarities with the region, in the context of building techniques, use of materials and architectural expression. Regarding to traditional wooden application, Bouzek states that remains of constructions in the Balkans and in Central Europe attest that this art of constructing houses was generally used on large parts of Europe.[117] However Kosovo maintains its identifiable rich architectural features as a reflection of Albanian culture of living in Kosovo. From the middle of 20th century, with the development of construction industry and the availability of clay brick and concrete as modern materials, the use of wood has declined significantly. Today, very few contemporary low rise non-residential buildings with timber as main construction material can be found in different urban and rural areas. There are several large-span constructed buildings with laminate wood technology during '80s and only one large-span building,[118] constructed in the year 2001. Since then, no significant tendency toward wood-based application is noticed.
In this context, this paper investigates and illustrates several wooden building typologies in two terms: traditional building systems and applied contemporary structures, by analyzing and classifying their structural elements as well as interpreting their architectural values.

3.2.1 Traditional wooden architecture

Traditional architecture in Kosovo is interpreted as Vernacular Architecture, which implies, among other definitions, the use of local materials and experience, as Rudofsky defines it: "architecture without an architect or architecture without pedigree".[119] Vernacular architecture in Kosovo has been developed under the impact of different natural-geographical and socio-economic factors taking place since 18th century, especially during 19th.[120] [121] In traditional buildings of Kosovo, wood construction takes a

[116] Institute for Spatial Planning, *Spatial Plan of Kosovo: Spatial Development Strategy 2010-2020+,* 19
[117] Jan Bouzek, "Wooden Architecture: Combining different techniques", *Histria Antiqua,* 19, no.19 (2010): 83-87.
[118] Internationally donated investment after the last war in Kosovo
[119] Bernard Rudofsky, *Architecture Without Architects: A Short Story to Non-Pedigreed Architecture* (New Mexico: University of New Mexico Press, 1987 (1964)), 7.
[120] Branislav Kojić, *Seoska arhitektura i rurizam* (Beograd: Gradevinska knjiga, 1973), 3.
[121] Fejaz Drançolli, *Kulla Shqiptare (*Kosovo: Rezniqi, 2001), 25.

considerable part along the application of stone and mud brick. Wood construction elements have been used as support structure or in combination with masonry, as reinforcement. They have mainly been applied in constructing one or more story individual urban and rural house buildings, but are also found in other facilities such as large street bazaars, so-called "Çarshia".

Hence, this study is focused on dwelling buildings as the main typology, signifying the presence of wooden structural and non-structural elements, as well as interior ornamental amenities. Such architectural systems and elements are used all over the country, sharing a unified character of utilization that demonstrates a long tradition and excellence of local construction mastery.[122] However, they maintain individuality in terms of volume, layout and facade. There are two main types of vernacular houses in Kosovo: traditional urban and rural houses. The main difference between them consists of the general size, building techniques and most important, indoor decoration, enriched with traditional aesthetic and detailed ornamentation with hand carved wood.[123]

3.2.1.1 Traditional urban houses

Traditional urban architecture has been developed predominantly during 19th century, until usages of new modern materials such as reinforced concrete were introduced. Materials with mixed structure of wood, stone and brick were used achieving specific architectural features, such as: constructive, functional, and artistic-aesthetic.[124] Houses are mostly single family houses, one to two stories distributed in the urban layout of the city. There is no classification of urban houses regarding the wooden structural elements, however two main types in terms of structural elements in the walls are observed: timber frame with masonry infill and combined construction where horizontal timber is embedded into bearing masonry walls.

Timber Frame House is a building system which existed throughout history around the world to the present, with masonry infill by bricks, stones or adobe (Figure 3.17). Timber elements in this typology provide the framework for the infill. Usually the masonry basement walls are made of stone or brick with adobe, strengthen by horizontal wooden lintel. They are load-bearing elements, thus serve as foundation while the upper floor applies timber-framed system. The frames are constructed by studs, usually 14x14cm and

[122] Flamur Doli, *Shkolla kosovare e mjeshtrit popullor shqiptar (*Kosovo: Zëri, 1993), 93.
[123] Emin Riza, *Qyteti dhe banesa qytetare shqiptare shek. XV-XI (*Albania: Dita 2000, 2009), 206.
[124] Fejaz Drançolli, *Destruction of Albanian Kulla (*Kosovo: Rezniqi, 2004), 56.

braced by diagonals and horizontals providing lateral support. Diagonals are placed on the corner supporting posts of the building. They are assembled with joints cut by hand and connected with nails. The walls are enclosed by plates on top of which beams and joists are placed in 40-55cm intervals. The structure of roofs is also constructed by wooden frames.

Figure 3.17 Timber framed house in Kosovo; *Source*: Author

In general, the frame constructed house is consisted of four main structural parts:

- Masonry ground floor or basement
- Timber framed floor
- Timber framed walls of the floors
- Timber framed roof

Combined Construction House is a typology developed during 18th and 19th century incorporating the rich traditional Albanian culture and art in its composition, therefore has a special value within entire national architecture. These types of buildings are single family houses with variations of sizes in relation to the family social-economic status. In these one to two story houses dwelling is organized in upper story while ground floor is comprised of supplementing areas (Figure 3.18 and 3.19).

Figure 3.18 Combined structure house in Kosovo; *Source*: Author

Figure 3.19 Combined structure house in Kosovo; *Source*: Author

In this typology the main construction materials are stone with mortar and horizontal timbers embedded into load-bearing masonry walls. These walls are usually 65-80 cm thick while in the upper floor layout is more flexible with thinner timber framed walls which are plastered on both sides, while the exterior walls usually maintain the same thickness. The general parts of the house comprised by wooden elements are the flooring, the open or closed porch which is supported by wooden posts, wooden jetty (so called Erker) and the wooden framed roof.

Similar building systems are found in several traditional urban street bazaars - Çarshia (Figure.3.20), located in the center of big cities of Kosovo. They offered functions of handicraft, trade and administration of the time.[125] Individual facilities were composed of one to two stories, with discrete architectural expression applying wood, stone and adobe in their structure.

Figure 3.20 Urban Entity Grand Bazaar (Gjakova); *Source*: Author

[125] Ministry of Youth and Sport, http://dtk.rks-gov.net/tkk_objekti_en.aspx?id=1259 (accessed March, 2015).

Main wooden structures observed are: sole plate as base of vertical structural elements, bay windows or jetty, posts, beams, roof structure, window and door structure and related functional elements, all composed with rich popular art.

Structural elements

Beams are supported by the bearing walls on the shorter side of the space and the reinforcement orthogonal beam. They have rectangular or square section around 25x25cm, placed at 50 - 70cm intervals, exposed in the ground floor (Figure 3.21) The secondary beams, 14x20cm section, lay on the primary beams and are covered with planking. When the upper floor layout differed from the ground floor, primary beams were extended creating cantilevered structure bearing the load from the upper floor (Figure 3.22). The elements are placed with grooved assembling and sometimes with nails too.

Figure 3.21 Timber beams, *Source*: Author

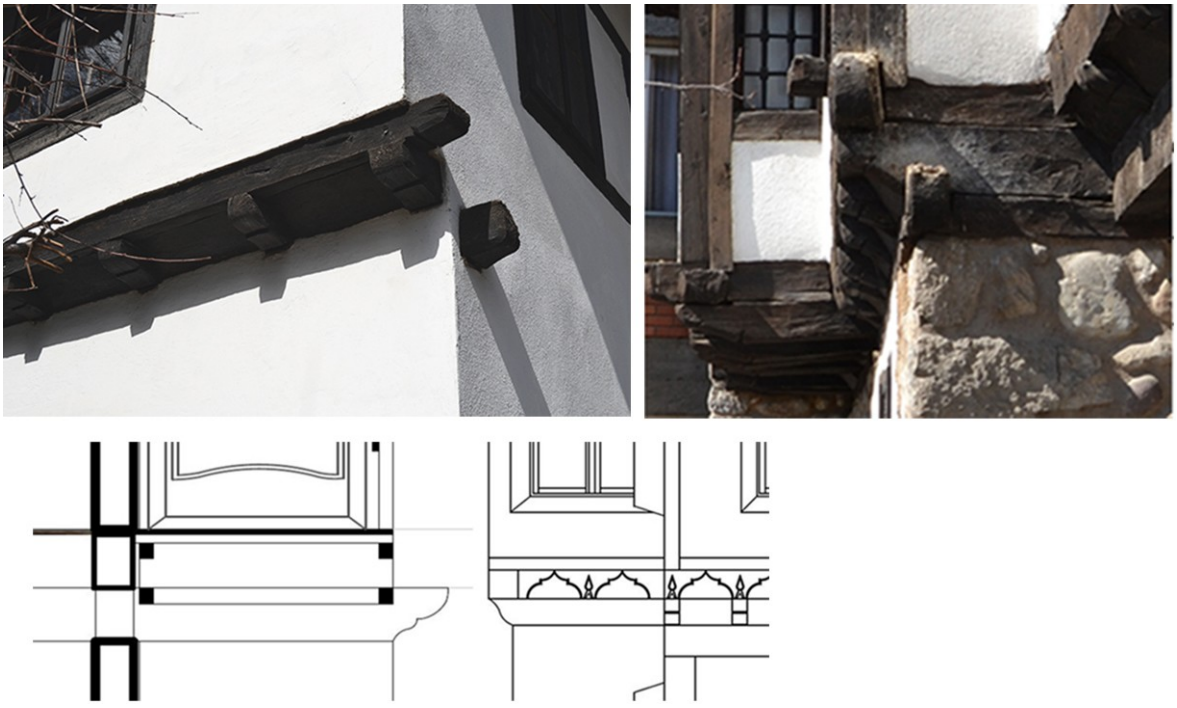

Figure 3.22 Timber jetty; drawings on the right by F. Kuleta and A. Gashi

A very special a wooden structure of a house is a large bay window or jetty (locally called Erker) (Figure 3.23) facing the gardens. Such application enabled more flexibility in the upper floor as inner space or supporting the open or closed porch. It is executed by super-positioning of several cantilevered joists creating an impressive forming structure with original and ingenious features.[126]

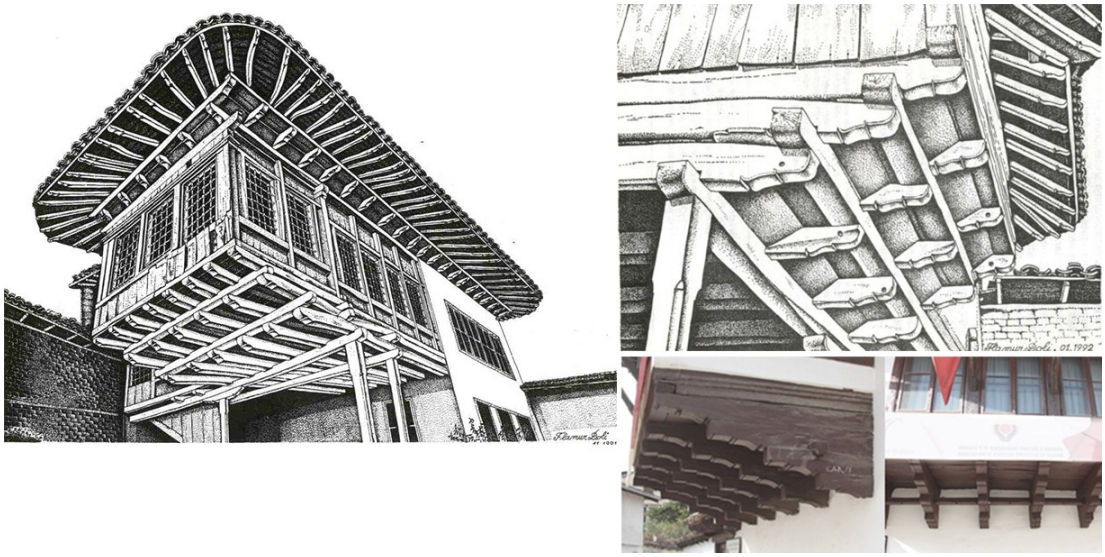

Figure 3.23 Wooden jetty drawings on the left (Doli, 2001) , the rest by the author

Each function of everyday life of the family was carefully designed within the composition of the house and executed with care and elegance. Such example is the extended structure as part of the kitchen, enabling the disposal of used water which flowed in to the garden of the house (Figure 3.24). Doors and windows are beautifully composed with wooden elements as supplementary functions.

Figure 3.24 Wooden exterior structures; *Source*: Author

[126] Flamur Doli, *Traditional popular architecture of Kosova,* (Kosovo: Flamur Doli, 2001), 106.

Posts have square sections, around 20x20cm supporting open or closed porches and the structure of the roof. The open/closed porches or the extension of the upper floor lay on the sole plate supported by the posts, elements which are assembled together with lap joint or half lap joint. Wooden posts stand on the polygonal or rectangular stone base (Figure 3.25). In the upper floor, in cases of larger houses with longer distances between the bearing walls, there are one or more posts around the centre of the area in order to support horizontally the separating thinner walls.

Figure 3.25 Wooden posts; Interior decoration
Source: Author

As it was already mentioned, since the living area of the family is organized in the upper floor, it is much more detailed in comparison to the ground floor, where supplementary functions of the family are positioned. The floor is particularly enriched with the semi open or closed wooden porches which are utilized during summer season, extending the area of dwelling. It is very important to emphasize the artistic work of popular art inside the houses. A number of functional and decorative amenities are made by hand-crafted wood with excellent composition of floral and geometrical symbols, thus giving the footprint of the identity of the time and culture of Kosovo art.

Typical example of the artistry of the work of the ceilings is shown on the following figure (fig.9). Different handicraft wooden elements are integrated in the living area, such as shelves, niche, cupboard etc (fig.10).

Figure 3.26 Wooden handicraft ceiling décor;
Source: Author

Figure 3.27 Wooden handicraft elements in the living area;
Source: Author

3.2.1.2 Traditional rural houses

The old traditional rural construction in Kosovo is also well known by its habitation buildings as a result of the inherited local art of mastery. Rural buildings are organized in two stories where the above level communicates the dynamics of the composition. Materials used for traditional rural dwellings were conjuncture of stone as dominant construction material, wood and adobe. Typologies of rural dwellings are generated through techniques, composition and aesthetics achieved from the local masters during 18th and 19th century.[127] In this paper, typologies with wooden components are elaborated, respectively: dwelling with balcony, dwelling porch and Kulla (a fortified house) with wooden structural components and small scale supplementary wooden facilities within the complex of the house such as corn-sheds.

Dwelling with balcony is a rectangular shape house in two stories. External stone walls are horizontally reinforced by wooden bond beams tying walls together. The upper floor is supported by the walls and two or more wooden columns. The column is consisted by the stone base, the body and the wooden capital. The joists laying on the capital hold the separating walls of the upper floor. The covered balcony is the central part of the main facade, constructed entirely by wooden elements (Fig. 3.28).

[127] Fejaz Drançolli, *Kulla Shqiptare (*Kosovo: Rezniqi, 2001), 56.

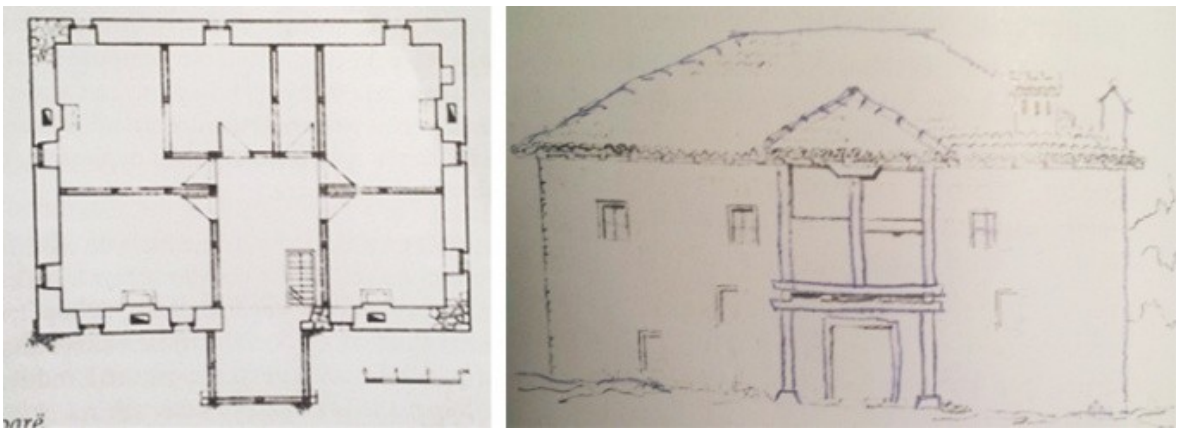

Figure 3.28 Dwelling with wooden balcony (Drançolli, 2001)

Dwelling with porch is characterized by the open or semi open wooden porch on the first floor. The porch was constructed by wooden elements assembled together (Fig. 3.29). The building technique is the same as the one with balcony, however the difference lies on the size and the functional organizing of the first floor. The porch served also for the maintaining and processing the goods of the family. From the outside, the "guest room" - Oda, which served for male guests, is accessed directly by the wooden stairs, while the other parts of the house were accessed by the secondary wooden stairs inside the house.

Figure 3.29 Dwelling with wooden porch (Drançolli, 2001)

Kulla - is a fortified Albanian dwelling where latest building techniques and protection elements were synthesized with the culture of living during 18th and 19th century, as Drançolli states: "Albanian kulla applies Albanian traditional elements which can be followed from the ancient times till the first decade of the 19th century".[128]

[128] Fejaz Drançolli, *Destruction of Albanian Kulla (*Kosovo: Rezniqi, 2004), 68.

Figure 3.30 Wooden elements of Kulla and Corn sheds in the complex; drawing in lower row (Doli, 2001)

Kulla has a rectangular plan, two to four stories. The basement was used as barn for sheltering the animals, the first level served as storage and "house of fire", on the upper floor was Oda, or the guest room. The buildings near the wood resources, utilized wood for structural elements as well as for decoration inside or small facilities for the family. Floors were constructed by wooden elements supported by exterior walls and the wooden central post inside the building that supports the separating walls as well. As shown in the figure 13, several wooden elements are integrated in the composition of Kulla dwelling: wooden floors, external covered stairs, main door; Kulla types with wooden porch; Corn sheds.

3.2.2 Contemporary timber architecture

Towards contemporary architecture development in Kosovo, a particularized tendency of timber-based application is noticed during '80s. It was the period during which urbanization and economy was growing in Kosovo, recently before the beginning of the collapse of Federal Yugoslavia formation. Projects of the public character dominated and were in correspondence with developments in the region, regarding the architectural expression and applied building technology. Hence, only four large-scale timber buildings are observed, constructed by laminated timber structure, three of which were executed during 80's while the forth, in 2001. General information is orally obtained since, no documentation was found in the cities' archives.

Large span building in Peja (Figure 3.31) was part of a automotive engineering complex of factories. It was a restaurant with all its facilities for the workers of the enterprise. It is a 30x30m span, 7m height (as observed), covered with prefabricated glue laminated timber structure. It was designed and produced by a enterprise from Bosnia and assembled by a Slovenian enterprise in 1984. The hall is covered by eight main beams, four of them in the corner are reinforced by four other smaller. The main beams are connected on the top by a circular metal hinge, while the reinforcement beams are connected to the main beam by metal plates and screw bolts. Structural elements are placed in 5m distance from each other. They are supported by reinforced concrete base.

Figure 3.31 Large span glue laminated timber structure, Pejë

Sport facility in Vushtrri (Figure 3.32) was constructed in 1984 under similar social circumstances, by the same enterprises as of the aforementioned building. The facility is comprised by two spaces, both covered by glue laminated timber structure. The first one is the entrance, covered by four linear beams, supported by columns, while the main hall is approximately 50x50m, 9.0 m height. Ten pairs of linear timber beams cover the hall, in regular 5m intervals. The pairs are connected to the top by means of metal hinges. The whole structure is supported by reinforced concrete base. The roof lays on top of the secondary timber beams connected to the main structure by metal beam hangers.

Figure 3.32 Large span glulam timber structure, Vushtrri

Primary school in Qabër (Figure 3.33) - In 2001, initiated by an international organization, a new school was constructed in the entirely destroyed Qabra village during the last war. The project was designed, prefabricated and assembled by international companies (from Bosnia, as orally informed). The structure is two span glulam timber supported by timber columns which are reinforced by square section timber beams and metal ropes in X and V shape. External masonry walls are reinforced by vertical and horizontal timber 14x14cm elements and metal ropes in X shape. The structure altogether is visible and part of the warm ambiance of the school.

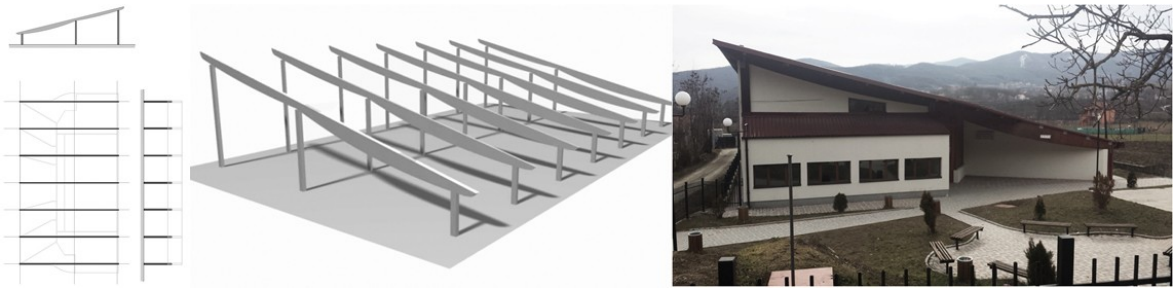

Figure 3.33 Glue laminated timber structure, Qabër

In vernacular wooden architecture of Kosovo, the impress of the popular master prevails, where the perfection of technique and the sense of local art has been developed and conserved throughout the ages. The existence itself of numerous wooden houses avouch their technical stability, thus proves the firmness of wood construction when properly attended.

Contemporary timber architecture is enclosed by its public destination. The large-span laminated timber buildings analyzed on site demonstrate stability at the same time structural distinctness as part of inner architectural expression. Necessity for public large-span buildings, advanced building technology of the time and international authority initiation are some of the factors that identify the character of the buildings.

Some results asserted:

- A firm time gap between the end of traditional wooden construction and contemporary timber-based application is apparent;

-While traditional architecture is identified by dwelling typology; the new architecture is recognized by its public character;

-There is lack of tendency towards timber application in residential or other sector, therefore a lack of confidence in timber application is evident;

- The expertise of local mastery in timber application is clearly heading toward extinction;

Vernacular wooden architecture requires more professional attention and further study of its technical and artistic features, therefore the know-how needs to pass on to the new generations to provide required and necessary knowledge for proper maintenance on the remained typologies. Local timber architecture needs to be further explored and new techniques can derive based and inspired by traditional master-ship, and professional academic support. Finally, by using local resources, local industry needs to be supported and encouraged therefore new economical opportunities will arise.

3.3 Kosovo forests

Discussions on forestry dominate concerns related to principles on using the forested land in a sustainable manner, with a focus on a well-managed yield of timber, meaning timber is extracted with regard to a continuous future supply of wood through investment in regeneration.[129] It is important to ensure that timber as building material is used from the sustainable forestry, in comply with national policies. Both, ecological and economic functions of forests as providers of timber and non-timber predicts, as the habitat for world's biological diversity, and as regulators of local, regional and global environments require constant regard.[130] In terms of timber extraction through sustainable timber management, the implementation of management plan is fulfilled with focus on long term perspective.

Kosovo forestry covers approximately 481, 000 ha of the total area or 44.7%[131] which is considered to be fairly stable and a potential as a natural resource for the Kosovo economy (Figure 3.34). From the total forest area, around 60% is in public ownership, while the

[129] David Pearce, Francis Putz and Jerome K. Vanclay, "Is sustainable forestry economically possible?", in *Valuing the Environment in Developing Countries: Case Studies*, ed. David Pearce, Corin Pearce and Charles Palmer (Cheltenham: Edward Elgar, 2004), 468
http://www.ucl.ac.uk/cserge/Sustainable_Forestry.pdf. (accessed October, 2015).
[130] Ibid., 458.
[131] Stein M. Tomter et al,.*Kosovo National Forest Inventory 2012*. Kosovo Ministry of Agriculture, Forestry and Rural Development/Norwegian Forestry Group. 2013

remaining part of 38% is split between approximately 120,000 private small scale forest holders owning on average less than 2 ha.[132] [133]

Figure 3.34 Overview map of Kosovo Forestry
Source: (Kosovo National Forest Inventory, 2013)

The highest authority in charge of Kosovo forestry is the Ministry of Agriculture, Forestry and Rural Development (MAFRD) through two main branches:

- Department of Forestry (DoF) with the role of developing the policy and regulatory framework as well as controlling/inspecting forest operation;

- Kosovo Forest Agency (KFA) which administers and manages public forestland and is responsible for the law enforcement in both public and private forests.

[132] Ministry of Trade and Industry. *Primary Wood Production and Wood Processing Industry*. ECIKS. 2008. Prishtina. Kosovo
[133] Peter Kampen "Growing Decentralised Forest in Kosovo", *Case Study 15*. 2010. 10 http://www.snvworld.org/fr/publications/growing-decentralised-forest-in-kosovo (accessed September , 2015)

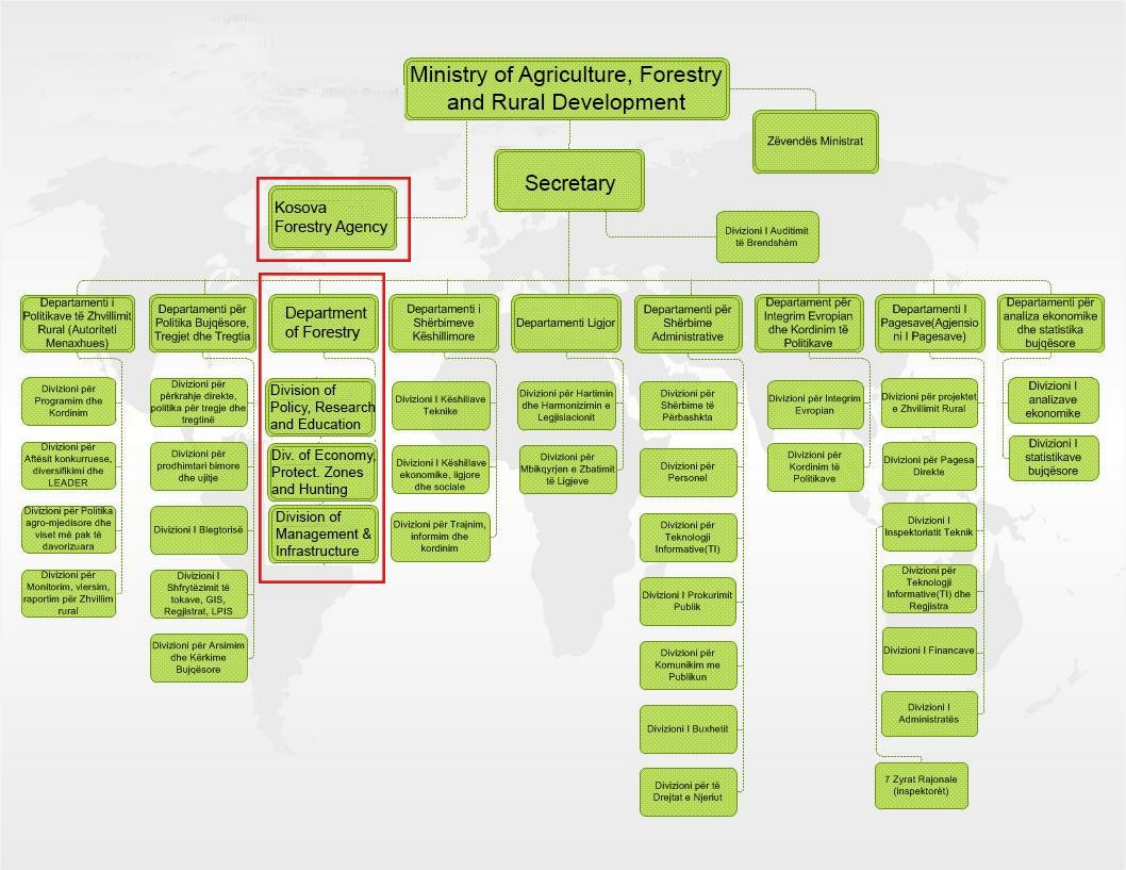

Figure 3.35: The structure of the Ministry of Agriculture, Forestry and Rural Development
Source: MAFRD, http://www.mbpzhr-ks.net/

Table 3.3 Forest area by forest composition and standard structure (ha)

Forest Composition	**Stand structure**				**Total**
	Regeneration	Even-aged	Two-storied	Uneven-aged	
Coniferous	2 200	6 600	6 200	8 800	23 800
Mixed	0	400	3 200	4 200	7 800
Broadleaved	45 400	236 000	123 600	44 400	449 400
Total	**47 600**	**243 000**	**133 000**	**57 400**	**481 000**

Source: Stein M. Tomter et al,.*Kosovo National Forest Inventory 2012*, 22, Table 5

As reported in the Kosovo national Forest Inventory, Kosovo forests are dominated by broadleaved trees, covering 93% or 449, 400 ha, while coniferous forests cover almost 5% of the forest area (23, 800 ha) are distributed between the various structure classes as presented in the Table 3.3. Considering the fact that half of Europe's forest is covered by conifers,[134] it demonstrates the lowest share available for technical wood supply.

