Social cohesion and interaction in high rise buildings

The effect of building and resident characteristics on social cohesion and interaction in high rise residential buildings

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Award date:
2023

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Master Thesis

Sara Noordenbos

Eindhoven, December 2022

Colophon

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Date
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Cover Image
Vector high rise buildings (PNGKey, 2021)

Preface

This master thesis on social cohesion and interaction in high rise buildings represents the final product of my graduation project. This report finalizes my master Architecture, Building, and Planning with a specialization in Urban Systems and Real Estate at the Eindhoven University of Technology. This graduation project was executed internally at the university under the supervision of my graduation committee. I want to express my deepest gratitude to my supervisors: Pauline van den Berg, Stephan Maussen, and Astrid Kemperman. I want to thank them for their committed guidance during the process of this research. I could not have finished this report without their support. I also have to thank all the respondents who filled in the survey. Without their involvement, this research would not have been possible. Finally, I would like to thank all my friends and family for supporting me during the process of writing my master thesis. For keeping to believe in me, for all their feedback and enthusiasm for my report, for keeping me sane with endless game nights, and for just listening to me talking about high rise developments in Eindhoven.

Eindhoven, December 2022

Sara Noordenbos

Summary

The population of the world is growing, with a population increase of 25% in less than 20 years (United Nations, 2022). Additionally, more people are living in urban areas, which will increase to nearly 70% by 2050 (United Nations, 2018). Next to that, the number of households is growing. The way of life is transitioning to be more individual and the average household size is decreasing (Eurostat, 2015). The increase in population and households is leading to an exponential demand for housing. The densification of cities means that more housing needs to be realized in the same urban area (PBL, 2016). The answer is building vertically, which is leading to a high rise development boom (van Soomeren, 2020).

High rise developments do need to provide a livable environment for their residents. History tells us that previous high rise buildings experienced problems with the livability of the residents (Helleman & Wassenberg, 2004; Krantz, et al., 1999; Turkington, et al., 2004). Taking livability into account is key in preventing problems in new high rise residential buildings (Dekker & van Kempen, 2004). Livability is a broad term that includes a range of different issues (Ahmed, et al., 2019). The experience of the residents is most important, which is why the research focuses on social interaction and cohesion in high rise residential buildings. Social cohesion and interaction have been researched at the neighborhood level (van den Berg, et al., 2015; Dekker & Bolt, 2005; van Dijk, et al., 2013; Völker, et al., 2007), but not a lot at the building level (Verhage, 2021).

The specific characteristics of high rise residential buildings can have a profound influence on the social interactions and cohesion of the residents. As the residents themselves also have a big impact on the interactions, the residents' characteristics are also part of this research. The main objective of this research is to identify the influence of the physical aspects of high rise residential buildings on the social cohesion and social interaction among residents in these buildings. This is formulated in the research question:

How do building characteristics and resident characteristics influence social cohesion and social interaction in high rise residential buildings?

In the literature research, the concepts of social cohesion and social interaction are defined. Social cohesion is "the glue that keeps the members of a social system together" (Dekker & Bolt, 2005). The social cohesion of the resident can be measured with the Neighborhood Cohesion Instrument (NCI). This is based on three dimensions of social cohesion: attraction to the neighborhood, neighboring, and psychological sense of community (Buckner, 1988). The name implies that this instrument can only be used in the neighborhood, but Wilkinson (2007) confirmed that it can also be used in communities. A high rise residential building can be defined as a specific community or vertical neighborhood (Aw & Lim, 2016).

Social interaction is about the contact between the residents of the building and this contact can be influenced by the design of the building (De Jaegher, et al., 2010). The interactions in the building are divided into social interaction frequency and satisfaction with these interactions. A sense of community can be created through social interaction between the residents. The frequency of interactions can be collected with seven questions based on Verhage (2021). The locations of interactions should differentiate between social spaces and traffic or transitional areas of the building. For social satisfaction, the residents are questioned about how satisfied they are with their interactions in the building.

High rise residential buildings are not designed equally, so each building is different. Each different design can influence social cohesion, social interaction, and social satisfaction in a specific way. This is why the characteristics of the building are important in this research. The characteristics of high rise residential buildings are divided into perceived building characteristics and objective building characteristics. The perceived characteristics look into the experience of the resident with the social spaces and transitional areas, while the objective characteristics are acquired through observations on location. The observations can look at the design of the building, the places of interaction, and specific users of the buildings.

Data on social cohesion, social interaction, social satisfaction, building characteristics, and resident characteristics are collected through a survey among high rise residents. The objective building characteristics are collected through observations. The surveys are distributed to 44 high rise residential buildings in Eindhoven. In the end, there are 355 valid and usable responses, which is 8.0% of the 4414 distributed surveys. The operational model for this research shows all the variables and their relationships. These are analyzed with bivariate and regression analyses.

The bivariate analyses test the relationships between the 31 independent variables and the three dependent variables. The results showed that four independent variables do not have a significant relationship and are therefore excluded from further analyses. These variables are safety transitional areas, household income, gender, and car parking facilities. Before conducting the regression analysis an additional four variables are removed due to a high correlation coefficient. The excluded variables are employment status, apartments per floor, online facilities type, and owner of the building. The multiple regression analyses are therefore performed with 23 independent variables and three dependent variables.

The final regression model looks at the social cohesion score and all variables that have a significant influence on social cohesion in high rise residential buildings. This includes the other two dependent variables: social interaction and social satisfaction, which have a great positive influence on social cohesion in the building. The final model can also explain 61.2% of the variability of the social cohesion score of the residents. The quality and usage of transitional areas in the building also have a positive relationship with social cohesion in high rise buildings. Older residents experience a higher social cohesion in their building. In addition, living longer in the building and owning the residence also has a positive influence on the social cohesion score of the resident. Furthermore, the presence of a social space and its specific type is important for the experienced social cohesion and interactions.

Some variables have a negative influence on the social cohesion score of the resident of high rise residential buildings. If the resident has a car available, they will have fewer interactions with their neighbors. A resident with a university master degree also has fewer social connections in their building. A building with four or five duplicate buildings also leads to fewer opportunities for social interactions. This is the same if the high rise residential building has a lot of entrances. If the design of the building is squarish and the access to the apartment is a corridor the social cohesion score of the building is also lower.

Developers and designers can implement new design philosophies in high rise developments and adapt exiting high rise residential buildings to improve social cohesion among the residents. The transitional areas of the building influence social cohesion. If their quality is low, social cohesion is low. Making small adjustments to improve quality will lead to higher social cohesion and a more livable environment. The presence of a social space has a positive effect on social cohesion in the building. If there is not a social space available, social cohesion will be lower. This can be remedied by looking at other ways to increase social cohesion and interactions in the high rise residential building.

High rise buildings are a main part of development for Eindhoven. The developers and policy makers in the city can use the findings to build and modify high rise residential buildings which will have a better livable environment for their residents. Other cities could even adopt these findings, but can also use the methodology to test the findings in their own environment.

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1. Introduction

This chapter introduces the research subject of this report and begins with the background to define the research focus. The problem description and research objective are explained in the following sections. Afterwards, research questions are formulated to achieve the goal of this research. The chapter continues with a preliminary explanation of the research methods and concludes with the structure of the report.

1.1. Background

The population of the world is growing. The global population is projected to reach eight billion people in November 2022 and is expected to increase to nearly ten billion people by 2050 (United Nations, 2022). This is a population increase of 25% in less than 20 years. At the same time, more people are living in urban areas. Currently, more than 50% of the world's population is living in urban areas. It is projected that this will increase to nearly 70% by 2050 (United Nations, 2018). The Netherlands is also experiencing these trends of population growth and urbanization (CBS, 2021). Additionally, the number of households is growing (Ministerie BZK, 2018). The way of life is transitioning to be more individual, and the average household size has been decreasing for decades. Because of this household dilution, the number of households is growing faster than the population (CBS, 2021; Eurostat, 2015). The increase in population and the increase in households are leading to an exponential demand for housing. Policies on zoning in cities may prevent the expansion of a city, so the increasing housing demand is also leading to the densification of cities (PBL, 2016). Simultaneously, there is a shortage on the housing market, which keeps increasing (PBL, 2021). All of this means that more housing needs to be realized in the same urban area. The answer to this problem is building vertically, which is currently leading to a boom in high rise developments (van Soomeren, 2020).

High rise residential buildings are not a new building concept, these buildings have been a part of city development for decades (Cortese, 2018; Turkington, et al., 2004). The first high rise buildings were constructed in the 19th century in North America. The economic prosperity of the region led to the development of high rise residential buildings in the big cities (Cortese, 2018). High rise development became a global phenomenon after the Second World War as Europe was dealing with urban housing shortages. The high rise housing production in Europe reached a construction peak in the 1960s and 1970s (Cortese, 2019). This peak was achieved with extraordinary speed and declined suddenly due to technical and social problems within high rise residential buildings (Turkington, et al., 2004). It was not until the 1990s that high rise development regained back its popularity in Western Europe. Since then, high rise development has been on an upward trajectory.

High rise buildings do need to provide a livable and sustainable environment to meet the needs of the residents. Lessons can be learned from the high rise developments from the 1960s and the 1970s, which experienced problems with the livability of the residents. Krantz et al. (1999) categorize these housing estates as problematic as they are “not providing good living conditions for their residents”. Additionally, Helleman and Wassenberg (2004) state that high rise residential buildings are “not the most popular areas in town”. Thirdly, Turkington et al. (2004) explain that “problems with the experience of living in high-rise blocks emerged soon after construction”. All these problems endangered the longevity of the high rise residential buildings and the buildings had to be adapted or even be demolished (Helleman & Wassenberg, 2004; Krantz, et al., 1999; Turkington, et al., 2004). Taking livability into account with the development of high rise buildings is key in preventing problems in new high rise residential buildings (Dekker & van Kempen, 2004).

Livability is a broad term that includes a range of different issues. As stated by Ahmed et al. (2019), “livability is not only inherent in environmental characteristics but most importantly, it incorporates a social dimension regarding how people interact within local environments”. Social interaction with the built environment facilitates in creating a livable urban environment (Ahmed, et al., 2019). Therefore, social interaction and cohesion are an important part of a livable environment in a high rise residential building, as these concepts relate most to the experience of the residents in their building.

These concepts are important for this research, especially taking into account social drawbacks that can arise while living in a high rise building. Amick and Kviz (1975) found that residents of high rise buildings experience higher levels of alienation than residents of low rise buildings. The physical environment imposes restrictions on social interaction and results in feelings of alienation, isolation, and powerlessness (Amick & Kviz, 1975). This is confirmed by Chile, Black, and Neill (2014), who report that low levels of social contact or sustained interaction with community members are the main cause of the social isolation of urban high rise residents (Chile, et al., 2014). Community feeling and social cohesion are key in the success of high rise residential buildings, so these aspects have to be maintained to keep the building livable (Dekker & van Kempen, 2004).

Social cohesion and social interaction have been studied before, but mostly in a neighborhood setting (van den Berg, et al., 2015; van den Berg & Timmermans, 2015; Dekker & Bolt, 2005; van Dijk, et al., 2013; French, et al., 2014; Völker, et al., 2007; Völker & Flap, 2007). A neighborhood is an organic partition within the borders of a city. However, a high rise residential building can be seen as a vertical neighborhood, as the building creates a contained vertical community of people living in the same building (Aw & Lim, 2016; Doevendans, 2005). Verhage (2021) found that the social interactions of high rise residents mainly take place in the transitional areas of high rise residential buildings. These transitional areas are the semi public traffic areas within a high rise building. Interactions will take place during the transition from entering the building to entering the private residence (Verhage, 2021). Verhage (2021) recommended further research into the cohesion and interactions of the residents in a high rise residential building.

The relationship between the social interactions in a high rise residential building and the characteristics of the building has not been researched thoroughly. Additional research into the different forms of transitional areas in different types of high rise buildings is also recommended by Verhage (2021). Furthermore, additional research should focus on the presence and design of social spaces. The typology of the high rise residential buildings also influences the building characteristics. This implies the objective design aspects of the building. This report focusses on the stated gap in the research, which is the relationship between social cohesion and social interaction in high rise residential buildings and the building characteristics and building typology of these high rise buildings. As the other residents have a big impact on the social interactions of the resident, the resident characteristics of the building are also analyzed.

1.2. Problem description

High rise development is here to stay as a part of city development. Our population is growing, more people are living in urban areas, individualization is leading to more households and urban centers will densify further. High rise residential buildings have to be a place where people want to live and where they can thrive (Modi, 2014). Apartments have to be more desirable because most people still wish to live in a single family home (Ministerie BZK, 2018). The problem is that there is not enough space to only create single family housing. Therefore, people will have to move into high rise residential buildings, even if they have other housing wishes. That is why the social cohesion and interaction in high rise residential buildings have to be researched to be optimized.

There is a gap in the current research regarding the physical aspects of high rise residential buildings and their relation to the social cohesion and social interaction within these high rise buildings. Verhage (2021) recommended further research into the transitional areas of high rise residential buildings and advised differentiation between varying forms of transitional areas and different types of high rise buildings. Social cohesion and social interaction are perceived concepts, based on the experience of the resident. Social contact in high rise residential buildings will mostly take place with other residents. Therefore, the resident characteristics of the high rise residential buildings are also a part of this research. The main focus of this research is on the building characteristics and resident characteristics of a high rise residential building that influence the social interaction and social cohesion within the high rise building.

1.3. Research objective

This research will examine the building characteristics and resident characteristics of high rise buildings that influence the social cohesion and social interaction within these high rise residential buildings. The objective of this research is to gain a better understanding of the effects of the building characteristics of high rise residential buildings on the social cohesion and social interaction of the residents of these high rise buildings. The effects of the resident characteristics of high rise residential buildings on the social cohesion and social interaction of the residents of these high rise buildings will also be explored. The results from this research can be used to improve social cohesion and social interaction in new high rise developments or refurbished high rise residential buildings.

1.4. Research questions

The background, problem description, and research objective explain the goal of this research. To achieve the objectives of this research, research questions are formulated which will be answered in this report. The main research question is:

How do building characteristics and resident characteristics influence social cohesion and social interaction in high rise residential buildings?

To answer the main research question, the following sub research questions are formulated:

- What is social cohesion and how can it be measured?
- What is social interaction and how can it be measured?
- What is the relationship between social cohesion and social interaction?
- Which building characteristics influence social cohesion and social interaction in high rise residential buildings?
- Which resident characteristics influence social cohesion and social interaction in high rise residential buildings?
- How do building characteristics and resident characteristics influence social cohesion and social interaction in high rise residential buildings?

These sub research questions are answered in this research and will contribute to answering the main research question during the conclusion of this report. A basic conceptual model for the research is shown in Figure 1. This model shows the relationships between the building characteristics and resident characteristics of the high rise residential buildings with the social cohesion and social interaction in these high rise buildings. The relationship between social cohesion and social interaction in high rise residential buildings is also shown. The model will be adapted and filled in with more specifics after the literature research for the research approach.

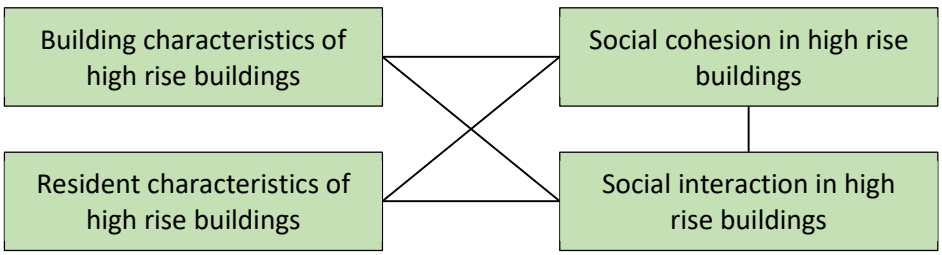


Figure 1. Basic conceptual model for the research.

1.5. Research methods

To create a method that can be used for further research, the concept of high rise residential buildings has to be defined. The definition of a high rise building can differ between countries and even between cities in a single country. Sometimes it is defined as a percentual increase of the height of the surrounding neighborhood, while other cities maintain a specific high definition (Stichting Hoogbouw, 2020). This research needs to use one specific definition for a high rise residential building that can be applied in different situations. This research will assume that a high rise building is a building with more than five floors. These buildings have an accessibility standard in the regulations of the government and are required to have an elevator (Ministerie BZK, 2022).

The research itself is split into two different approaches to answering the research questions. Firstly, literature research is executed to define the concepts of social cohesion and social interaction. The relationship between social cohesion and social interaction is also explored. Another goal of the literature study is to find out which building characteristics and resident characteristics affect social cohesion and interaction in high rise residential buildings according to the previous research. The outcomes of the literature research will serve as input for the adapted conceptual model.

Secondly, new data will be collected to research the social cohesion and interaction experience of the residents of high rise residential buildings. The information on social cohesion and interaction will be obtained with a survey, as it focuses on the experience of the residents. Information about the high rise residential buildings will be added through observation on location and additional online research. Afterwards, the data will be analyzed to show the relationships between the building and resident characteristics on social cohesion and interaction in high rise residential buildings. This information can be used for future development or refurbishment of high rise residential buildings.