[134] FOREST EUROPE, UNECE and FAO 2011: State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe.

According to Kosovo National Forest Inventory, the growing stock has not changed much since 2002, respectively the growing stock in forest in 2012 is estimated 40,508,000 m3, whereof conifers growing stock was 5,992,000 m3. The average growing stock per hectare was 84 m3/ha, while in Europe as a whole the average growing stock is 105 m3/ha, which is less than the world's average of 130 m3/ha.

The key criterion of sustainable forest management is that no more wood is harvested than it re-grows. In 2012 the total annual increment / felling of trees with dbh>=7cm was 1,556,000 m3 / 959,000, corresponding to 77% of the annual increment, whereas in coniferous forests the ratio was 232,000 m3/135,000 m3. It is estimated that over 90% of the annual felling are not carried out according to regulation, with 59% taking place in public forests and 34% in private forests. Out of the total annual felling allowance, 43% is categorized as technical wood (class 1 and 2), while the remaining is used for heating purposes.[135]

Based on the current forest status, the allowed annual felling was estimated to be 900,000m^3. About 700,000 m^3 lies in high forests and about 200,000 m^3 in low forests (including tops, bark and larger branches).[136] The distribution, by ownership and main types of the total annual allowed felling is presented in the following table.

Table 3.4 Breakdown of allowed annual forest felling (in 1,000 m^3), by type and ownership

Type	**National forests (Neto)**	**Private forests (Neto)**	**Total Volume (Neto)**
Quercus ssp	50	162	212
Fagus ssp	320	116	436
Broadleves other	64	65	129
Abies alba	36	6	42
Picea abies	13	13	26
Pinus ssp.	48	1	49
Coniferous other	5	1	6
Total	**536**	**364**	**900**

Source: Lars Norden et al., *Studim i Sektorit Pyjor te Kosoves 2013*, 11, Table 1

According to Kosovo state environmental analysis, average fund of wood in Kosovo forests in fine ecological condition is calculated in 114 m3/ha. In average 10% of wood

[135] Ministry of Trade and Industry. Primary Wood Production and Wood Processing Industry. ECIKS. 2008. Prishtina. Kosovo

[136] Lars Nordén et al., *Studim i Sektorit Pyjor te Kosoves 2013*, 2013, 21 http://kosovoforests.org/wp-content/uploads/2013/04/Final-draft-ALB-2013-05-271.pdf (accessed October 20, 2015)

can be used as a technical wood, while 90 % for combustion.[137] Rate of wood in the forest, excluding transport, processing, sale and utilization, is calculated 30 euro/ m3, while the rate of combustible wood is 10 €/m3. Overall value of one forest hectare in fine ecological condition is 342 € for technical wood + 1,026 € combustible wood = 1,368 €. In degraded forest the loss value of wood material is supposed at 2/3 of 342 € hence the value of combustion wood is reduced in 80% of 1,026€—so overall value amounts to 821 € /ha. In the table 3.5 the annual value loss from forest degradation is indicated according to state environmental analysis.

Table 3.5 Annual value loss from forest degradation

Degrading			
Overall area (ha)		464, 800	
Fine condition (ha)		299, 331	
Degradation (ha)		165, 469	
Value of forest in fine condition (€/ha)		5, 262	
Value of degraded forest (€/ha)		2	
Value loss from forest degradation (€/ha)		10, 524	
	Low	Medium	High
Annual degraded area (net, ha/year)	5,566	6,244	6,922
Degrading gross/net factor	3,980	4,522	5,064
Annual degraded area (gross, ha/year)	1,587	1,722	1,858
Annual cost of degradation (average) (€)	**16,7**	**18,1**	**19,5**

Source: World Bank. 2013. Vlerësimi i kostos së degradimit mjedisor, rishikimi institucional dhe rishikimi i shpenzimeve publike për mjedisin. Washington, D.C.: World Bank Group, 60.

In the recent years due to the incorporation of some of the higher quality and best yielding forest units into official national park areas the potential supply of legally-harvested local lumber has been significantly reduced. The law on national parks for these designated areas apparently was issued without collaboration with the Agency for Forestry within the

[137] World Bank. 2013. *Vlerësimi i kostos së degradimit mjedisor, rishikimi institucional dhe rishikimi i shpenzimeve publike për mjedisin*. Washington, D.C. : World Bank Group, 60. http://documents.worldbank.org/curated/en/953141484650269931/Vlerësimi-i-kostos-së-degradimit-mjedisor-rishikimi-institucional-dhe-rishikimi-i-shpenzimeve-publike-për-mjedisin (accessed February 13, 2017)

MAFRD.[138] Another discouraging pressing concern is that the larger part of the annual felling is not recorded. As a result of violations of actual regulations or wood theft, more commonly the violations of regulations are found on private forests as the owners view the adherence of rules and permits for felling and transport as too costly and complicated. Theft of wood extends from small individual offenses for personal gain, to the organized theft of large quantities of wood for sale in Kosovo markets. The volume of informal cuts and illegal logging is not known. The implementation of regulations, actions and execution of court decisions by the law implementing bodies are slow and ineffective, and cannot reverse the damage by the illegally felling of Kosovo forests.[139]

However In 2016 the MAFRD, with focus on a long term vision of Kosovo forest sector development, in cooperation with the FAO project jointly organized Kosovo Forest Think Tank. Its objective was to identify and raise discussions on innovative approaches towards creation of conditions for capital investments in forestry sector, with a special attention on public financing and subsidies in forestry sector, such as implementation of the Aforestation and Reforestation Program and education and training on forestry management.[140]

3.4 Wood industry

Wood industry is an important sector of Kosovo economy. Wood processing has a long tradition in construction (production of both, structural and non-structural elements), handcrafted furniture and rich decorative amenities integrated in the living areas, such as shelves, niche, cupboard and so forth.

According to Tax Administration of Kosovo, in the end of 2012, out of 21,615 total registered businesses in Kosovo, 565 operated in the wood sector which is dominated by micro and small enterprises.

[138] USAID, *Kosovo Wood Sector Assessment: 2015 Opportunities and Challenges Update*, United States Agency for International Development, 2, http://empowerkosovo.org/wp-content/uploads/2015/04/KOSOVO-WOOD-SECTOR-ASSESSMENT-ENG.pdf (accessed June 24, 2016)

[139] Lars Nordén et al., *Studim i Sektorit Pyjor te Kosoves 2013,32*

[140] Ministry of Agriculture, Forestry and Rural Development, Kosovo Forest Sector Think Tank, 2nd Session, http://kosovoforests.org/wp-content/uploads/2016/07/Summary-of-the-second-session-of-the-Kosovo-Forest-Think-Tank-April-2016.pdf (accessed June 24, 2017)

The main activities in wood industry are listed below:

- Joinery and carpentry products;

- Production of wooden dining-room and kitchens elements, and wooden furniture;

- Wooden doors and windows;

- Manufacture of veneer sheets, plywood, particle board and other panels;

- Sawmilling and impregnation of wood;

- Other raw wood products;

Kosovo forestry contribution to the wood processing industry is very limited, while the substantial portion of the national territory is forested. Only a small portion of harvested timber is used as industrial saw logs. Lumber production is still being underdeveloped mainly due to the management deficiencies and limited saw log supply. Locally harvested lumber are utilized by local sawmills serving mostly micro-to small furniture and joinery producers. The industry still largely depends on imported lumber.[141]

As a subset of the secondary production sector, there are several enterprises in cutting or grinding lumber, with most "live sawing" without consideration of established grade practices. A considerable quantity of low-grade hard wood is also used as firewood.[142] Due to the absence of kilns and surfacing equipment, mills are generally incapable of production of pre-cut dimensions, wood frames, flooring, or structural elements according to international standards. The majority of sawmills in Kosovo only saw logs into coarse, mixed grade lumber.

Access to timber construction Materials- Resulting from forestry issues and insufficiency of high quality local wood based products, many essential inputs are to a great extent imported by specialized traders.[143] The imported products include: chipboard, OSB and fiberboards (MDF) length and side glue lam panels (finger joint), long span construction laminated beams and massive hardwood (beech and oak) and softwood (pine, spruce/fir) lumber.

[141] USAID, *Kosovo Wood Sector Assessment: 2015 Opportunities and Challenges Update*, 2.
[142] USAID, *Kosovo Cluster And Business Support Project, Wood Processing in Kosovo Secondary Manufacturing, Sawmilling and Dry Kilns*, United States Agency for International Development, 3. http://pdf.usaid.gov/pdf_docs/Pnadd835.pdf (accessed June 24, 2016)
[143] USAID, *Kosovo Wood Sector Assessment: 2015 Opportunities and Challenges Update*, 8.

A survey conducted by UNDP in 2013, as cited in sector profile of wood processed industry in Kosovo,[144] states that the majority of companies operating in the wood sector (99.5%) sell mainly to the domestic market, with less than 15% of companies selling abroad. The highest share has been indicated in 2009 with a distinct decline in 2010 due to the global crisis. However the international marked is being targeted progressively more. 83% of the companies sell their products only in Kosovo, while less than one percent collects revenues from the international markets. Around one-third of companies use their own raw material and intermediate goods and 68% of companies are supplied from domestic market which covers an average of 76% of their needs. Around one fifth of companies import raw material from Turkey, Montenegro and Germany, Bosnia and so forth.

While panel production and wood lamination plant to date are not present in Kosovo, the import is still favorable due to easy accessibility from the plants in western bordering town in Montenegro with a capacity of approximately 18,000 m3 of timber and laminated plates and 15,000 m3 panel board production per year.[145]

Through the efforts and engagement of the members of the institutional environment of the wood Industry, incentives that aim to further promote and facilitate primary and secondary wood production are being followed up in Kosovo. Recently, a zero tariff rate was approved by the Government for the imports of machinery and capital goods related to this sector, furthermore the implementation of various programs in cooperation with several international institutions, for quality improvement, proficiency and economic results of this industry.[146]

[144] Ministry of Trade and Industry. Sector Profile of Wood Processing Industry. 2014. Prishtina Kosovo
[145] Montenegrin Investment Promotion Agency, *Montenegro Investment Opportunities*, Ministry of Economy
[146] Investment Promotion Agency of Kosovo – IPAK and Ministry of Trade and Industry, *Primary Wood Production and Wood Processing Industry* (Austria: Economic Initiative for Kosovo –ECIKS), 18.

3.5 Conclusion

The overviews provided in this chapter are not directly correlated with the research issues, however they are indispensable in order to better understand the local context of the research topic.

The profile of Kosovo is depicted in context of historical/political, geographical and social structure of the population. The urban sprawl of collective residential sector in the post conflict Kosovo, largely caused by population shift has developed without appropriate construction standards and urban regulative plans. However at the present time there is a tendency toward rebuilding the quality of urban identity with the development of mid-rise residential buildings with improved urban standards.

The second part of this chapter focuses on the traditional wooden architecture and contemporary developments of wood based-architecture in Kosovo residential sector. While traditional Kosovo vernacular wooden architecture and the sense of local art has been maintained and developed throughout the ages, in contemporary architecture there is void in predisposition towards wood based application in residential sector in Kosovo.

In the third part the impacts of Kosovo forestry opportunities in terms of timber extraction for utilization in wood based construction through sustainable timber management, conform to national policies, were considered. As there are a lot of drawbacks from poor forestation management from the respective authorities, only 10 % of wood grown in Kosovo`s forest is designated as technical wood and can be utilized in construction sector. Thus wood processing industry largely relies on imported wood. Also presented is an overview of current situation of wood processing industry in Kosovo, the quantity and quality of technical wood products manufactured by local producers as well as wood processing technologies.

Chapter 4
METHODOLOGY APPLIED

abstract:

The fourth chapter outlines the approved methodology to achieve the objectives of this research. It provides an introduction and conceptualization of research design and strategies for adopting the most appropriate method for conducting this study. Mixed methods in research practices are described, hence the integration of both quantitative and qualitative approaches to collect required data for further analysis and discussion. The procedures undertaken to conduct this study are described and the process of data collection are elaborated.

4 METHODOLOGY APPLIED

4.1 Background

The research scope of this thesis is timber-based architecture, respectively multi-storey residential construction. Its aim is identifying the motivation and barriers that support / limit the increase of timber use in residential construction industry in the interest of short-term and long-term benefits for Kosovo.

Theoretical background of this study consists of two main sections: 1) an overview on the progress of multi-storey timber-based architecture in Europe (Chapter 2) which covers: the increase of timber construction – reasoning and understanding; support groups and their roles; residential construction systems; advantages and disadvantages and the measures to overcome them in order to achieve the required building performances, and 2) historical perspective of wood-based housing and latest application in Kosovo (Chapter 3) as well as a discussion of main actors involved which influence or affect the use of timber in construction.

The setting of this research is extensive since a large domain of fields is integrated (forestry, construction industry and technology - in particular timber industry, government and academy). Hence, the background of study environments in different areas affects the direction of research.[147] Systems view of development where the whole is dependent of the parts is required, and that knowledge is system's dependent.[148]

This chapter provides theoretical definitions on research design and methods, thereupon the methodology adopted to reach the assigned research objectives and the aim. The chosen research strategy for collection of necessary data and the implication of outcomes is justified due to comprehensive framework of this research

[147] Tomas Nord, "Prefabrication Strategies in the timber housing industry - A comparison of Swedish and Austrian markets." (PhD diss., Lulea University of Technology, Dept. of Civil and Environmental Engineering, Sweeden, 2008), 67.
[148] Ingeman Arbnor and Björn Bjerke, *Företagsekonomisk metodlära* (Lund: Studentlitteratur, 2nd ed., 1994), quoted in Ibid.

4.2 Research Strategy

4.2.1 Research Design

Theoretical understanding on research design is a significant part when intending to pursue an inquiry, prior to discussing the methodological approaches. It builds up the relation between the development of knowledge on particular field and the process by which the research is to be conducted. A research design is an outline describing the way of collecting the data and the techniques intended for further processing in quest of research answers. It is an integrated development in research project, "*a process of making all decisions related to the research project before they are carried out*."[149] The definition of research design, in a more generalized way has been indicated by Yin:

> *Colloquially, a research design is a logical plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answers) about these questions. Between 'here' and 'there' may be found a number of major steps, including the collection and analysis of relevant data.*[150]

Contributing to knowledge and understanding of world phenomena are considered to be the main objectives of scholarly research which is best organized in the form of theory with predictive capacity.[151] A chosen theory reflects the researcher's interest in being general, simple or accurate and shapes the study accordingly, focuses attention, limits the choices and provides explanations.[152] Research design dictates the overall plan and technology of research project, thus it should be carefully selected by the researcher.[153]

[149] Norman Blaikie, *Designing Social Research: The Logic of Anticipation,* 2nd ed. (Cambridge: Polity Press, 2010), 15.
[150] Robert Yin, *Case Study Research: Design and Methods,* 3rd ed. (Thousand Oaks: Sage Publication, 2003), 20.
[151] Senevi Kiridena and Anneke Fitzgerald, "Case study approach in operations management research" *ACSPRI Social Science Methodology Conference* (2006): 4, http://ro.uow.edu.au/engpapers/650 (accessed March 7, 2016).
[152] John P. Bean, "Intellect, light, and shadow in research design" in *The SAGE handbook for research in education: Pursuing ideas as the keystone of exemplary inquiry*, ed. Clifton F. Conrad and Ronald C. Serlin (USA: SAGE Publication, 2011), 166.
[153] Khawaja Khalid, Haim Hilman and Dileep Kumar, "Get along with quantitative research process" *International Journal of Research Management* 2, no. 2 (March 2012):19, http://rspublication.com/ijrm/march%2012/2.pdf (accessed January 23, 2016).

4.2.2 The process

> *Whether we are considering the physical sciences, the life sciences or the social sciences, the research process begins with an interesting thought about the world around us. Without this there is no research. The interesting thought or research question is the common starting point of all research work in all fields of study. From this point research is always concerned with the emergence of theory whereby concepts and notions develop thought the application of ideas, the observation of evidence and the evaluation of results. It is worth always keeping in mind that the final result of research is to add something of value to the body of theoretical knowledge*[154].

Strategies to be adopted for conducting a research are conditioned by many factors. It is a challenge for the researcher whose intention is applying the best forms of inquiry. The definition of research aim and objectives, thus the main research questions facilitates establishing the most appropriate way to carry out the research. Design process is developed by the adopted methodologies through procedures and techniques for collecting, analyzing and interpreting data.[155] Or, as Handfield and Melnyk point out: *"the transformation of observations into empirical generalizations is therefore affected by the choice of measures, sample, and parameter estimation techniques employed."*[156] According to Cooper and Schindler, as cited by Khalid et al., a research process consists of following steps:[157]

- Identification of the problem.
- Defining the management question and the research question(s).
- Conducting exploratory study (if required), to clarify the problem and/or to refine management question/research question(s).
- Developing a research proposal.

[154] Dan Remenyi, "Research Strategies – Beyond the Differences", *Electronic Journal of Business Research Methods* 1, no. 1 (2002): 38, 39, http://www.ejbrm.com/volume1/issue1/p46 (accessed September 24, 2016).
[155] Senevi Kiridena and Anneke Fitzgerald, "Case study approach in operations management research" *ACSPRI Social Science Methodology Conference* (2006): 6, http://ro.uow.edu.au/engpapers/650 (accessed March 7, 2016).
[156] Robert B. Handfield and Steven A. Melnyk, "The scientific theory-building process: a primer using the case of TQM" *Journal of Operations Management* 16 (1998): 326,
[157] Donald Cooper and Pamela Chindler, *Business Research Methods,* 8th ed. (USA: McGraw-Hill, 2003), quoted in Khawaja Khalid, Haim Hilman and Dileep Kumar, "Get along with quantitative research process" *International Journal of Research Management* 2, no. 2 (March 2012):19, http://rspublication.com/ijrm/march%2012/2.pdf (accessed January 23, 2016).

- Outlining a research design specifying type, purpose, time frame, scope, and environment of research.
- Developing an instrument for data collection and conducting pilot study to test the instrument for validity and reliability.
- Data collection (through observation, experiments, or surveys – the choice of data collection method depends on nature of study).
- Data Analysis.
- Reporting research results.

The process of defining the research strategy for this study has been initially counted on five proposed types of research strategies by Yin,[158] which are: *Experiment* – a strategy suitable for cases requiring control of behavioral events and operation on one or more variables; *Survey* – when a researcher aims on portraying a phenomenon through a sampling frame; *Archival analysis* – using archival data as main source; *History* – using primary or secondary documents as main source for the research; *Case study* – when examining contemporary events, when behaviors cannot be manipulated.

As shown in Table 4.1, according to Yin, definition of strategies are strongly related to the form of serial research questions, whether the research requires a control of behavioral events and whether it focuses on contemporary or historical events.

Table 4.1 Definition of strategies in relation to research questions

METHOD	Form of research questions	Requires control of behavioral events?	Focuses on contemporary events?
Experiment	How, Why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, when, how many, how much?	No	Yes / No
History	How, why?	No	No
Case study	How, why?	No	Yes

Source: Robert K. Yin, Case Study Research: Design and Methods, 4th ed. (USA: Sage Publication, 2009), 8, fig. 1.1.

[158] Robert K. Yin, *Case Study Research: Design and Methods,* 4th ed. (USA: Sage Publication, 2009), 8

This dissertation deals with contemporary timber application in residential sector, seeks answers concerning barriers and opportunities toward utilizing timber in Kosovo, which is best defined through 'how', 'what', 'who', 'why' and 'how much' question forms, at the same time no control over the 'event' is evident. According to this form of orientation towards strategies to adopt, *survey,* as a method seems to be the most appropriate strategy to guide this research throughout the first phase, and incorporate archival analysis on the way as well.

4.3 Scientific perspective, approach, method and timeframe

In this section, the stages that structure the research process, from the research philosophy to the data collection based to the 'research onion'[159] are described. It was developed by Saunders et al., to assist the researchers build research strategy phases until the data collection methods are designed. Figure 4.1 illustrates the 'research onion' elements in an adapted form.

Scientific perspective – There are two main scientific perspectives acknowledged: *positivism* and *interpretivism*. *Positivist* paradigm starts with existing theory, creating hypothesis to be tested afterwards, which are seen as objective rather than subjective statements. It is *"usually associated with natural science research and involves empirical testing."*[160] Controlled empirical means, such as experiments and value-free representation of reality, provide results to be reliable, consistent, unbiased as well as replicable by other researchers.[161] *Interpretivism* on the other hand, aims to find new interpretations, based on multiple approaches in relation to time, context and researcher; hence it suits for human behavior, documents and social phenomena studies[162] where subjective view is applicable allowing multiple interpretations.

This research is to be conducted from the *interpretivist* perspective as it doesn't start from any exiting theory; on the contrary, it aims to generate a theory, interpreting the results from the context of this investigation.

[159] 'Research Onion' is a diagram developed by Saunders et al. (2007) with the stages to be considered when building the research strategy. It covers the layers of: research philosophy, approaches, strategies, time horizons, and data collection methods. https://onion.derby.ac.uk/ (accessed: February 3, 2015).
[160] Sue Greener and Joe Martelli, *An Introduction to Business Research Methods*, 2nd ed. (n.p.: n.p., 2015): 21, Bookboon e-book.
[161] M. R. (Ruth) De Villiers, "Models for Interpretive Information Systms research, Part 1: IS Research, Action Research, Grounded Theory – A Meta – Study and Examples," in *Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems,* ed. Myla Harty and Erika Gallagher (US: IGI Global, 2012), 223.
[162] Ibid., 224

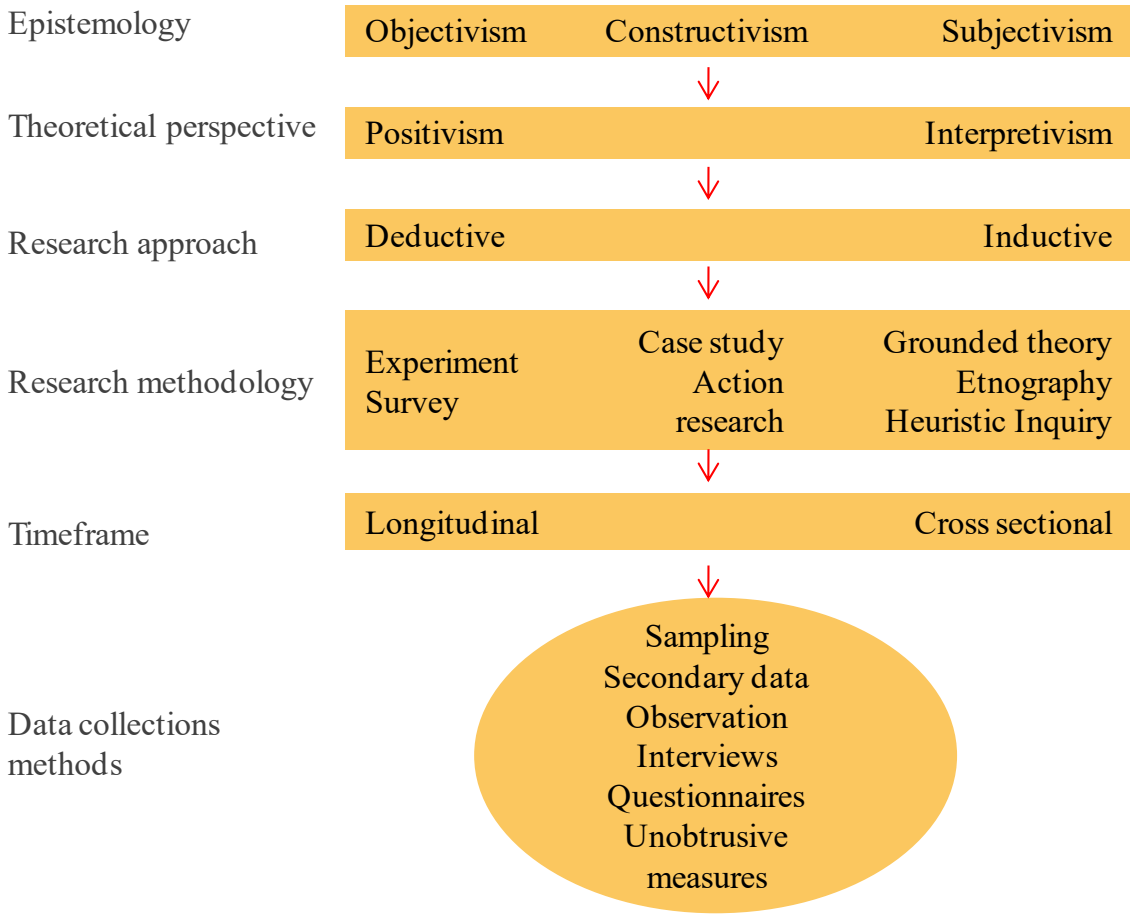

Figure 4.1 Research process elements – the research 'onion'
Source: Saunders et al., 2012 adapted by David. E. Gray, "Theoretical Perspectives and Research Methodologies", Doing Research in the Real World, 3rd ed. (London: Sage Publication, 2013): 35, fig. 2.3.

Scientific approach - Two main approaches in relation to the direction of scientific study till the generation of conclusions are known to be applied: *inductive* - a 'bottom-up approach' and *deductive*, so called 'top-down' approach. Inductive refers to the approach where the research doesn't start from any approved theory, instead, through investigation by various research methods generates a theory. On the contrary, deductive approach begins with existing theory to create a hypothesis to be tested afterwards, therefore confirmed or rejected. Deduction is a process directed from the general to the specific, while induction goes from specifics to the broader generalizations, from which patterns and generalization will 'emerge'.[163]

[163] Wilfried Decoo, "The Induction-Deduction Opposition: Ambiguities and Complexities of the Didactic Reality", *IRAL- International Review of Applied Linguistic* 34, no. 2 (May 1996): 96,

Research conducted through inductive strategy is based on data collection by operating concepts, and then searching for patterns in the data, to create a network of generalizations which is considered to be a theory.[164] Deductive approach follows the course of logic precisely where the argument is valid or invalid, with no degree of validity and no judgment is necessary for getting the results.[165] The Figure 4.2 illustrates the relation between the two approaches.

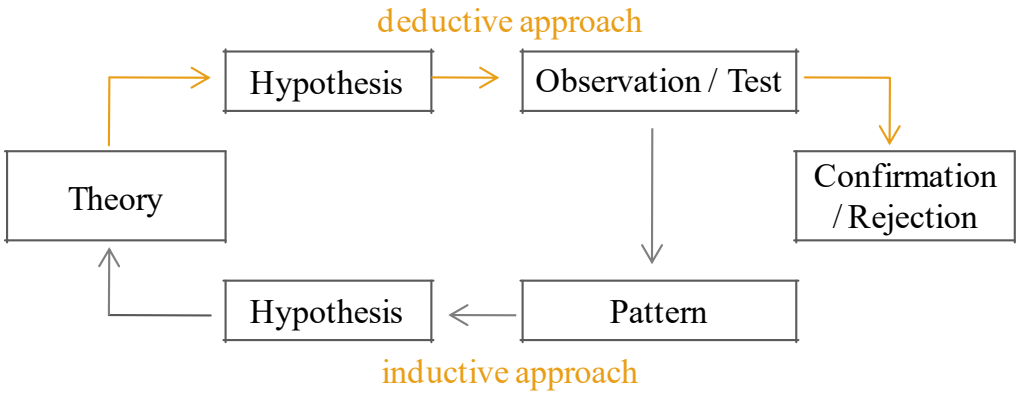

Figure 4.2 Deductive / Inductive research approach
Source: Adapted from: http://research-methodology.net/research-methodology/research-approach/

The scientific approach of this study is *inductive* as it doesn't rely on existing theory, but has an interpretative character in understanding the role of the actors involved in Kosovo with regard to the potential of expansion of timber-based residential architecture. The role of the researchers in the research process is active and free in terms of direction of the process. At the end, a theory will be generated, evolved as a result of using Grounded Theory from the findings of qualitative and quantitative methodology within the mixed inquiry.