1.6. Report structure

A research report consists of five parts: the introduction, the literature research, the research approach, the research analysis, and the conclusion (Swales & Feak, 2012). This general structure of the report is shown in Figure 2. These five parts follow the chronological order in which the research is conducted and contribute to answering the research questions that have been stated before. The research approach and research analysis are divided into multiple chapters, which are also shown in Figure 2.

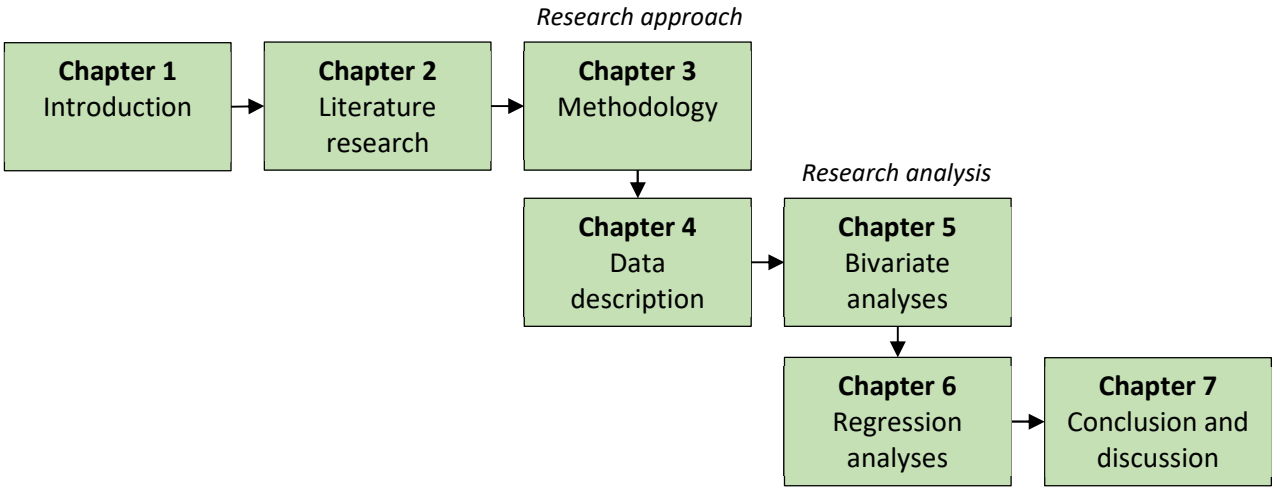


Figure 2. The research structure of the report.

The report starts with the introduction of the research problem, the objective of this research, and the research questions in chapter 1. Chapter 2 presents the literature research for this report. The concepts of social cohesion and social interaction are explored in this chapter. Furthermore, research is conducted into the building characteristics and resident characteristics of high rise residential buildings. The chapter concludes with the adapted conceptual model with input from the literature research.

The research approach consists of the methodology in chapter 3 and the data description in chapter 4. The methodology explains the data collection methods and the operationalization of all the variables, which leads to the operational model for this research. Afterwards, the collection of the data and the statistical analysis methods are explained. The gathered data for all the variables is described in the data description in chapter 4. The research analysis is divided into two chapters. The bivariate analyses are explained in chapter 5 and the regression analyses are explained in chapter 6. The results from these analyses are also explained in their respective chapters. The last part of the report is the conclusion in chapter 7, which consists of the conclusion, discussion, limitations, and recommendations for the research. The main research question is answered in the conclusion and all the findings of this research are interpreted. The report ends with recommendations for further research.

2. Literature research

The introduction introduced the subject, problem, and objective of this research. The literature research will look into the previous scientific studies regarding social cohesion, social interaction, and high rise buildings and how this research can assist in answering the research questions. Firstly, the concepts of social cohesion and social interaction are explained. Afterwards, research into high rise residential buildings will give more information about building and resident characteristics and how they can affect social cohesion and social interaction. The chapter will end with a conceptual model for the research approach.

2.1. Social cohesion

Social cohesion is not a concept that has a definition in any dictionary. It is a subjective concept, but in general, it is seen as the main part of a livable built environment. It deals with the perception of the residents and how there is unity between the residents through the built environment. As stated by Dekker and Bolt (2005), "social cohesion can be seen as the glue that keeps the members of a social system together". Social cohesion can also be seen as the psychological sense of community for a collective. Sense of community is the experience of the individual, but cohesion can be seen as a descriptor on the collective level (Buckner, 1988). Social cohesion can even help to enhance the livability in the neighborhood (Dekker & Bolt, 2005), as the neighborhood is an important place where social life is shaped (Forrest & Kearns, 2001).

Kearns and Forrest (2000) explore the concept of social cohesion by dividing it into five key dimensions. These dimensions are: common values and a civic culture, social order and social control, social solidarity and reductions in wealth disparities, social networks and social capital, and place attachment and identity (Kearns & Forrest, 2000). These dimensions of social cohesion are further defined by Dekker and Bolt (2005) and Forrest and Kearns (2001). Common values focus on the moral principles, codes of behavior, and participation in politics of the residents and if they have these values in common. Social order and control are based on the tolerance and respect of the residents and the absence of conflicts. Social solidarity is based on equal access to opportunities and services for all residents, which leads to a harmonious society. Social networks focus on the interactions of the residents in the neighborhood. Place attachment look at the attachment of the residents to the neighborhood and the intertwining of place and personal identity (Dekker & Bolt, 2005; Forrest & Kearns, 2001; Kearns & Forrest, 2000). It has to be noted that these dimensions of social cohesion are interconnected and often overlap (Dekker & Bolt, 2005; Kearns & Forrest, 2000).

For the resident, social cohesion is a perceived attribute of a community. To quantify this concept, Buckner (1988) developed the Neighborhood Cohesion Instrument (NCI). This measuring tool is based on three dimensions of social cohesion: the attraction to the neighborhood, neighboring, and psychological sense of community (Buckner, 1988). The social cohesion dimensions of the NCI overlap with the local attributions of the five key dimensions defined by Kearns and Forrest (2000). The NCI can be used as a measuring tool to analyze social cohesion on a local scale. Wilkinson (2007) evaluated the NCI with the three social cohesion dimensions and confirmed that the instrument is an appropriate method to measure social cohesion in a community. Therefore, the NCI can be recommended to be used in future studies on social cohesion (Wilkinson, 2007). As the name implies, the NCI is often used to analyze social cohesion in a neighborhood (van Dijk, et al., 2013; French, et al., 2014; Verhage, 2021), but it can also be used in communities (Wilkinson, 2007). A high rise residential building can be defined as a specific community, which is why the NCI can be used to analyze the social cohesion in a high rise building (Verhage, 2021).

2.2. Interactions in the building

The interactions of the residents in high rise residential buildings are a part of the social networks. This is one of the dimensions of the social cohesion of the resident (Kearns & Forrest, 2000). More interactions in the building lead to higher social cohesion in the building. The interactions of the resident can be divided into two different variables: the frequency of the social interactions and the satisfaction with the social interactions. The scale and measurement level for these two aspects are different: one focusses on how often the interactions take place, while the other looks into the satisfaction with these interactions. Therefore, it is better to separate these two aspects of the interactions and analyze the data separately. In this research, the frequency of the interactions is identified as social interaction, while satisfaction with the interactions is identified as social satisfaction.

2.2.1. Social interaction

The concept of social interaction is defined by De Jaegher et al. (2010) as “complex phenomena involving different dimensions of verbal and nonverbal behavior” which take place in “varying contexts” and with a “number of participants” (De Jaegher, et al., 2010). To simplify, social interaction is about contact between people. And contact and interactions between people can be influenced and stimulated by the design of the built environment. One of the five dimensions of social cohesion also focuses on the social interactions of the residents in a community (Kearns & Forrest, 2000).

The high quality of public space can impact the frequency of social interaction between residents (Gehl, 2011). Social contact will occur more frequently if the physical environment is of good quality. People will spend more time in good public spaces and therefore interact more with each other. Superficial interactions between people can lead to more important social contact (Gehl, 2011). The key is to design physical spaces that promote social interactions between users. This design philosophy can also be applied to the level of high rise residential buildings to encourage interactions between the residents of these buildings (Yuen & Yeh, 2011). Furthermore, a sense of community can be created through social interactions between the residents. The social cohesion of the building can be improved with a higher frequency of social interaction between the residents. Social interactions in a high rise residential building are already more likely because residents of an apartment tend to socialize more with their neighbors (van den Berg, et al., 2016).

The frequency of the social interactions of the residents is measured as a perceived variable. Van den Berg and Timmermans (2015) also collected data about the frequency of interaction of the respondent with their neighbors. The respondents had six answer options on an ordinal scale: never, once a month or less, 2 or 3 times per month, once a week, several times per week, and (almost) every day. The interactions with the neighbors can also be divided into different places of interaction, to identify if interactions are more prominent in a specific part of the building. Verhage (2021) adapted an instrument for measuring social interaction in a high rise residential building, which is based on Rogge et al. (2018) and Sugiyama et al. (2008) and used in this research to collect data about social interactions.

2.2.2. Social satisfaction

The satisfaction of the resident with the social interactions in the community is defined as social satisfaction. People who are more satisfied with their neighborhood are found to interact more often with their neighbors (van den Berg & Timmermans, 2015). Verhage (2021) collected data about social satisfaction with social interaction. However, it is chosen to detach social satisfaction from social interaction. Satisfaction with the interactions of the resident is focused on a completely different scale from one to ten. This means that social satisfaction is also a perceived variable. It is about how satisfied the resident is with their social interaction in high rise residential buildings.

2.3. High rise residential buildings

Van den Berg et al. (2015) state that local social interaction can be affected by the characteristics of the neighborhood. A neighborhood could also be defined as a community, the community of residents within a high rise building (Wilkinson, 2007). Furthermore, a high rise building can also be identified as a vertical neighborhood (Aw & Lim, 2016). So the characteristics of the high rise building can affect the interactions and social networks of the resident.

All high rise residential buildings are not designed equally, as a different design can be applied for each development. This is why the characteristics of the building are an important aspect of this research and how these building characteristics contribute to social cohesion, social interaction, and social satisfaction (Modi, 2014). The characteristics of a high rise residential building can be divided into perceived building characteristics and objective building characteristics. The perceived characteristics focus on the experience of the resident with the building and the data is collected with the survey among the residents of high rise residential buildings. The objective characteristics are factual aspects of the building and are acquired through observations of the buildings during the distribution of the survey. In this research, the perceived building characteristics are identified as the building characteristics and the objective building characteristics are identified as the building observations.

2.3.1. Building characteristics

The building characteristics focus on the experience of the resident with the building. These experiences are divided between the social spaces and the transitional areas of the building. Social spaces are places where residents come together intentionally and places for recreation withing the building (Aw & Lim, 2016). These can be a shared garden, a roof terrace, or a seating area. The transitional areas are the traffic areas within the building. These are the semi public traffic spaces between entering the building and entering the private residence and can be entrances, corridors, and elevators (Turkington, et al., 2004). Both of these aspects are analyzed by their quantity, quality, usage, and safety. As the transitional areas always have to be used, is the usage of the transitional areas excluded from the survey. How residents interact with these places in the building can help to provide a healthy community life in the building.

2.3.2. Building observations

All aspects of the building need to be analyzed to know how it affects the social contacts of the residents. This relates to the space syntax for the building. The space syntax analyzes the relationship between the layout of the building and the social interactions within the building (Bafna, 2003). Space syntax looks into how the spatial layout of the building can facilitate social connections between the residents. For the space syntax, all the specific characteristics of each building are collected. The goal is to find out where residents interact with their neighbors and how the design of the building influences the interactions of the residents. These social interactions affect the cohesion the resident experiences with the building.

Design of the building
The design of the building can be divided into the size, layout, and access of the building. The building design can influence the interactions of the residents (Aw & Lim, 2016). A variety in the layout of the buildings can get the most out of the collected data. It can tell which design aspects influence the social cohesion, interaction, and satisfaction of the resident. This connects to the space syntax of the building. The “physical residential environment is generally assumed to play a considerable role” in the social connections of the residents (van den Berg & Timmermans, 2015). An inevitable consequence of high rise development is the creation of common areas. These can be necessary aspects like halls, corridors, elevators, refuse disposal areas, entries, alleys, and garages (Turkington, et al., 2004). These can also be voluntary common areas, but they are explored as places of interaction.

Places of interaction
The places of interaction can be the social spaces in the building, the online facilities that are present in the building, and the other meeting points in the building. The specific design of the social spaces can also influence the connections between the residents. Additionally, other social activities in the building also affect the social interactions of the residents. Local facilities in the building are expected to increase the opportunities for social interaction among residents (van den Berg, et al., 2015; Völker & Flap, 2007). The creation of a community in the building depends further on the facilities that are present in the high rise residential building (Völker, et al., 2007). Other meeting places in the building could be unique to a building and will be collected during the building observations.

Building specific users
A high rise residential building can also have specific users. If the residents are already connected on a specific aspect, their chances of interactions will increase. If the building is designed for a specific user group, there might also be specific facilities present in the building. This could also affect social cohesion, interaction, and satisfaction in high rise residential buildings. In addition, the owner of the building can tell a lot about the possibility of interactions in the building and the type of residents in the building.

In total, seven building observations variables that have a relevant relation with the social connections of the resident have been identified. These are size, layout, access, social spaces, online facilities, meeting points, and building specific users. These independent variables are added to the conceptual model in Figure 3 and will be explored further in the operationalization of this research.

2.4. Resident characteristics

Dekker and Bolt (2005) found that diversity in ethnic and socioeconomic characteristics of neighborhood residents influences social cohesion in the neighborhood. Furthermore, Van den Berg et al. (2015) state that the likelihood of social interactions is associated with the characteristics of the residents. The likelihood of social interactions also increases if the residents spend more time in their building or live among likeminded neighbors (van den Berg, et al., 2015; Völker & Flap, 2007). Therefore, the characteristics of the residents of high rise residential buildings can influence social cohesion, social interaction, and social satisfaction in these buildings. The characteristics of the residents are divided into household and individual characteristics.

Household characteristics
An important aspect of the household of the resident is the composition of the household. Van den Berg et al. (2015) have found that the size of the household affects social interaction. People with children often spend more time at home, which influences their chances of having social interactions in their neighborhood (van den Berg, et al., 2015). Households with children often have more interactions with their neighbors (van den Berg & Timmermans, 2015; Völker & Flap, 2007), as children do enhance the creation of a sense of community in the neighborhood (Völker, et al., 2007). In line with these statements, French et al. (2014), have found that households without children experience a lower sense of community. The size of the household and the presence of children can also affect the social cohesion and interaction of the residents of the high rise buildings (Verhage, 2021).

Secondly, income can affect the social connections of the residents of high rise residential buildings. Van den Berg et al. (2015) argue that the frequency of social contact is lower between neighbors in low income neighborhoods. The household income could also be related to the ethnicity of the residents and affect social interactions (van den Berg, et al., 2015). Additionally, a resident with a lower income is more likely to have fewer social connections (van den Berg, et al., 2016). Furthermore, Van den Berg and Timmermans (2015) state that a higher income has a positive effect on the frequency of interactions and the size of the social network of the resident. Income also influences the social cohesion of the residents (van Dijk, et al., 2013).

Another aspect of the household that can affect social cohesion and interaction is the mobility of the resident. Households with more cars available are less likely to have local social interaction (van den Berg, et al., 2015). As stated by Van den Berg et al. (2015): "an extra car in the household decreases the odds of interaction with a local tie by 20%". Contrary to the availability of a car, walking for transportation has a positive effect on the sense of community (French, et al., 2014).

Individual characteristics

The age of the resident has been found to affect the social connections in the neighborhood (van Dijk, et al., 2013; Ellaway, et al., 2001; Völker, et al., 2007). Verhage (2021) has found that age has a significant relationship with social cohesion and interaction in high rise residential buildings, which is specifically the case for residents older than 65 years (van den Berg, et al., 2016; Verhage, 2021). Additionally, Van den Berg et al. (2015) also found a positive relationship between social interaction and age. The likelihood of social interactions is higher for older residents. Older people are more likely to spend time at home and depend more on their neighbors for their social interactions (van den Berg, et al., 2015). Elderly living in high rise residential buildings also have more local social connections (van den Berg, et al., 2016). Völker and Flap (2007) agree with these findings as older residents are more likely to have a neighbor in their social network. Van den Berg and Timmermans (2015) add that older people often have a smaller social network overall. Furthermore, age has a positive effect on the sense of community in the building (French, et al., 2014).

In correlation to the age of the resident, their health status also influences the social cohesion and interaction of the high rise residents. Older residents can have fewer social interactions due to disabilities and health issues, which could hinder the social connections of the resident with their neighbors (van Dijk, et al., 2013). Van den Berg et al. (2016) found that residents who are restricted in their daily activities can have a smaller social network. People with poor health also benefit from facilities to enhance their social connections in the building (van den Berg, et al., 2015). Furthermore, residents that require support or help may have more neighbors in their social network (Völker & Flap, 2007). On the contrary, residents with a good health status are more likely to have a higher social cohesion (van Dijk, et al., 2013; Ellaway, et al., 2001).