Timeframe - It implies two time horizon choices: *the cross-sectional*, a study conducted in a short-term and the *longitudinal*, conducted in a longer period of time.[166]

[164] Norman Blaikie, *Designing Social Research: The Logic of Anticipation,* 2nd ed., 154.
[165] Hasan Zalaghi, "The Role of Deductive and Inductive Reasoning in Accounting Research and Standard Setting", Asian Journal of Finance & Accounting 8, no. 1 (2016): 27 http://www.macrothink.org/journal/index.php/ajfa/article/viewFile/8148/7372 (accessed October 6, 2016)
[166] https://onion.derby.ac.uk/

The longitudinal study refers to a phenomenon which occurs over an extended period, (i.e. new products, from launching to maturity, or industry trends over time).[167] Cross-sectional study is most common as it enables the achievement in a shorter period. The data gathered from an entire population or a subset, represents the occurrence at only one point of time.[168] The topic explicated endeavors to reveal the barriers and motivations, therefore the opportunities for sustainable development in Kosovo, applying a methodology for gathering data from actors involved within a defined period of time. The analysis from different participant groups and comparison of different variables are carried out at a single point in time. In this context, the study is associated with cross-sectional format of study.

Scientific method – Selecting appropriate methods and principles, is very important during the designation of the research design. As Saunders et.al. stated: *"There is an inevitable relationship between the data collection method you employ and the results you obtain."*[169] In dependence on the type of required data for the research subject, how they are gathered and the way they are to be processed, two main different scientific research methods are classified: *quantitative* and *qualitative* methods. *Quantitative* method employs techniques such as graphs and statistics to examine and describe relationships within data.[170] Simple frequencies of occurrences to complex statistical modeling established by statistical relationships between variables can be interpreted through quantitative analysis.[171] *Qualitative* method "*aims to acquire an in-depth understanding of human behavior and the reasons of occurrence of that behavior*."[172] Analyses comprise a range from simple categorization of responses to identifying relationships between these categories through deep understanding.[173] A relation among the features from the two methods is demonstrated in table 4.2.

[167] Greener and Martelli, *An Introduction to Business Research Methods,* 44.
[168] Chris Olsen and Diane Marie M. St. George, *Cross-Sectional Study Design and Data Analysis* (Chicago: College Entrance Examination Board, 2004):7. http://www.collegeboard.com/prod_downloads/yes/4297_MODULE_05.pdf (accessed October 7, 2016)
[169] Mark Saunders, Philip Lewis and Adrian Thornhill, *Research Methods for Business Students*, 3rd ed. (Harlow: Pearson Education, 2003) quoted in Donald Currie, *Developing and Applying Study Skills*, (UK: CIPD, 2005), 90.
[170] Mark Saunders, Philip Lewis and Adrian Thornhill, *Research Methods for Business Students*, 4th ed. (USA: Financial Times/Prentice Hall, 2007): 406.
[171] Ibid.
[172] Khalid, Hilman and Kumar, *Get along with quantitative research process*, 19.
[173] Saunders, Lewis and Thornhill, *Methods for Business Students, 4th ed.,* 470, 471.

Table 4.2 Features of Quantitative and Qualitative research

Type of approach	Quantitative	Qualitative
Research question	Highly focused: How much? To what extend?	Open and flexible: In what way…? What are the essential features?
Sample	Large and representative of the population from which it is drawn	Often small, occasionally purposefully selected
Data collection tools	Survey instruments	In-depth interviews focus groups, observational techniques.
Data	In the form of numerical values	Typically in the form of text as a result of interviews transcribed verbatim or observational commentaries
Analysis	Statistical	Thematic
Presentation of findings	In the form of graphs and tables	In the form of data extracts to illustrate themes

Source: *Antony Arthur and Beverly Hancock, "Introduction to the Research Process"* The NIHR RDS for the East Midlands / Yorkshire & the Humber*, 2007: 12, Tab. 1.* *https://www.schulich.uwo.ca/pathol/research/pdf/2a_Introduction_to_the_Research_Process_Revision_2009.pdf (accessed November 20, 2016)*

Both methods, integrated in mixed inquiry are used for this research complementing each other and are elaborated in the next sections.

4.4 Mixed Methods: the rationale

Integration of quantitative and qualitative methods has become common to the research society, being recognized as a methodology on its own. "*Mixed methods are procedures for collecting, analyzing and mixing both quantitative and qualitative data in a single study or in a multiphase series of studies."*[174] Certain methods of multi-methodological approach can be used in different layers of the research, therefore complement each other and subsequently provide a solid foundation for generating new knowledge.[175] Using integrated approach enables combining, comparing methods between each other, or even assisting

[174] John W. Creswell, *Educational Research: planning, conducting and evaluating quantitative and qualitative research*, 4th ed. (Boston: Pearson, 2011), 22.
[175] Roger Beach et al., "The role of qualitative methods in production management research," *International Journal of Production Economics* 74, no. 1-3 (2001): 201-212

one, in dependence to the study and adopted research design. Another comprehensive definition on mixed methods is given by Johnson et al.:[176]

> *Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration.*

The research topic explicated is comprehensive and complex; it covers a wide specter of indispensable aspects integrated. The reason why timber-based architecture is a growing trend globally derives from a sustainable long-term support of different 'groups' of actors which are involved directly or indirectly in the national economy (government, construction industry, forestry management, R&D institutions, professionals, technology, and the like). Building a pre-understanding on the context in Kosovo necessitates in-depth investigation as there is scarceness of information and research with regard to timber development in particular and opportunities for the future. Since a number of key-players and factors are interrelated and affect development of timber, different approaches towards these groups are needed to employ in order to construct a viable set of data for further analysis. Consequently, employing mixed methods of inquiry is the most appropriate approach to gather relevant information and perform analysis conductive to valid and credible research outcomes.

The stage of research when methods mix with each other differs among definitions on mixed methods, but also refers to the study itself. Some definitions indicate that the mixing is carried out in the stage of data collection; some indicate that it occurs in both data collection and analysis; while other definitions suggests that mixing is part of all the stages of the research.[177] Aside from applying mixed methods in defined stages of research, the priority given to a certain method, how the 'mixing' will occur and whether the use of theories will guide the study, are necessary within the process.[178]

Methodology implemented is *qualitative dominant method* (quan >> QUAL), as the research relies on a qualitative view, while including quantitative data and approaches into

[176] R. Burke Johnson, Anthony J. Onwuegbuzie and Lisa A. Turner, "Toward a Definition of Mixed Methods Research," *Journal of Mixed Methods Research* 1, no. 2 (2007): 123.
[177] Ibid. 122
[178] Creswell, *Educational Research: planning, conducting and evaluating quantitative and qualitative research*, 4th ed., 22

the project.[179] Data collection starts with quantitative method which provides a basic overview on the subject implicated. The findings will assist on designing the qualitative methodology of data collection to be applied secondarily. The generated results from the qualitative approach therefore will be integrated with quantitative outcomes for the interpretation phase. The sequential explanatory line is demonstrated in the Figure 4.3.

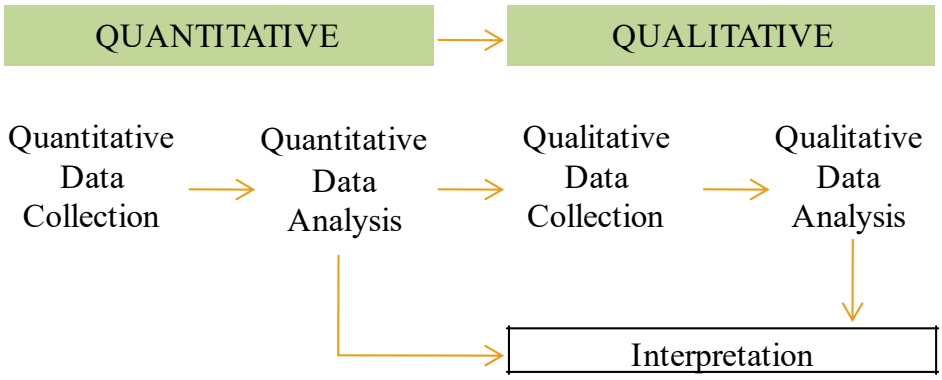

Figure 4.3 Explanatory strategy applied
Source: Steven R. Terrell, "Mixed-Methods Research Methodologies" The Qualitative Report 17, no. 1(2012), 261 http://nsuworks.nova.edu/tqr/vol17/iss1/14 (accessed November 21, 2016)

4.5 Grounded Theory in Mixed Methods

In educational disciplines, theoretical knowledge is a basis for building a practice, an insight or an understanding into situations.[180] According to Glaser and Strauss, who have coined Grounded Theory, a theory as a strategy, is used in research for processing the data, providing modes of conceptualization for describing and explaining the situation being researched.[181] Grounded theory is a suitable approach when designated to explain a process by generating theories in social phenomena, hence "*develop a higher level of understanding that is "grounded" in, or derived from a systematic analysis of data."*[182] Results derived, in a form of integrated theoretical formulation provide an understanding how a group of population, organizations or communities perceive, experience or respond

[179] Johnson et al., *Toward a Definition of Mixed Methods Research, 125.*
[180] Juliet Corbin and Nicholas L. Holt, "Grounded Theory," in *Research Methods in the Social Sciences*, ed. Bridget Somekh (Great Britain: SAGE Puplication, 2005), 49.
[181] Barney G. Glaser and Anselm L. Strauss, *The Discovery of Grounded Theory: Strategies for Qualitative Research* (USA: Aldine Transaction, 1999),
[182] Lorelei Lingard, Mathieu Albert and Wendy Levinson, "Grounded theory, mixed methods, and action research," *BMJ* 337 (2008): 459

to the occurrence. [183] The aim of a research based on this approach is generating theories, thus not testing existing ones, neither being guided by a defined theory; accordingly, this type of research associates with the inductive research approach in qualitative methods of inquiry.

The basis for emerging of grounded theory is identifying concepts of the occurrence through analysis using multiple sources of qualitative data, such as observations, documents, graphs, narrative interviews or similar.[184] Evolving concepts are subsequently used for data collection through adopted methods, which aim toward the validation of the research findings.[185] Data gathered thus derive categories, named as codes or labels, to group and structure data, in relation to the research objective for further organization and analysis.[186] Data in these cases, as Suddaby suggests, are not treated as raw, contrariwise, they are subjected to a conceptual level, eliciting information under examination in order to draw conclusions to a theoretical level.[187] After the disaggregation of data into coding (the *open coding* process), the relationship between categories of data is identified, and this phase, termed *axial coding* process, occurs when the subject of the research is explored and explained.[188] The last phase is *selective coding*, during which the central category to which other categories relate, is identified and the relationship between categories are recognized in order to develop the explanatory theory. [189]

Theoretical viewpoint on Grounded Theory as an approach, the summary on its implication as qualitative strategy in mixed methods, as well as defined objectives and research questions for this study, have manifested Grounded Theory as the most suitable strategy to be applied. In view of explorative and interpretative nature of this research, the process of gathering the relevant data employs quantitative and qualitative methods, whereas data analyses are guided by GT in order to generate an explanatory theory. The research process begins with observations and other qualitative means, on the topic which classifies the concepts of interest. These concepts define methods for data collection, in this case starting with quantitative approach within selected samples of population which constructs the basis for the study. Data analyzed provide insights toward the designation of qualitative

[183] Corbin and Holt, *Grounded Theory,* 49.
[184] Ibid., 50.
[185] Ibid.
[186] Mark Saunders, Philip Lewis and Adrian Thornhill, *Research Methods for Business Students*, 5th ed. (USA: Financial Times/Prentice Hall, 2009): 490-493.
[187] Roy Suddaby, "From the Editors: What Grounded Theory is not," *Academy of Management Journal* 49, no. 4 (2006): 635,636
[188] Saunders et. al. Research Methods for Business Students, 5th ed., 509-511.
[189] Ibid., 511.

method as it is the central approach of this research and strives on in-depth understanding of the environment where the key-player of the study are involved. Categories are identified afterwards, which in this case relate to the actors involved and their role referring to the development of timber-based architecture in Kosovo. The information obtained from categories are explored and compared, hence the relationship between them is established, with reference to the *selective coding* phase. Finally, Grounded Theory is used to generate answers for research questions raised and provide a comprehensive platform for further implications.

4.6 Research proceeding

The mixed-methods research approach utilizes both quantitative and qualitative means for collecting research data. Due to complexity and extensive nature of this research, relying on one method doesn't ensure it would encapsulate different dimensions of the topic. When designing methods to employ, the researcher should select techniques that enable the cross-check of the data and the use of one set of results to corroborate another.[190] After the definitions of the concepts of the study, quantitative method is the first approach for collating data. The outcomes provide a general overview on the issues perceived within the selected samples, therefore it assist employing qualitative method in the study. As explained earlier, results from mixed method will be integrated during the interpretation phase. Different techniques are used to collate data (primary data, secondary data and literary data) based on Triangulation tool, as illustrated in Figure4.4. Triangulation tool refers to the use of different data collection techniques in one study to provide confirmation and completeness in order to increase the credibility and validity of findings through convergence of different perspectives.[191]

[190] Currie, *Developing and Applying Study Skills*, 92

[191] Sabina Yeasmin and Khan Ferdousour Rahman, "'Triangulation' Research Method as the Tool of Social Science Research" *PUB Journal* 1, no. 1 (2012):154 http://www.bup.edu.bd/journal/154-163.pdf (accessed December, 2016)

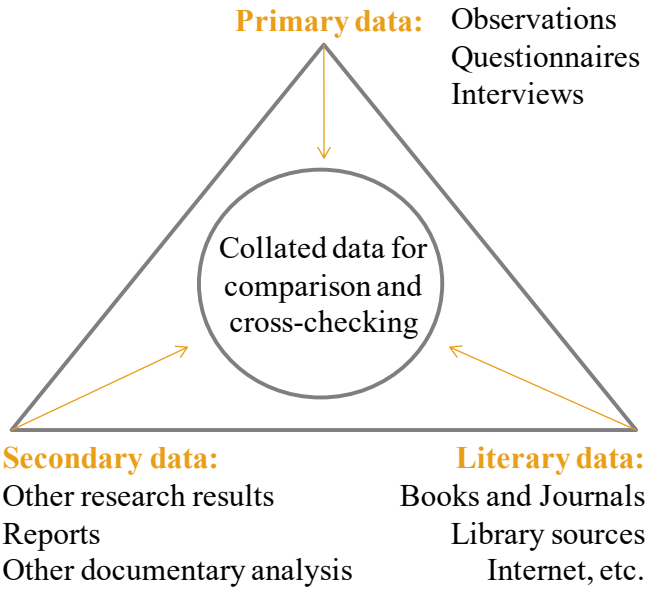

Figure 4.4 Data sources used for this study by triangulation scheme
Source: Adopted from Donald Currie, Developing and Applying Study Skills: 91, Fig. 11.

4.6.1 Quantitative approach and methods applied

Quantitative research is characterized by the intent to describe a research problem through a description of overall tendency of responses and pointing out the variation of tendency among individuals, or by explaining a relation among variables, verifying whether variables influence others.[192] Data analyses are carried out through statistics which consist of classifying the data into smaller parts and comparing or relating scores with the aim to address the research questions or hypotheses.[193] Quantitative research covers representative sets of data mostly using questionnaires as a research technique, typically associated with multiple-choice questions and pre-coded responses, or even open-ended questions.[194]
Some of the strengths of quantitative research, listed by Johnson and Onwuegbuzie (2004), are: 1) it can generalize research findings when collected data are based on random samples of sufficient size, when it has been replicated on different sub/populations; 2) provides precise, quantitative, numerical data from input collected within short time; 3) objectivity – there is no influence from the researcher on the research results (e.g., effect size, statistical significance), therefore own higher credibility; 4) it is useful to cover a

[192] Creswell, *Educational Research*, 4th ed., 13.
[193] Ibid., 15.
[194] Loraine Blaxter, Christina Hughes and Malcolm Tight, *How to research*, 4th ed. (Maidenhead: Open University Press, 2010), 65,186

large number of peoples in a sample.[195] The abovementioned strengths, likewise relate to the objectives of the first phase of this study. The research problem at this point is to build a pre-understanding on the perception of building community, respectively architects and engineers with regard to the use of timber as a structural material in residential sector. Covering a large set of data within a shorter time is substantial; findings from data analysis will provide a general overview on the research problem, hence help with constructing the subjects for the qualitative investigation to be carried out afterwards.

4.6.1.1 Surveys

The most common method to conduct quantitative research is the use of surveys. Survey gathers data from respondents that represent a population using closed ended, semi-open, or open ended questions.[196] Trends, attitudes and opinions from selected population are given by numeric description, where results lead to generalization or drawing of conclusions to a population.[197] The use of *cross-sectional* surveys as a starting point for data collections in this study has been done due to the interest for covering a large sample during a short period of time. *This design is most often used to document the prevalence of particular characteristics in a population*[198] at a single point of time and *offers the opportunity to assess relations between variables and differences between subgroups in a population.*[199] There are few options to deliver standardized questionnaires to the respondents: as a written document, online questionnaires, a face-to-face fulfill, mail or a telephone interview.[200] With the intention to positively influence the response rate, along with methods for applying surveys, other relevant factors such as, how and to whom the questionnaire will administer, have to be carefully weighted. In this context, *self-administered* approach through online and mail survey techniques is adopted. When designing *self-administered questionnaires*, the full context for the survey in introductory

[195] R. Burke Johnson and Anthony J. Onwuegbuzie, "Mixed Methods Research: A Research Pardigm Whose Time Has Come," *Educational Researcher* 33, no. 7(Oct. 2004):19. http://www.jstor.org/stable/3700093?origin=JSTOR-pdf&seq=1#page_scan_tab_contents (accessed December 22, 2015)
[196] Carrie Williams, "Research Methods," *Journal of Business & Economic Research* 5, no. 3 (March 2007): 67.
[197] John W. Creswell, *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 4th ed. (USA: SAGE Publication, 2014), 156.
[198] Penny S. Visser, Jon A. Krosnick and Paul J. Lavrakas, "Survey Research" in *Handbook of research methods in social and personality psychology*, ed. Harry T. Reis and Charles M. Judd (UK: Cambridge University Press, 2000), 225.
[199] Ibid.
[200] Writing@CSU, "Survey Research", Colorado State University, https://writing.colostate.edu/guides/guide.cfm?guideid=68 (accessed December 3, 2016).

e-mail and the front cover is provided with the intention to reduce non-responses and measurement error.[201] Mae Sincero suggests that while *online survey* is appropriate when a huge sample size is required, it is less expensive and companies can conduct survey with decent precision, members of the sample must be computer literate; on the other hand, *mail survey* facilitates administering of the survey, as by reviewing mails before they are sent control is secured, however nowadays it is evident that this technique has shown a lower response rates from the participants when compared to years ago.[202]

After the target population for the study has been identified, the survey sample of a population has to be selected, which is called *sampling frame.*[203] This study employs a sample frame within two categories of responders. The first category represents active construction professionals, respectively architects and civil engineers, and conversely, the second group covers random inhabitants as home owners, with no background in construction. The two categories are selected specifically; the professionals are the focus group of this phase of the study and have a major role on the purpose of the survey, while the second group will provide a different perspective on the subject. The purposive classification of the sample frame and the exploratory nature of the research, has determined the *non-probability* sampling as a general approach to be followed. As the population of interest is selected based on the judgmental criteria which is non-random, this approach does not allow the estimation of sampling errors.[204] The main purpose of the survey of this study is to identify the perception of the construction community on different aspects of timber-based typologies for residential buildings and identify motivations and barriers for development of timber-based architecture in Kosovo. The purpose of this survey dictates the use of *purposive sample* method, as the individuals are purposely selected. On the other hand, the other category of the other survey leans toward the *haphazard/accidental* sampling method since it surveys individuals to be reached easily. It covers random inhabitants with now professional background, but computer literate who will provide their opinion on sustainability and how they would perceive living in a timber apartment/house. These two categories are not comparable but the second one will

[201] Nancy Thayer-Hart et al., *Survey Fundamentals: A Guide to Designing and Implementing Surveys* (Madison: University of Wisconsin-Madison, 2010), 11. https://oqi.wisc.edu/resourcelibrary/uploads/resources/Survey_Guide.pdf (accessed December 4, 2016).
[202] Sarah Mae Sincero, "How to Conduct a Survey". Retrieved Feb. 01 from Explorable.com. https://explorable.com/how-to-conduct-a-survey (accessed February 2, 2017).
[203] Writing@CSU, "Sampling", Colorado State University, https://writing.colostate.edu/guides/page.cfm?pageid=1417&guideid=68 (accessed December 3, 2016).
[204] Kanupriya Chaturvedi, "Sampling Methods", University of Pittsburgh, http://www.pitt.edu/~super7/43011-44001/43911.ppt (accessed February 2, 2017).

complement the general overview on how do random inhabitants perceive timber as a structural material in residential construction.

Sample errors – Surveys errors are related to sample size and the fact that sampling error are inevitable occurs due to the fact that samples differ from their populations and are considered only as estimators.[205] Contrary to probability sampling, in non-probabilistic sampling it isn't possible to determine the accuracy. *To minimize sampling error, it is usually advantageous to select a relatively large sample size*. [206]

Sample size and response rate – Unlike probability sampling, Saunders states that for non-probability sampling techniques the sample size follows no specified rules and it is basically dependent on research questions and objectives, and principally when intended to proceed with qualitative method using interviews.[207] Representatives (architects and civil engineers) are chosen on the basis that they are particularly informative in order to address subjects of the study. There are some considerations on the minimum sample sized in non-probability sampling, according to which, in case that the nature of study is Grounded Theory, the minimum sample size is estimated 35-36 respondents.[208]

The main attention at this phase is assuring the highest possible response rate. Response bias may distort results provided, hence an increased attention during the construction of questionnaires should be considered in order to minimize them. "*A response rate is commonly defined as the proportion of completed interviews to the total number of eligible respondents, and it indicates how successful the researcher was in gaining cooperation of potential respondents in a sample*".[209] There are different statements on the acceptable response rate: 50%-70% (Babbie, 20003); 65% (Dolson & Machlis, 1991); 25%-35% (Mitra & Lankford, 1999) etc.[210] However, there are discussions on acceptable response rate considering the fact that in case of low response rate, such as 30% or lower, it may be

[205] Writing@CSU, "Sampling", Colorado State University.
[206] Mark D. Needham and Jerry J. Vaske, "Survey implementation, sampling, and weighting data," in *Survey research and analysis: Applications in parks, recreation and human dimension*. (State College, PA: Venture Publishing, 2008), 179. http://nature.forestry.oregonstate.edu/sites/default/files/2008-3%20Needham%20%26%20Vaske%20-%20Chapter%2008%20-%20Survey%20Implementation%2C%20Sampling%20%26%20Weighting%20-%20Second%20Proofs.pdf (accessed November 2, 2016).
[207] Saunders et al., Research Methods for Business Student, 5th ed., 233-234.
[208] John Dudovsky, "Non-probability Sampling," *Research Methodology*, http://research-methodology.net/sampling-in-primary-data-collection/non-probability-sampling/#_ftn1 (accessed February 2, 2017).
[209] Needham and Vaske, "Survey implementation, sampling, and weighting data", 208
[210] Ibid., 208-209.

acceptable if there is no difference between the respondents and non-respondents, such as in case of homogeneous groups.[211]

The first sample consists of architects and engineer only, hence it is estimated that the response rate doesn't endanger the reliability considering the homogenous structure of respondents. Approximately 3,000 architects and civil engineers are estimated to be professionally active in Kosovo.[212] The process of registering architects and engineers in Kosovo has started in 2015 and it is still an on-going process; the list of both professionals publicized by Commission for Registration has been used to collect e-mails for this sample. In total 564 professionals were contacted, through e-mail and social media; 13 e-mails were undeliverable (incorrect e-mail address) and 236 completed questionnaires were returned. The response rate is calculated with the following equation: **Response Rate = C / E**, where: C- no. of completed questionnaires and E- total no. of eligible respondents[213] and resulted **42.83%**. Considering the fact that questionnaires were delivered using also *snowball sampling,* (where participants are used to recruit more participants into the study), the response rate doesn't necessarily reflect the exact proportion between questionnaires sent and completed returned.

The second sample consisted of computer literate random inhabitants. In total 56 completed questionnaires using contacts from social media as the easiest form to receive responses were gathered.

Pilot survey - When conducting surveys, there is always a chance for failure due to different factors such as: poor compilation, lack of clarification, layout, grammar etc. Pilot surveys on respondents who represent the final sample are commendable. When conducting pilot survey in the exploratory stages, non-probabilistic sample is considered as the most practical although it would not determine the extent of the problem.[214] Boynton (2004) states some considerations to benefit from pilot survey, which would provide a guide for rephrasing questions for richer responses, such as: the reaction of participant to

[211] Needham and Vaske, "Survey implementation, sampling, and weighting data", 213.
[212] Ministry of Environment and Spatial Planning, *Koncept Dokument për Rregullimiin e Profesionit të Arkitektëve dhe Inxhinierëve në Fushën e Ndërtimit* (Government of Kosovo, 2015) https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwipv_qh65HMAhWCAJoKHWo7BNMQFggcMAA&url=http%3A%2F%2Fmmph-rks.org%2Frepository%2Fdocs%2FKD_p%25C3%25ABr_Rregullimin_e_Profesionit_t%25C3%25AB_Arkitekt%25C3%25ABve_dhe_Inxhinier%25C3%25ABve__ALB_236983.docx&usg=AFQjCNG9YSe8Bm32zAo_ggQ8yFGETnOXPg&bvm=bv.119745492,d.bGg (accessed March, 2016).
[213] Needham and Vaske, "Survey implementation, sampling, and weighting data", 209.
[214] Saunders et al., Research Methods for Business Student, 5th ed., 233.

the general format or questions, timing, the need to provide additional explanations to specific questions, the way participants would indicate to have been arrived at an answer, and similar.[215]

Prior to the final compiled questionnaire, a pilot survey (Paper III) has been employed within a group of architects and engineers. Around 120 surveys were delivered and 47 completed questionnaires were received. This project has indicated some of the potential errors in compilation, at the same time, revealed new issues to incorporate in the questionnaire which has been considered when constructing the final questionnaire.

4.6.2 Qualitative approach and methods applied

In this Mixed method study, Qualitative approach is the subsequent phase after the Quantitative findings have been revealed, and it has an imperative role to the overall study conclusions. Quantitative approach has provided credible outcomes from the large-scale of respondents engaged, and built the setting for the Qualitative method to proceed further in order to explicate identified issues deeper through the participation of competent key-players. Qualitative research can be hardly explained through a 'fixed' definition and it has to do with the fact that the nature of this type of inquiry is evolving in time, thus definitions advance.[216] Latest definition by Denzin and Lincoln follows:

> *"Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. They turn the world into a series of representations, including field-notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative research study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them."*[217]

[215] Petra M. Boynton, "Administering, analyzing, and reporting your questionnaire", BMJ, 2004. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC420299/#ref3 (accessed February 4, 2017).
[216] John W. Creswell, *Qualitative Inquiry & Research Design: Choosing Among Fife Approaches*, 2nd ed. (Thousand Oaks: Sage Publication, 2007), 36.
[217] Norman K. Denzin and Yvonna S. Lincoln, The SAGE Handbook of Qualitative Research, 3rd ed. (Thousand Oaks: Sage Publication, 2005), 3.