Gender is another characteristic of the resident that is important for this research (Verhage, 2021). It is confirmed by Van den Berg et al. (2015) that men are less likely to have social interactions in their local area and when "all else is equal, men are 0.7 times as likely as women to interact with someone living within 1 km" (van den Berg, et al., 2015). Other studies have also included gender in their research, but they did not find any significant relationships. Nevertheless, gender is an important descriptive characteristic of the resident and is therefore included in this research.

Minority residents often have social networks that are more locally oriented. In addition, a variety in ethnicity and race in the neighborhood can also affect social connections (van den Berg, et al., 2015). Völker et al. (2007) show that the percentage of ethnic minority residents negatively affects the number of neighbors in a social network and the community in the neighborhood. Furthermore, ethnic minorities have fewer social interactions in the building and often prefer to interact with neighbors of a similar ethnic background (van Dijk, et al., 2013). Dekker and Bolt (2005) also found that the ethnicity of the resident affects all the dimensions of social cohesion.

A fifth individual characteristic that can influence social cohesion and interaction is the level of education of the resident. Van Dijk et al. (2013) found that education influences social cohesion. Residents with a higher education level may have more local social connections if they live around likeminded neighbors (van den Berg, et al., 2015). Völker and Flap (2007) argue that higher educated residents are more likely to have a neighbor in their social network. However, higher educated residents can have fewer social interactions with their neighbors (van den Berg & Timmermans, 2015; Völker, et al., 2007). Residents with lower education experience more sense of community in their neighborhood (Völker, et al., 2007) and higher education leads to a lower sense of community (French, et al., 2014). The attachment to the neighborhood is also affected by the education level of the resident (Dekker & Bolt, 2005; Lewicka, 2005).

People without work or retired people are more likely to spend time at home, which increases their chances of social interactions. A variety of occupations could also affect the social connections between residents (van den Berg, et al., 2015). Additionally, full time workers are less likely to have social interactions with their neighbors (van den Berg, et al., 2015; van den Berg & Timmermans, 2015). The chance of neighbors in the social network is higher if the resident does not have a job (Völker, et al., 2007). Furthermore, retirees report a higher sense of community (French, et al., 2014). Therefore, the employment status of the resident is collected in this research.

A longer residence in the neighborhood has been found to increase social contact and social satisfaction in the neighborhood (van den Berg, et al., 2015). Van den Berg and Timmermans (2015) argue that the number of years at the residence positively affects the number of neighbors in the social network of the resident. Additionally, the length of residence also has a positive effect on the social interactions of the neighbors (van den Berg & Timmermans, 2015). The intention to leave the neighborhood has an obvious negative effect on the community, as residential stability is a community predictor (Völker, et al., 2007). The duration of the residence also positively affected the sense of community (Ellaway, et al., 2001; French, et al., 2014) and the place attachment and social contacts (Lewicka, 2005).

Finally, home ownership is an important predictor of the creation of a community in the building (Völker, et al., 2007). Home owners experience higher levels of social cohesion in their neighborhood (Dekker & Bolt, 2005; van Dijk, et al., 2013; Ellaway, et al., 2001). Furthermore, the sense of community appears to be higher in wealthier owner-occupied areas, as residents of these neighborhoods are often acting as a unified group (Forrest & Kearns, 2001). Home ownership can affect the social cohesion and interaction of the residents in a high rise residential building, which is why it is included in this research.

In total, eleven resident characteristics are identified to be relevant for this research. These are household composition, household income, resident mobility, age, health status, gender, ethnicity, education level, employment status, length of residence, and home ownership. These independent variables are added to the conceptual model in Figure 3.

2.5. Conclusion

Based on the literature research, the conceptual model from the introduction is adapted. The information obtained during the literature research can be added to make a definitive conceptual model. This definitive conceptual model for this research can be found in Figure 3. The model is expanded with the addition of social satisfaction and objective building observations. The three categories of independent variables are also further defined into 25 separate variables. The objective of this research is therefore expanded to include the building observations and the social satisfaction score.

In addition, the relationships between the dependent and independent variables are shown in the model. All independent variables can affect social cohesion, social interaction, and social satisfaction. As stated in the literature, one of the dimensions of social cohesion is the social networks of the residents (Kearns & Forrest, 2000). The frequency and satisfaction of the interactions of the resident are a part of social networks. Therefore, the dependent variables social interaction and social satisfaction can influence the social cohesion score of the resident. These relationships are also defined in the definitive conceptual model in Figure 3. The data analysis will determine if these relationships are significant and therefore relevant.

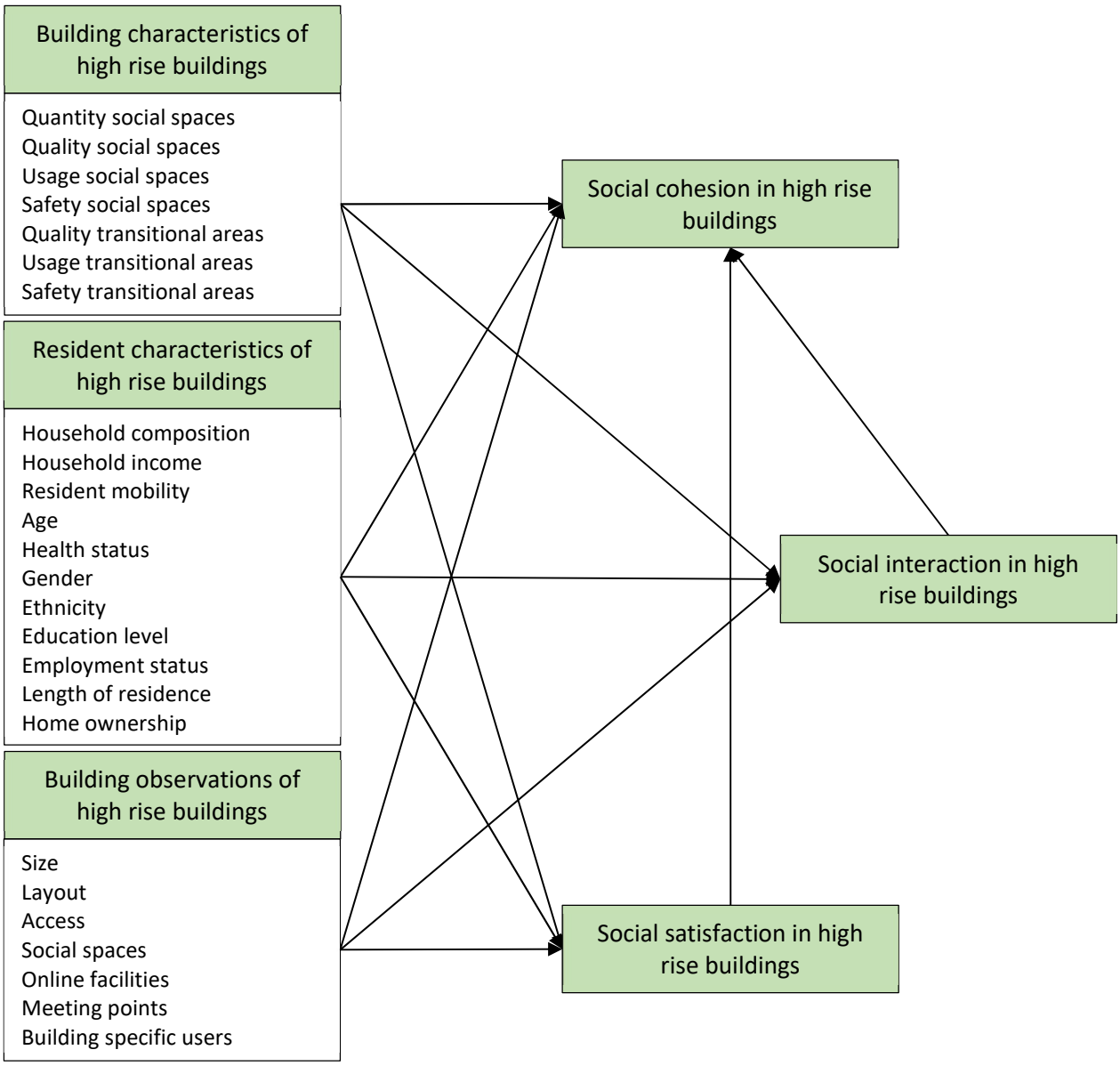


Figure 3. Definitive conceptual model based on the literature research.

3. Methodology

The literature research concludes with the definitive conceptual model in Figure 3. This model includes the three dependent variables: social cohesion, social interaction, and social satisfaction. The independent variables in the model are divided into three categories: building characteristics, resident characteristics, and building observations. The goal of this research is to test and analyze all the relationships between the variables in the model. Specific data will be collected to answer the research question. In this chapter, the methodology of this research is explained. The chapter starts with an explanation of the used data collection methods and continues with the operationalization of the variables. The data collection consists of a survey for residents of high rise residential buildings and observations of these high rise buildings. The definitive operational model for this research is shown in section 3.3. Afterwards, the collection of the data will be explained. The chapter concludes with the statistical analysis methods that will be used to analyze the data in the rest of the research.

3.1. Data collection methods

This research is a quantitative research with an exploratory character. The goal of the research is to find relationships between social cohesion, social interaction, and social satisfaction in high rise residential buildings and the characteristics of the building and residents of these high rise buildings. This research is a cross-sectional analysis, as the data of all the variables are collected at one given point in time. The main goal of the research approach is to gather information about high rise buildings and the living environment of their residents. Through a survey for the residents and observations about the high rise building, a large amount of data can be acquired quickly and efficiently.

A survey is designed for this research to gather data on social cohesion, social interaction, and social satisfaction in a high rise residential building. The survey can also obtain perceptions about the building and information about the residents of the building. Additional building information will be collected through observations of the buildings during the distribution of the survey. Gaps in the building information will be filled in with online research. The data will be collected in two separate ways and merged into one definitive dataset at the end of the data collection.

3.1.1. Survey for high rise residents

The survey for the high rise residents is based on the survey of Verhage (2021), who collected data about social cohesion and interaction in high rise residential buildings and the neighborhood. However, this research will collect new data and Verhage's research will only serve as a reference. The goal of the data collection for this research is to find out as much as possible about the high rise building, which was not sufficient in the available data. Furthermore, Verhage (2021) looked at social cohesion and interaction in the neighborhood and the building. The respondents found it hard to differentiate between these two places, which could have influenced the data. Based on the respondents' feedback, the survey for this research will be compact, to reduce the impact the survey will have on the respondent. How each aspect of the research can be measured will be described in the operationalization in section 3.2.

The survey is made with LimeSurvey and consists of six parts, which will be explained below (LimeSurvey, 2021). It is available in both English and Dutch, to make it as accessible as possible for the respondents. The complete survey in English can be found in Appendix II and in Dutch in Appendix III. The survey starts with the front page, which features a short introduction to the research and the survey privacy and data policy. Each research with human participants or recognizable data of individuals has to protect the privacy of the respondents. The General Data Protection Regulation (GDPR) requires researchers to provide transparency to the respondents about their personal data and the security of the data.

At the Eindhoven University of Technology, each research project with personal data has to be approved by the Ethics Review Board (TU/e, 2022). The approval of this research can be found under the reference ERB2021BE59. For this research, each participant has to accept the survey data policy and give their consent before they can participate in the survey. The full data policy can be found in English in Appendix II and in Dutch in Appendix III. The collected data will include personal aspects of the participants and has to be stored safely. This is done by using SURFdrive for the data, which is a safe solution and is approved by the university.

When the respondent accepts the data policy, the survey continues. The first part of the survey is about the building and the social spaces and traffic areas in the building. This part also asks for the postal code of the respondent, which is needed for identifying which building the respondent is from. The second part of the survey is about the social interaction and social satisfaction between the residents in the building. The next part is about the social connections in the building. Part four is about some general household characteristics and part five is about some general individual characteristics. The measurement of these parts will be explained below. The final part of the survey has room for additional remarks by the respondent, after which the answers can be submitted. In total, the survey will take the respondent about five minutes to complete (LimeSurvey, 2021). To prevent missing data, the survey is made mandatory and a no answer option is added to all questions. Any no answers or possible missing data are recoded during the data preparation and data description in chapter 4.

3.2. Operationalization

The operationalization explains how all the variables in the conceptual model are measured. Most of the data is collected through a survey for residents of high rise buildings. The social cohesion, social interaction, and social satisfaction of the resident are collected with questions in the survey. This is also the case for the building characteristics and resident characteristics. Additional information about the buildings is collected through observations at the locations and online research.

3.2.1. Social cohesion

The social cohesion of the resident in a high rise building is measured with the Neighborhood Cohesion Instrument (NCI), which is developed by Buckner (1988). The name of the method implies that it is developed to use for analysis in a neighborhood, however the instrument can be applied to all kinds of communities (Buckner, 1988; Wilkinson, 2007). A high rise residential building is also a specific community, so the NCI is suited for measuring social cohesion in high rise residential buildings. The questions in the model do have to be adapted to a building scale instead of a neighborhood scale. The NCI by Buckner (1988) consists of 18 items, which are adapted by Verhage (2021) to research the social cohesion in a high rise residential building.

The questions that will be used to measure social cohesion in high rise buildings are:

1. I feel like I belong to this building.
2. The friendships and associations I have with other people in my building mean a lot to me.
3. If the people in my building were planning something I'd think of it as something "we" were doing rather than "they" were doing.
4. I think I agree with most people in my building about what is important in life.
5. I feel loyal to the people in my building.
6. I would be willing to work together with others on something to improve my building.
7. I like to think of myself as similar to the people who live in this building.
8. A feeling of fellowship runs deep between me and other people in this building.
9. Living in this building gives me a sense of community.
10. Overall, I am very attracted to living in this building.
11. Given the opportunity, I would like to move out of this building.
12. I plan to remain a resident of this building for a number of years.
13. I visit my neighbors (in this building) in their homes.

14. If I needed advice about something I could go to someone in my building.
15. I believe my neighbors (in this building) would help me in an emergency.
16. I borrow things and exchange favors with my neighbors (in this building).
17. I rarely have neighbors (in this building) over to my house to visit.
18. I regularly stop and talk with people in my building.

The respondents of the survey have to answer to what extent they agree or disagree with these 18 statements. The answer options are: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree, and no answer. The answer range from strongly disagree to strongly agree is a 5-point Likert scale. A Likert scale is used because these questions are about the experience of the respondent and this scale was developed to quantify feelings (Deckelmann, 2021; McLeod, 2019). There is also a no answer option if the respondent does not wish to answer the question.

The research will only use an overall social cohesion score, which is calculated by summing up the scores of all 18 questions with equal weighting. The scores for the questions can be between 1 for strongly disagree to 5 for strongly agree. The social cohesion score can therefore range from 18 points to 90 points. A higher score equals a higher social cohesion among the residents. Questions 11 and 17 are negatively toned and will conflict with the positive tone of the other questions. Therefore the answers to these questions need to be flipped to suit the rest of the data (Buckner, 1988).

3.2.2. Social interaction

The social interaction of the resident in a high rise residential building is measured with the sum of seven questions. These questions are about how often the respondent has social interactions with their neighbor in their building. These questions are based on the research of Verhage (2021) and are derived from the research of Rogge et al. (2018) and Sugiyama et al. (2008). The survey questions differentiate between social interactions in the social spaces of the high rise building and social interactions in the transitional or traffic areas of the high rise building (Rogge, et al., 2018; Sugiyama, et al., 2008; Verhage, 2021).

The questions that will be used to measure social interaction in high rise buildings are:

1. How often do you greet your neighbors in social spaces in your building (e.g. shared garden, roof terrace, seating areas)?
2. How often do you greet your neighbors in traffic areas in your building (e.g. entrances, corridors, elevators)?
3. How often do you stop to talk with a neighbor in social spaces in your building (e.g. shared garden, roof terrace, seating areas)?
4. How often do you stop to talk with a neighbor in traffic areas in your building (e.g. entrances, corridors, elevators)?
5. How often do you have people from your building come over to your home?
6. How often do you visit people in your building in their homes?
7. How often do you engage in social activities in your building?

The respondents of the survey have to answer how often they are in the situations stated in the seven questions. The answer options are on a specific scale from almost never to almost daily. All answer options are: (almost) never, 1 time per month, 2 - 3 times per month, 1 time per week, 2 - 5 times per week, (almost) daily, and no answer. Van den Berg and Timmermans (2015) used a similar scale to collected data about the frequency of interactions of the respondent with their neighbors. The no answer option can be used by the respondent if they do not wish to answer the question or do not have a social space in their building. This research will only use an overall social interaction score, which is calculated by summing up the scores to the seven questions with equal weighting. The scores for the questions can be between 1 for (almost) never to 6 for (almost) daily. The social interaction score can therefore range from 7 points to 42 points and a higher score equals a higher frequency of social interactions.

3.2.3. Social satisfaction

The social satisfaction of the resident in a high rise building is measured with the survey question: how satisfied are you with your social exchanges with the people in your building? The respondents of the survey can answer the question on a scale of 1 through 10, from very unsatisfied to very satisfied. There is also a no answer option if the respondent does not wish to answer the question, which will be recoded during the data description. The answer to this question is the social satisfaction score of the resident of which a higher score equals a higher social satisfaction of the resident.

3.2.4. Building characteristics

The building characteristics are collected with seven questions in the survey, which translates into seven independent variables. The building characteristics of a high rise residential building are divided into four questions about the social spaces and three questions about the transitional areas. Social spaces are places where people come together intentionally and places for recreation, while transitional areas are traffic areas in the building. The respondent has to indicate how much they agree with the statements from these seven questions.

The four questions about the social spaces in a high rise residential building are:

1. I am satisfied about the quantity of social spaces in my building.
2. I am satisfied about the quality of the social spaces in my building.
3. The social spaces in my building are frequently used.
4. I feel safe in the social spaces in my building.

The three questions about the traffic areas in a high rise residential building are:

5. I am satisfied about the quality of the traffic areas in my building.
6. The traffic areas in my building are frequently used as places to stay.
7. I feel safe in the traffic areas in my building.

The respondents of the survey have to answer to what extent they agree or disagree with these seven statements. The answer options are: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree, and no answer. The answer range from strongly disagree to strongly agree is a 5-point Likert scale, which is used to quantify the experience of the respondent (Deckelmann, 2021; McLeod, 2019). There is also a no answer option, if the respondent does not wish to answer the question or if there is no social space in their building. The missing data from these questions will be recoded during the data description.

3.2.5. Resident characteristics

The resident characteristics are divided into household and individual characteristics in the survey. There are 11 questions in the survey, which will translate into 11 independent variables for the resident characteristics. The household composition is assessed with the survey question: what is the composition of your household? The answer options are single person household, couple without resident children, couple with resident children, single parent household, other, and no answer.

Household income is assessed with the survey question: what is your household's monthly net income? The answer options are less than €1000 a month, €1001 - €2000 a month, €2001 - €3000 a month, €3001 - €4000 a month, more than €4001 a month, I do not know, and no answer. The monthly net income for a household is the sum of all sources of income for the residents. The mobility of the resident is measured by the availability of a car. Car availability corresponds with the survey question: does your household have a car available? The answer options are yes, one car, yes, more than one car, no, and no answer.

The individual characteristics are a separate part of the survey. The age of the respondent is asked with the survey question: what is your age? The answer options are 18 - 24 years old, 25 - 34 years old, 35 - 44 years old, 45 - 54 years old, 55 - 64 years old, 65 years or older, and no answer. The health status of the respondent is assessed with the survey question: how would you describe your health? The answer options are poor, fair, good, very good, excellent, and no answer. This scale is based on the research of Van Dijk et al. (2013) and Verhage (2021).

The gender of the respondent is obtained with the survey question: what is your gender? The answer options are male, female, non-binary, and no answer. Ethnicity is adapted as it can easily lead to profiling of the respondent based on their ethnicity. Society and professional publications are currently moving away from this definition (CBS, 2022). Therefore, ethnicity is changed to birth region, which is a more scientific definition and will not implicate a profiling bias. The birth region is asked with the survey question: what is your birth country or region? The answer options are Netherlands, Europe, North America, South America, Africa, Asia, Oceania, and no answer.

Education level corresponds with the survey question: which degree have you completed? The answer options are primary school or less, MAVO / VMBO / lower vocational education, secondary vocational education, HAVO / VWO, higher professional education / bachelor's degree, university master's degree, and no answer. Employment status is checked with the survey question: what is your employment status? The answer options are employed full-time (36 + hours per week), employed part-time (12 - 35 hours per week), employed part-time (less than 12 hours per week), student, unemployed, and retired. This question is a multiple choice question because a respondent could have more than one job.

The length of residence is measured as the amount of time the resident has been living in the building. This is measured with the survey question: for how many years have you been living in this building? This is an open question where the respondent can only enter numbers. Home ownership is asked with the survey question: do you live in an owner-occupied dwelling or in a rented dwelling? The answer options are owner-occupied dwelling, rented dwelling, and no answer. The missing data or no answers for these questions will be recoded during the data description in chapter 4.

3.2.6. Building observations

The building observations are the objective characteristics of the high rise residential buildings which are collected during the distribution of the survey for the residents. Any gaps in the data will be filled in with online research. Seven aspects of the building which have a relation with social cohesion, interaction, and satisfaction are observed, which results in 17 independent variables for this research. All captured building information is displayed in Appendix VIII.

For the size of the building the number of floors, the number of apartments, and the number of apartments per floor are noted. Afterwards, the collected data will be divided into different categories. The number of floors is divided into 8 floors or less, between 9 and 12 floors, between 13 and 19 floors, and more than 20 floors. The number of apartments has a scale from less than 50, between 51 and 100, between 101 and 150, and more than 150 apartments. The apartments per floor can be less than 5, between 5 and 10, and more than 10.

The layout of the building looks at the shape of the building and the number of duplicate buildings. The shape of the building can be either rectangular or more centered, which translates into the answer options: elongated and squarish. In city development copying buildings is very common, to speed up development and reduce costs. Therefore it is noted if there are duplicate buildings and how many duplicate buildings there are, which can be two, four, five, or six buildings.

Access to the building notes the number of entrances and the access to the apartment in the building. The number of entrances can be between one and four. The access of the apartment has five answer categories: core, cores, cores with gallery, gallery, and corridor. Each of these provide information about where residents can interact with each other. If the access to the apartment is from one point, then it is a core. If the access to the apartment is along a line, then it is a corridor or gallery. A corridor is inside the building, while a gallery is on the outside of the building.

With the social spaces in the building, it is noted if a social space is available in the building and what type of space it is. A social space is a designated space that can be used for socializing between the residents. The type of social space can be a common room, entrance, gym, shared garden, shared rooftop, or none at all. For the online facilities, it is also noted if they are available and what kind of type it is. The type of online facilities can be a specific app, Facebook group, Whatsapp group, or none at all.

The meeting points in the building where residents can interact are divided into plinth activities, the location of the mailboxes, car parking facilities, and private balconies. The plinth activities are observed during the distribution of the surveys and are divided into eight options, which can be businesses, care facilities, housing, housing and businesses, housing and storage, other housing, social space, and storage. The location of the mailboxes can be either inside or outside of the building, which can also be a meeting point for the residents. The car parking facilities can be in the basement or ground level of the building. It can also be in an additional parking complex or on the street. Private balconies can negatively affect the interactions between the residents. The answer options for the private balconies are yes, no, or some.

The final aspect of the building that is observed are the specific users of the building. This is divided into the ownership of the building and specific building type. The owner of the building has 13 answer options: Hartje Eindhoven, Holland2Stay, Holland2Stay with VVE, NMG Wonen, Rentberry, Sint Trudo, Vb&t, Vb&t with VVE, Vestide, VVE, Woonbedrijf, Wooninc, and SeniorenPunt Basis. Building ownership also relates to a specific building type, as the building can be designed specifically for students or older residents.

3.3. Operational model

The conceptual model is operationalized and the definitive operational model that is used in this research can be found in Figure 4. This model shows the independent and dependent variables that will be used in the statistical research analysis. For this research, there are 35 independent variables which are divided into three groups: building characteristics, resident characteristics, and building observations. There are also three dependent variables in this research: social cohesion, social interaction, and social satisfaction. The relationships that are shown between these variables are analyzed during the statistical analyses.

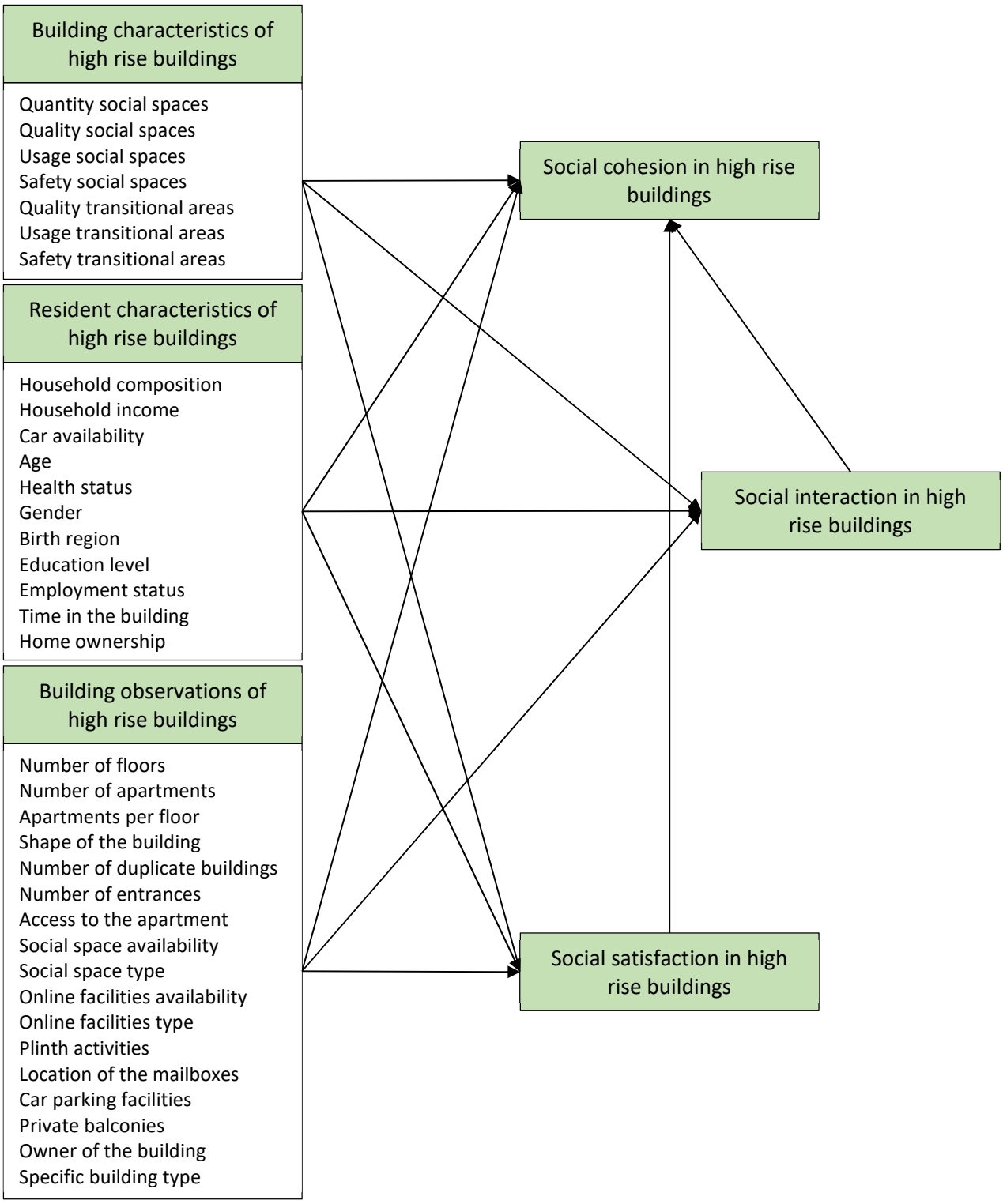


Figure 4. Operational model for this research.

3.4. Data collection

The data on social cohesion, social interaction, and social satisfaction as presented in Figure 4 is collected with a survey. The resident characteristics and building characteristics are also collected with the survey. The building observations are collected during the survey distribution. Firstly, the research area and research buildings have to be defined, which results in a research sample with 44 high rise residential buildings. Afterwards, the distribution of the survey among residents in these buildings and the definitive dataset are explained. In the end, the reliability and validity of the data are discussed.

3.4.1. Research area and buildings

For this research, the level of analysis is the individual and the unit of analysis is the resident of a high rise building. It is not feasible to approach every individual that fits into these categories. Therefore, a research sample is established to test the operational model of this research.

Research area

The city chosen for this research is Eindhoven in the Netherlands. High rise development is peaking in Eindhoven. The city has a lot of high rise buildings and this is increasing quickly. It was less than four years ago that Eindhoven was on the eve of a high rise explosion (Theeuwen, 2018). The skyline of Eindhoven is growing. Even the region around the city, Brainport, is expanding into a metropolitan area. This is also translating into high rise developments like Haasje Over and Trudo Toren (Allpro, 2020). The municipality of Eindhoven even branded the development of the city center with a name: Knoop XL (Gemeente Eindhoven, 2021). An impression of the development of Knoop XL can be found in Figure 5. Eindhoven is on track to become an international hub. The city even has its own high rise development plan (Stichting Hoogbouw, 2020). In the next 20 years, high rise buildings will be built and public urban space will be developed. The goal is to retain the growth of Brainport and keep the city energetic, accessible, and livable (Gemeente Eindhoven, 2021).

Figure 5. Impression of the development of Knoop XL in Eindhoven (Gemeente Eindhoven, 2021).

This research aims to create a methodology that can be used in different cities in further research, so a general definition of a high rise building is needed. By looking at the regulations of the government, high rise buildings can be defined as buildings with more than five floors. Buildings with more than five floors have an accessibility standard and are required to have an elevator (Ministerie BZK, 2022). This is a clear cut off line for this research while also taking into account the different heights of high rise buildings, which are more common in the city development of Eindhoven. Therefore, this research will be conducted in high rise buildings with more than five floors in the city of Eindhoven in the Netherlands.

Research buildings

There are a lot of high rise buildings in Eindhoven, with many different usages. In this research, only high rise residential buildings are used. While high rise buildings are also often used for hotels, care facilities, offices, and educational facilities, these buildings are excluded from this research. Furthermore, buildings that have too much mixed use will not be used in this research. This could affect the results and therefore these buildings are excluded from the list of research buildings. The activities in the plinth do not have to be residential, as most high rise buildings tend to have different activities on their ground floor.

A list of suitable high rise buildings for this research was compiled using different sources, to make sure the list would be as complete as possible. As this research extends the research done by Verhage (2021), that list of high rise buildings was the beginning for this research. Google Maps was the main source of the information, especially with the 3D view (Google, 2021). It was used to fly over the city and identify suitable high rise buildings. Within Google Maps it is also possible to make your own map, highlight important locations, and share it with others. There are already two maps that highlight high rise buildings in Eindhoven: 'Hoogbouw in Eindhoven' and 'Bouwprojecten Eindhoven' (Google My Maps, 2022). Both of these also contributed to the list of suitable high rise buildings. Another 3D map made with the land registry highlighted other possible research buildings (Kadaster, 2021). This leads to a list of 138 possible high rise buildings, which can be found in Appendix IV. A visual representation of these buildings is made with Google My Maps (2022) named 'High rise buildings' and is shown in Figure 6.

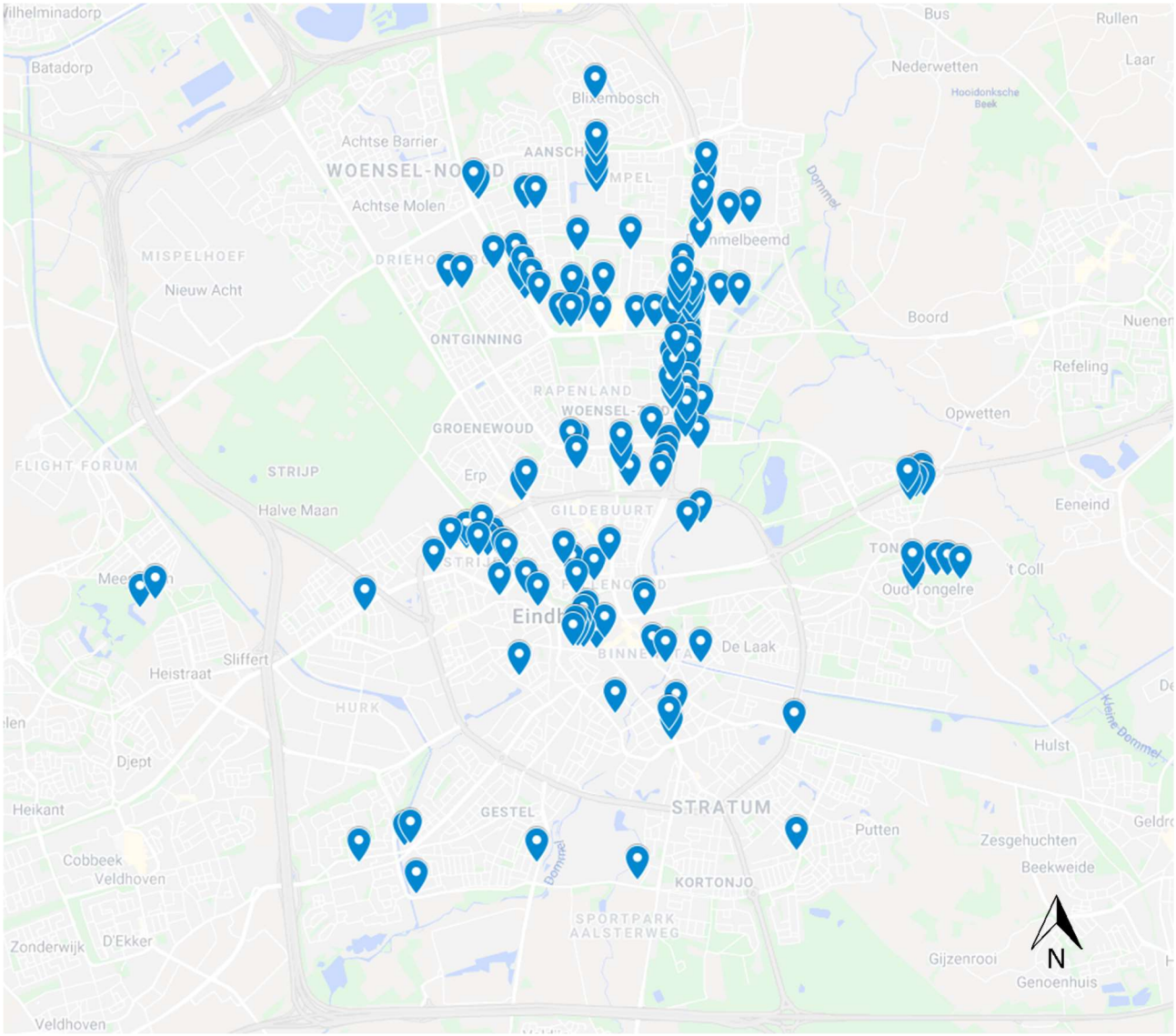


Figure 6. All possible high rise buildings for this research in Eindhoven (Google My Maps, 2022).