Some of the vital features of qualitative research that also distinguishes it from quantitative research are: it deals with opinions, experiences and feelings of individuals producing subjective data; understanding of a situation is obtained through a holistic perspective; data are used to develop concepts and theories that help to understand the social world, as it is an inductive approach; data are collected through direct encounters with individuals, through interviews or observations, which is time consuming; the intensive and time consuming nature of data collections therefore necessitates the use of small samples; different sampling techniques are used to demonstrate the representativeness of findings through random selection of subjects. These techniques deal with seeking information from specific groups and subgroups in the population.[218]

Data collection in Qualitative approach is carried out through direct communication with individuals or a group of population. Data are obtained from a smaller group of people. The advantages from using this approach consist of the richness of data and the deeper insight into the topic being explored.[219]

Development of timber-based architecture and the recognition of potential benefits from the use of timber as structural material relates to many relevant indicators in the whole complex process. This study intends to reveal key-players involved, their role and potential to support and benefit from, the increase of timber in residential construction. Qualitative method allows direct interaction with academics, professionals and government officials 'in charge' and it will assist to build an understanding on the circumstances present in Kosovo. Several new issues have emerged from the quantitative phase, hence using qualitative inquiry is necessary to 'clear the air'; herewith general setting is to be revealed. In this research, two methods are used for collecting qualitative data: *Individual Interviews* and *Observation*.

4.6.2.1 Interviews

Qualitative research interview seeks to understand the topic under study from the point of subject's view, to clarify the occurrence prior to scientific explanations; it is a professional interchange of views between the interviewer and the interviewee on a topic of mutual interest where knowledge is constructed; the process *goes beyond the spontaneous*

[218] Beverly Hancock, *Trent Focus for Research and Development in Primary Health Care: An Introduction to Qualitative Research*, Trent Focus, 1998. http://classes.uleth.ca/200502/mgt2700a/Articles/Qualitative%20Research.pdf (accessed Feb. 4, 2017).
[219] Beverly Hancock, *An Introduction to Qualitative Research*, 1998.

exchange of views in everyday conversations, and becomes a careful questioning and listening approach with the purpose of obtaining thoroughly tested knowledge.[220] Interviews are useful for gathering valid and reliable data relevant to the research question and objectives, or when they are not yet nominated, preliminary interviews help identify them.[221]

Several methods of conducting interviews are available in the research domain: face-to-face or focus group interview and telephone/video interview. Interviews can be categorized as: *structured interviews* – using questionnaires based on predetermined set of questions, using pre-coded answers, hence identified as 'quantitative research interviews'; *semi-structured interviews* – referred as 'qualitative research interviews' where the researcher uses a set of questions and topic to be discussed in relevance to the interviewers which means that particular interviews are specifically designed in relation to the theme explored. In semi-structured interviews, conversations are recorded or notes are taken; *unstructured interviews* – are informal, used for in depth exploration of the general area without predesigned questions where the interviewee talks freely on the subject discussed.[222] *Standardized interviews* are associated with structured interviews as data collected are analyzed quantitatively. On the other hand, with *non-standardized interviews* (semi-structured and unstructured) data are qualitatively analyzed.[223]

Non-standardized, semi-structured interview is the most appropriate method to be used in this research; it corresponds to the main research questions and objectives as well as to the new issues which have risen during the analysis of the surveys. Several target groups are identified as important to be interviewed in order to acquire deeper and valid information on a number of aspects that require to be addressed. As mentioned before, a 'chain' of several indicators are integrated in a complex configuration which directly and indirectly, in short-term and long-term basis, influences the opportunity to develop timber architecture and national benefits moreover. Interviews, all face-to-face conversations are conducted in the sector of wood industry, in the Department of Forestry and Kosovo Forest Agency, academics from the technical universities, and experienced architects.

[220] Steinar Kvale, *Interviews: An Introduction to Qualitative Research Interviewing* (London: Sage Publication, 1996), 1-3.
[221] Saunders et al., Research Methods for Business Student, 5th ed., 318.
[222] Ibid., 320-321.
[223] Ibid., 321.

Interviews are conducted informally, where the *interviewees should feel as though they are participating in a conversation or discussion rather than in a formal question and answer situation*.[224] McNamaara suggests that when conducting interviews, wording of questions should be carefully considered: they should be open-ended so that respondents can choose their own terms; questions should be as neutral as possible, not to influence answers; questions should be asked one at a time; questions should be clearly worded, and a consideration should taken when asking the "why" question – it might cause respondents to feel defensive and justify their response.[225]

4.6.2.2 Observations

Observing is a form of 'recording' the environment through our senses; where the researcher observes specific research phenomenon. Observation is something we are familiar with, even if it is not identified as a formal research method; it is not only recording data from the surrounding; the researcher is active during observations, brains are engaged as well as other senses, organizing data into something recognizable.[226] This technique can provide valuable background information on the environment of the research project; it also can be used to verify or nullify information provided in face to face or group encounters.[227]

Observation was initial technique during the setting of the research proposal. It involved generally *photographic* techniques on existing traditional wooden houses and structural components which provided a historical background on local wooden typologies. Objects and artifacts inform us on the topic under investigation due to their significance to the same topic.[228] Contemporary multi-storey timber-based residential buildings constructed in different European countries have also been investigated in terms of structural and architectural features and sustainable urban context. *Documentation* is the other observational technique used in this study which consists of secondary data - a range of written materials during the whole process of investigation. Different official documents

[224] Beverly Hancock, *An Introduction to Qualitative Research*, 1998, 10.
[225] Carter McNamara, *General Guidelines for Conducting Research Interviews*, Free Management Library. http://managementhelp.org/businessresearch/interviews.htm (accessed Feb. 4, 2017).
[226] Nick Fox, *Trent Focus for Research and Development in Primary Health Care: How to Use Observations in a Research Project*, Trent Focus, 1998, http://web.simmons.edu/~tang2/courses/CUAcourses/lsc745/sp05/observation.pdf (accessed February 4, 2017).
[227] Beverly Hancock, *An Introduction to Qualitative Research*, 1998, 12.
[228] Ibid., 13.

such as: EU and government reports, institutions, industrial and NGO's publications, building law and similar, have been used with this technique.

4.7 Scientific reliability and validity

In the research design adopted to conduct the study, certain data collection methods are employed in different phases. It is essential to ensure that the study purpose relates clearly and entirely to the research process that is being undertaken. Instruments which ensure the credibility of the research results are *reliability* and *validity.*

Reliability refers to *"the extent to which your data collection techniques or analysis procedures will yield consistent findings."*[229] Easterby-Smith et al., 2008, have posed the following three questions to assess research reliability:

1. Will the measures yield the same results on other occasions?
2. Will similar observations be reached by other observers?
3. Is there transparency in how sense was made from the raw data?[230]

Validity is a measure characterized by *the extent to which a score truthfully represents a concept.*[231] It assures whether the results do portrait what they are intended to portrait.

These two measures are important especially in quantitative research methodology as they assure the objectivity of research.

4.8 Ethical consideration

Ethical consideration in research discusses the role of value in the research process and in general, deals with the following two questions:

- *How should we treat the people in whom we conduct research?*
- *Are there activities in which we should or should not engage in our relations with them?*[232]

[229] Saunders et al., Research Methods for Business Student, 5th ed., 156.
[230] Mark Easterby-Smith et al., *Management Research*, 3rd ed. (London:Sage Publication, 2008) quoted in Ibid.
[231] Khalid et al, "Get along with quantitative research process", 22.
[232] Alan Bryman, *Social Research Methods*, 4th ed. (New York: Oxford University Press, 2012), 130.

Discussions, also transgressions of ethical principles in social research are stated by Diener and Crandall (1978) into four areas: whether there is *harm to participants*; whether there is a *lack of informed consent*; whether there is an *invasion of privacy*; and, whether *deception* is involved.[233] Ethical concern is inseparable aspect for consideration during the whole process of research, from formulating the research topic, designing the research, identifying relevant organizations and individuals for data collection, collection of data, analysis and writing up the finding in a moral and responsible way, while ensuring the fact that the whole process of the research in both methodologically and morally defensible to all actors involved.[234] Saunders et al. have listed general ethical issues to be taken into consideration, which may occur during all stages of research along with stage-specific ethical issues, as follows: privacy, voluntary nature, consent, deception, confidentiality, anonymity, embarrassment, stress, harm, discomfort, pain, objectivity and quality of research.[235]

In this research, the issue of ethical consideration has been mostly present during the phase of designing the research methodology to apply, respectively assuring access to the targeted groups for data collection, both for quantitative and qualitative phases of inquiry. When compiling online surveys, the surveyors were provided with the introductory page with the researcher's personal information and affiliation. Next, the topic title followed by a short abstract and purpose of the research, and the importance of participation of the selected individuals by completing and submitting the questionnaire was stated. Also, each contact person has been informed on the source where the researcher has gotten his/her e-mail or social media contact. The qualitative phase of interviewing has begun with contacting each person by phone, or by visiting respected institutions and providing the same information as per abovementioned phase. Afterwards, when the potential responder has shown interest, the date and place of meeting was set for the interview to take place. It is worth to mention that each of participants has supported the work being carried out and shown interest for conducting the interview. For both methodologies, the respondents were assured the confidentiality as one of the main issues of ethical consideration.

[233] Edward Diener and Rick Crandall, *Ethics in Social and Behavioral Research* (Chicago: University of Chicago Press, 1978) quoted in Ibid. 135.
[234] Saunders et al., Research Methods for Business Student, 5th ed., 184.
[235] Ibid., 188.

4.9 Conclusion

This chapter has outlined the theoretical perspective of the approved methodology to conduct this research, therefore achieve the objectives. The research design and strategies for adopting a research methodology for this topic is thoroughly explicated. It discusses the mixed methods of inquiry in research practices, hence the integration of both quantitative and qualitative approaches to collect the research data. The research proceeding using inductive approach where subsequent to qualitative data analysis, a theory is generated guided by Grounded Theory of qualitative research, is elaborated. Finally, the generated theory, by achieving the research objectives, provides an answer to the research questions, on the topic of development of mid-rise residential timber-based architecture in Kosovo: barriers and opportunities. A summarized overview on the applied methodology is shown in Figure 4.5.

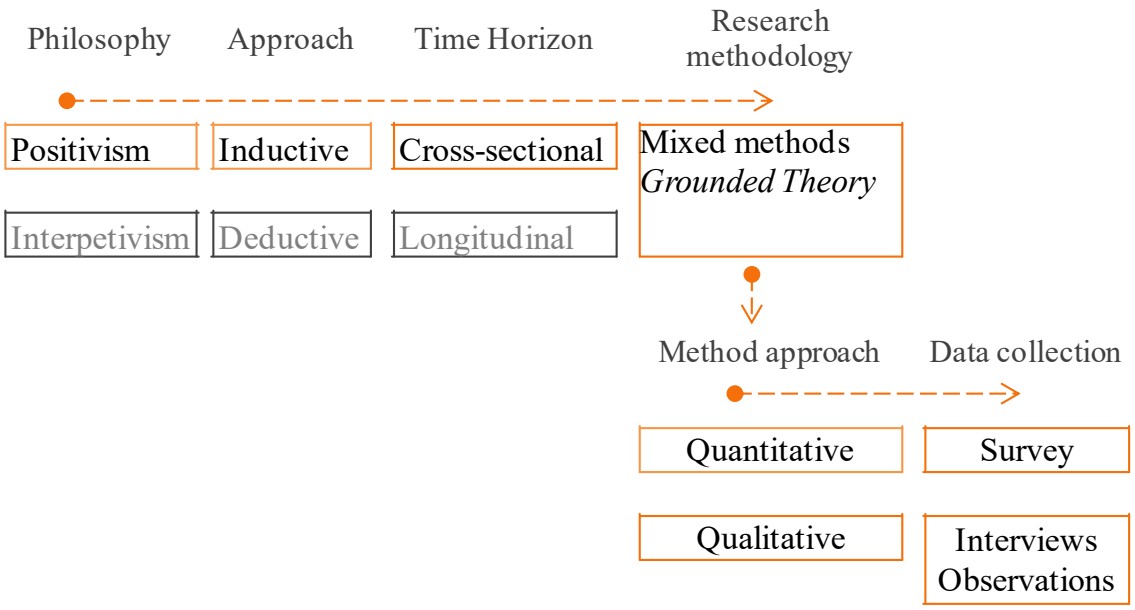

Figure 4.5 Applied methodology

The next chapter will analyze and discuss the findings from both quantitative and qualitative approaches for collecting necessary data using surveys and interviews.

Chapter 5
RESULTS AND DISCUSSIONS

abstract:

This chapter discusses the data collection methods adopted and the process applied, subsequently describes the results gained from mixed method approach. The first part of the chapter explicates the quantitative phase of inquiry, the process of conducting the surveys for building community and non-professional inhabitants. The second part of enquiry, the qualitative phase, is constructed on the basis of the findings from the surveys conducted. It discusses the results from interviews carried out with several professionals involved in different sectors related to the development of timber architecture with the aim to reveal the motivations and barriers, therefore potential for sustainable development of timber-based residential buildings in Kosovo.

5 RESULTS AND DISCUSSIONS

5.1 Introduction

This study incorporates both quantitative and qualitative approaches in Mixed methods strategy for collecting and analyzing the research data. This integration of the two approaches has been adopted with the aim to provide a better understanding of the research problem than either approach alone would have.[236] The research involves sequential use of the two approaches, which implies collecting data in an iterative process where one phase of data collection contributes to the other phase of inquiry.[237] The quantitative phase of inquiry explicates the process of conducting the surveys for *(1) architects and civil engineers,* and *(2) non-professional inhabitants*. The survey's purpose is to understand the current role and perception of building community toward timber-based residential architecture and various attributes of timber as a structural material. Inhabitants with no construction background are surveyed with the interest to present a general idea on their knowledge on the concept of environmental sustainability and their perception on different aspects of timber-based residential buildings. The second part of enquiry, the qualitative phase, is constructed on the basis of the findings from the conducted surveys, which helped identifying new issues needed to be further investigated. It discusses the results yielded from interviews carried out with several professionals involved in different sectors related to the development of timber architecture with the aim to reveal the motivations and barriers, thus potential and strategies for sustainable development of timber-based residential buildings in Kosovo. This multi-method research brings together numbers and narratives, description and understanding of the context, providing a fuller discernment of the phenomenon under study,[238] therefore, using Grounded Theory a generalized conclusion as the aim of the study will emerge.

[236] John W. Creswell, "Mixed Methods Research: Design and Procedures." Lecture at the University of Pretoria, October 21, 2008. http://www.up.ac.za/media/shared/Legacy/Education/mixed-methods-research_-design-and-procedures_-by-john-w-creswell.zp37294.ppt (accessed January10, 2017).
[237] David L. Driscoll et al. "Merging Qualitative and Quantitative Data in Mixed Methods Research: How to and why not to," Ecological and Environmental Anthropology (University of Georgia) 3, no. 1(2007): 21. http://digitalcommons.unl.edu/icwdmeea/18 (accessed January10, 2017).
[238] Kurt C. Stange, Benjamin F. Crabtree and William L. Miller "Publishing Multimethod Research" *Ann Fam Med*. 4 no.4 (2006):292. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1522167/ (accessed January10, 2017).

5.2 Quantitative results and analysis

Quantitative inquiry is the first phase adopted for conducting data collection and analysis. Two different surveys were performed for two different social groups: *(1) architects and civil engineers,* and *(2) non-professional inhabitants*. These two categories are not comparable at this stage but the second one complements this phase of the research. The second group has no construction education background so it was necessary to compile a different questionnaire that would suit their role in this study thus provide a general overview on how do random inhabitants perceive timber as a structural material in residential construction.

Different rounds of data analysis when seemed necessary were applied in dependence to the types of responses and how extensive analysis, were desirable. Survey analysis results clearly depend on the 'research question' or what is intended to be known, as a result, an analysis plan of linking research questions to the survey questions is important.[239]

5.2.1 The process

The fist group was surveyed with the purpose to generate an overview on the role and perception of architects and civil engineers toward mid-rise timber-based residential architecture and various attributes of timber as structural material in comparison to steel and concrete. Additionally, the survey seeks to understand the issues on professionals' experience, knowledge and interest on contemporary timber-based residential construction. The role of academy and vocational schools in Kosovo, focusing on timber as renewable material in construction and wood industry is addressed. This group of professionals in construction industry was purposively selected due to its experience and professional reliability on the abovementioned range of technical, educational and environmental issues the survey has covered. The surveyors were contacted through social media and e-mails, using snowball sampling. Acquainted colleges and professional groups were contacted through social media and the rest of professionals by e-mails publicized by Commission for Registration in Kosovo.

The second group, random inhabitants with no construction background is surveyed separately with the interest to gain a general idea on their knowledge on the concept of environmental sustainability and their perception on timber-based residential buildings.

[239] American Association of Community Colleges, *Survey Analysis Guideline* (2009): 36. http://www.aacc.nche.edu/Resources/aaccprograms/Documents/6_SurveyAnalysis.pdf (accessed January10, 2017).

Aside from wood-based traditional housing typologies present in Kosovo, there is no tendency of contemporary application. Hence, their perception on different attributes, regarded as sensitive, such as technical performance, fire safety and similar, is an important indicator for this study. This category of surveyors is identified by the haphazard/accidental sampling method considering the fact that reaching easily the potential inhabitant is the aim. The main condition considered when recruiting this group, was that they should be random inhabitants that are computer literate. In this case, a group of friends, colleagues and family were contacted through social media as the easiest from to collect responses, although responses were received anonymously.

As explained in section 4.6.1.1, this purposive classification of the sample frame and the explanatory nature of the research, has determined the non-probability sampling as a general approach, where the population of interest is selected based on judgmental criteria set by the researcher. Given the actuality how, with the rapid growth of interest, internet is affecting the survey research industry, the process of data collection and evaluation has also been in many ways facilitated.[240]

Opposed to traditional survey participation, web surveys enable researcher, using self-administered methods, to get access to a large number of responders and conduct a large-scale data collection in a shorter time and lower costs.[241] The use of web surveys, disseminated through e-mails and social media has facilitated the response rate and speed, and data processing afterwards.

Since the sample uses the purposive sample method, as the individuals are purposely selected, the approach does not allow the estimation of sampling errors. Even though it isn't possible to determine the accuracy of sampling errors, they were taken into consideration by the choice of the sample size and response rate. The main attention was to assure the highest possible response rate during the construction of questionnaires as well as during the phase of distribution. The use of snowball sampling is taken into account as the study cannot be generalized for the entire population, but estimates the features of a certain professional network within a population; the initial subject generates additional

[240] Mick P. Couper, "Web Surveys: A Review of Issues and Approaches," Public Opinion Quarterly 64, no. 4, (2000): 464.
[241] Ibid., 464-465.

subjects respectively, until the size of the sample is considered sufficient for analysis proceeding.[242]

One of the sampling errors to be accounted at this stage, was the fact that the number of the contacts available could not represent the whole group of respective professionals as well as the possibility that a number of 'aged' professionals are not computer literate therefore do not own e-mail or other online contacts, or may not easily follow online survey instructions. Demographic differences are evident in internet-based studies, which indicate that younger respondents are usually overrepresented in web surveys as they are more likely to be adaptive to new technologies and familiar to internet services.[243] Potential sample error due to this cause is considered recoverable due to ensued interviews carried out.

5.2.2 Pilot survey

Questions for the survey were developed based on observations, discussions among colleagues and literature review. Besides the purpose and question appropriateness, there is always a possibility for failure due to poor compilation, lack of clarification, layout, grammar, and similar. Employing survey is an iterative process, where during analysis, new issues and questions may raise and additional information me be important to collect. Conducting a pilot survey prior to the definitive survey to test the abovementioned concerns was regarded as worthwhile.

The development of this pilot survey among architects and engineers is elaborated in Paper III, attached in Appendix 1. The research was carried out through a web-based questionnaire for the targeted professionals, chosen randomly and the survey was conducted anonymously. The aim was to assess the role and perception of architects and civil engineers on the choice of construction material during design phase and different attributes of timber products as main construction material in mid-rise buildings, subsequently, the relation between professionals' experience on timber application, their interest on acquiring more information about timber technical performance and the barriers they perceive as present.

[242] Manuela Rozalia Gabor, "Types of Non-probabilistic Sampling used in Marketing Research: "Snowball" Sampling," Management & Marketing 2, no. 3 (2007): 4-5. http://econpapers.repec.org/article/ephjournl/v_3a2_3ay_3a2007_3ai_3a3_3an_3a7.htm (accessed January10, 2017).

[243] Nojin Kwak and Barry Radler, "A Comparison Between Mail and Web Surveys: Response Pattern, Respondent Profile, and Data Quality" Journal of Official Statistics 18, no. 2 (2000):264.

Approximately 120 surveys were addressed to potential professionals and companies using e-mails. Contacts were acquired through social networks and similar. The survey provided the respondents with the introductory section on the author's background, the purpose of the research and the types of questions. In total 47 architects and engineers engaged in different professional sectors have submitted completed questionnaires. As shown in Table 5.1, 29 or 61.70% of the respondents were architects and 18 respondents or 38.3% were engineers.

Table 5.1 The number of surveyors of the pilot survey and their occupation

	Designer / Consultant	Contractor	Academic Institution	Public Institution		
Architect	18		5	6	29	61.70%
Civil Engineer	8	5	2	3	18	38.30%
				Total	**47**	100%

After results asserted from pilot survey, adjustment and changes were incorporated for the final survey. Introductory section was improved textually and visual data were incorporated; additional questions were added; questions formulation has been improved and necessary clarifications have been given; comment lines were added where additional options would be provided; questions were reorganized starting with introductory questions, to simpler questions towards more in-depth technical questions.

5.2.3 Architects and Engineers Survey

The AE Survey provided the introductory first page with all the information on the researcher's education background and contact details, the purpose of the survey, confidentiality and the time it takes to complete the questionnaire. The final form of the survey questionnaire is attached in the Appendix 1.

The topics investigated in the questionnaire were structured as below:

- Introductory section on professionals' background information; demographics; occupation
- The role and influence of architects and engineers, on the choice of construction materials

- Their perception on different attributes of timber as main structural material such as: technical performance, environmental impact, energy and cost efficiency, fire safety, thermal and sound insulation, comfort and durability etc.
- The level of their professional interest on acquiring more information on timber application in architecture
- The role and potential of vocational and academic education
- Sustainability and the role of timber as a renewable construction material
- Their perceived barriers of using timber as a main construction material
- Motivations and potentials

The options of the questionnaires are dichotomous, multiple choice, open response and rating scale options – using five-point Likert-scale.

Introductory

From 564 contacted professionals through e-mail and social media, 13 e-mails were undeliverable (incorrect e-mail addresses) and 233 questionnaires were submitted. As shown in section 4.6.1.1, response rate resulted 41, 31%, a value which is acceptable in case of non-probability sampling. In total, 145 individuals or 62.2% of the respondents were architects and 88 or 37.8% of the sample were civil engineers, being engaged on various professional activities indicated below on Table 5.2. From the overall sample, 225 professionals declared their occupation. Designing / consulting / supervision were the predominant occupations declared by the respondents, respectively 72%, while the least dominant occupation declared was working in NGOs with 12% of participation.

Table 5.2 Occupation declared by surveyors

		Design/ Consulting/ Supervision	Contractor	Research/ Academic Institution	Public Institution	NGO
Architect	M	66	19	12	7	6
	F	43	1	11	10	3
	total	*109*	*20*	*23*	*17*	9
Civil Engineer	M	46	28	4	7	0
	F	8	1	0	7	3
	total	*54*	*29*	*4*	*14*	*3*
	total	**163** *72%*	**49** *22%*	**27** *12%*	**31** *14%*	**12** *5%*

Table 5.3 presents the gender and the age groups participated in the survey. The younger age-group dominates the sample. Females were underrepresented covering 36% of the

survey population and this ratio could be due to the fact that females, in general, are not dominant in construction industry as males are.

Table 5.3 Total number of surveyors participated in AI Survey

Age-group		**20-30**	*%*	**30-40**	*%*	**40-50**	*%*	**50-65+**	*%*	**Total**	*%*
Architects	F	36	*15.45*	19	*8.15*	3	*1.29*	5	*2.65*	63	*27%*
	M	31	*13.3*	31	*13.3*	6	*2.58*	14	*6.01*	82	*35%*
Civil Engineers	F	10	*4.29*	7	*3*	1	*0.43*	2	*0.86*	20	*9%*
	M	25	*10.73*	21	*9.01*	11	*4.72*	11	*4.72*	68	*29%*
	Gender	102	*43.8%*	78	*33.5%*	21	*9.02%*	32	*14.0%*	**233**	**100%**

Nevertheless, due to the lack of gender statistics of active architects and engineers in Kosovo, it cannot be accurately estimated whether this percentage truly represents the female participation.

The online survey raw data derived as .cvs spreadsheet were analysed using Microsoft Excel 2007. Descriptive statistics explicate quantitative information using summary measures as: *mean* values of ranking Likert-scale, *frequencies*, *cross-tabulated* tables and info-graphics. Written comments on open-form questions are analyzed through qualitative analysis procedures by identifying main codes from the written comments. Basic coding from open-form responses alongside numerical data implies that the *material can be put into nominal-level categories*.[244]

The role and influence of professionals on the choice of construction materials

The whole selected sample, involving architects and engineers were asked of their opinion on the level of influence, the stated professionals and actors involved in the process of design and built, have on the choice of construction materials (both structural and non-structural), in residential and non-residential sector.

As indicated by the mean values in Figure 5.1 for the both sectors, architects and investors are perceived to be the most influential, although they are not ranked at the highest level, while engineers and public authorities is shown to have moderate influence. Public authorities are perceived to have the lowest influence on the choice of construction

[244] Statistical Services Centre, *Approaches to the Analysis of Survey Data* (The University of Reading: UK, 2001), 14 http://www.reading.ac.uk/ssc/ (accessed January10, 2017).

material in residential sector; for the same sector, investors are perceived to have the highest influence.

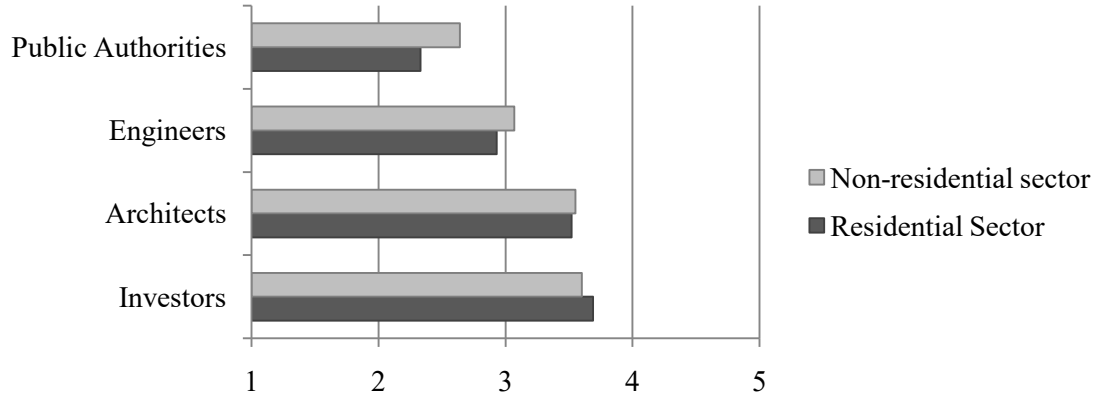

Figure 5.1 The level of influence by involved professionals and actors on the choice of construction materials, expressed in mean values (Likert scale: 1-no influence; 5-high influence)

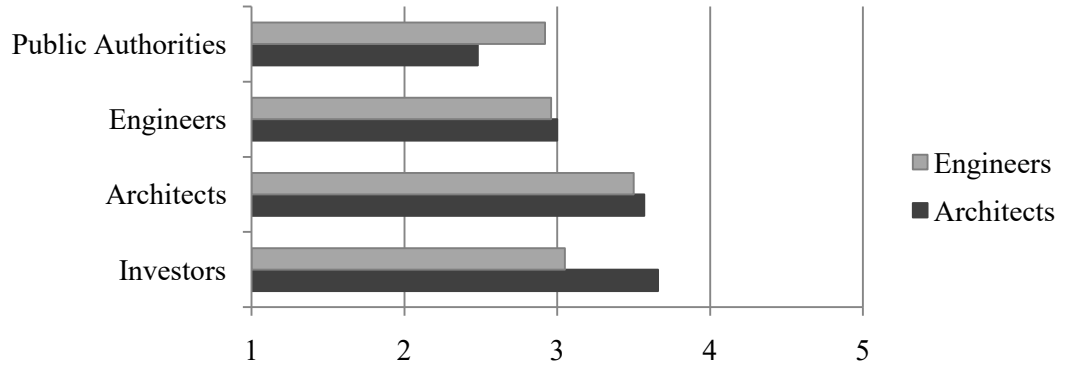

Figure 5.2 The level of influence by involved professionals on the choice of construction materials for *residential sector*, declared by architects and engineers. Ranking is indicated in mean values (Likert scale: 1-no influence; 5-high influence)

With regard to *residential sector* only, considering family houses as well as multi-storey apartments, architects perceive that architects and investors are the most influential when choosing construction materials and public authorities the least; engineers have a moderate influence (calculated mean value: 3). Engineers otherwise perceive that architect have a higher influence when compared to other actors positioned at a similar level, around 3, as shown above on Figure 5.2.