A selection of the possible high rise buildings has to be made, as 138 buildings are not feasible for this research. The first step was excluding full-time nursing homes. These facilities are often in high rise buildings but also have created their own social environment. These buildings are specifically designed for the health of the residents, which includes their social interactions. This is not in line with the objective of this research. However, housing specifically designed for the elderly and senior housing is suitable (SeniorenPunt, 2022). Age is an important factor in social cohesion and interaction in a high rise building, so it is important to include senior housing.

Secondly, buildings can be duplicated when a city is expanding quickly. Of all these identical buildings, only one high rise residential building will remain on the list of research buildings. Another criterion is that there needs to be a variation in the building characteristics, as they are an important aspect of this research. The goal is to have a list of research buildings that are as diverse as possible. The final list of research buildings will have high rise residential buildings with different layouts, designs, building years (Kadaster, 2022), heights, and inhabitants.

The final criterion is that the buildings have to be located throughout the city. In the survey, the buildings will be identified with their postal code. Buildings with the same or nearly the same postal code are not advisable. In that case, it would not be possible to identify in which building the respondent lives. Therefore, all high rise buildings in the research sample have a unique postal code. If there were multiple buildings with the same postal code, only one building can be included in this research. This leads to a list of research buildings of 42 high rise buildings in Eindhoven that are suitable for this research. During the evaluation of this list, it was noted that it was missing some buildings with unique building characteristics. Two additional high rise buildings with shared spaces are therefore added to the list of research buildings. The final list of research buildings consists of 44 high rise residential buildings in Eindhoven. A map of the selected high rise buildings is made with Google My Maps (2022). Figure 7 shows the map with the 44 selected high rise buildings and their corresponding number. Table 1 lists the buildings with their number and name. The full addresses of these high rise buildings can be found in Appendix IV.

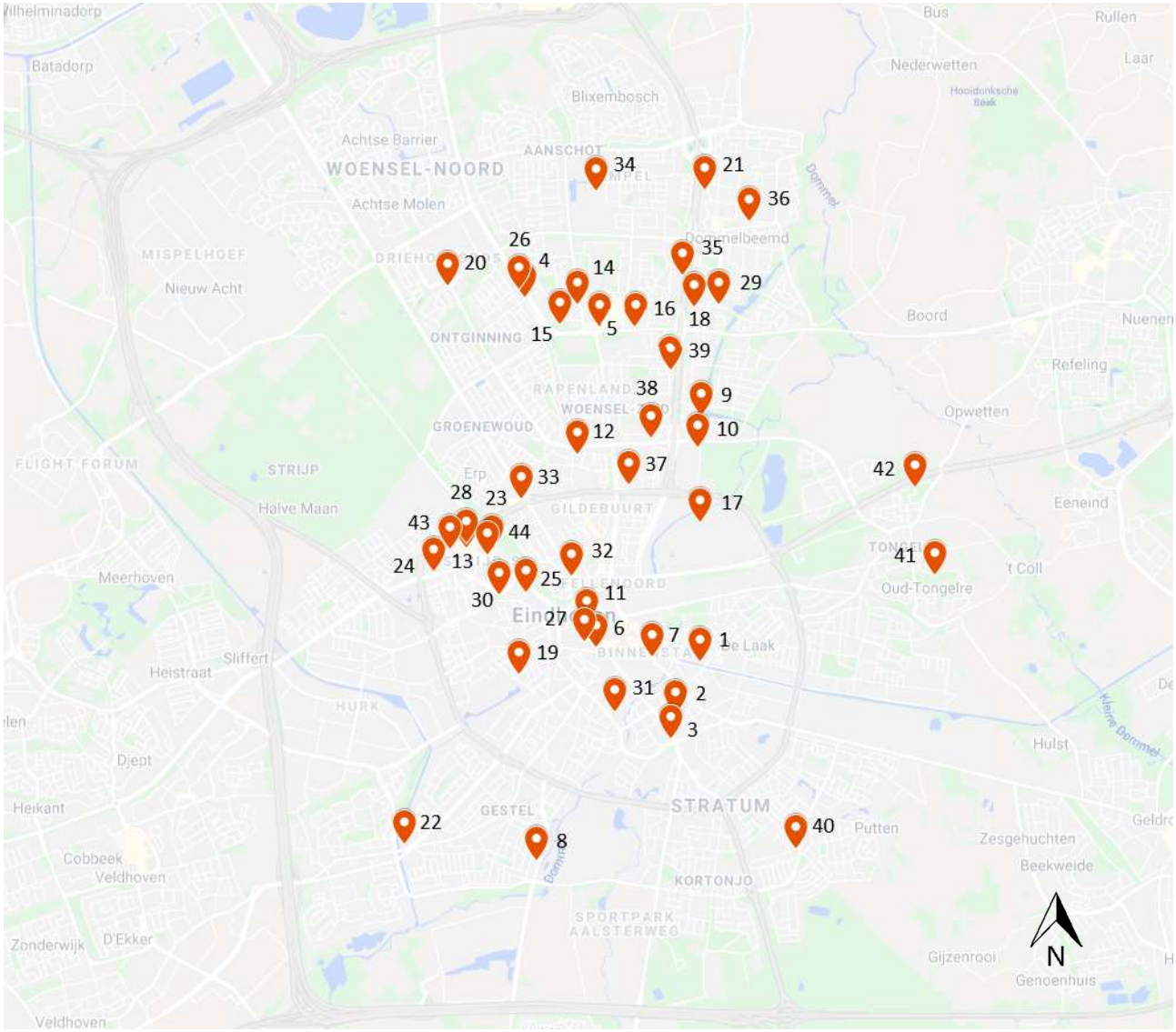


Figure 7. The 44 selected high rise building with their corresponding numbers (Google My Maps, 2022).

Table 1. The 44 selected high rise buildings with their number and name.

1	Treurenburgstraat	16	Apostelflat II	31	Cornelis Paradise
2	De Hertoghof	17	Aurora	32	Boschdijk I
3	Elzentlaan	18	Artemis	33	Boschdijk II
4	Gerretsonplein	19	Grote Graaf	34	Houthalenlaan
5	Porthos	20	Die Fledermaus	35	Heeghtakker
6	De Regent	21	De Koppele	36	Amandelpoort
7	Vestedatoren	22	Messiaenpark	37	Gunsele
8	Winter	23	Philitelaan	38	Willemsenflat
9	De Ranken	24	Cederlaan	39	Generaal Wicherslaan
10	De Parade	25	Hartje New York	40	Kalmoesplein
11	Onyx Tower	26	Doctor Hermansweg	41	Urkhovenseweg
12	Mgr. Swinkelsstraat	27	De Graaf	42	Vlinderflat
13	Anton	28	Haasje Over	43	Space-S blok 5
14	Badelochstraat	29	Andromedaplaats	44	Trudo Toren
15	Apostelflat I	30	Philips Bedrijfsschool		

3.4.2. Survey distribution

The inhabitants of the selected high rise buildings were approached for the digital survey with an invitation in their mailbox. The invitation for the survey was designed to have an inviting look (Allpro, 2020), which would hopefully result in more responses to the survey. There is also general information about the research and the researcher on the invitation. The inhabitants can use the QR code or website link to go to the digital survey (Gratis QR, 2021; LimeSurvey, 2021). The invitation for the survey is shown in Appendix V.

The invitations for the first 42 buildings were distributed between 7 December and 10 December 2021. The two additional buildings were approached on 10 January 2022. These buildings had the same postal codes as buildings in the first round of invitations. Therefore, data from these two buildings were collected at a later date. All responses after 10 January with these postal codes are assumed to be about these two buildings. The survey was closed on 26 January 2022. The survey was distributed to 4414 addresses in 44 high rise residential buildings in Eindhoven. There are 439 responses in total, which is a response rate of almost 10%. The collected data from the survey is exported to SPSS.

During the survey distribution, the building information is also collected. Appendix VIII shows all the collected building information. This is defined by the variables of the building observations and is also converted to SPSS. Afterwards, the survey data and the building data are combined into one dataset in SPSS.

3.4.3. Definitive dataset

The dataset with the 439 responses is merged with the information about the building observations, which is collected per building. As shown in Figure 7 and Table 1, each of the 44 high rise buildings has a number. The postal code of the building in the survey is used to match the response to the corresponding high rise building. Not all responses have a correct postal code, so these 59 responses were excluded from the dataset. After that 380 responses remain, which is a response rate of 8.6%. However, only complete responses can be used in this research. An additional 25 incomplete responses are removed, which means that there are 355 usable responses in the dataset. This corresponds with 8.0% of the 4414 distributed surveys. Table 2 shows the response rate and usability rate of the collected data per high rise building. The collected data will be prepared and recoded for the analyses during the data description in chapter 4.

Table 2. Response rate and usability rate of the collected data.

Building		Approached apartments	Responses	Response rate	Usable responses	Usability rate
1	Treurenburgstraat	76	9	11.8%	9	11.8%
2	De Hertoghof	175	21	12.0%	19	10.9%
3	Elzentlaan	44	10	22.7%	10	22.7%
4	Gerretsonplein	60	3	5.0%	3	5.0%
5	Porthos	108	13	12.0%	13	12.0%
6	De Regent	102	10	9.8%	8	7.8%
7	Vestedatoren	46	8	17.4%	8	17.4%
8	Winter	58	6	10.3%	5	8.6%
9	De Ranken	60	8	13.3%	8	13.3%
10	De Parade	48	11	22.9%	11	22.9%
11	Onyx Tower	136	9	6.6%	8	5.9%
12	Mgr. Swinkelsstraat	36	3	8.3%	2	5.6%
13	Anton	148	16	10.8%	16	10.8%
14	Badelochstraat	80	2	2.5%	2	2.5%
15	Apostelflat I	72	4	5.6%	4	5.6%
16	Apostelflat II	54	1	1.9%	1	1.9%
17	Aurora	225	9	4.0%	6	2.7%
18	Artemis	40	3	7.5%	2	5.0%
19	Grote Graaf	90	9	10.0%	9	10.0%
20	Die Fledermaus	82	4	4.9%	4	4.9%
21	De Koppele	90	9	10.0%	9	10.0%
22	Messiaenpark	37	2	5.4%	2	5.4%
23	Philitelaan	156	15	9.6%	15	9.6%
24	Cederlaan	227	20	8.8%	20	8.8%
25	Hartje New York	110	13	11.8%	9	8.2%
26	Doctor Hermansweg	124	17	13.7%	17	13.7%
27	De Graaf	92	4	4.3%	3	3.3%
28	Haasje Over	185	17	9.2%	17	9.2%
29	Andromedaplaats	100	7	7.0%	7	7.0%
30	Philips Bedrijfsschool	437	30	6.9%	28	6.4%
31	Cornelis Paradise	158	12	7.6%	12	7.6%
32	Boschdijk I	110	4	3.6%	4	3.6%
33	Boschdijk II	48	4	8.3%	2	4.2%
34	Houthalenlaan	32	5	15.6%	4	12.5%
35	Heeghtakker	60	4	6.7%	4	6.7%
36	Amandelpoort	114	3	2.6%	3	2.6%
37	Gunsele	40	9	22.5%	9	22.5%
38	Willemsenflat	85	5	5.9%	4	4.7%
39	Generaal Wicherslaan	32	2	6.3%	2	6.3%
40	Kalmoesplein	42	11	26.2%	11	26.2%
41	Urkhovenseweg	112	8	7.1%	7	6.3%
42	Vlinderflat	48	1	2.1%	1	2.1%
43	Space-S blok 5	110	9	8.2%	9	8.2%
44	Trudo Toren	125	10	8.0%	8	6.4%
Total		4414	380	8.6%	355	8.0%
No postal code / incomplete			59	1.3%	84	1.9%
Total		4414	439	9.9%	439	9.9%

3.4.4. Reliability and validity

The reliability and validity of the data for this research explain the quality and usefulness of the results. The reliability indicates the ability of the chosen research methods to measure the data consistently. It is also a prerequisite for the validity of the data (Ho, 2014). In this research, several factors might affect the reliability of the results. Firstly, the survey data that is collected has the possibility of errors, as environmental factors could have influenced the answers of the respondents. Respondents answered the survey in their own time, which was not monitored. So, there was no control over whether the survey was filled in individually and truthfully. However, the survey questions are mandatory, so the risk of incomplete or incorrect surveys is low.

Secondly, the content and structure of the survey could have influenced the answers of the respondents. Therefore, the survey is designed specifically to prevent biased responses. All answer options range from negative to positive and no difficult terminology is used in the questions. The survey also begins with the difficult questions, to address the attention span of the respondent. Additionally, the survey is concise and available in English and Dutch, to make it as easy as possible to fill in for the respondents.

The validity of the data can be split between internal and external validity. For internal validity, the survey questions should represent what they are expected to represent. The survey questions are all formalized straight forward with existing measurement scales. The building observations are also collected with simple answer scales. This is all prepared during the operationalization, so the results of this research are internally valid. For external validity, the data should represent a generalization of the research, but also be representative of the research sample. This research is performed in only one city with high rise buildings, so the results are only valid for this city. However, the chosen research buildings are as diverse as possible and therefore are representative of the research sample. The external validity can be improved with additional further research in other research areas.

3.5. Statistical analysis methods

Statistical analyses are used to test all the relationships shown in the operational model in Figure 4. Two different statistical analysis methods will be used in this research: bivariate analyses and regression analyses. These analyses are performed with the software IBM SPSS Statistics 25.

Firstly, bivariate analyses are performed to identify the variables that have a significant relationship with one of the dependent variables. Only these variables will be included in the dataset to reduce the complexity of the regression analyses. Different types of statistical tests can be used during the bivariate analyses, it all depends on the measurement levels of the variables. In this research, the relationship between an independent variable and a dependent variable is tested with one of these three tests: an independent t-test, a one-way ANOVA, or a Pearson's correlation. The bivariate analyses are conducted in chapter 5.

Secondly, multiple regression analyses are performed with the significant variables found in the bivariate analyses. Where the bivariate analyses analyze the relationship between one independent variable and one dependent variable, the regression analyses analyze the relationship between all significant independent variables and one dependent variable. The regression analyses are conducted with the stepwise method. The significant independent variables are added to the model one by one. The final model will only have the independent variables that stay significant when taking into account all significant independent variables. The results of the regression analyses are the final model of this research. These results are used in answering the research questions. The regression analyses are conducted in chapter 6.

3.6. Conclusion

The goal of this research is to find out how building characteristics, resident characteristics, and building observations influence social cohesion, social interaction, and social satisfaction in high rise residential buildings. The methodology is formulated to answer this research question. Data is collected with two methods: a survey for the residents of high rise residential buildings and objective observations of these high rise buildings. The operationalization of the variables leads to the operational model for this research shown in Figure 4. The data is collected at 44 high rise residential buildings throughout the city of Eindhoven. There are 355 valid responses from the 4414 distributed surveys, which is a response rate of 8.0%. The reliability and validity of the data are also taken into account during the collection of the data. The final dataset will be analyzed with two statistical analysis methods: bivariate analyses and regression analyses. These will test the relationships defined in the operational model in Figure 4. The following chapters will describe and analyze the collected data to answer the main question of this research.