Experience, source of information and importance of education

The following set of questions (Q7- Q12) deal with the experience of the respondents using timber as structural material in domestic and non-domestic architecture, their sources of information for gaining knowledge and experience, and their opinion on the relevance of academic and vocational education.

The bar graph in Figure 5.3 provides an overview on professionals' experience on different categories of domestic and non-domestic timber-based construction. A considerable number of respondents have declared to have had no experience using timber as main structural material for both sectors. It is used moderately in facades of non-domestic buildings, while more on non-supportive buildings elements. The highest use of timber as technical material is in domestic pitched roof structures. In this category, it is worth mentioning that technical timber utilized is mainly local while the other categories are mostly executed with imported timber.

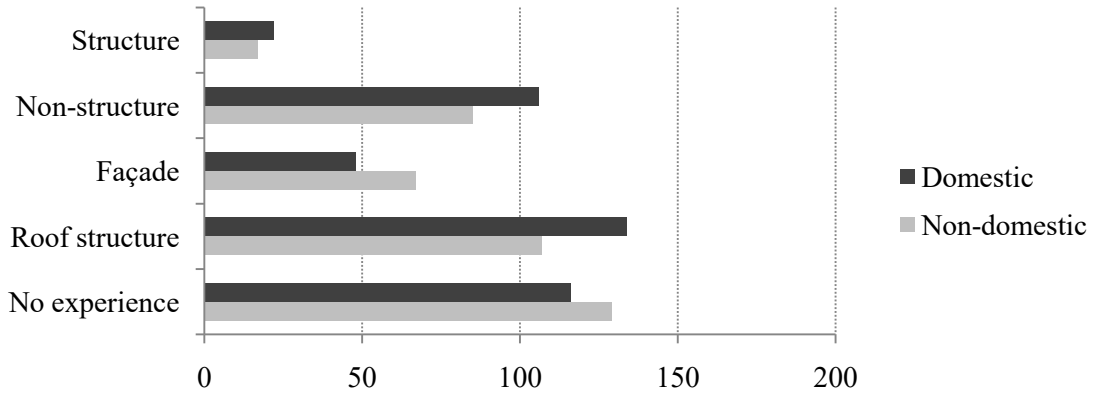

Figure 5.3 Professionals' experience using timber as construction material in domestic and non-domestic buildings, expressed by the number of respondents

The professionals were asked to rate their general understanding with regard to timber-based residential architecture. Most of them declared to have an average understanding, or 62% of the whole sample; 3% of participants declared to have a minimum rate of knowledge, and while 60 architects judged to have sufficient understanding, only 22 civil engineers responded the same (Table 5.4).

Table 5.4 Participants' view of their knowledge on timber-based residential architecture, expressed by the number of participants responded by occupation, and the total in %

Q7		Minimum	Average	Sufficient
How would you rate your understanding in regard to timber-based contemporary mid-rise residential architecture	*Architects*	4	81	60
	Engineers	3	63	22
	Total in %	*3%*	*62%*	*35%*

Considering the fact that in Kosovo there are aren't many opportunities for professionals to design and build timber-based buildings, it is essential to reveal professionals' sources of information and how they advance their theoretical understanding and practical experience. Internet sources are the most appropriate sources of information in this context, followed by the knowledge they achieved during academic education, foreign academic literature and various international trainings and workshops, (Figure 5.4). Other sources professionals declared to use, in written comments, are international conferences and fairs, construction sites, site visits in Europe, and professional documentaries.

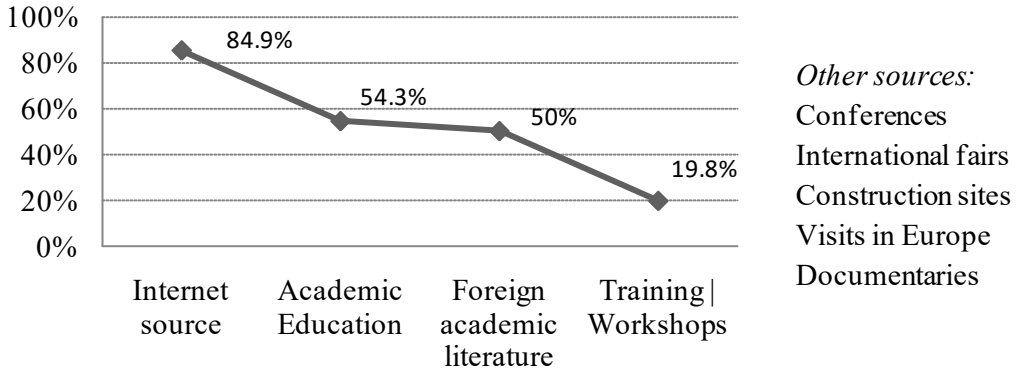

Figure 5.4 The source of information on timber-based architecture

In the perspective of knowledge and education, the majority of the respondents, respectively 94% of the sample agreed that academic education should provide more professional expertise on timber architecture. Vocational education on timber application in construction, along academic education, from the point of view of both, architects and engineers (97% of the sample), is considered with the highest interest for the young professionals who are to be employed in construction industry. Expressed by percentage, both, architects (94%) and civil engineers (94%) have shared the same respond rate within their category. In both survey questions, 5%, respectively 2% of the respondents were neutral, and 1% or 2 individuals had negative attitude toward the subject. Records are shown in Figure 5.5.

Table 5.5 Participants' view on importance of education on timber-based architecture, expressed by the number of participants responded by occupation, and the total in %

Q9 | Q10		Agree	Don't know	Disagree
Academic education should provide more professional expertise on timber architecture	*Architects*	136	8	1
	Engineers	83	4	1
	Total in %	*94%*	*5%*	*1%*
Along academic education, vocational education on timber application in construction is needful	*Architects*	140	4	1
	Engineers	86	1	1
	Total in %	*97%*	*2%*	*1%*

Main attributes of timber as construction material in comparison to steel and reinforced concrete

Q13-Q15 from the questionnaire discusses several attributes of timber, steel and concrete as main construction materials in residential sector. The levels of perceived performance of these attributes pronounced by respondents are compared and indicated in mean values by the Likert scale (from level 1- as the lowest performance – to 5- as very high). Main attributes of timber as construction material are also severally elaborated with the intention to reveal ranked attributions from the highest to the lowest perceived performances by professionals. Participants were asked on their interest on acquiring more professional information with regard to different aspects of timber application in residential architecture. Results are presented graphically in Figure 5.5, 5.6 and 5.6, and cross-tabulated Table 5.5.

Concrete | As shown in graphic and table below (Figure 5.5 and Table 5.6), concrete is the most highly perceived structural material, hence it is rated very high with reference to attributes such as: durability, structural performance, availability of technical information and product supply, fire safety, cost and architectural expression. The lowest rated attributes regarding concrete structures are: recyclability, flexibility/renovation, energy efficiency, insulation properties and environmental impact. **Timber** | Respondents have ranked very high timbers role in aesthetics, energy efficiency, environmental impact, recyclability, flexibility/renovation and sound/thermal insulation. Additionally, cost is ranked almost equally amongst timber and concrete; as for most of attributes, they stand quite shifted. **Steel** | Respondents perceived steel as positive with regard to structural performance, durability and recyclability. Lowest ranked aspects for steel are: sound/thermal insulation, fire safety, environmental impact, energy efficiency; the rest of the attributes are ranked moderately.

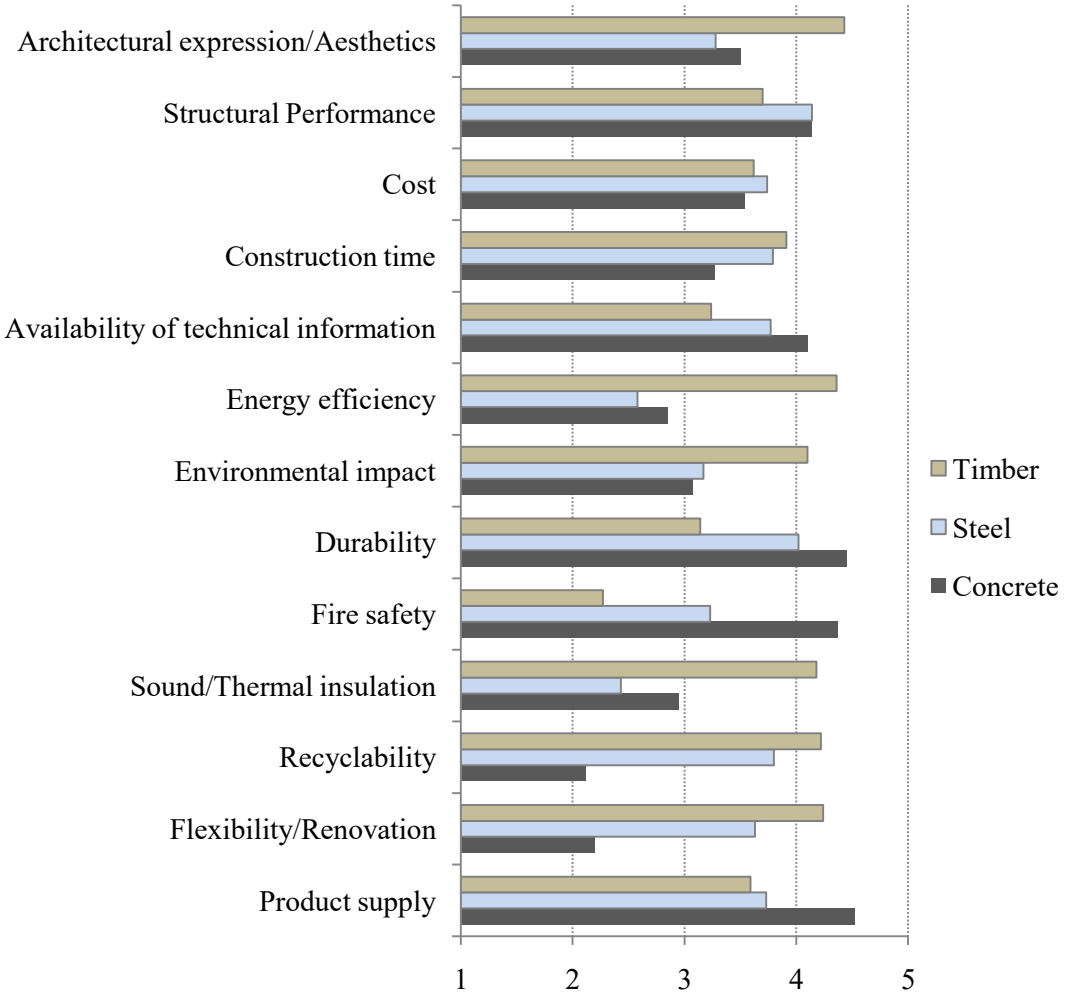

Figure 5.5 The level of perceived performance, expressed in mean values, of different attributes of timber, concrete and steel as construction materials (Likert-scale: 1-low 5-high)

Table 5.6 The level of perceived performance, in mean values, of different attributes of TCS

Q13	Sample		Timber		Concrete		Steel	
Architectural expression/aesthetics	*Architects*	F	4.48	4.55	3.89	3.85	3.33	3.24
		M		4.41		3.92		3.42
	Engineers	F	4.25	4.25	2.91	2.65	2.90	2.95
		M		4.25		3.17		2.84
Structural performance	*Architects*	F	3.86	3.8	4.17	4.11	4.14	4.07
		M		3.92		4.22		4.21
	Engineers	F	3.4	3.35	3.99	3.8	4.02	3.85
		M		3.44		4.18		4.19
Cost	*Architects*	F	3.71	3.73	3.56	3.66	3.77	3.68
		M		3.68		3.45		3.86
	Engineers	F	3.68	4	3.33	3.1	3.65	3.73
		M		3.36		3.55		3.56
Construction time	*Architects*	F	3.98	3.91	3.34	3.38	3.81	3.51
		M		4.04		3.3		4.1
	Engineers	F	3.28	3.58	3.1	2.94	3.70	3.58
		M		2.97		3.25		3.82
Availability of technical information	*Architects*	F	3.26	3.27	4.03	4.01	3.67	3.68
		M		3.24		4.04		3.65
	Engineers	F	3.29	3.42	4.16	4	3.84	3.63
		M		3.15		4.31		4.04
Energy efficiency	*Architects*	F	4.5	4.43	2.93	3	2.55	2.73
		M		4.57		2.85		2.37
	Engineers	F	4	3.8	2.91	3.14	2.77	2.94
		M		4.19		2.67		2.59
Environmental impact	*Architects*	F	4.18	4.3	3.01	3.17	3.07	3.01
		M		4.06		2.85		3.13
	Engineers	F	3.99	4	3	2.63	3.22	3.05
		M		3.98		3.37		3.38
Durability	*Architects*	F	3.28	3.35	4.32	4.28	4.09	4.21
		M		3.21		4.35		3.96
	Engineers	F	2.82	2.66	4.63	4.63	1.98	
		M		2.98		4.63		3.96
Fire safety	*Architects*	F	2.34	2.32	4.12	4.43	3.17	3.32
		M		2.35		3.8		3.01
	Engineers	F	2.19	2.22	4.36	4.26	3.39	3.52
		M		2.16		4.45		3.25
Sound/thermal insulation	*Architects*	F	4.19	4.18	2.89	3.16	2.39	2.68
		M		4.2		2.62		2.1
	Engineers	F	3.84	3.57	3.29	3.58	3.22	3.95
		M		4.1		2.99		2.48
Recyclability	*Architects*	F	4.45	4.64	2.17	2.31	3.84	3.7
		M		4.26		2.02		3.98
	Engineers	F	3.89	3.89	2.09	2.11	3.53	3.72
		M		3.88		2.07		3.34
Flexibility/renovation	*Architects*	F	4.02	3.71	2.12	2	3.72	3.79
		M		4.32		2.23		3.65
	Engineers	F	4.04	3.94	2.12	2	3.38	3.15
		M		4.13		2.23		3.61
Product supply	*Architects*	F	3.67	3.64	4.19	4.47	3.71	3.9
		M		3.7		3.91		3.52
	Engineers	F	3.54	3.68	4.39	4.1	3.78	3.73
		M		3.39		4.67		3.83

Figure 5.6 reveals results from question Q14 where professionals were asked additionally to rank listed timber attributes in Likert scale. The aim of this section is to identify the relation of listed aspects with regard to their perceived performance for multi-storey residential buildings. The perceived performances of listed attributes are ranked by mean values, in decreasing order with regard to timber as main construction material for residential sector.

The participants have ranked the following attributes as the most positive with regards to utilizing timber as structural material: architectural expression/aesthetics, energy efficiency, flexibility, environmental impact, construction time and recyclability. Sound/thermal insulation and structural performance are ranked as moderate (mean values: 3.94 – 3.88). The least perceived attribute by respondents is fire safety with a value of 2.39.

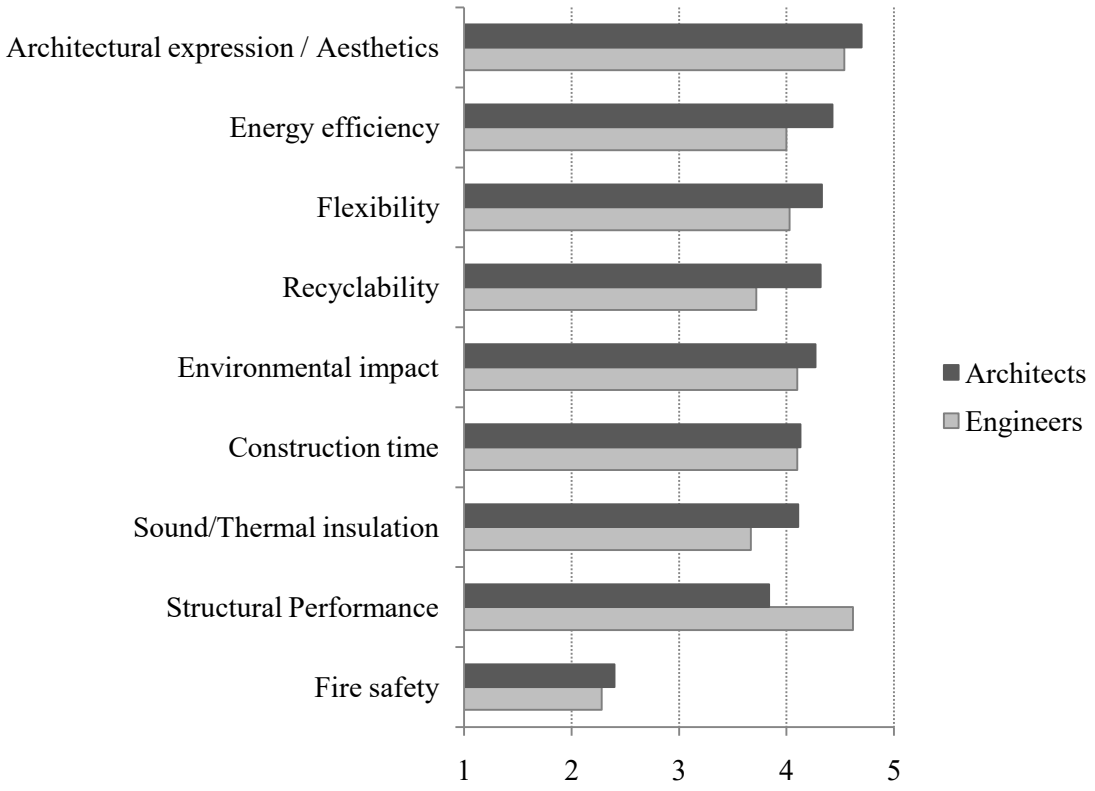

Figure 5.6 The level in mean values (ranked in decreased order) of perceived performance of different attributes of timber as construction material (Likert-scale: 1-very low; 5-very high)

For architects, aspects such as: architectural expression / aesthetics, energy efficiency, flexibility and recyclability are the highest ranked ones, while the least ranked aspects are fire safety, structural performance and sound/thermal insulation. Engineers on the other

hand, rate structural performance, aesthetics and construction time as the highest and, fire safety, energy efficiency, sound/thermal insulation to have a lower level of performance in residential construction.

Professionals were asked to rate the listed aspects according to their interest on acquiring more professional information on timber-based application for residential buildings. In general, when compared to building with concrete and steel, it is perceived a lack of information with regard to timber application in residential construction, therefore high demand for almost all aspects of timber as technical material, as shown graphically below on Figure 5.7. Architects have declared the need for information on design, timber building systems, environmental impact, sound/thermal/moisture, comfort and durability at the highest rank, whereas almost all categories were rated higher than scale 4.0. Engineers expressed their interest mostly on structural performance, design, comfort and durability and timber building systems.

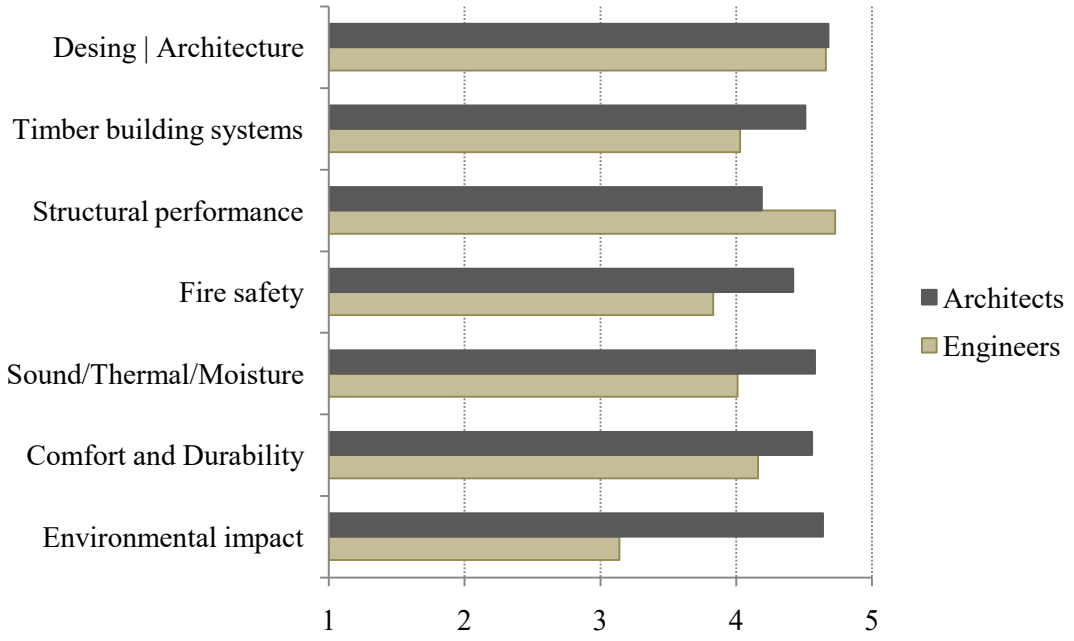

Figure 5.7 The level of professionals' interest on acquiring more information on timber application (Likert-scale: 1-no interest; 5-very high interest)

Sustainability and timber as sustainable construction material in multi-storey residential architecture

The following questions of the survey are focused on the surveyors' view on environmental sustainability and on the role of timber as a renewable construction material in the context of Kosovo. Cross-tab responses are processed in percentage separately for architects and engineers (Table 5.7) and written comments on Q18, Q19 and Q20 are categorized in Table 5.8.

Table 5.7 Professionals' view on timber as building material in the context of environmental sustainability, indicated in percentage of the overall sample

Q16 | Q17 | Q18 | Q19 | Q20 | in the context of Kosovo		Cross-tab responses in %		
		Agree	Don't know	Disagree
More focus on environmental protection from the perspective of construction industry is needful	*Architects*	62	/	0.5
	Engineers	37	/	0
	Total	*99.5*	*/*	*0.5*
More eco-friendly building materials should be used in residential construction	*Architects*	62	/	0
	Engineers	37	/	0.5
	Total	*99.5*	*/*	*0.5*
Timber is a promising eco-friendly building material *... if not, why?*	*Architects*	53	8	2
	Engineers	28	9	1
	Total	*80.5*	*17*	*2.5*
Would you reside in a timber-based house or mid-rise apartment? *... if not, why?*	*Architects*	53	/	10
	Engineers	30	/	7
	Total	*83*	*/*	*17*
Timber-based application is an alternative application toward sustainable urban development *... if not, why?*	*Architects*	36	22	5
	Engineers	19	14	4
	Total	*55*	*36*	*9*

Surveyors were asked on the role of construction industry with regards to environmental protection and the majority, 99.5% agreed that more focus environmental protection from the perspective of construction industry is needful, while only one respondent did not support the issue. The same percentage of participants agreed that more eco-friendly building materials should be used in residential construction, whereas 80.5% agreed that timber is a promising eco-friendly building material, 17% of the respondents were sceptical and 2.5% disagreed. The 'agreeing' group is proportionally extended within architects and engineers while the sceptical engineers dominated the architects, respectively 9% to 8% of the sample. Some of the reasons for not supporting timber in this context are related to the perception that using wood means destroying forestry, when they

are not properly managed; whether the maintenance required for the building structures could be provided; the lack of knowledge on life-span of construction etc.

More than a half of participants (55%) agreed that timber-based application is an alternative application toward sustainable urban development in Kosovo; 36% were neutral and 9% did not agree with the proposition. On the question '...if not, why', main distrusts were related to the lack of local resources, no wood-processing technology, lack of expertise and cost. The majority of respondents were positive when asked whether they would reside in a timber-based house or mid-rise apartment, respectively 83% of participants; 17% did not seem likely to the proposition due to: sensitive issues like fire safety, acoustics, dampness, thermal, lack of expertise in terms of technical performance, structural durability, lack of collective culture of maintenance and similar.

The categorized written comments on '...if not, why?' for the above questions, are summarized below in Table 5.8.

Table 5.8 Respondents' written comments on Q18, Q19 and Q20

Q18 | Timber is a promising eco-friendly building material |… if not, why?
Using wood means destroying forestry, if they are not properly managed
Requires appropriate structural maintenance, and I doubt it can be treated in a proper way
Lack of knowledge on durability
It is a long-term alternative due to the lack of technical wood in our forestry
Q19 | Would you reside in a timber-based house or mid-rise apartment? |… if not, why?
Discouraged by the fire safety
Lack of expertise in terms of technical performance
Preferable for low rise - up to one storey, not multi-storey. Distrust on technical performance accuracy in Kosovo.
Issues like acoustics, dampness, thermal and maintenance
Seismic / technical resistance
Lack of collective culture of maintenance
Lack of wood-processing technology and knowledge on wooden building technology
Skeptic on structural durability
Q20 | Timber-based application is an alternative application toward sustainable urban development | … if not, why?
Lack of technical wood in our forestry
Lack of wood-processing technology, timber products and industry
Lack of information how timber buildings relate to climatic conditions
Potential high price
A big YES if our forestry would be better managed in the future
Constructors feel safe with the acknowledged concrete application

Barriers for using timber as structural material

The final section of the questionnaire is focused on the barriers the architects and engineers perceive to be the most indicative regarding the lack of using timber as a structural material in Kosovo. The most common barriers perceived among actors were identified by multiple-choices. 'General perception that wood is sensitive to fire and not as reliable as concrete' is the most perceived barrier (24%) by the professionals to be present in society; lack of experience and knowledge on timber detailing and lack of certified timber products are covered by 22% from the overall multiple-choices, along with lack of professional gain during education on timber application (19%) and national building code (13%).

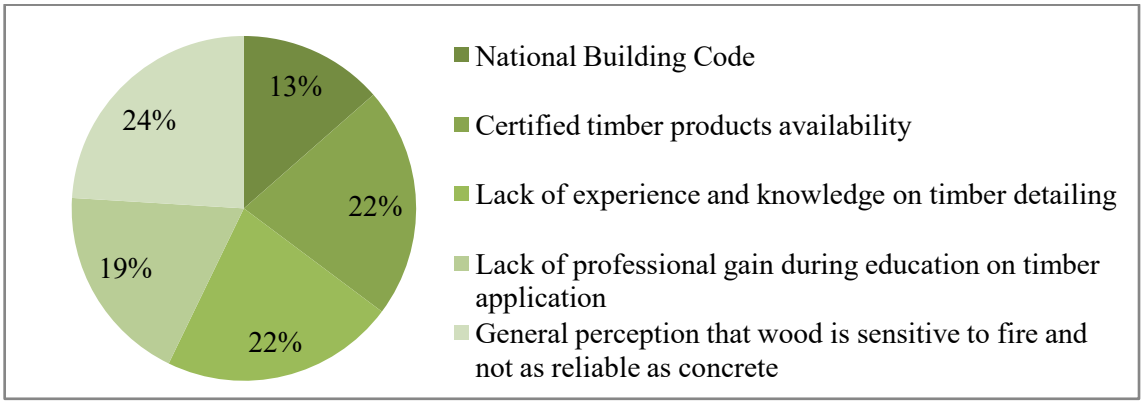

Figure 5.8 Barriers perceived for using timber as structural material in residential sector

In addition to the barriers indicated above, respondents were asked to identify other barriers they perceive to affect the motivation toward using timber in residential construction. Answers given are categorized into main five sections, summarized below:

Table 5.9 Respondents' written main comments on other barriers they perceive

Q21 | Respondents written comments on barriers they perceive
Higher cost due to lack of local resources limits the use of timber as an alternative method
The lack of R&D institutions, vocational schools and the acknowledgement of vernacular architecture as a national treasure to promote and advance the potential of timber in architecture
The nature of wood as an organic material requires proficient detailing and maintenance compared to concrete, and this makes its application more complex in construction systems
Structural detailing require high professionalism and precision during assembly; in Kosovo we face a lack of specialized construction workers to execute complex designs, therefore professional education would be required
No interest of support from relevant state institutions on promotion and education on sustainable strategies and similar

5.2.4 Random Inhabitants Survey

The second survey dedicated to random inhabitants with no construction educational background, aims to provide an overview on their familiarity with the concept of environmental sustainability, the implication of construction industry and their perception on positive and negative aspects of timber-based residential buildings. The RI Survey introduced the potential participants with the researcher's education background and contact details, the purpose of the study, the relevance of selected population to the study and confidentiality. The survey has been conducted online, while being available to communicate with participants in case any kind of misunderstanding would occur and having in mind their professional background unlike design and engineering. The form of the survey questionnaire is attached in the Appendix 2.

In total 56 completed questionnaires using contacts from social media as the easiest form to receive responses were gathered. Female participants cover 59% while males cover 41% of the sample. The age-group of 50-65+ dominates with 41% of the overall sample of population. The structure of population is shown below in Table 5.10.

Table 5.10 Total number of surveyors participated in RI Survey

Age-group		**25-40**	*%*	**40-50**	*%*	**50-60+**	*%*	**Total**	*%*
Gender	F	5	*9*	14	*25*	12	*21*	31	*55*
	M	10	*18*	7	*13*	8	*14*	25	*45*
	Total	15	*27*	21	*38*	20	*35*	**56**	***100%***

The first two questions surveyors were asked are related to the concept of sustainability:

Q1 | Are you familiar with the concept of *Sustainability / Environmental Protection?*

Q2 | Are you familiar with the environmental impact of construction industry and building materials?

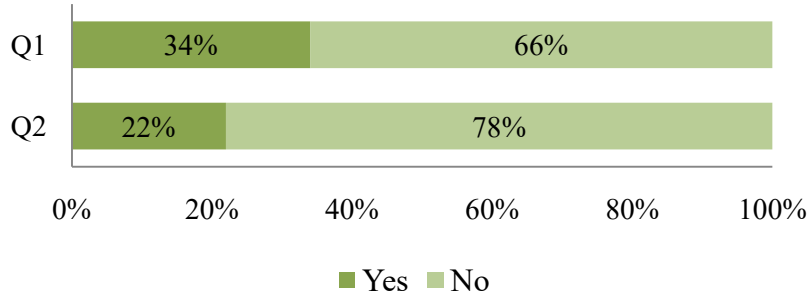

Figure 5.9 Participant's familiarity on Sustainability and construction materials

The collection of responds from the above questions, as shown in Figure 5.9, point out that majority of participants, respectively 66% and 78%, declared not to be familiar with the concept of Sustainability / Environmental Protection, consequently with the environmental impact of construction industry and building materials. The majority of random inhabitants, who replied to be familiar with the subjects (84%/Q1 | 75%/Q2), were dominated by the age-group of 25-40. Males also dominated by 57%/Q1 and 58%/Q2.

The second set of questions regards their perception toward timber residential housing:

Q3 | Have you ever been inside a timber house / apartment?

Q4 | Would you live in a timber house / apartment? ... if not why?

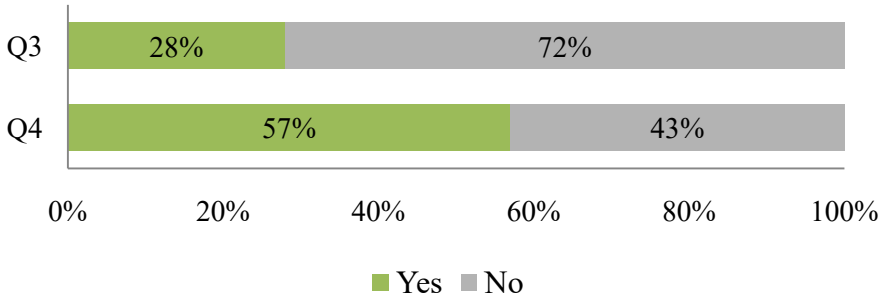

Figure 5.10 Participant's view on timber residential house / apartment

Almost the third of the participants declared to have been inside a timber house / apartment while the majority did not. When asked whether they would live in timber house or apartment, 43% were negative and the females were dominant, (Figure 5.10). Some of the reasons stated when asked '... if not, why?', were: fire safety, never seen timber-residential house/multi-storey apartment aside from mountain log cabins and technical performance/ fire resistance.

The last questions to the random inhabitants aimed identifying the positive/negative aspects they perceive regarding timber-based residential buildings.

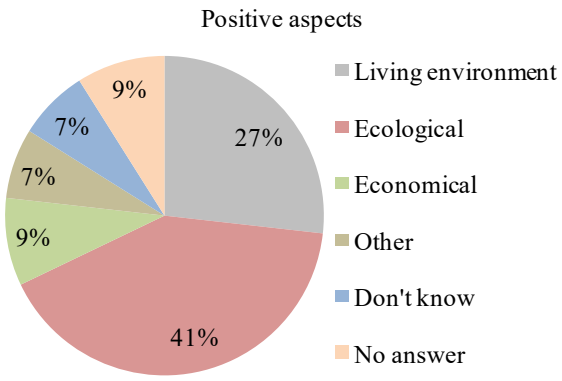

Figure 5.11 Positive aspects inhabitants perceive regarding timber-based residential housing

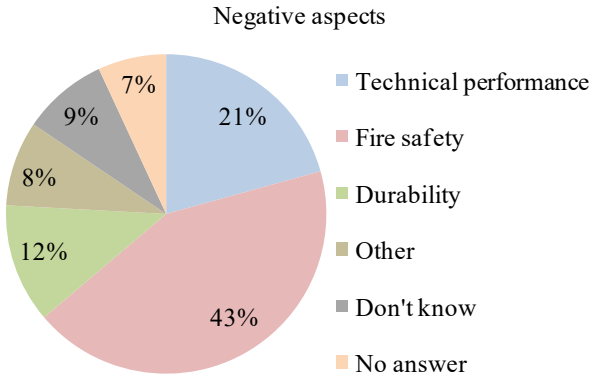

Figure 5.12 Negative aspects inhabitants perceive regarding timber-based residential housing

The findings indicate that 41% of the participants recognize ecological aspect as most positive and 27% acknowledge living environment.

Other positive aspects they indicated are: timber buildings are beautiful, provide healthy environment and are related to traditional architecture (Figure 5.11). Otherwise, 43% of the respondents distrust timber buildings due to fire safety, 21% dispute technical performance and 12%, durability (Figure 5.12). Other negative aspects respondents indicated are: lack of local resources, collective lack of carefulness and again, fire safety was pointed out.

5.3 Qualitative results and analysis

The quantitative phase applied to the chosen communities - architects and civil engineers as professionals, and random inhabitants with no professional background with regards to the topic explicated, has provided a comprehensible view on their role and perception towards the use of timber in residential sector in the context of Kosovo, and its main attributes. Quantitative research identified some of the vital issues; however, using qualitative method of inquiry enables a further and deeper analysis of the revealed findings. As elaborated in the previous section, the *non-standardized semi-structured interview* correspond the most to analyze the data qualitatively. The interactional dialog between participants, the topic-centred approach with themes and issues to cover through fluid and flexible structure, and the assurance from the researcher to bring the relevant contexts into focus are some of the features of semi-structured interview that suits this phase of the study.[245] As a less formal process, the interview is a potentially learning event on certain aspects of the topic and the interview itself, for both, participants, the interviewers and interviewees.[246]

The questions of the interviews discuss the use of timber-based products in mid-rise residential design, with the aim to further investigate the results from the surveys. Hence, receive professionals' opinion on the importance of the topic, identify categories from the analysis to ascertain the motivation and barriers, therefore opportunities for Kosovo.

5.3.1 The process

This stage of the process has targeted a smaller group of different experienced professionals. The limited number of interviewers was imposed due to the time restriction which implied careful selection criteria for the participants. Owing to the complexity of the study, it was imperative that they belong to specific sectors and background in order to cover certain issues raised from the previous results.. Obviously, the *purposive sampling method*, rather than random sampling was recommended considering the importance of particular experience, work position and respondent's role on selective sectors to better assist with the research. Aside for experience background and knowledge, the ability and willingness to participate and communicate opinions and experience in a reflective and

[245] Jennifer Mason, *Qualitative Researching*, 2nd ed. (Great Britain: SAGE Publication, 2002), 62.
[246] Rosalind Edwards and Janet Holland, *What is qualitative interviewing?*, (Great Britain: Bloomsbury Publishing Plc,, 2013), 3-4.

expressive manner is the essence of purposive sampling method.[247] Interviews were conducted through face-to-face conversations to assure the participants' commitment and direct discussion.

The targeted sample had to meet a certain criteria such as: being an experienced architect or civil engineer with knowledge, interest and preferably experience with the use of timber in construction and, being a professional engaged in related sectors such as: wood industry, Kosovo Forestry Agency and/or Department of Forestry, the Department of Higher Education, construction companies and academy / research institute.

Initially, the sample was obtained through academic and professional associates who would subsequently suggest the other relevant contacts. Participants were contacted through social media and phone and provided with the interest of the researcher to carry out the interview and topics to be discussed. Altogether, 22 respondents fulfilling the ascertained criteria were interviewed, as summarized in following Table 5.11. As shown below, main participants are architects and engineers that are engaged as freelance design practitioners in private residential construction companies, and researchers within academic institutions. Considering the relevance of the business sector, as the main actor in residential construction industry, three contractors and a project manager were interviewed. This group would provide an insight on practical issues on the use of timber in residential sector, and discuss results gained from the conducted survey, therefore ascertain the barriers of construction community, and future opportunities for Kosovo. Local manufacturers and suppliers of wood products were also visited to gain an overview on technical wood product availability and cost.

The other group consists of a number of officials engaged in governmental forestry sectors with whom, issues regarding to forestry as a national potential resource in wood construction industry are discussed. Local governmental administration officials from two bigger municipalities gave details in regard of taxation system for construction of new buildings. An official from the Department of Higher Education has provided additional view with regards to the role of vocational high schools in Kosovo and the potential of wood industry to the education programs. For discerning insurance policies for residential construction, interviews with three insurance companies were conducted.

[247] Ilker Etikan, Sulaiman Abubakar Musa and Rukaya Sunusi Alkassim, "Comparison of Convenience Sampling and Purposive Sampling", *American Journal of Theoretical and Applied Statistics* 5, no. 1(2016): 2.

Table 5.11 Semi-structured interview participants

Interviewer	Sector	Occupation
I.1	Kosova Forestry Agency	Agency Official / Forestry professional
I.2	Department of Forestry	Forest Administrator / Forestry professional
I.3	Municipality 1 - Directorate of Urbanism	Directorate Official of Municipality 1
I.4	Municipality 2 - Directorate of Urbanism	Directorate Official of Municipality 2
I.5	Wood Industry 1 – Manufacture, trade and develop	Head Contractor
I.6	Wood Industry 2 - Manufacture and trade of wood products	Head Contractor
I.7	Wood Industry 3 – Supply of wood products	Engineer
I.8	Ministry of Education, Science and Technology	Official from the Division for Development and Quality in Higher Education
I.9	Academy 1	Professor / Architect
I.10	Academy 2	Professor / Architect
I.11	Academy 3	Professor / Architect
I.12	Architectural Studio 1	CEO / Architect
I.13	Architectural Studio 2	CEO / Architect
I.14	Architectural Studio 3	Project Manager / Architect
I.15	Engineering Design Studio	Project Manager/ Eng. Design / Civil Engineer
I.16	Business Sector - Construction Company 1	Contractor / Civil Engineer
I.17	Business Sector - Construction Company 2	Contractor / Businessman
I.18	Business Sector - Construction Company 3	Contractor / Businessman
I.19	Business Sector - Construction Company 4	Project manager / Architect
I.20	Insurance Company 1	Insurance Agent
I.21	Insurance Company 2	Insurance Agent
I.22	Insurance Company 3	Insurance Agent

In addition to conducted interviews, the observational techniques such as photographic documentation and other secondary data – different written materials, such as institutional and government reports and publications have complemented the investigation process.

5.3.2 Semi-structured interview and observational analysis

Prior to asking questions, the participants were informed on the research topic, the aim and objectives. In addition, several study cases of mid-rise residential wood-based buildings constructed in three main structural systems were shown and shortly discussed about. This introduction would make the interviewers aware about the topic to be discussed further. The next questions covered the results obtained from the conducted survey with the intention to receive participants' view on the 'validity' of results; how the perception of building community towards the use of timber in residential sector corresponds to the reality in Kosovo. More specific questions were asked in dependence of the respondent's professional background.

After the analysis of the recordings transcript and notes taken, the main aspects addressed during the discussions were categorized. These include:

- Perception and Knowledge
- Cost Efficiency
- Technical Performance
- Sustainability

Categorized topics are analyzed separately and each of them includes other relevant sub-topics which have also emerged throughout the observational phase of the study A particular consideration was paid on identifying barriers each group perceive, hence potential opportunities.

Perception and Knowledge

Participants have discussed various issues with reference to their perception of timber-based application in mid-rise construction, but also how they observe the general perception from random inhabitants' point of view. The aspects raised were basically compared with reference to traditional methods and materials used in local construction industry.

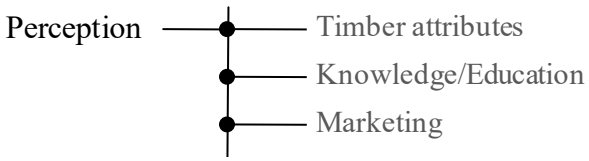

Figure 5.13 Perception and sub-topics

At the first thought, timber-based residential construction is seen as an interesting alternative to traditional masonry and concrete structures; faster and simpler assembly, cleaner and healthier environment, reduced labour force; however the second thought becomes more sceptical when it comes to more specific issues involved. Some of the main *attributes* that respondents found as most positive, which confirmed the results gained from the conducted survey regard the: construction time, recyclability & flexibility ("You can build a building considering the options for easier future re-destination" an architect expressed), the architectural aesthetics (the latest timber residential architecture is perceived as more aesthetic, natural and desirable), acoustics and thermal insulation as well as structural performance is seen as superior selection especially for the seismic-prone regions. On the other hand attributes such as fire safety, cost efficiency, maintenance by the users are perceived as the least ranked ones.

One of the interviewers, an architect, who has built his own timber frame one-story house, shared his experience of having a lot of doubtful judgment by the relatives with regards to fire safety and structural performance. Several years later, they choose to extend their housing space using timber construction and improving details due to more information gained on its application. The family feels very comfortable and pleased for the choice they made. When asked on the cost of construction, he stated that expenses were similar to concrete structure, on a square meter basis.

Figure 5.14 A private individual timber frame house in Prishtina

Knowledge / Education on timber construction is another issue raised by interviewers. They perceive that in comparison to building with concrete and steel, a lack of information and practice is evident, therefore higher demand for almost all aspects of timber as technical material. Some of the main aspects of interest stated are: timber building systems, environmental impact, comfort and durability and structural performance. Some participants stated that academic education should provide more training on engineered timber structures. “Students should have more basic information on new alternatives to building systems”. “Vocational schools as undergraduate education should incorporate timber practices to their programs; wood industry is an important industry of Kosovo and the youth needs to be prepared for the future market” Most of the respondents have expressed the lack of opportunities for professionals to design and build timber-based buildings.

The need of *marketing* is another issue respondents perceive to e necessary. People need to be introduced to new ways of construction even though it would take time and effort. “Larger companies should be supported by governmental programs and develop projects that would demonstrate the performance of timber in residential sector; perception is something that changes when people are more informed”.

Another *barrier* respondents perceive is the fast urban sprawl after the last war which is manifested in rapid construction – the investors feel much more comfort using traditional materials and building systems versus new alternatives. Mutual development programs between wood industry, education and construction developers can overcome the identified barriers towards new opportunities for new building alternatives.

Cost Efficiency

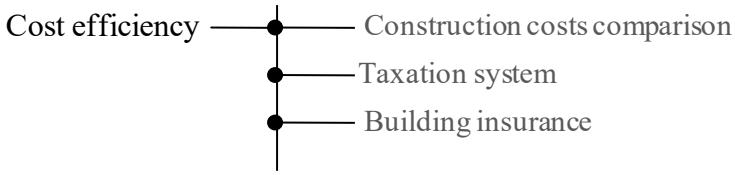

Figure 5.15 Cost efficiency and sub-topics

Many respondents stated that unfamiliarity with timber practice in order to make comparisons to concrete structures is a barrier during the feasibility stage of planning, hence whether multi-storey timber-based residential construction is cost effective. "Potential savings such as the reduction of work force, material transport and fast erection time need to be taken into account to be able to compare to conventional concrete construction in the rate of square meter". Another issue, they state, is that timber prefabricated construction differs a lot to building in situ, which involves many other external factors to the overall estimation.

Construction cost comparison - The following cost comparison refers to a previous study on economical feasibility of four-storey wood-based residential building construction in comparison to conventional construction in Kosovo (focusing on financial point of view).[248]

A common design of a typical structural layout is developed for four chosen typologies: (concrete structure, solid cross lam panel structure, timber frame and timber frame modular structure). The model is divided in two parts: the common part, consisting of reinforced concrete basement and the core of the building which is mutual for all typologies; and, the separated structures with adopted envelopes for each typology (Figure 5.16).

[248] Arta Januzi, "Comparative study on economical feasibility of 4 storey wood-based residential building construction to conventional construction in Kosovo" (Master's Thesis, Technische Universität Wien, Austria, 2008)

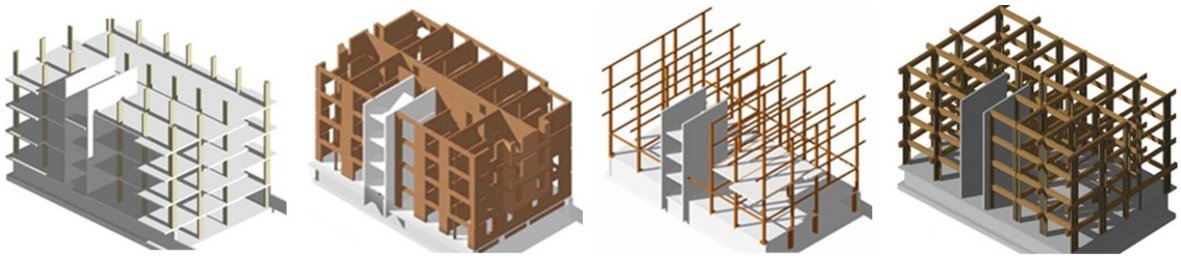

Figure 5.16 Models adopted for cost-efficiency comparison; *Source*: Januzi, A.[13]

The Figure bellow shows the calculated structure and envelope for each typology excluding calculated cost of the common part designed in reinforced concrete (basement, stairway and roof). Since it wasn't possible to estimate the cost of labor work for the structure of timber typologies, for the same ones, the labor work was calculated for the non-structural walls and envelope. Assuming that work cost of the structure wouldn't exceed the price of labor work for the concrete building, the concrete typology does not differ a lot to the both frame typologies. However, the solid timber system appears to be almost 195% more expensive.

The calculated weight of the structures has shown that the weight of both timber frame buildings amounts around 30% of the weight of the concrete typology. This is an optimistic indicator regarding the cost of the foundations in case of wood-based multistory application as a lightweight structure.[249]

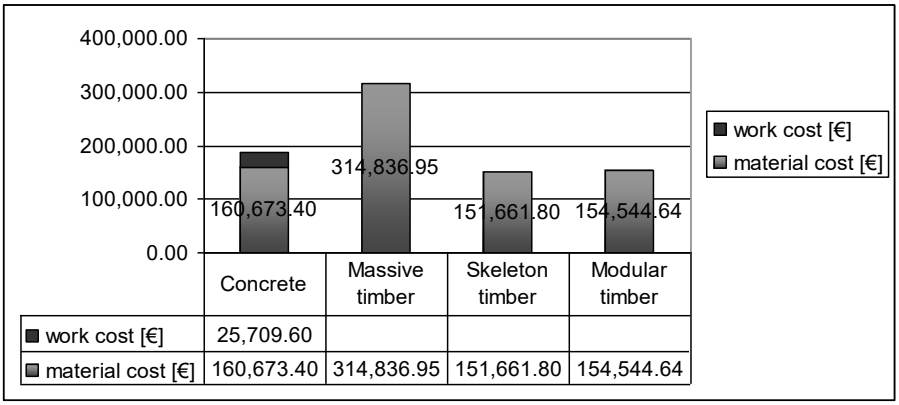

Figure 5.17 The cost of structure and envelope construction material

The same model has been employed with the aim to estimate the average market price for a reinforced concrete, timber frame and solid cross laminated mid-rise building. The average

[249] Januzi, *Comparative study on economical feasibility of 4 storey wood-based residential building,* 70.

construction value with regards to concrete model is derived from discussions with design studios and construction companies – investors in residential sector. As regarding the timber-based models, the values are estimated from the manufacturers, traders and developers of wood products. The average market value for a multi-storey residential building varies around 700 euro/m^2 (gross area), within which, the property value varies around 30% and administrative taxation around 1-4% from the overall market price. Construction value for a concrete building varies around 350 euro/m^2, or 50% of the overall market value. Whereas, as shown below in Figure 5.18, construction costs for a timber frame structure would vary around 400-500 euro/m^2, and, for a solid CLT structure, the construction value would range between 800-1000 euro/m^2.

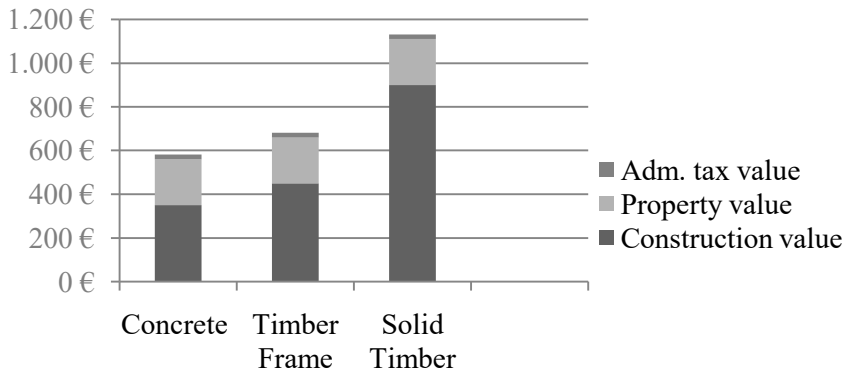

Figure 5.18 Average construction cost (price in €/m^2) of reinforced concrete and timber-based residential mid-rise buildings

The high price for both timber-based typologies results from the higher price of foreign construction labor necessary to be contracted, as the main and biggest interviewed wood manufacturer / developer explained. This manufacturer emphasized the importance of training for new professionals for the wood construction industry. He explained that they manufacture various structural solid and gluelam elements, supply a range of certified timber products for the domestic market and even several European countries. However the entire raw material is imported as a result of low quality raw material in the market. "Vocational schools should be much more focused on timber construction industry aside from wood furniture industry"; "Young generation would be an asset for both, local and international wood construction industry market."

Wood-based construction price is distinctly higher for the local market. Main factors identified are: the lack of local labor, meaning higher cost hiring foreign construction labor; the complexity of managing the process from design, prefabrication, orders and site

works which require more detailed planning ahead; and lack of high quality local raw material.

Administrative taxation system regarding construction industry is regulated in the local level, approved by Municipality Assembly and periodically revised.[250] A new construction is subjected to: (1) the administrative tax for granting the building permission; (2) the rate due to the increase of infrastructure density; and (3) the rate for the infrastructure construction. For multi-storey residential buildings above 450 m^2 of their gross area as part of the II category of construction works as set by the Administrative Instruction,[251] tax rates are calculated by m^2 of the utilized building's area. The rate differs among Municipalities and varies between 1-4% of the local market value of the building. Additional tax reductions are applied for new construction in rural areas.

In the tax rates, regulated in each local governance level, there is no differentiation between buildings that employ different building materials as main construction material. Hence, in addition to building material selection, environmental impact as well as ecological aspects, do not determine the tax rates.

Whether this lack of categorization in the taxation system affects the selection of construction materials and systems, construction companies in the residential business sector, architects and two officials from two different municipalities were interviewed. Local government officials confirmed the above stated form of taxation. All investors stated that the selection of construction materials and the overall building quality in terms of design, services and comfort, varies from the targeted buyers they are driven from, but not from special requirements or governmental / local governmental beneficiaries with regards to the use of ecological building materials and methods as well as environmental impact. One investor stated: "In case of such requirements and/or forms of support from the government or any organization programs, environmentally friendly materials and designs would probably be more taken into consideration from the construction sector".

[250] Municipal Assembly of Prishtina, *Rregullore mbi taksën administrative për dhënien e lejes së ndërtimit dhe tarifën për rregullimin e infrastrukturës*, 2016, https://kk.rks-gov.net/prishtina/getattachment/Municipality/Assembly/Draft-rregulloret/5-1prop-rregullore-mbi-taks-adm--per-dhenien-e-lejes-se-ndertimit.pdf.aspx (accessed September 15, 2017).

[251] Ministry of Environment and Spatial Planning, Administrative Instruction No. 09/2013 on the Categorization of Construction Works (Government of Kosovo, 2013) http://mmph-rks.org/repository/docs/MINISTRI-UA-09-13-1714-2013-2_810699.pdf (accessed September 15, 2017).

In view of the fact that the taxation system is equally applied to multi-storey residential construction, regardless of the main construction material, it is neither considered as a barrier, nor an incentive factor with regards to use of timber as main construction material. However, an architect stated that "…the fact that timber-based construction is not disfavored at this point, yet, it is not well supported in construction industry, mainly because of the general perception with regards to its fire resistance and technical performance".

Building Insurance in Kosovo is another issue addressed while conducting interviews. Three insurance companies were visited and confirmed the fact that in Kosovo building insurance is not obligatory; buildings are insured based on free will and personal grounds. When asked how a new timber-based construction would be categorized, two companies stated that they would not provide building insurance for any type of timber-based buildings, due to higher risk they perceive with regards to fire and stability. When asked in case they would receive a confirmation from a respective directorate approving the fulfilled quality for both concerns raised, they firmly responded negatively: "…any quality verification would not encourage us to cover the insurance". The third insurance company responded slightly positively, though reserved with regards to covering fire and earthquake insurance for new constructed timber building. It would require a particular evaluation considering the higher risk they perceive when compared to a concrete building.

Technical Performance

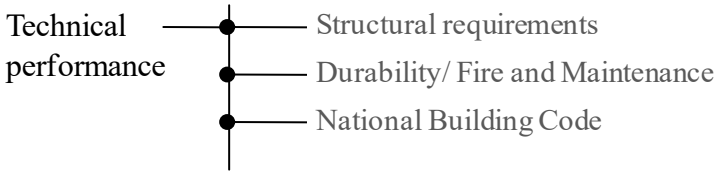

Figure 5.19 Technical Performance and sub-topics

The general opinion of the interviewers on the technical performance of timber as building material in multi-storey was positive - that it assures the optimal *structural requirements* for the limiting height, especially for the moderate seismic-prone regions. Few participants with no engineering background felt sceptical. After they were shown some cases of local traditional combined-wooden housing from the 19th century and still in a solid state, they stated that perhaps there's a perspective but they aren't well informed on timber structural ability. Most of the respondents feel that people are used to building with solid masonry

and concrete; “the house is a symbol of security, a fortune to be inherited to the next generation”; “clients/investors lack of trust on timber structural performance especially fire resistance, some pilot project might change their mind, but it will take some time”, were some of their comments.

Another concern raised was the *durability* - fire resistance & maintenance. If appropriate measures are undertaken there wouldn’t be a problem for the calculated time resistance, architects and engineers stated. “There are several non-residential timber buildings, but when it comes to residential typologies, people need to be more informed how to maintain and feel safe and comfort... professionals as well.”

A design engineer referred to the national *building code* as another concern with regards to timber construction in general but especially residential buildings. “The building code does not specify structural and other technical requirements, as well as product certification as a technical quality assurance, specifically for multi-storey residential timber buildings”, “It all refers to European Standards, but it should comply with the local conditions, for instance the height of the building, specific detailing on structural design and measures to be taken with regards to fire safety”.