4. Data description

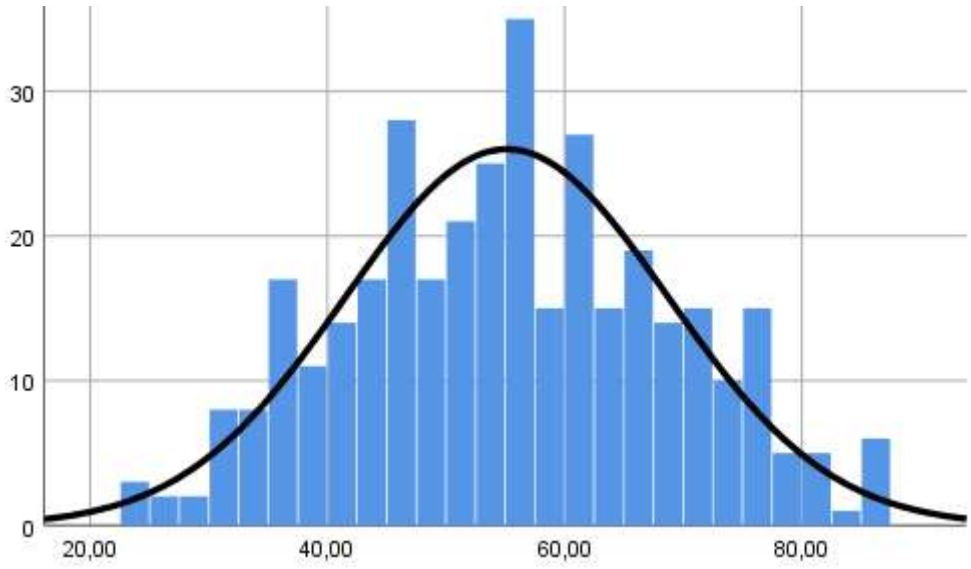
The definitive operational model in Figure 4 consists of 35 independent variables and three dependent variables. This chapter will describe the data for all the variables of this research. The three dependent variables are social cohesion, social interaction, and social satisfaction. The independent variables are divided into seven building characteristics variables, 11 resident characteristics variables, and 17 variables of the building observations. Appendix VI shows the full data preparation for the research. This includes the bar charts and the recoding of each variable. The data description will also explain the level of measurement for each variable (Scribbr, 2022). The data collection in section 3.4 showed that 355 valid responses can be used in the statistical analyses.

4.1. Social cohesion

Social cohesion is one of the three dependent variables in this research. The social cohesion score for each respondent is calculated with the 18 questions from the survey. Each question can be scored between 1, strongly disagree, and 5, strongly agree. There is also a no answer option with a value of 6. A visualization of the answers to the 18 questions can be found in Appendix VI. For each question, a bar chart with the answers is shown. All questions do have some no answer, which have to be recoded. There is no apparent relationship between the no answers, so it is possible to recode the collected data and keep all the questions about social cohesion.

During the recoding, the no answers are removed and changed into the average answer of the respondent to the other social cohesion survey questions. The recoded 18 questions are then used to calculate the social cohesion score for each respondent, which is the sum of the 18 questions with an equal weighting.

The data description for the social cohesion score is shown in Figure 8. To test if the social cohesion score is reliable, Cronbach's Alpha is calculated. Cronbach's Alpha is used to measure the degree of internal consistency between the 18 social cohesion survey questions (Scribbr, 2022). The Cronbach's Alpha for the social cohesion score is 0.924, which is near 1, and therefore the internal consistency is excellent. The Cronbach's Alphas if an item is deleted are also between 0.916 and 0.924. It can be confirmed that the social cohesion score is reliable and can be used for the analyses. A histogram of the social cohesion score is also shown in Figure 8. The level of measurement for the social cohesion score is ratio.



Description
Number of items = 18
Cronbach's Alpha = 0.924
Minimum = 22.81
Maximum = 87
Mean = 55.12
Std. dev. = 13.619

Figure 8. Histogram and data description for the social cohesion score.

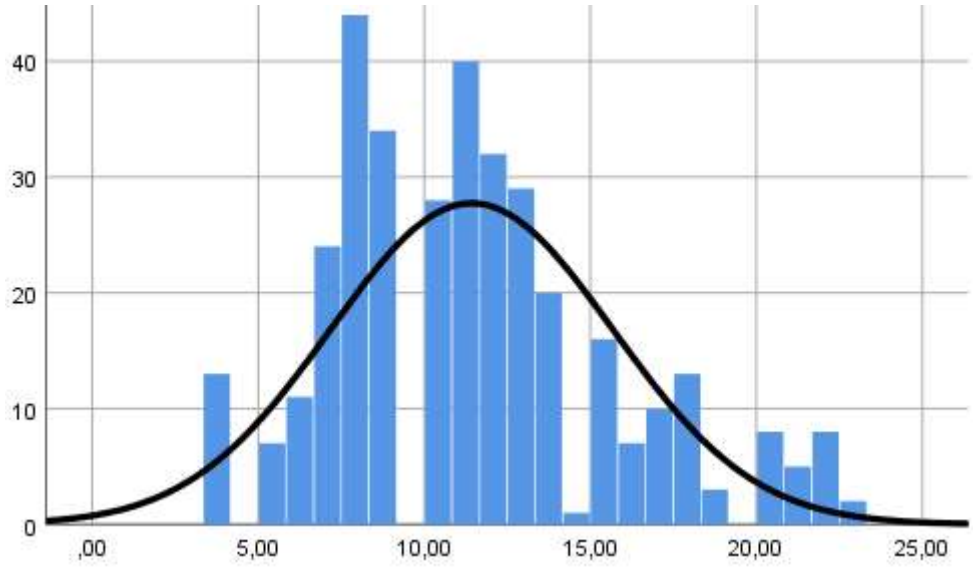
4.2. Social interaction

Social interaction is another dependent variable in this research. The social interaction score for each respondent is calculated with seven questions from the survey. Each question can be scored between 1, (almost) never, and 6, (almost) daily. There is also a no answer option with a value of 7. The answers to these questions are visualized in Appendix VI. The answers to each question are shown on a bar chart. All questions have a percentage of no answers, which need to be recoded to be usable for the statistical analyses.

The percentages of no answers are very high for survey questions 1, 3, and 7. These questions are all about the social spaces and social activities in a high rise building, but these answers were expected because not all buildings have a social space. The answers to these questions are divided between responses from buildings with a social space and buildings without a social space. Bar charts comparing these two can also be found in Appendix VI. It can be seen in the bar charts that the relationship between the no answers and the social space availability is not clear, it can not be explained. The collected data is influenced by the social spaces and the interpretation of the no answer option and what a social space is by the respondent. Therefore, the three questions regarding social spaces in the building are excluded from the social interaction score for this research.

With the exclusion of questions 1, 3, and 7, the social interaction score is going to be calculated with the four remaining questions. These questions also have a few no answers and have to be recoded. For questions 2, 4, 5, and 6, the no answers are removed and changed into the average answer of the respondent to the other social interaction questions. The four recoded questions are then used to calculate the social interaction score for each respondent, which is the sum of the four questions with equal weighting.

The social interaction score is calculated with questions 2, 4, 5, and 6. The data description for the social interaction score is shown in Figure 9. To test if this social interaction score is reliable, Cronbach's Alpha is calculated. This is used to measure the degree of internal consistency between the four social interaction survey questions (Scribbr, 2022). The Cronbach's Alpha for the social interaction score is 0.764, which is acceptable. The Cronbach's Alpha, if an item is deleted, is between 0.662 and 0.786. The social interaction score with four questions is reliable and can be used for the analyses. A histogram of the social interaction score is shown in Figure 9 and the measurement level of this variable is ratio.

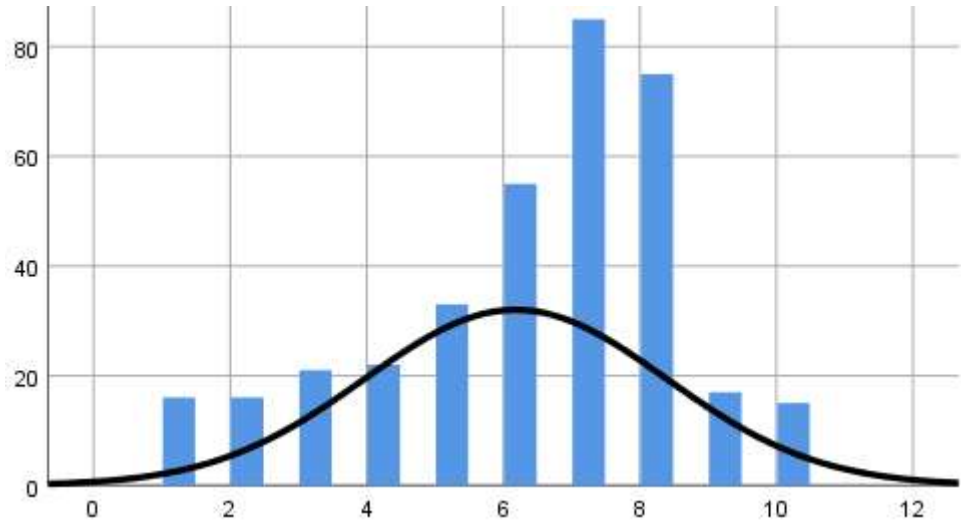


Description
Number of items = 4
Cronbach's Alpha = 0.764
Minimum = 4
Maximum = 23
Mean = 11.43
Std. dev. = 4.254

Figure 9. Histogram and data description for the social interaction score.

4.3. Social satisfaction

Social satisfaction is the last of the three dependent variables of this research. The social satisfaction score is calculated with one question from the survey. This question can be scored between 1, very unsatisfied, to 10, very satisfied. There is also a no answer option with a value of 11. A bar chart with the answers to this question can be found in Appendix VI. The no answers from this question are recoded to the average value of this question. Figure 10 shows the mean, standard deviation, and histogram for the social satisfaction score. The level of measurement for this dependent variable is ratio with ten groups.



Description
Mean = 6.18
Std. dev. = 2.212

Figure 10. Histogram and data description for the social satisfaction score.

4.4. Building characteristics

In the survey, there are seven questions about the characteristics of the building. Each question can be scored between 1, strongly disagree, and 5, strongly agree. There is also an option for no answer. A visualization of the answers to these questions can be found in Appendix VI. All questions do have no answers, which need to be recoded.

The first four questions have a high percentage of no answers. These questions are about the quantity, quality, usage, and safety of the social spaces in the building. These answers were expected because not all the buildings in the research sample have a social space. The answers to these four questions are divided between responses from buildings with a social space and buildings without a social space, which is also shown in Appendix VI. However, this can not provide a clear explanation for the no answers. The collected data is influenced by the interpretation of the no answer option and the definition of a social space. This can happen to a perceived variable. However, this can not be remedied and therefore the four questions about the building characteristics are excluded from further statistical analyses.

The remaining three questions from the building characteristics are about the transitional areas in the buildings. There are not a lot of no answers, because every building has to have transitional areas to be functional. The few no answers are recoded with the average score of the corresponding question. The data description for the building characteristics with these three questions can be found in Table 3.

Table 3. Data description for the building characteristics.

Building characteristics	Mean	Std. dev.	Level of measurement
Quality transitional areas	3.64	1.110	Interval (5 groups)
Usage transitional areas	1.99	0.993	Interval (5 groups)
Safety transitional areas	4.07	0.896	Interval (5 groups)

4.5. Resident characteristics

Individual and household characteristics are part of the resident characteristics. Bar charts with the answers to the survey questions can be found in Appendix VI. There are also no answers to these questions, which are recoded in Appendix VI. An overview of the resident characteristics is shown in Table 4. It displays the frequency and percentage of the answers for all 355 responses to each question. The measurement level for each variable is also distinguished (Scribbr, 2022).

What stands out about the resident characteristics from Table 4 is that 55.5% of the respondents are a single person household. This is a lot more than the average of the country, which is around 18% of single households (CBS, 2021). Multi person households are more likely to live in single family dwellings instead of apartments (Ministerie BZK, 2018). Secondly, more than 50% of the respondents are between 18 and 34 years old, while only 25% of the population of the Netherlands is between 20 and 40 years old (CBS, 2021). Furthermore, nearly 65% of the respondents identify as male, which is more than the 50% of the Dutch population (CBS, 2021). Therefore, the respondent sample for this research is very young, male, and single, but this was partly expected for this type of residence in a city like Eindhoven.

More than 80% of the respondents have completed a higher education degree, while only a third of the entire population of the country is highly educated. However, most highly educated people do live near university cities and specialized work (CBS, 2021). Both education and specialized work can be found in and around Eindhoven. Nevertheless, 80% of the respondents with higher education is still a lot. Their response rate might also be influenced by their own research experience and therefore their willingness to participate in a research survey.

The income of the households is evenly divided between the categories, but the variable household income still has the no answer option. Some respondents do not wish to share their income and therefore this option was kept intentionally during the recoding. However, the measurement level of this variable is still ordinal with five groups, even with the no answer option. In the statistical analyses, ordinal variables will be treated the same as nominal variables with more than two answer groups. Therefore, the level of measurement will not influence the analyses. It is better to highlight the ordinal relationship between the other four answer groups of household income.

Finally, it can be noted that 74.4% of the respondents live in a rented dwelling and 25.6% of the respondents live in an owner-occupied dwelling. The length of residence in the building for the respondents is also not very long. Most respondents have only lived for less than five years in their respective high rise residential buildings. Any other information about the resident characteristics can be observed from the complete data description in Table 4.

Table 4. Data description for the resident characteristics.

Resident characteristics	Frequency	Percentage	Level of measurement
Household composition			
Single person household	197	55.5	Nominal (2 groups)
Multi person household	158	44.5	
Household income			
Less than €2000 a month	76	21.4	Ordinal (5 groups)
€2001 - €3000 a month	99	27.9	
€3001 - €4000 a month	69	19.4	
More than €4001 a month	74	20.8	
No answer	37	10.4	
Car availability			
Yes	216	60.8	Nominal (2 groups)
No	139	39.2	

Age			
18 - 34 years old	187	52.7	Ordinal (3 groups)
35 - 64 years old	95	26.8	
65 years or older	73	20.6	
Health status			
Not so good	35	9.9	Ordinal (4 groups)
Good	153	43.1	
Very good	104	29.3	
Excellent	63	17.7	
Gender			
Male	230	64.8	Nominal (3 groups)
Female	118	33.2	
Other	7	2.0	
Birth region			
Netherlands	269	75.8	Nominal (3 groups)
Europe	41	11.5	
Other	45	12.7	
Education level			
Compulsory education or vocational education	68	19.2	Ordinal (3 groups)
Higher professional education or bachelor degree	161	45.4	
University master degree	126	35.5	
Employment status			
Employed full-time	165	46.5	Nominal (4 groups)
Employed part-time	43	12.1	
Student (with part-time job)	60	16.9	
Retired or unemployed	87	24.5	
Time in the building			
Less than 2 years	129	36.3	Ordinal (3 groups)
2 - 5 years	129	36.3	
More than 5 years	97	27.3	
Home ownership			
Rented dwelling	264	74.4	Nominal (2 groups)
Owner-occupied dwelling	91	25.6	

4.6. Building observations

Observations about the 44 high rise buildings are done during the distribution of the surveys. All this information about the buildings is displayed in Appendix VIII. An impression of each of the 44 buildings can also be found in this appendix. The collected building information leads to 17 independent variables about the building observations, which are added to the dataset with all the responses. Therefore, the observations can be explained for the 355 responses and the 44 buildings. The complete preparation and recoding can be found in Appendix VI, as some variables had too many answer options. A complete overview of the building observations with frequency, percentage, and measurement level (Scribbr, 2022) is shown in Table 5.

What stands out is that the percentages of the variables differ between all responses and all buildings, but this does not affect the validity of the variables for this research. Notable highlights are that a lot of buildings have only one entrance and there are not a lot of duplicate buildings. In addition, 44.5% of the responses have a social space available in their building, while only 36.4% of the buildings do. Online facilities are even less available in only four of the 44 buildings. 10 of the buildings are designed for either students or elderly. All other observations can be explored below in Table 5.

Table 5. Data description for the building observations.

Building observations	Frequency responses	Percentage responses	Frequency buildings	Percentage buildings	Level of measurement
Number of floors					
8 floors or less	75	21.1	7	15.9	Ordinal (4 groups)
9 - 12 floors	93	26.2	16	36.4	
13 - 19 floors	109	30.7	14	31.8	
20 floors or more	78	22.0	7	15.9	
Number of apartments					
Less than 50	64	18.0	12	27.3	Ordinal (4 groups)
51 - 100	72	20.3	14	31.8	
101 - 150	102	28.7	11	25.0	
More than 150	117	33.0	7	15.9	
Apartments per floor					
Less than 5	98	27.6	15	34.1	Ordinal (3 groups)
5 - 10	112	31.5	18	40.9	
More than 10	145	40.8	11	25.0	
Shape of the building					
Elongated	185	52.1	23	52.3	Nominal (2 groups)
Squarish	170	47.9	21	47.7	
Number of duplicate buildings					
2 buildings	12	3.4	4	9.1	Ordinal (5 groups)
4 buildings	16	4.5	4	9.1	
5 buildings	2	0.6	1	2.3	
6 buildings	4	1.1	2	4.5	
None	321	90.4	33	75.0	
Number of entrances					
1 entrance	273	76.9	33	75.0	Ordinal (4 groups)
2 entrances	55	15.5	7	15.9	
3 entrances	23	6.5	3	6.8	
4 entrances	4	1.1	1	2.3	
Access to the apartment					
Core	170	47.9	21	47.7	Nominal (5 groups)
Cores	26	7.3	4	9.1	
Cores / Gallery	11	3.1	2	4.5	
Gallery	42	11.8	9	20.5	
Corridor	106	29.9	8	18.2	
Social space availability					
Yes	158	44.5	16	36.4	Nominal (2 groups)
No	197	55.5	28	63.6	
Social space type					
Common room	34	9.6	3	6.8	Nominal (6 groups)
Entrance	61	17.2	9	20.5	
Gym	8	2.3	1	2.3	
Shared garden	11	3.1	1	2.3	
Shared rooftop	44	12.4	2	4.5	
None	197	55.5	28	63.6	
Online facilities type					
App	24	6.8	2	4.5	Nominal (4 groups)
Facebook	19	5.4	1	2.3	
Whatsapp	20	5.6	1	2.3	
None	292	82.3	40	90.9	

Online facilities availability					
Yes	63	17.7	4	9.1	Nominal (2 groups)
No	292	82.3	40	90.9	
Plinth activities					
Businesses	129	36.3	12	27.3	Nominal (8 groups)
Care facilities	11	3.1	1	2.3	
Housing	41	11.5	6	13.6	
Housing / Businesses	36	10.1	2	4.5	
Housing / Storage	2	0.6	1	2.3	
Other housing	28	7.9	2	4.5	
Social space	15	4.2	2	4.5	
Storage	93	26.2	18	40.9	
Location of the mailboxes					
Inside	153	43.1	13	29.5	Nominal (2 groups)
Outside	202	56.9	31	70.5	
Car parking facilities					
Basement parking	131	36.9	15	34.1	Nominal (4 groups)
Ground level parking	73	20.6	7	15.9	
Parking complex	48	13.5	5	11.4	
Street parking	103	29.0	17	38.6	
Private balconies					
Yes	208	58.6	32	72.7	Nominal (3 groups)
Some	14	3.9	2	4.5	
No	133	37.5	10	22.7	
Owner of the building					
Hartje Eindhoven	9	2.5	1	2.3	Nominal (13 groups)
Holland2Stay	48	13.5	3	6.8	
Holland2Stay / VvE	19	5.4	1	2.3	
NMG Wonen	15	4.2	1	2.3	
Rentberry	2	0.6	1	2.3	
Sint Trudo	45	12.7	5	11.4	
Vb&t	12	3.4	2	4.5	
Vb&t / VvE	19	5.4	2	4.5	
Vestide	52	14.6	4	9.1	
VvE	89	25.1	12	27.3	
Woonbedrijf	32	9.0	8	18.2	
Wooninc	8	2.3	2	4.5	
SeniorenPunt Basis	5	1.4	2	4.5	
Specific building type					
Elderly	30	8.5	6	13.6	Nominal (3 groups)
Student	52	14.6	4	9.1	
None	273	76.9	34	77.3	

4.7. Conclusion

This chapter described the collected data for this research, which included the 355 valid survey responses and the objective information on 44 high rise buildings. Any no answers or missing data have been recoded during the preparation. Two main adaptions had to be made to the collected data. The social interaction score is calculated with four of the seven questions and the building characteristics are reduced from seven to three variables. The final dataset will be used to perform the statistical analyses in the following chapters to answer the research questions.

5. Bivariate analyses

Bivariate analyses are conducted to test the relationship between the 31 independent variables and the three dependent variables. The operational model in Figure 4 shows the relationships that have to be statistically analyzed. The results of the bivariate analyses will indicate which of the variables are relevant to add to the regression analyses. The variables are relevant if their relationship with the dependent variable is significant with a p-value lower than 0.05 (Kent State University, 2022). This chapter begins which the principles of bivariate analyses and describes the bivariate analyses for each group of independent variables afterwards. All significant relationships are shown in the conclusion of this chapter.

5.1. Bivariate analysis types

There are a lot of different types of bivariate analyses that can be performed. The test that is chosen is based on the measurement levels of the variables. The level of measurement for all three dependent variables (social cohesion, social interaction, and social satisfaction) is ratio, so the chosen test method is based on the measurement level of the independent variables. There are 31 independent variables, which have a nominal, ordinal, or interval level of measurement. For this research, three different statistical tests are used to provide insights into the relationships between the independent and dependent variables. These are the independent t-test, one-way ANOVA, and Pearson's correlation (Laerd Statistics, 2020). Each of these statistical tests is explained below.

Independent t-test
An independent t-test is used to test the relationship between an independent variable that has a nominal measurement level with two categorical groups and a dependent variable that is on an interval or ratio level (Laerd Statistics, 2020). There are three assumptions to take into account for this test: independence, normality, and homogeneity of variance. The groups of the independent variable have to be independent from one another, the dependent variable has to be normally distributed, and both groups of the independent variable need to have the same distribution of variance (Ho, 2014). The homogeneity of variance is checked with Levene's test for equality of variances in SPSS. If Levene's test is significant, the t-test and p-value can be observed from 'equal variances not assumed'. If Levene's test is not significant, then the t-test and p-value can be observed from 'equal variances assumed' (Kent State University, 2022).

One-way ANOVA
A one-way analysis of variance (ANOVA) is conducted for the relationship between an independent variable that has a nominal or ordinal measurement level with more than two groups and a dependent variable that is on an interval or ratio level. In the regression analysis, ordinal independent variables will be treated the same as nominal independent variables with more than two groups. Therefore, a one-way ANOVA is conducted for both types of independent variables (Kent State University, 2022; Laerd Statistics, 2020). There are also assumptions to take into account with the one-way ANOVA: normality and homogeneity of variance. The dependent variables have a normal distribution and the groups have roughly equal variance on the dependent variable (Ho, 2014).

Pearson's correlation
A Pearson's correlation is used to test the relationship between an independent variable and a dependent variable that both have an interval or ratio level of measurement (Laerd Statistics, 2020). There are two assumptions to take into account: linearity and homoscedasticity. The variables need to have a linear relationship and the variability of values along the dependent variable have to remain constant at all values of the independent variable (Ho, 2014). A positive relationship means that both variables have a high value or both variables have a low value. A negative relationship means that one of the variables has a high value, while the other variable has a low value.

5.2. Building characteristics analyses

Three building characteristics need to be analyzed. These are the quality, usage, and safety of the transitional areas in the building. The level of measurement for these variables is interval with five groups. Therefore, a Pearson's correlation will be performed for all these variables. Table 6 shows Pearson's correlation for the building characteristics.

Table 6. Pearson's correlation for the building characteristics.

Pearson	Social cohesion		Social interaction		Social satisfaction	
	r	Sig.	r	Sig.	r	Sig.
Quality transitional areas	0.192	0.000**	0.086	0.104	0.086	0.104
Usage transitional areas	0.116	0.028*	0.008	0.878	-0.011	0.837
Safety transitional areas	0.058	0.276	-0.011	0.842	0.089	0.092

*** Significant at the 0.01 level (2-tailed)* *** Significant at the 0.05 level (2-tailed)*

Only the quality and usage of the transitional areas have a positive significant correlation with social cohesion. If the respondent is satisfied with the quality of the transitional areas, the social cohesion score is higher. The respondent experiences a higher level of social cohesion. This is also the case for the usage of transitional areas. If the transitional areas are frequently used as places to stay, the respondent experiences a higher level of social cohesion. However, these variables have no significant correlation with the other two dependent variables. Additionally, the safety of the transitional areas has no significant correlation with any of the dependent variables and is completely removed from further analyses.

5.3. Resident characteristics analyses

For the resident characteristics, 11 independent variables need to be analyzed. The measurement level of each variable is explained during the data description and shown in Table 4. The resident characteristics variables have three different types of measurement levels: nominal with two groups, nominal with three or more groups, and ordinal. Therefore, the analyses that are performed are an independent t-test and a one-way ANOVA. Household composition, car availability, and home ownership are analyzed with an independent t-test in Table 7. Household income, age, health status, gender, birth region, education level, employment status, and time in the building are analyzed with a one-way ANOVA and are shown in Table 8.

Table 7. Independent t-test for the resident characteristics.

t-test	Social cohesion			Social interaction			Social satisfaction		
	Mean	t	Sig.	Mean	t	Sig.	Mean	t	Sig.
Household composition									
Single person household	54.10	-1.586	0.114	10.97	-2.285	0.023*	6.02	-1.471	0.142
Multi person household	56.40			12.00			6.38		
Car availability									
Yes	56.25	2.045	0.042*	12.18	4.288	0.000**	6.34	1.679	0.094
No	53.36			10.25			5.93		
Home ownership									
Rented dwelling	52.88	-5.478	0.000**	10.81	-4.820	0.000**	5.93	-3.943	0.000**
Owner-occupied dwelling	61.60			13.22			6.92		

*** Significant at the 0.01 level (2-tailed)* *** Significant at the 0.05 level (2-tailed)*

The household composition only has a negative significant relationship with the social interaction score. Home ownership also has negative significant relationships with all three dependent variables. Car availability is positively related to social cohesion and social interaction. All these independent variables will be kept in the dataset for the multiple regression analyses.

Table 8. One-way ANOVA for the resident characteristics.

ANOVA	Social cohesion			Social interaction			Social satisfaction		
	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.
Household income									
Less than €2000 a month	52.97	0.997	0.409	10.95	1.556	0.186	5.91	1.894	0.111
€2001 - €3000 a month	56.98			11.20			6.43		
€3001 - €4000 a month	54.60			11.10			5.87		
More than €4001 a month	55.61			11.84			6.60		
No answer	54.55			12.79			5.79		
Age									
18 - 34 years old	51.31	32.597	0.000 **	10.25	30.001	0.000 **	5.93	4.036	0.018 *
35 - 64 years old	54.80			11.41			6.21		
65 years or older	65.28			14.46			6.79		
Health status									
Not so good	54.45	4.364	0.005 **	12.09	6.426	0.000 **	5.79	1.709	0.165
Good	57.45			12.39			6.47		
Very good	54.88			10.47			6.07		
Excellent	50.23			10.29			5.88		
Gender									
Male	55.11	0.616	0.541	11.05	2.619	0.074	6.20	0.549	0.578
Female	55.46			12.13			6.19		
Other	49.58			12.00			5.31		
Birth region									
Netherlands	56.38	5.121	0.006 **	12.06	13.414	0.000 **	6.54	16.268	0.000 **
Europe	52.25			9.38			5.13		
Other	50.20			9.47			4.97		
Education level									
Compulsory education or vocational education	59.53	7.214	0.001 **	13.72	17.569	0.000 **	6.61	2.465	0.087
Higher professional education or bachelor degree	55.68			11.50			6.23		
University master degree	52.02			10.09			5.88		
Employment status									
Employed full-time	52.02	16.126	0.000 **	10.27	21.396	0.000 **	5.99	2.660	0.048 *
Employed part-time	55.39			12.44			6.23		
Student (with part-time job)	51.74			10.04			5.86		
Retired or unemployed	63.20			14.07			6.73		
Time in the building									
Less than 2 years	53.04	13.006	0.000 **	10.15	16.929	0.000 **	5.83	5.314	0.005 **
2 - 5 years	52.82			11.27			6.09		
More than 5 years	60.94			13.32			6.77		

*** Significant at the 0.01 level (2-tailed)* *** Significant at the 0.05 level (2-tailed)*

The independent variables of household income and gender have no significant relationship with any of the dependent variables. Therefore, these two variables are excluded from the regression analyses. The other six variables have at least one significant relationship with a dependent variable. The variables age, birth region, employment status, and time in the building have a positive significant relationship will all three dependent variables. Nearly all of these relationships are also significant on the 0.01 level. Health status and education level also have positive significant relationships, but only with social cohesion and social interaction. Social satisfaction has fewer significant relationships but remains in the research.

5.4. Building observations analyses

There are 17 independent variables of the building observations that need to be analyzed. The measurement levels of these variables are explained in the data description and shown in Table 5. The variables have three different types of measurement levels: nominal with two groups, nominal with three or more groups, and ordinal. Therefore, the analyses that are performed are the independent t-test or a one-way ANOVA.

Shape of the building, social space availability, online facilities availability, and location of the mailboxes are analyzed with an independent t-test, which can be found in Table 9. Number of floors, number of apartments, apartments per floor, number of duplicate buildings, number of entrances, access to the apartment, social space type, online facilities type, plinth activities, car parking facilities, private balconies, owner of the building, and specific building type are analyzed with a one-way ANOVA, which are shown in Table 10.

Table 9. Independent t-test for the building observations.

t-test	Social cohesion			Social interaction			Social satisfaction		
	Mean	t	Sig.	Mean	t	Sig.	Mean	t	Sig.
Shape of the building									
Elongated	53.49	-2.373	0.018 *	10.75	-3.162	0.002 **	5.93	-2.207	0.028 *
Squarish	56.90			12.16			6.45		
Social space availability									
Yes	60.02	6.407	0.000 **	12.31	3.567	0.000 **	6.64	3.529	0.000 **
No	51.19			10.72			5.81		
Online facilities availability									
Yes	53.85	-0.814	0.416	10.25	-3.028	0.003 **	5.85	-1.295	0.196
No	55.39			11.68			6.25		
Location of the mailboxes									
Inside	53.45	-2.015	0.045 *	10.54	-3.589	0.000 **	5.99	-1.378	0.169
Outside	56.38			12.10			6.32		

*** Significant at the 0.01 level (2-tailed)* *** Significant at the 0.05 level (2-tailed)*

The four variables that are analyzed with an independent t-test all have a significant relationship with one of the dependent variables and are therefore kept in the dataset for the regression analyses. However, the significant relations for shape of the building, online facilities availability, and location of the mailboxes are all negative. Their effect on the dependent variable results in a lower score for the dependent variable. However, social space availability has a positive relationship with all three dependent variables.

Table 10. One-way ANOVA for the building observations.

ANOVA	Social cohesion			Social interaction			Social satisfaction		
	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.
Number of floors									
8 floors or less	50.88	5.781	0.001 **	9.72	7.715	0.000 **	5.70	2.718	0.045 *
9 - 12 floors	53.21			10.98			5.99		
13 - 19 floors	58.36			12.48			6.36		
20 floors or more	56.95			12.12			6.62		
Number of apartments									
Less than 50	62.38	12.819	0.000 **	13.69	15.293	0.000 **	6.94	5.898	0.001 **
51 - 100	56.33			12.06			6.31		
101 - 150	55.51			11.62			6.31		
More than 150	50.07			9.62			5.57		

Apartments per floor									
Less than 5	59.82	11.417	0.000 **	12.98	14.630	0.000 **	6.77	5.712	0.004 **
5 - 10	55.58			11.74			6.14		
More than 10	51.59			10.13			5.81		
Number of duplicate buildings									
2 buildings	67.38	4.351	0.002 **	15.58	4.144	0.003 **	7.25	0.747	0.560
4 buildings	50.23			9.50			6.06		
5 buildings	34.24			8.50			6.50		
6 buildings	51.50			10.25			6.00		
None	55.08			11.40			6.15		
Number of entrances									
1 entrance	55.79	3.072	0.028 *	11.54	1.148	0.329	6.30	1.607	0.187
2 entrances	51.83			10.51			5.73		
3 entrances	57.57			12.12			6.04		
4 entrances	40.74			12.00			4.80		
Access to the apartment									
Core	57.40	4.902	0.001 **	12.31	12.052	0.000 **	6.57	3.938	0.004 **
Cores	56.07			11.23			6.04		
Cores / Gallery	56.84			14.24			5.29		
Gallery	56.88			12.64			6.40		
Corridor	50.35			9.27			5.59		
Social space type									
Common room	65.01	15.405	0.000 **	13.62	9.984	0.000 **	6.89	4.739	0.000 **
Entrance	61.69			12.97			6.82		
Gym	72.96			16.75			8.38		
Shared garden	56.11			12.45			6.36		
Shared rooftop	52.47			9.55			5.93		
None	51.19			10.72			5.81		
Online facilities type									
App	64.04	7.893	0.000 **	12.13	4.865	0.003 **	6.80	3.014	0.030 *
Facebook	47.28			9.74			5.40		
Whatsapp	47.87			8.50			5.15		
None	55.39			11.68			6.25		
Plinth activities									
Businesses	58.57	6.515	0.000 **	12.24	4.910	0.000 **	6.44	2.850	0.007 **
Care facilities	70.73			14.91			7.73		
Housing	54.82			11.75			5.64		
Housing / Businesses	49.19			8.64			5.39		
Housing / Storage	59.00			12.50			5.50		
Other housing	47.25			9.89			5.38		
Social space	55.58			10.73			6.53		
Storage	53.12			11.38			6.38		
Car parking facilities									
Basement parking	55.26	0.457	0.712	11.61	1.197	0.311	6.30	1.842	0.139
Ground level parking	53.62			10.82			5.74		
Parking complex	55.02			10.90			5.93		
Street parking	56.05			11.86			6.46		
Private balconies									
Yes	55.52	2.692	0.069	11.95	6.173	0.002 **	6.21	2.270	0.105
Some	46.89			8.43			4.95		
No	55.36			10.92			6.26		

Owner of the building									
Hartje Eindhoven	57.67			11.89			7.22		
Holland2Stay	48.36			8.54			5.15		
Holland2Stay / VvE	47.28			9.74			5.40		
NMG Wonen	44.63			9.73			5.20		
Rentberry	36.00			6.50			6.09		
Sint Trudo	63.02			12.64			7.12		
Vb&t	50.46	9.296	0.000 **	10.50	6.770	0.000 **	5.67	3.860	0.000 **
Vb&t / VvE	53.28			12.00			6.59		
Vestide	49.76			9.83			5.54		
VvE	61.27			12.97			6.66		
Woonbedrijf	58.62			13.33			6.41		
Wooninc	45.48			12.13			5.77		
SeniorenPunt Basis	70.75			16.60			8.60		
Specific building type									
Elderly	69.27			15.89			7.23		
Student	49.76	22.975	0.000 **	9.83	22.988	0.000 **	5.54	5.736	0.004 **
None	54.58			11.24			6.19		

*** Significant at the 0.01 level (2-tailed)* * *Significant at the 0.05 level (2-tailed)*

Car parking facilities is the only variable that has no significant relationship with any of the dependent variables and is therefore not included in the multiple regression analyses. All the other variables have a significant relationship with one or more dependent variables. All these significant relationships are also positive and will be tested further during the regression analyses.