The 2nd draft of the Building Code – Timber Structures, chapter IV of ‘Unified Construction Code of Republic of Kosovo’, defines the technical characteristics for timber structures, the requirements for the design, execution, usability, maintenance and construction products intended to be incorporated into the timber structure.[252] According to this draft, specific properties, attestations, certifications of conformity and marking of construction products, testing of construction products, and specifics during design and construction, necessary control procedures and other requirements that construction products must fulfil are listed below:[253]

- Wood Products; the list of European Standards (Appendix A, pp. 123)
- Mechanical Fastener; the list of European Standards (Appendix B, pp. 126)
- Adhesives; the list of European Standards (Appendix C, pp. 129)
- Prefabricated Elements; the list of European Standards (Appendix D, pp. 133)
- Preservation of Timber Structures; the list of European Standards (App. E, pp. 140)

[252] Ministry of Environment and Spatial Planning, “Chapter IV – Timber Structures” in *Unified Construction Code of Republic of Kosovo*, Section 2 http://mmph-rks.org/en-us/Home/Chapter-IV---Timber-Structures-612 (accessed September 15, 2017).
[253] Ibid.

- Design of Timber Structures; the list of European Standards (Appendix F, pp. 143)
- Execution and Maintenance of Timber Structures; the list of European Standards (Appendix G, pp. 145)

Sustainability

Environmental benefits from using timber are increasingly acknowledged in residential construction industry. Life cycle assessments of timber buildings demonstrate using less energy and lower carbon balance when compared to heavy materials. An engineer stated that "When dismantle would be necessary, in cases of timber buildings less waste would result and the remaining would likely be recyclable." Another engineer pointed out the fact that "Environmental benefits and sustainability are not well acknowledged to be taken into account; they should be driven and regulated by the state government otherwise it is hardly expected from clients themselves to be willing to pay more". Another commented: "More research on environmental impact of main construction materials should be conducted by our universities and other relevant institutions, also, the role of our forestry as national potential for the future should be carefully regarded through clever management of our forestry". A forestry official stated that "Aside from not being informed on the environmental benefits using timber in construction sector, the economical contribution from our national forestry need to be encouraged and supported by the government and construction industry". Both government forestry officials from the DoF and KFA were asked on the role of their institutions toward Kosovo Forestry; their listed priorities included: protection of forestry from illegal logging, sustainable management, afforestation of forest and forest lands, maintaining biodiversity etc. Most of the projects were enabled by the support of many international grants, mainly from the European Commission. Their focus regards awareness on forest protection, raising capacities for forestry protection from potential fire, support to sustainable forestry management, decentralizing of the sustainable private forestry, and support to implementation of the forest policy and strategy. The economical potential of Kosovo forestry is recognized through eco-tourism, haunting and local employment on management. "Research Projects in corporation with wood industry and construction industry must become a priority towards the recognition of forestry potential as national resource".

With regards to opportunities the interviewees were asked what measures are necessary for timber-based residential buildings to enter the market; respectively, what would make an investor to accept wood buildings. Main remarks from investors were that: more

information in necessary with regards to cost efficiency, professionals' knowledge to design and work with timber, technical performance assurance, and studies on dynamic plan so comparison to concrete construction would be clearer. Afterwards, as a beginning, projects that would be in a major scale supported by the government would be necessary for the investors, but also clients and wood industry to demonstrate the possibility for to gradually consider other options such as multi-storey timber buildings. A responder form the wood industry suggested that firstly, pilot projects, starting from small-scale to multi-storey buildings, possibly governmental administrative buildings would be a good starting point in order to consider the possibilities for residential individual housings and later, why not, multi-storey timber buildings. Grants international governmental organisations have considerably assisted the development of wood industry and local business, which have enabled them to advance the technology and hire more professionals; such support is necessary from the government programs. On the other hand main issues raised by architects and engineer, were related to the necessity of governmental support for R&D on timber buildings; governmental clear strategies, support programs to revise the building code and initiate project for all the active parties to participate in the process.

5.4 Conclusion

This study has adopted the mixed-method of investigation in order to secure the necessary data and proper analysis for the raised research topics. Quantitative methodology was applied at first, targeting a larger number of professionals in building community as well as random inhabitants with no engineering professional background. This phase has laid the foundations for the next stage in the process of inquiry, the qualitative method. Discussions raised during semi-structured interviews have ascertained most of the results gained from the conducted surveys.

The main aspects addressed were categorized and sub-categorized to be separately analyzed. Motivations and barriers identified were discussed further with the aim to explore potential opportunities towards the development of multi-storey residential buildings. Many advantages of timber as construction were perceived by the build & design community including environmental impact and forestry potential as national resource. Nevertheless, concerns raised included the lack of local expertise, education, national building code and support from the government. Fire resistance, acoustics and cost effectiveness were the main attributes perceived as barriers.

Chapter 6
CONCLUSION

abstract:

The final chapter recapitulates the content of the dissertation theoretical background, the adopted research methodology and the discussion of the analyses. It summarizes the main perceived barriers to multi-storey timber construction and afterwards proposes future implications – potential opportunities with regards to increase of timber-based multi-storey residential construction.

6 CONCLUSION

Material selection in architecture as one of many integral factors has recently shown a significant role in sustainable construction development. Wood-based construction has become an optimistic alternative due to its low weight structural soundness, flexibility and longevity, and environmentally friendly properties – renewability and recyclability. Another distinguished benefit of multi-storey timber buildings is related to the increase of prefabrication of construction elements which reduces time considerably, hence facilitated weather protection of buildings. Cost efficiency is another recognized benefit driven from the reduced load on foundations, reduced assembly time and even demolition costs (when it would become relevant).

Nevertheless, in developing countries little has been done on developing contemporary wood-based construction, respectively multi-storey buildings. Since many factors are involved in the overall process, this study aimed to address main aspects, therefore the research is divided into three main sections:

- A comprehensive *theoretical background* which elaborates the development of multi-storey timber architecture in general. Main structural typologies are exemplified with cases and the principle differences between construction methods. Advantages of multi-storey timber buildings as well as disadvantages are categorized and discussed (*Chapter 2*). The second part of theoretical background (*Chapter 3*) provides an overview on Kosovo background with the aim to better understanding of the local context of the research topic. Aside from Kosovo profile, local wood-based architecture is discussed and an overview on national forestry as local potential and wood industry is provided.

- The second section (covered by *Chapter 4*) outlines the approved *methodology* to achieve the objectives of this research. The conceptualization of research design and strategies for adopting the most appropriate method for conducting this study is discussed. The adopted mixed methodology and the procedures undertaken to conduct this study are described and the process of data collection is given.

- The third section of this research (*Chapter 5*), consist of a comprehensive discussion of the collected and processed data during the mixed phases of inquiry:

the quantitative phase of conducted surveys for building community and non-professional inhabitants, and the qualitative phase, interviews carried out with several professionals of different sectors related to development of timber in construction industry.

The discussed findings obtained from the use of quantitative and afterwards qualitative methods within the approach of Grounded Theory have enabled to conceptualize the topics under the study. Data gathered during the discussion have been categorized according to the research objectives for further analysis. Consequently, it could be generalized that:

> *Economical, social and environmental potential of wood in construction industry and in particular [multi-storey] residential sector is poorly recognized in Kosovo.*

The investigation has enabled to identify the main barriers that professionals perceive which were categorized into four analyzed codes.

A number of interviewed professionals and several surveyors have acknowledged that the raise of discussion on the potential of wood in construction industry is very well received. This research aims to contributing to the knowledge and perspective of professional communities of relevant sectors which are, in various ways, related to the issues raised with the main focus on timber-based residential construction industry. It is the first study undertaken which deals with multi-storey timber-based construction in Kosovo, adding knowledge to the current state of construction profile, and contributing to potential opportunities of main actors involved. By conducting the surveys to the large sample and carrying out the interviews, it enabled the identification of main barriers and motivations therefore revealing opportunities on the future use of timber in residential construction sector.

6.1 Main barriers to multi-storey timber construction

Construction industry in Kosovo is based on steady concrete and steel industry, which makes it more difficult for the timber to enter the construction market. This study aimed revealing the main barriers perceived by the construction community, investors in particular, towards the increase of use of timber in residential multi-storey sector. Main barriers perceived and the relevant topics generated from the inquiry have brought forth the identification of the main actors in this network. These main 'drivers' could thus address the issues raised, therefore support and promote timber-based construction, in particular multi-storey residential sector, as the most dominant sector in construction industry, through developing appropriate strategies for future economic development.
The identification of barriers was firstly tackled in the survey questionnaire designated for architects and engineers, and afterwards in the second phase of inquiry, each group interviewed were asked to openly discuss on important barriers in multi-storey timber construction industry. Most of barriers perceived are related to the fact that construction industry almost entirely relies on concrete, which, as stated, explains the lack of experience and information about the use of timber in construction. Another observed barrier for the local wood industry is that the role of vocational schools in educating new professionals in construction sector, aside from furniture manufacture, is not yet considered as significant from authorities. Lack of academic education and training on engineered timber construction has been commonly stated by professionals.

Timber production technology differs, thus is less developed, which affects the price of timber-based products. Another factor that influences the price of timber products is related to the lack of high quality local raw wood material and the necessity to entirely import the high quality semi-manufactured products.

Sustainability and environmental impact in construction industry are not well acknowledged to be taken into account by investors; it is also hardly expected from clients to be willing to pay more. With regards to timber as a renewable construction material, the economical development opportunities from national forestry are not encouraged by the government authorities. Apart from economic losses from improper forest management, a discouraging concern is the ecological degradation due in the larger part to illegal felling. The annual felling is not properly recorded, mainly as a result of wood theft and violation of actual regulations.

Another barrier refers to the national building code which does not strictly regulate structural and technical requirements for multi-storey timber-based constructions, in terms of time-related requirements, maximum number of stories in relation to fire-extinguishing measures. It only refers to European Standards which although might be seen as opportunistic, it however refrains the business sector due to general low perception on several attributes, such as fire safety and technical performance.

6.2 Opportunities to multi-storey timber construction

The summarized barriers and motivations have enabled to identify the new categories - the main '*actors involved'*. The limited recognition of timber in construction industry is in large part affected by the lack of interrelated objectives among the actors involved. The study aims to encourage the expansion of mid-rise timber residential construction while recognizing its benefits for the national economy, environment and professional development.

The main 'actors involved' are:

- Government institutions
- Research and education institutions
- Construction industry / business sector
- Wood processing industry

This study will contribute as a starting point as it reveals the main actors from the categorized topics during the discussion phase. A future implication aims at building the network between the stakeholders, by identifying their common authorities and tasks, and strategies for development. It is of a highest importance that the actors involved recognize their common potential and share their interest towards the development of wood-based construction technology. Their supportive measures would ensure a future progress of multi-storey timber application in construction industry as a sustainable alternative to the existing heavy material based application.

Government institutions

The government holds the highest authority to promote and support development of multi-storey timber-based construction. Up to now, the Ministry of Environment and Spatial Planning as well as other governmental authorities have not shown any interest towards targeting timber-based construction in general. There has not been any promotional support, allocated budget or any strategic objective for development of timber construction. Environmental policies encourage construction industries that ensure reduction of environmental impacts throughout their life cycle and wood as a renewable construction material is seen as an optimistic alternative to benefit from such climate policies. As, Riala and Ilola point out: *"Wood products industry is already a part of bioeconomy, but if there is demand for more sustainable construction, this could generate more possibilities for multi-storey timber construction."*[254]

Proper environmental impact policy systems need to be taken into consideration. Strategies of building with timber need to be involved within governmental guidelines and programs of national environmental and construction strategies.

The MESP is necessary to collaborate with other ministries as well as potential municipalities with a larger share of forests that could show initiatives for becoming a 'green city' model for a sustainable development. Design promotional strategies can empower local wood industry through supporting programs to use wood in new building projects. Aside from potential municipalities, a good coordination with other actors involved in wood industry, education and construction industry can improve the prospect for building in wood and the development of the industry.

Major authorities could promote and develop multi-storey timber-based construction by means of supporting pilot building project. Many issues can be addressed, whereas different phases of construction process would provide an educational model for the parties involved. This would be a momentum for wood industry and construction companies to be involved in common design projects. Possible pilot design projects comprise municipality buildings, administrative buildings for the Agency of Forestry and/or Association of wood processors to the multi-storey timber-based social housing under municipalities' objectives. Such experiences in Europe have indicted a large effect and spreading of the

[254] Maria Riala and Lauri Ilola, "Multi-storey timber construction and bioeconomy – barriers and opportunities." *Scandinavian Journal of Forest Research* 29. no. 4 (2014), 369. http://dx.doi.org/10.1080/02827581.2014.926980 (accessed September 28, 2017).

idea of new possibilities in construction design to the public, construction industries and other relevant parties. A pilot project though requires clear policy and governmental support for all the phases of project development.

Sustainable development of timber-based mid-rise residential construction encourages local manufacturers to extend varieties of engineered wood products, hence the national forest economy and quality. Forest government organizations managing public forestry as well as private forest owners should be encouraged by national environmental strategies. Afforestation programs need to consider forest composition as national renewable resource for the future timber construction industry. The acknowledged potential as national resource in construction industry would encourage foresters to better maintain the quality of forest trees; the authorities to consolidate their control over the illegal felling and apply strategies to strengthen forest economy through sustainably managed forests.

Research and Education institutions

Research and education institutions can provide an important role providing support to the government and industry with necessary R&D infrastructure, expertise and knowledge that target the expansion of timber-based construction. Comprehensive studies can influence the government, forestry to develop new policies towards the recognition of the potential of national timber as a future resource. Today research is focusing its attention towards the environmental perspective of construction processes, where as mentioned above, wood as a renewable construction material is considered as an optimistic alternative. Nevertheless, with regards to multi-storey timber-based construction, a lack of collaboration between Kosovo academic and research institutions, and government institutions for developing strategies and approving most appropriate policies is evident. Experts and R&D infrastructure need to extend their activities with governmental institutions with regards to developing environmental and forestry strategies and policies; on another hand and extensive collaboration with construction industry and wood processing industry could help the development of wood-based pilot projects as starting point and future expansion of mid-rise timber construction.

Kosovo academy needs to prioritize research and education studies on multi-storey timber-based development and its relevance to climate benefits, national forestry based economy, construction industry and wood industry. Another significant role of this actor is its focus on technical studies on timber typologies which would better perform in the context of

Kosovo; studies and support on amending National Building Code to better address timber construction, hence technical solutions to assure the required performance of such typologies; studies on fire resistance and durability and technical solution for fire safety; standardization and harmonization of EU standards with NBC.

The role of vocational technical schools (grade X to XIII) needs to be highlighted. Kosovo is dominated by the young population structure and studies on their role in construction industry are relevant. The shift from furniture design and manufacture dominance of vocational high schools toward engineering wood processing and wood-based construction needs more consideration. The lack of educated professionals on timber industry has been affirmed by all wood processing manufacturers.

Construction industry / Business sector

Construction industry is an important industry in Kosovo economy, especially the multi-storey residential construction, albeit with dominance of heavy construction materials. The business sector has an important role in all stages of construction processes, from the construction material preference, design and management. It is perceived that the lack of local authorities influences the investors' role, often exceeding professionals' references. The fact that the use of timber is slightly present in residential sector (it is more present on non-residential buildings and small-scale temporary buildings) makes it clear that it is hardly expected from the business sector to embrace timber and shift towards multi-storey timber residential buildings.

> *"As for the realisation of the firsts large distinctive pilot projects, the European experience demonstrates that sometimes in order for a large construction firm to participate in construction of pilot project and even in the initial development stage, all that is required is a high profile dominant figure who is committed to the idea and its potential."*[255]

It is necessary to collaborate with government institutions and academy to strengthen and market local skills, and with interested developers who would want to expand the use of wooden structures. Nonetheless, a clear government policy and support measures are inevitable for the business sector to welcome timber in their investments.

[255] Kagami, *A study on multi-storey timber residential building in Japan*, 199.

Wood processing industry

Wood industry is one of most profitable industries in Kosovo, even though the majority of raw material is imported. Growth in the wood industry by strengthening its competence would generate new local employment opportunities. Wood processing industry is mainly focused on construction material supply and furniture manufacture. For the wood industry to enter the construction market and potential increase of multi-storey timber-based residential construction, wood processing industry and construction industry need to strengthen their interrelated services and objectives.

Timber-based building systems that have shown to be more optimistic to compete in the local market, through supportive programs, are timber frame system, especially panel system, since most of construction elements are locally produced. Local building capacity through professional trainings and education can have a significant effect to the overall market prise and facilitate initiatives from the wood industry. Some activities to be undertaken:

- Organization of seminars and meeting new companies to identify their common challenges and opportunities;

- To strengthen cooperation with respective universities and support new research and development towards promoting a new application using timber as construction material;

- Cooperation with municipalities' vocational schools to complement the curriculums; organize workshops and prepare students for wood processing industry;

- Exchange programs with other key players such as Kosovo Wood association and design companies;

The following tables present institutions and organisation within main actors: their authority, opportunities through increased use of wood in construction and limitation (Table 6.1), and, proposed organisational mechanism, resource and measures for the respective institutions and organisations to achieve the listed opportunities through their cooperative-based activities (Table. 6.2).

Table 6.1 Main actors involved: their authority and role, opportunities through increased use of wood in construction and limitation

Actors	Institutions	Authority and role of each organization/actor	Opportunities through incresead use of wood in construction	Limitations
GOVERNMENTAL INSTITUTIONS	• Ministry of agriculture and forestry *Department of forestry* *Kosovo forestry agency* *Department for European integration and policy coordination*	˚Drafting and implementing of policies and development strategies ˚Forest management and development ˚Provision of policies, plans and stratagies compatibility with EU standards and coordination of external assistance	˚Promote environmental and climate benfits- lower CO_2 emissions ˚Promote locally sourced raw material ˚Increase of local employment ˚Improved forestry management ˚Afforestation with a larger variety of plantation appropriate for wood industry	˚Insufficiency of human and monetary resources for proper management and development ˚Poor cooperation with other key actors in taking active role towars improving the prospects for wood-based construction industry ˚Lack of forestry potential recognition as future national benefit ˚Lack of control towards illegal felling
	• Ministry of environment and spatial planing *Department of spatial planing, housing and construction* *Department for European integration and policy coordination*	˚Drafting and implementing of building laws and regulations ˚Proposing and monitoring strategies, programs and measures for spatial planning, construction and housing ˚Provision of policies, plans and stratagies compatibility with EU standards and coordination of external assistance	˚Environmental friendly urban regeneration ˚Low environmental impact construction ˚Reduced carbon footprint of construction ˚Revise and improve the building code in regards to wood based construction ˚Strengthen cooperation towards the adaption of respective EU recomendations	˚Wood-based multi-storey construction is not sufficiently addressed in the national building code ˚Poor cooperation with other key actors in taking active role towars improving the prospects for wood-based construction industry
	• Ministry of trade and industry *Department of industry* *Department for European integration and policy coordination*	˚Drafting and implementing of policies and industrial development strategies ˚Measures in enhancing Kosovos industry ˚Provision of policies, plans and stratagies compatibility with EU standards and coordination of external assistance	˚Strengthen the local business sector ˚Encouraging taxation system in support of local wood industry and trade ˚Increase of local employment	˚Wood-based multi-storey construction is not sufficiently addressed in the national taxation system
	• International government supporting organizations	˚External assistance and support in research, consulting and resource provission for Kosovo as a developing country	˚Conformity of respective national codes and standards with EU recommendations ˚Improved social and professional infrastructure	˚Poor local social and professional infrastructure
	• Local Municipalities	˚Drafting and implementing of policies and development strategies on local level ˚Implementing building codes in construction division	˚Identification and empowerment of municipalities with higher potentials for developing timber industry ˚Development of environmentaly friendly pilot projects using timber as main construction material	˚Insufficiency of human and monetary resources for proper management and development ˚Lack of potential recognition of wood construction industry as future national benefit
RESEARCH AND EDUCATION INSTITUTIONS	• Academic education *Faculties of architecture, Civil engineering and Applied sciences* *Resarch institute*	˚Academic education, research and support in the field of Architecture, Civil Engineering and Applied science	˚Advancing academic curriculum on conteporary timber-based technology, design and engineering ˚Research and support aimed at promoting the development of environmental sustainable multi-storey construction ˚Engagement in international academic/research networking	˚Lack of experience and R&D on timber-based multi-storey construction ˚Lack of research support resources
	• Vocational education	˚Higher secondary education and preparation of staff for labor market in field of industry and construction	˚Capability building of young professionals in construction/wood industry	˚Lack of potential recognition of wood construction industry as future national benefit
CONSTRUCTION INDUSTRY	• Bussines sector *Investors / Developers*	˚Economical development ˚Multi-storey construction development	˚Enhancing economical potential ˚Quality improvement through sustainable and cost efficient construction development ˚Development of environmentaly friendly pilot projects using timber as main construction material	˚Lack of potential recognition of wood construction industry as future national benefit ˚Lack of governmental support and subsidies in opting for wood-based construction ˚Poor perception on fire resistance and technical performance of timber as structural material
WOOD PROCESSING INDUSTRY	• Producers and developers • Suppliers	˚Economical development ˚Trade and marketing	˚Expansion of versatility and quality of wood construction products in local and international market ˚Beneficion of grants and subsidies ˚Technological advancement and skilled labor ˚Utilization of local raw material alternatively to imported wood material	˚Lack of governmental support and subsidies in opting for wood-based construction ˚Poor cooperation with other key actors in taking active role towars improving the prospects for wood-based construction industry

Table 6.2 Proposed Institutions' organizational mechanism, resource and measures for development opportunities

	INSTITUTION	ORGANISATIONAL MECHANISM	RESOURCE AND MEASURES	OPPORTUNITIES
GOVERNMENTAL INSTITUTIONS	**• Ministry of Agriculture and Forestry**	•Establishing a technical working group (TWG) - Development of forestry strategies	Professional and resource provision *Capacity building, drafting, workshops*	•Construction Industry (CI) - Localy grown wood as a national resource opportunities •CI - Aforestation strategies and forest management •CI - Environmental and climate benfits- new policies
	• Ministry of Environment and Spatial Planing	•Establishing a technical working group (TWG) - Development of residential wood-based construction	Professional and resource provision *Capacity building, drafting, workshops*	•Residential wood-based construction (RWC) - Revision of National Building Code •RWC- Environmental impact and urban regeneration strategies
		•Establishing a technical working group (TWG) - Standardisation of EU recommendations	Professional and resource provision *Capacity building, drafting, workshops*	•RWC- Adaption of respective EU recommendations
		TWG	Consulting	/
		WG	Consulting	/
	• Ministry of Trade and Industry	•Establishing a technical working group (TWG) - Wood-based construction industry / Taxation	Professional and resource provision *Capacity building and drafting*	•Wood-based construction industry (WCI)- Encouraging taxation system •WCI- Strengthen the local business sector
		TWG	Consulting	/
	• International Government Supporting Organizations	TWG	Consulting, professional and resource provision	/
		TWG	Consulting, professional and resource provision	/
		TWG	Consulting and professional	/
		TWG	Consulting and professional	/
		CM	Consulting, professional and resource provision	/
		WG	Consulting and professional	/
	• Local Municipalities	•Establishing a working group (WG) - Timber construction industry development	Professional and resource provision *Capacity building*	•Timber Construction Industry Development - Potentials and opportunities
		•Development Group (DG) - Multi-storey timber residential construction	Professional and resource provision *Development*	•Residential wood-based construction (RWC) - Mid-rise pilot project
		TWG	Consulting	/
		TWG	Consulting	/
		CM	Supporting	/
RESEARCH AND EDUCATION INSTITUTIONS	**• Academic Education**	•Collaboration Mechanism (CM)- Multi-storey timber residential construction	Professional, R&D *Capacity building, conferences and workshops*	•Multi-storey Timber Residential Construction / Sustainable urban development - Networking, promoting and developing
		TWG	R&D and consulting	/
		TWG	R&D and consulting	/
		TWG	Consulting and professional	/
		DG	R&D and consulting	/
	• Vocational Education	DG	Supporting	/
CONSTRUCTION INDUSTRY	**• Bussines sector**	•Development Group (DG) - Multi-storey timber residential construction	Professional and resource provision *Development*	•Residential wood-based construction (RWC) - Mid-rise pilot project
		CM	Resource provision	/
WOOD PROCESSING INDUSTRY	**• Producers / Developers / Suppliers**	TWG	Consulting	/
		CM	Consulting and resource provision	/
		CM	Consulting	/

**Each color represents specific Institutions' Organisational Mechanism, Resource and Measures for certain Opportunities.*
Attendant support institutions are indicated by the same particular color.

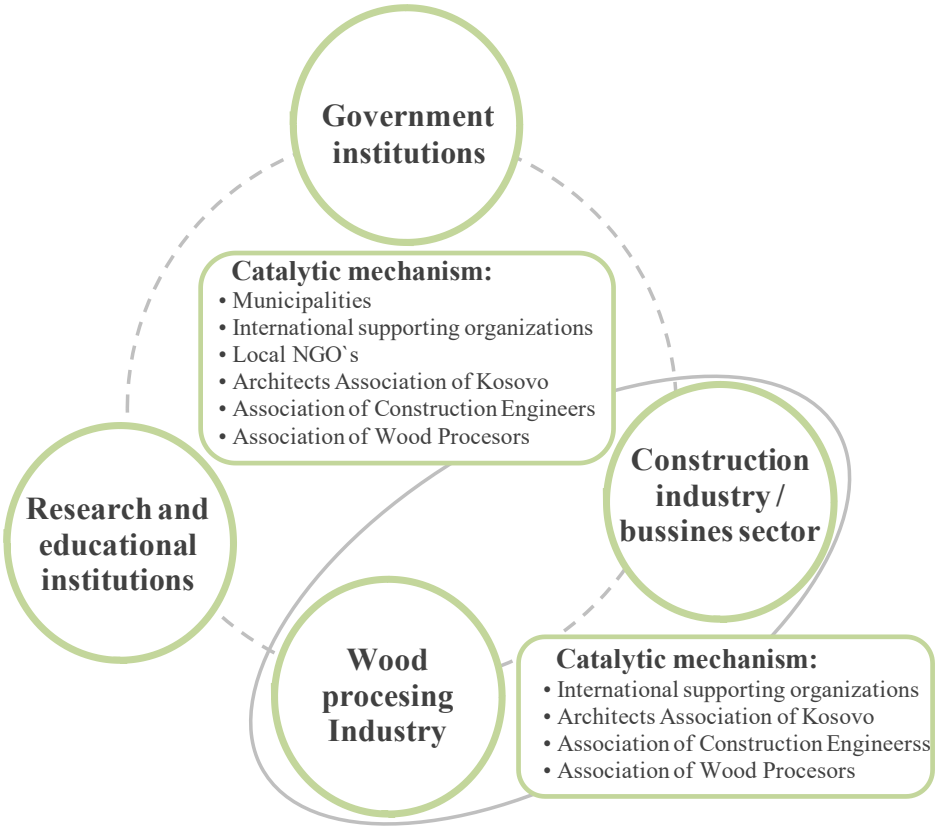

Figure 6.1 Sustainable development of multi-storey timber-based residential construction

A close cooperation between the government, educational institutions, wood industry and business sector is essential to increase the use of wood in constructions projects. Environmental awareness is a mutual objective to sustain the link between the actors.

The gathered outcomes which were derived from the adopted methodology – the Grounded Theory in Mixed Methodology enabled to elicit a conclusion with a set of recommendations that would also apply to other developing countries or post conflict societies that share similar circumstances in political, economical and social developments. Considering the complexity of the raised issue, with many integrated factors which in various ways affect the development of timber-based construction, it may take time for the main objectives to be achieved. A comprehensive engagement from the abovementioned relevant actors would be necessary to assure a sustainable progress with regards to the identified long term benefits.

"The best time to plant a tree was 20 years ago. The second best time is now."

Chinese Proverb

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APPENDIX 1

PILOT SURVEY

(ARCHITECTS AND ENGINEERS)

INTRODUCTION

This study aims to assess the role and perception of architects and civil engineers on the choice of construction material during design phase and the attributes of timber and its products as main construction material in low-rise buildings, subsequently, the relation between professionals' experience on timber application, their interest on acquiring more information about timber technical performance and the barriers they perceive as present.

METHODOLOGY

The research was carried out through a quantitative method using a web-based questionnaire for the targeted professionals. Experienced architects and civil engineers in design, research and construction were chosen randomly and the survey was conducted anonymously. Around 120 surveys were delivered to potential individuals and companies through e-mails. Contacts were acquired mainly through social networks, such as forums, and similar. The survey provided the respondents with the information on the author's background and the purpose of the research. In total, 47 architects and engineers engaged on different professional activities responded. As shown on the Table 1, 29 or 61.70% of the respondents were architects and 18 or 38.3% were engineers. The questions of the questionnaires were categorized by a five-point Likert-scale (1- lowest scale and 5- the highest scale).

Table 1: *The number of surveyors and their occupation*

	Architect	*Civil Engineer*	
Designer / Consultant	18	8	
Contractor		5	
Academic Institution	5	2	
Public Institution	6	3	
		Total	**47**

The questions are focused on timber performance as a main construction material. Considering the fact that timber, as a structural material is an underutilised material in Kosovo construction industry, previous experience with wood of the contacted professionals has not been particularly considered. Aspects investigated were focused on:

- The role and influence of architects and engineers, as key-role players on the choice of construction material
- Their perception on the different attributes of timber as main structural material such as: technical performance, environmental impact, energy and cost efficiency, fire safety, thermal and sound insulation, comfort and durability etc.
- The level of their professional interest on acquiring more information on timber application in architecture
- Their perceived barriers for using timber as a main construction material

RESULTS

The results gathered from the questionnaires are presented graphically categorized by a five-point Likert scale (1- lowest scale and 5- the highest scale) and are given in mean values of the responds for each attribute. Asked on the level of their experience working with timber as construction material (low, moderate and high), 34% of the respondents declared not to have experience at all while the rest declared to have moderate experience, showing that timber in general is an underutilised material in construction.

The influence on the choice of construction material – Figure 1 present the level influence, in mean values, of different actors when choosing construction material (both structural and non-structural). Contractors and engineers are perceived to be most influential, while architects and constructors is shown to have moderate influence. Public authorities are perceived to have very low influence on the choice of construction material.

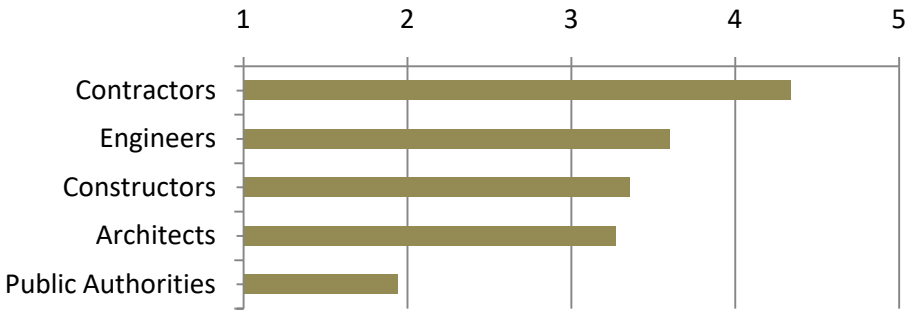

Figure 1: *The level of influence by involved professionals on the choice of construction material, expressed in mean values (1-no influence; 5-high influence)*

Experience working with timber as construction material - Figure 2 provides an idea on the level of different categories of domestic and non-domestic construction by timber. It is obvious that timber has almost no use as the main structural material. It is used moderately in facades of non-domestic low-rise buildings, while more on non-supportive building elements. However the highest use of timber as technical material is in domestic pitched roof structures. It is worth mentioning that technical timber utilized in roof structures, is mainly locally produced while other categories are mostly executed with imported timber elements.

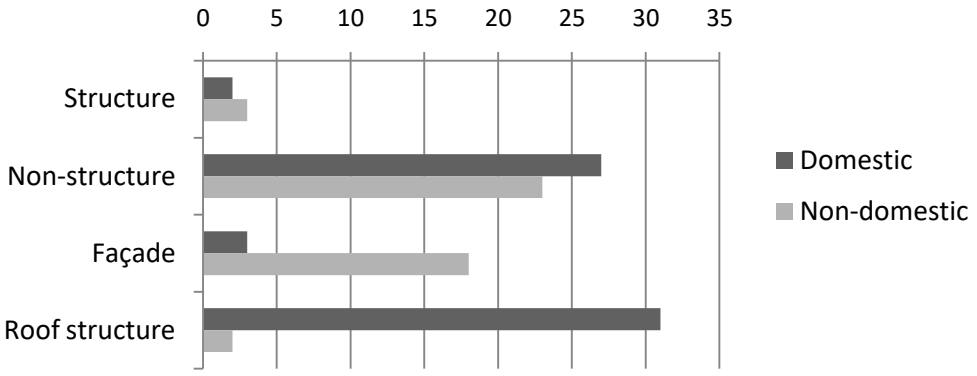

Figure 2: *Professionals' experience using timber as construction material in domestic and non-domestic buildings, expressed by the number of respondents*

Different attributes of timber, steel and concrete as main construction material - Figure 3 shows the perceived performance of three main construction materials in relation to construction attributes presented below. Concrete is the most used structural material

which is also rated very high with reference to durability, structural performance, availability of technical information and product supply, fire safety as well as architectural expression. Most poorly rated attributes regarding concrete structures are recyclability, energy efficiency, insulation properties and environmental impact. Respondents ranked very high timbers aesthetics, energy efficiency, cost, recyclability, flexibility and time of construction. Additionally, aspects such as flexibility, aesthetics, and insulation are ranked almost equally amongst timber and concrete. Steel is perceived positive regarding construction time, durability and recyclability.

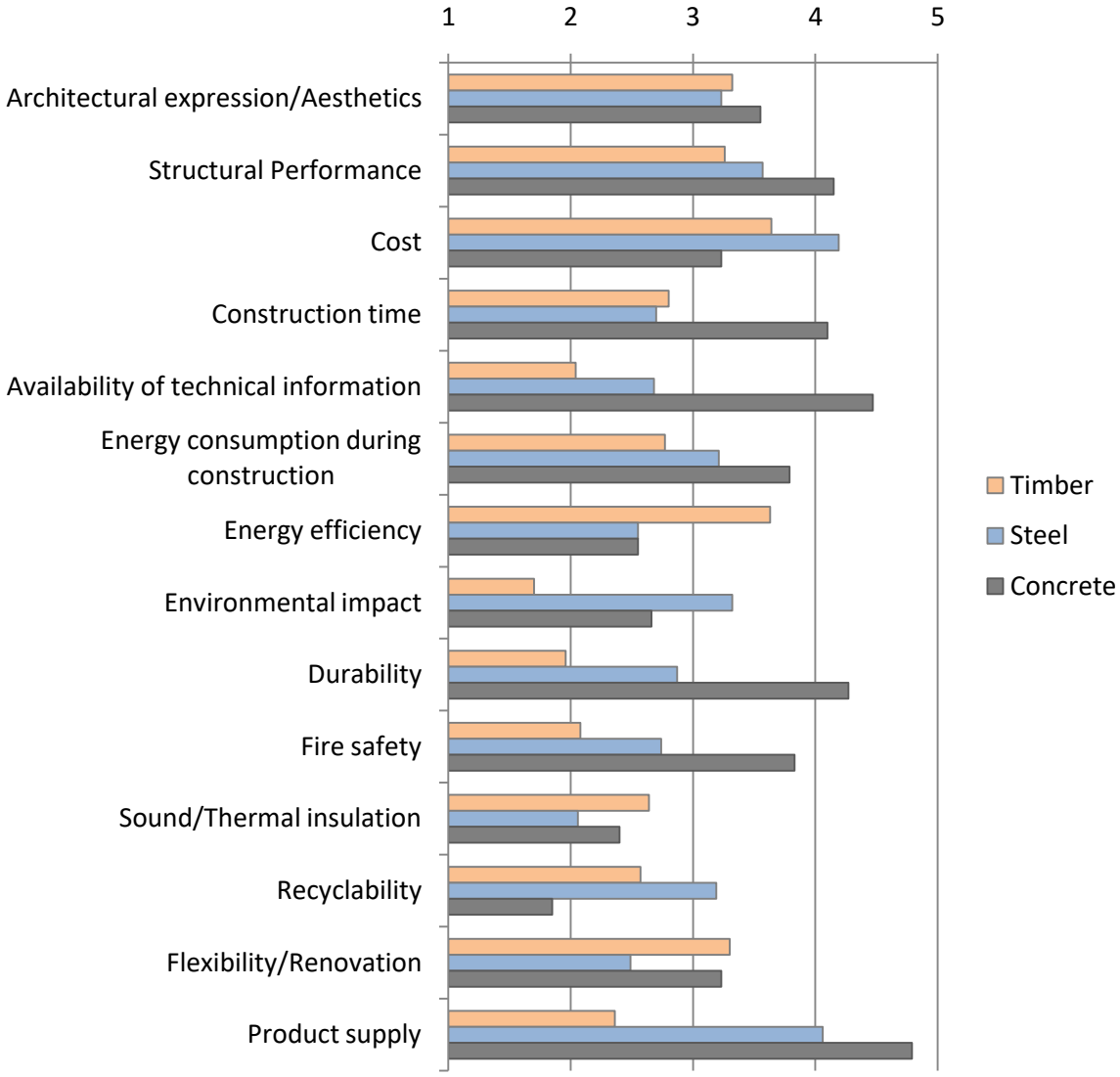

Figure 3: *The level of perceived performance, in mean values, of different attributes of timber, concrete and steel as construction material (1-very low; 5-very high)*

Different attributes of timber as main construction material - Figure 4 shows the perceived performance, in mean values ranked in decreasing order. The building community perceives the construction time and energy efficiency along with design expression, flexibility and structural performance as most positive with regard to utilizing timber as structural material. The cost, energy consumption, insulation properties and recyclability are ranked as moderate (mean values 2.8 - 2.36). The less perceived attributes according to the respondents are product supply, fire safety, availability of technical information, durability and environmental impact.

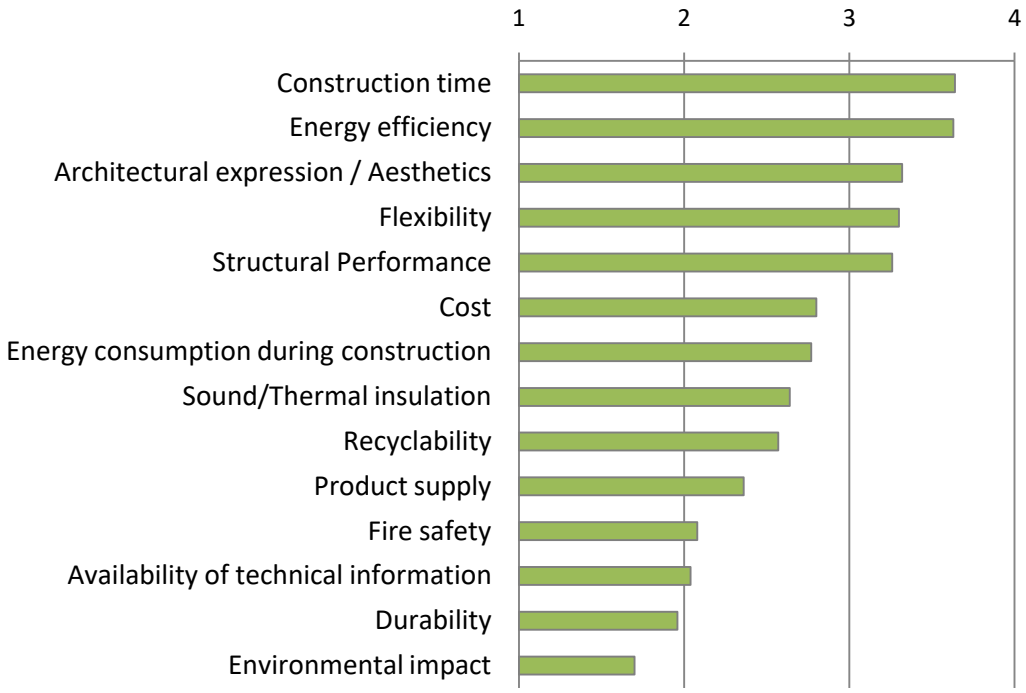

Figure 4: *The level in mean values (ranked in decreased order) of perceived performance of different attributes of timber as construction material (1-very low; 5-very high)*

Professionals' interest on acquiring more information on timber application – In general, when compared to building with concrete and steel, it is perceived a lack of information with regard to timber application in construction, therefore high demand for almost all aspects of timber as technical material, as shown in Figure 5. Architects declared the need for information on design, building systems, fire safety at the highest rank, while almost all categories were rated higher than 3.0. Engineers expressed the interest mostly on technical aspects, such as building systems, structural performance, fire safety and durability.

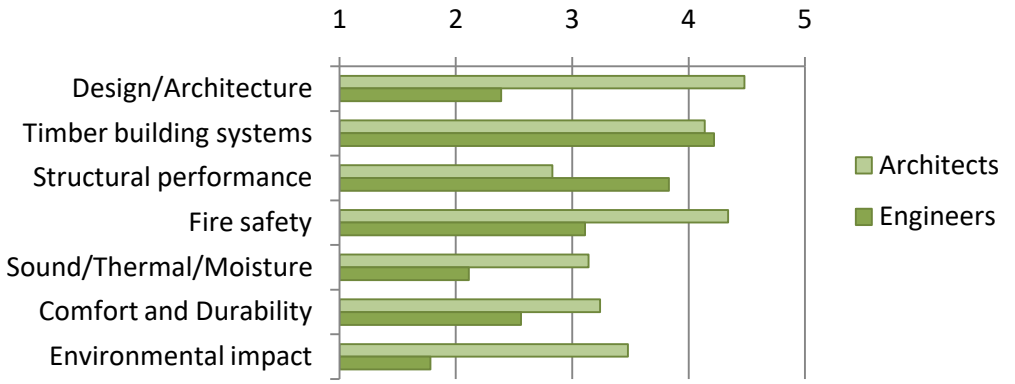

Figure 5: *The level of professionals' interest on acquiring more information on timber application (1-no interest; 5-very high interest)*

Barriers for using timber as structural material – surveyors were asked to identify barriers they do perceive to be the most indicative regarding the lack of timber presence as a structural material in Kosovo. The most common barriers listed among actors' perceptions as main obstacles to apply and promote construction using timber as main building material are categorized below:

- Building Code
- Timber products availability
- Lack of experience and technical details
- Lack of professional gain during education associated with timber application
- Durability
- General perception that wood is sensitive to fire and not as reliable as concrete

APPENDIX 2

QUESTIONNAIRE - SURVEY 1
(ARCHITECTS AND ENGINEERS)

Survey: The role and perception of building community on timber-based architecture - Kosovo

I would like to invite you to participate to this survey on the role and perception of timber as a main construction material in residential architecture. This survey is being undertaken within the framework of doctoral studies through the Polis University, Albania and University of Ferrara, Italy.

The study explores the progress of contemporary low-rise timber-based architecture: historical perspective, construction typologies, positive / negative aspects, key-role players and support groups (government institutions, academia and timber industry) in a context of sustainable urban development and national economical benefit. The results from this survey and other inquiries related to this study will provide a scientific overview on the role, perception, motivation and barriers of building community in Kosovo, toward timber application in residential sector, which will serve as basis for the future developments.

The questionnaire should take around 10 minutes and all the data will be treated with confidence and solely for the purpose of the research.

Your contribution is much appreciated and I look forward to receive your response.

For any suggestions or questions, please contact me on: januzi.arta@gmail.com.

Sincerely,

Arch. Arta Januzi-Cana, Msc.

PhD candidate - IDAUP
International Doctorate in Architecture and Urban Planning

Mid-rise timber-based residential buildings. Photo: Arta Januzi-Cana

1. **1. Age group**
   Mark only one oval.
   - ◯ 20 - 30
   - ◯ 30 - 40
   - ◯ 40 - 50
   - ◯ 50 - 65+

2. **2. Gender**
   Mark only one oval.
   - ◯ F
   - ◯ M

3. **3. Profesion**

Mark only one oval.

- ◯ Architect
- ◯ Civil Engineer

4. **4. Occupation**

Check all that apply.

- ☐ Designer / Consultancy
- ☐ Private Construction Company Director
- ☐ Academic Institution
- ☐ Public Institution (municipal / governmental)
- ☐ NGO

5. **Other:**

_____

6. **5. Which is the level of influence of involved professionals in Kosovo on the choice of construction materials in residential sector? (1-no influence; 5-high influence)**

Mark only one oval per row.

	1	2	3	4	5
Architects	◯	◯	◯	◯	◯
Civil engineers	◯	◯	◯	◯	◯
Public Authorities (e.g.. respective depart.)	◯	◯	◯	◯	◯
Investors (private / institutional)	◯	◯	◯	◯	◯

7. **6. Which is the level of influence of involved professionals in Kosovo on the choice of construction materials in non-residential sector? (1-no influence; 5-high influence)**

Mark only one oval per row.

	1	2	3	4	5
Architects	◯	◯	◯	◯	◯
Civil engineers	◯	◯	◯	◯	◯
Public Authorities (e.g.. respective depart.)	◯	◯	◯	◯	◯
Investors (private / institutional)	◯	◯	◯	◯	◯

8. **7. Do you have knowledge on development of contemporary residential timber-based architecture?**

Mark only one oval per row.

	None	Avarege	Quite informed
.	◯	◯	◯

9. **8. The source of information**

Check all that apply.

- ☐ Internet source
- ☐ Academical education
- ☐ Training / Workshops
- ☐ Foreign academic literature

10. **Other:**

11. **9. Do you think academic education in Kosovo should provide more professional knowledge on timber-based architecture development?**
Mark only one oval per row.

	Yes	Don't know	No
.			

12. **10. Please specify your experience using timber as construction material in domestic buildings**
Check all that apply.

- [ ] Structural
- [ ] Non-structural
- [ ] Facade
- [ ] Structural roof elements

13. **11. Please specify your experience using timber as construction material in non-domestic buildings**
Check all that apply.

- [ ] Structural
- [ ] Non-structural
- [ ] Facade
- [ ] Structural roof elements

14. **12. How do you perceive the level of performance of of different attributes of timber, concrete and steel as construction materials?**
Mark only one oval per row.

	1	2	3	4	5
Architectural expression/Aesthetics -TIMBER					
Architectural expression/Aesthetics / Estetika - CONCRETE					
Architectural expression/Aesthetics - STEEL					

15. *Mark only one oval per row.*

	1	2	3	4	5
Structural Performance - TIMBER					
Structural Performance - CONCRETE					
Structural Performance- STEEL					

16. *Mark only one oval per row.*

	1	2	3	4	5
Cost- TIMBER					
Cost- CONCRETE					
Cost- STEEL					

17. *Mark only one oval per row.*

	1	2	3	4	5
Construction time - TIMBER	◯	◯	◯	◯	◯
Construction time - CONCRETE	◯	◯	◯	◯	◯
Construction time - STEEL	◯	◯	◯	◯	◯

18. *Mark only one oval per row.*

	1	2	3	4	5
Availability of technical information -TIMBERR	◯	◯	◯	◯	◯
Availability of technical information - CONCRETE	◯	◯	◯	◯	◯
Availability of technical information - STEEL	◯	◯	◯	◯	◯

19. *Mark only one oval per row.*

	1	2	3	4	5
Energy efficiency - TIMBER	◯	◯	◯	◯	◯
Energy efficiency- CONCRETE	◯	◯	◯	◯	◯
Energy efficiency - STEEL	◯	◯	◯	◯	◯

20. *Mark only one oval per row.*

	1	2	3	4	5
Environmental impact - TIMBER	◯	◯	◯	◯	◯
Environmental impact- CONCRETE	◯	◯	◯	◯	◯
Environmental impact -STEEL	◯	◯	◯	◯	◯

21. *Mark only one oval per row.*

	1	2	3	4	5
Durability - TIMBER	◯	◯	◯	◯	◯
Durability - CONCRETE	◯	◯	◯	◯	◯
Durability -STEEL	◯	◯	◯	◯	◯

22. *Mark only one oval per row.*

	1	2	3	4	5

24. *Mark only one oval per row.*

	1	2	3	4	5
Recyclability- TIMBER					
Recyclability- CONCRETE					
Recyclability-STEEL					

25. *Mark only one oval per row.*

	1	2	3	4	5
Flexibility/Renovation- TIMBER					
Flexibility/Renovation - CONCRETE					
Flexibility/Renovation -STEEL					

26. *Mark only one oval per row.*

	1	2	3	4	5
Product supply- TIMBER					
Product supply- CONCRETE					
Product supply -STEEL					

27. **13. How do you perceive the level of performance of of different attributes of timber, construction materials? (1-very low; 5-very high)**
Mark only one oval per row.

	1	2	3	4	5
Architectural expression/Aesthetics					
Structural Performance					
Construction time					
Energy efficiency					
Environmental impact					
Siguria ndaj Zjarrit					
Izolimi Termik/Akustik					
Reciklueshmëria					
Fleksibliteti gjatë shfrytëzimit/renovimit/demolimit					

28. **14. What is the level of your interest on acquiring more information on timber application (1-no interest; 5-very high interest)**
Mark only one oval per row.

	1	2	3	4	5
Design/Architecture					
Timber building systems					
Structural performance					
Fire safety					
Sound/Thermal/Moisture					
Comfort and Durability					
Environmental impact					

29. **15. Should we focus more, as a society in Kosovo, on environmental protection from the perspective of construction industry?**
Mark only one oval per row.

	Yes	No
.	◯	◯

30. **16. Should we use more environmental sustainable construction materials?**
Mark only one oval per row.

	Yes	No
.	◯	◯

31. **17. Do you consider timber a promising environmentally sustainable material?**
Mark only one oval per row.

	Yes	Don't know	No
.	◯	◯	◯

32. **18. Would you reside in a timber-base house or apartment?**
Mark only one oval per row.

	Yes	No
.	◯	◯

33. **If not, why?**

_____

34. **19. Do you consider timber application an alternative towards sustainable urban development, for the future in Kosovo?**
Mark only one oval per row.

	Yes	Don't know	No
.	◯	◯	◯

35. **19. Please identify the barriers for using timber as a construction material in residential sector in Kosovo**
Check all that apply.

- [ ] Building Code
- [ ] Timber products availability
- [ ] Lack of experience and technical details
- [ ] Lack of professional gain during education associated with timber application
- [ ] General perception that wood is sensitive to fire and not as reliable as concrete

36. **Other:**

_____

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QUESTIONNAIRE - SURVEY 2
(RANDOM INHABITANTS)

RANDOM INHABITANTS SURVEY

1. Are you familiar with the concept of Sustainability / Environmental Protection?

Yes ■ No ■

2. Are you familiar with the environmental impact of construction industry and building materials?

Yes ■ No ■

3. Have you ever been inside a timber house / apartment?

Yes ■ No ■

4. Would you live in a timber house / apartment? ... if not why?

Yes ■ No ■

5. Please identify positive aspects regarding timber-based residential buildings

Living environment ■
Ecological ■
Economical ■
Don't know ■
Other _____

6. 5. Please identify negative aspects regarding timber-based residential buildings

Technical performance ■
Fire safety ■
Durability ■
Don't know ■
Other _____

APPENDIX 3

INTERVIEW GUIDE

QUESTIONS FOR SEMI-STRUCTURED INTERVIEWS

1. MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

2. MINISTRY OF AGRICULTURE, FORESTRY AND RURAL DEVELOPMENT

3. INSURANCE COMPANY

4. WOOD INDUSTRY

5. HIGHER ACADEMICALLY EDUCATION

6. ARCHITECTS, ENGINEERS

7. BUSINESS SECTOR

8. MUNICIPALITY OFFICIAL, TAXATION SYSTEM

1. MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
- Division for Vocational and adult education

1. How many vocational schools are in Kosovo?
2. How many technical vocational schools are in Kosovo>
3. Are there vocational schools on wood manufacture?.. If yes,:
4. Does the curriculum cover the sector of construction and/or furniture manufacturing?
5. Who supports them? With whom do they collaborate?
6. Do they collaborate with wood industry?
7. How relevant is wood construction industry in vocational schools curriculum?

2. MINISTRY OF AGRICULTURE, FORESTRY AND RURAL DEVELOPMENT
- Department of Forestry
- Kosova Forestry Agency

1. What is your position in the institution?
2. What is the role and authority of Department of Forestry / Kosova Forestry Agency?
3. What kinds of projects are developed in this institution? How are they funded?
4. What are your objectives?
5. Is the number of staff sufficient for your objectives?
6. Do you collaborate with research institutions and/or Universities?
7. Do you collaborate with the representatives of wood industry?
8. What are your objectives/strategies with regards to afforestation?
9. Is the potential of Kosovo Forestry as a natural resource with regards to construction industry addressed?
10. What is your opinion on this issue?
11. Should your Department/Agency cooperate more with wood industry, construction
12. What are the main barriers that Kosovo forestry and your institution face?
13. How would these barriers overcome? How to overcome these barriers?

3. INSURANCE COMPANY

1. What is your position in the company?
2. What insurance are we as Kosovo residents obliged to secure?
3. Are residential buildings required to insured?
4. Who would take the responsibility in case of fire or similar?
5. Do you cover timber-based buildings?
6. (when no) Why? If you would have a quality approval from a municipality or similar authority, would you then cover?
7. (when yes) What is the rate? Comparison to concrete buildings.

4. WOOD INDUSTRY
Company:_____

1. Since when do you operate?
2. Does your company supply, manufacture?
3. What types of products do you provide?
4. Where are you supplied from?
5. What types of wood do you provide?
6. What products do you manufacture and trade?
7. Are your products certified?
8. What is you market? (local and/or international?)
9. Are you supported from Government? If yes, how?
10. Do you collaborate with research institutions, vocational schools, NGOs or other?
11. Do you find it necessary for you future development and expansion?
12. Are you informed on timber construction; multi-storey timber-based construction?
13. What are your objectives?
14. What are the main barriers that wood industry and your company face?
15. How would these barriers overcome?

5. HIGHER ACADEMICALLY EDUCATION
UNIVERSITY/COLLEGE:

1. What is your position in the institution?
2. How many student applicants are accepted annually?
3. Do you think that our society needs to focus more in sustainable design on environmental context?
4. How extensive is the curriculum on materials in respect of sustainability on environmental context?
5. Is there a specific subject where wood as a construction material is elaborated? If so which subject?
6. What does the syllabus encompass?
7. In pilot survey, the need, respectfully the lack of proper knowledge on contemporary trends of wood based application in architecture was stipulated. What do you think, should the focus be increased?
8. Do you consider the cooperation with other relevant institutions necessary e.g. Vocational schools, wood industry, forestry institutions in order to create awareness on the potentials of wood as natural construction material for future economical benefits of Kosovo?

6. ARCHITECTS, ENGINEERS

1. What is your position in the institution?
2. Discussion on questions from the Survey
3. Discussion on the results from the survey
4. How do you perceive safety in a residential wood-based building?
5. What are the main barriers your community faces?
6. What is the main barriers business sector faces?
7. What are the main barriers the development of mid-rise timber based residential construction face?
8. How would these barriers overcome?

7. BUSINESS SECTOR
Construction company:

1. What is your position in the company?
2. Since when do you operate?
3. Are you familiar with multi-storey timber based residential construction?
4. What is your opinion on these building typologies?
5. Do you think that our society needs to focus more in sustainable design on environmental context?
6. Do you use eco-friendly construction material? Do you follow any 'eco-policy'?
7. How do decide on the overall design and construction quality?
8. What taxation systems are applied in residential construction?
9. What is the price for compensating the property for building construction?
10. Would you try to construct a timber-based building?
11. What are your positive and negative perception regarding timber-based buildings?
12. What are the main barriers?
13. How would these barriers overcome? What would make you invest on a timber-based mid-rise residential building?
14. Do you collaborate with local timer industry?
15. Could multi-storey timber buildings be constructed in Kosovo?

8. MUNICIPALITY OFFICIAL, TAXATION SYSTEM

1. Your position in the institution?
2. Taxation system in construction industry – Residential sector?
3. The role of municipality with regards to forestry development?
4. The role of municipality with regards to social housing – the potential of developing timber-based multi-storey social housing.
5. Residential building insurance – accountability in case of fire or other engagers