5.5. Analyses between dependent variables

Bivariate analyses are also performed for the dependent variables to analyze how social cohesion, social interaction, and social satisfaction relate to each other. The level of measurement for these variables is ratio. Therefore, a Pearson's correlation is performed for all these variables. Table 11 shows Pearson's correlation for the dependent variables. All correlations between the dependent variables are positive and significant. Therefore, all dependent variables will stay in the dataset for the regression analyses.

Table 11. Pearson's correlation for the dependent variables.

Pearson	**Social cohesion**		**Social interaction**	
	r	Sig.	r	Sig.
Social interaction	0.673	0.000**		
Social satisfaction	0.442	0.000**	0.347	0.000**

*** Significant at the 0.01 level (2-tailed)* * *Significant at the 0.05 level (2-tailed)*

5.6. Conclusion

The bivariate analyses started with 31 independent variables and three dependent variables. An overview of the results of all bivariate analyses can be found in Table 12. All significant relationships are highlighted in this table. Social cohesion has a significant relationship with 24 variables. These are two variables of the building characteristics, eight variables of the resident characteristics, and 14 variables of the building observations. Social interaction has a significant relationship with 24 variables. These are nine variables of the resident characteristics and 15 variables of the building observations. Social satisfaction has a significant relationship with 16 variables. These are five variables of the resident characteristics and 11 variables of the building observations.

The dependent variables also have a significant relationship with each other. Additionally, four independent variables do not have any significant relationships with any of the dependent variables. These variables are therefore excluded from the dataset for the regression analyses. The bivariate analyses conclude with 27 independent variables and three dependent variables that will be used in the multiple regression analyses.

Table 12. Bivariate analyses results of the relationships between the variables.

	Social cohesion	Social interaction	Social satisfaction
Building characteristics			
Quality transitional areas	**		
Usage transitional areas	*		
Safety transitional areas			
Resident characteristics			
Household composition		*	
Household income			
Car availability	*	**	
Age	**	**	*
Health status	**	**	
Gender			
Birth region	**	**	**
Education level	**	**	
Employment status	**	**	*
Time in the building	**	**	**
Home ownership	**	**	**
Building observations			
Number of floors	**	**	*
Number of apartments	**	**	**
Apartments per floor	**	**	**
Shape of the building	*	**	*
Number of duplicate buildings	**	**	
Number of entrances	*		
Access to the apartment	**	**	**
Social space availability	**	**	**
Social space type	**	**	**
Online facilities availability		**	
Online facilities type	**	**	*
Plinth activities	**	**	**
Location of the mailboxes	*	**	
Car parking facilities			
Private balconies		**	
Owner of the building	**	**	**
Specific building type	**	**	**
Dependent variables			
Social cohesion		**	**
Social interaction	**		**
Social satisfaction	**	**	

*** Significant at the 0.01 level (2-tailed)* * *Significant at the 0.05 level (2-tailed)*

6. Regression analyses

In this chapter, four multiple regression analyses are performed for the three dependent variables: social cohesion, social interaction, and social satisfaction. The results from these regression analyses can answer how building characteristics, resident characteristics, and building observations influence social cohesion, social interaction, and social satisfaction in high rise residential buildings. The significance and usability of these findings will be explored further in the conclusion. The bivariate analyses in the previous chapter have found 27 independent variables that have a significant relationship with at least one of the three dependent variables, which can be seen in Table 12. Only the independent variables that have a significant relationship with a dependent variable are included in their respective multiple regression analysis. The variables with a p-value lower than 0.05 in the multiple regression analyses are significant and can be used in the final model to answer the research question (Laerd Statistics, 2020).

This chapter begins with an explanation of the principles of a multiple regression analysis. Afterwards, the four regression analyses are performed and their results are explained. The first three regression analyses are one for each of the dependent variables and their significant independent variables as predictors. The fourth regression analysis is also for the social cohesion score with the addition of the other significant dependent variables as predictors. The chapter will end with the final regression model for this research.

6.1. Regression analysis principles

Multiple regression analysis is a statistical test that can analyze the relationship between a dependent variable and a set of independent variables (Ho, 2014). It can determine the overall fit of the model and the relative contribution of each of the independent variables (Laerd Statistics, 2020). To achieve a valid result for the regression analysis, it needs to be checked if the data can actually be analyzed using multiple regression. Therefore, the data needs to pass the following assumptions.

6.1.1. Assumptions

There are eight assumptions to take into account to perform a valid multiple regression analysis, which are shown below. It is also explained how it can be checked whether the data violated the assumptions.

The first assumption is about the dependent variable, which should be measured on a continuous scale. This means that the level of measurement has to be either interval or ratio (Ho, 2014; Laerd Statistics, 2020). All dependent variables in this research have a measurement level of ratio and are therefore suitable for regression analysis. Secondly, there have to be two or more independent variables. They can be either continuous, with a measurement level of interval or ratio, or categorical, with a measurement level of ordinal or nominal (Ho, 2014; Laerd Statistics, 2020). This is the case for all the independent variables in this research.

The next assumption is about linearity. There needs to be a linear relationship between the dependent variable and each of the independent variables (Laerd Statistics, 2020). The linearity can be examined by the residual plots and has already been established in the previous analyses. The fourth assumption is that there should be no significant outliers. They will reduce the predictive accuracy and the statistical significance of the results (Laerd Statistics, 2020). The significant outliers are removed during the data description and recoding of the variables. Therefore, the dataset passes this assumption.

The fifth assumption is that there should be independence of observations. This can be checked with the Durbin-Watson statistic in SPSS during the multiple regression analysis. If the Durbin-Watson statistic is between 1.5 and 2.5, it can be assumed that there is no linear autocorrelation in the dataset (Ho, 2014; Laerd Statistics, 2020).

The next assumption is that the data needs to show homoscedasticity, with equal variances between pairs of variables. This can be checked with a scatterplot of the standardized residuals and the standardized predicted values in SPSS (Laerd Statistics, 2020). This assumption is met if there is no clear pattern in the scatterplot for each multiple regression analysis. Another assumption that has to be checked during the multiple regression analysis is the assumption of normality. The residuals, the errors, have to be approximately normally distributed, which can be checked with a P-P plot in SPSS. The P-P plot shows a straight line, which indicates the perfect normal distribution (Laerd Statistics, 2020). If the dataset follows this line, the assumption is met.

The eighth and final assumption is that the data must not show multicollinearity: when two or more independent variables have a high correlation between them. This is checked in two ways: with the inspection of the correlation coefficients and the tolerance / VIF values. A correlation matrix with all the variables is conducted before the regression analyses. If the correlation is higher than 0.7, the variables have to be changed or removed. The multicollinearity is also checked during each multiple regression analysis with the tolerance / VIF values. Tolerance values indicate the percentage of variance in the predictor that cannot be accounted for by the other predictors. VIF stands for variance inflation factor and is calculated as 1 / tolerance. If the VIF values are greater than 10, further evaluation of the data is advisable (Ho, 2014).

The first four assumptions of the dependent variable, independent variables, linearity, and significant outliers have already been checked at this point in the research. The first part of the multicollinearity will be checked with the correlation matrix, which can be found in section 6.1.3. With the final dataset, multiple regression analysis can be performed for each dependent variable. The last four assumptions of independence of observations, homoscedasticity, normality, and multicollinearity are checked with each regression analysis.

6.1.2. Dummy variables

Before the multiple regression analyses, the categorical variables have to be changed to dichotomous dummy variables. These dummy variables represent one value of the nominal or ordinal variable. One value serves as the reference group, so for each variable with K values, K - 1 dummy variables are created. There is always one less dummy variable as the number of values of the original variable (Laerd Statistics, 2020). 18 variables have to be recoded into dummy variables. The reference group of the dummy variables is the first value of the variable or the no, none, or other option.

The variables that are recoded into dummy variables are age, health status, birth region, education level, employment status, time in the building, number of floors, number of apartments, apartments per floor, number of duplicate buildings, number of entrances, access to the apartment, social space type, online facilities type, plinth activities, private balconies, owner of the building, and specific building type.

6.1.3. Correlation matrix review

To test the multicollinearity, a correlation matrix review is conducted. The bivariate analyses have identified the variables that have a significant relationship with one of the dependent variables. In the correlation matrix, all the significant independent and dependent variables are combined to check if there is a prominent multicollinearity between the variables. If the correlation coefficient is higher than 0.7, one of the variables should be excluded from the regression analysis. This correlation matrix is executed with the dummy variables of the 18 independent variables and the other significant variables.

Two variables that are highly correlated are employment status: retired or unemployed and age: 65 years or older. The correlation coefficient between these two variables is 0.828. This correlation is highly expected, as only older residents can be retired. The variable employment status is omitted from the regression analyses because age is more important for this research.

A correlation of 0.735 can be found between access to the apartment: corridor and apartments per floor: more than 10. This is also an expected correlation. A building with a corridor is a longer building, which by definition will have more apartments per floor. Access to the apartment is more important for this research, so apartments per floor is omitted from the regression analyses. Another correlation of 0.813 can be found between online facilities type: Facebook and plinth activities: other housing. Plinth activities are more important for this research and the online facilities are also represented by online facilities availability. Therefore, the variable online facilities type is excluded from the regression analyses.

The variable owner of the building has a lot of correlations with multiple other variables. The value VvE has a correlation of 0.717 with home ownership: owner-occupied dwelling. The value Wooninc has a correlation of 0.703 with number of entrances: 4 entrances. The value Holland2Stay has a correlation of 0.850 with plinth activities: housing / businesses. The value Holland2Stay / VvE has a correlation of 0.813 with plinth activities: other housing and a correlation of 1.000 with online facilities type: Facebook. The value Vb&t / VvE has a correlation of 0.752 with social space type: shared garden. The value Vestide has a correlation of 1.000 with specific building type: student. The value Sint Trudo has a correlation of 0.707 with online facilities type: app. Therefore the variable owner of the building is omitted from the regression analyses.

Four variables are omitted from the dataset for the regression analyses because they have high correlations with other variables. The excluded variables are employment status, apartments per floor, online facilities type, and owner of the building. That leaves 23 independent variables and three dependent variables for the multiple regression analyses.

The independent variables that are used for the regression analyses are quality transitional areas, usage transitional areas, household composition, car availability, age, health status, birth region, education level, time in the building, home ownership, number of floors, number of apartments, shape of the building, number of duplicate buildings, number of entrances, access to the apartment, social space availability, social space type, online facilities availability, plinth activities, location of the mailboxes, private balconies, and specific building type. All the dependent variables of social cohesion, social interaction, and social satisfaction are used in the multiple regression analyses.

6.1.4. Multiple regression method

The chosen multiple regression method for this research is a stepwise regression. In this method, the statistically significant variables are entered into the regression model one at a time. The order is determined by the strength of the correlation with the dependent variable. The highest correlated variable will be entered first and all other variables will follow afterwards. If at any step a variable no longer contributes significantly to the regression model, the variable will be removed. This process will continue until all variables have entered the model. The probability of entering the model is set to 0.05, while the probability of removal is set to 0.10 (Ho, 2014). Due to the use of dummy variables in the dataset, only one value of a variable may be significant, while the other values are not significant. In that case, only the significant dummy variable is added to the regression model.

Four multiple regression analyses are performed. One for each of the dependent variables with their significant independent variables as the predictors in the analysis. The fourth regression analysis is also for the social cohesion score with the addition of social interaction and social satisfaction as independent variables in the group of predictors. This relationship between the dependent variables has been defined during the literature research and can be found in the conceptual and operational models. Adding the other two dependent variables to the model will have a big influence on the model, which will be explored in during the analyses.

6.2. Social interaction analysis

The social interaction regression analysis will only include the independent variables that have a significant relationship with social interaction. This leaves 20 independent variables that are added to the regression analysis as predictors. These variables are household composition, car availability, age, health status, birth region, education level, time in the building, home ownership, number of floors, number of apartments, shape of the building, number of duplicate buildings, access to the apartment, social space availability, social space type, online facilities availability, plinth activities, location of the mailboxes, private balconies, and specific building type. First, the assumptions are checked to see if the results are valid and the results of the analysis are explained afterward.

Check of the assumptions
Four assumptions have to be checked with each regression analysis. The independence of observations is analyzed with the Durbin-Watson test, which needs to be between 1.5 and 2.5. The Durbin-Watson value for this analysis is 1.942, so the assumption is met. The homoscedasticity and normality are tested with the scatterplot and P-P plot, which are shown in Appendix VII. Both assumptions are met because the scatterplot does not show a pattern and the P-P plot is close to the linear line. The final assumption that has to be checked is the multicollinearity. The VIF values are between 1.000 and 1.788, which is below 10. Therefore is assumption is also met. It can be concluded that the results of the multiple regression analysis for social interaction are valid.

6.2.1. Results of the analysis

The results of the multiple regression analysis for the dependent variable social interaction are shown in Table 13. The adjusted R^2 value for this model is 0.319, so the model explains 31.9% of the variability of social interaction in high rise residential buildings. This regression analysis ran through 11 steps to produce the model for social interaction in Table 13. The F-ratio in the ANOVA table of the regression analysis tests the goodness of fit for the data. All 11 steps are significant, with each a p-value of 0.000. This means that the independent variables can statistically predict the social interaction score and that the regression model is a good fit for the data.

Table 13. Multiple regression model for social interaction.

Model	Unstand. Beta	Stand. Beta	t	Sig.
(Constant)	10.247		21.005	0.000**
Age: 65 years or older	1.101	0.105	1.786	0.075~
Education level: university master degree	-1.181	-0.133	-2.899	0.004**
Time in the building: 2 - 5 years	0.956	0.108	2.074	0.039*
Time in the building: more than 5 years	2.594	0.272	4.651	0.000**
Number of duplicate buildings: 4 buildings	-2.148	-0.105	-2.353	0.019*
Access to the apartment: corridor	-1.085	-0.117	-2.305	0.022*
Social space type: common room	3.468	0.240	4.902	0.000**
Social space type: gym	5.759	0.201	4.491	0.000**
Specific building type: elderly	3.240	0.212	4.042	0.000**

*** Significant at the 0.01 level* * *Significant at the 0.05 level* ~ *Significant at the 0.10 level*

The regression model for social interaction consists of nine variables. Six variables have a positive effect on social interaction and three variables have a negative influence on the social interaction score. Social space availability: yes was significant during the analysis, but was removed from the model because it was no longer significant. Afterwards, an additional three independent variables were added to the model. Of all predictors, time in the building: more than 5 years has the strongest influence on social interaction in the building with a standardized Beta-value of 0.272.

A visualization of the regression model for social interaction can be found in Figure 11. The positive relationships are highlighted in green, while the negative relationships are shown in red. This provides a clear view of the positive and negative significant relationships between the independent variables and the social interaction score.

Positive effects on social interaction in high rise buildings are found with age: 65 years or older and specific building type: elderly. This confirms the findings in the literature research that older residents have more social interactions in their building (van den Berg, et al., 2015). Secondly, a longer time in the building has a positive relationship with the interaction in the building. The Beta-value of time in the building: more than 5 years is even higher than the Beta-value of time in the building: 2 - 5 years. Living longer in the building leads to more interactions with the neighbors, which Van den Berg and Timmermans (2015) also found in their research.

Additionally, social space type: common room and social space type: gym have a positive effect on the interactions. Having a specific place for interaction leads to more interactions between neighbors. Design a space to promote social interactions between the residents (Gehl, 2011). A higher education level has a negative effect on social interaction in high rise buildings. Residents with a university master degree experience less place attachment to the building. This is in line with the literature findings by Van den Berg and Timmermans (2015) and Völker et al. (2007). A lot of duplicate buildings also have a negative influence on social interactions. More buildings lead to more places of interaction, which in turn leads to less social interactions between the residents (Bafna, 2003).

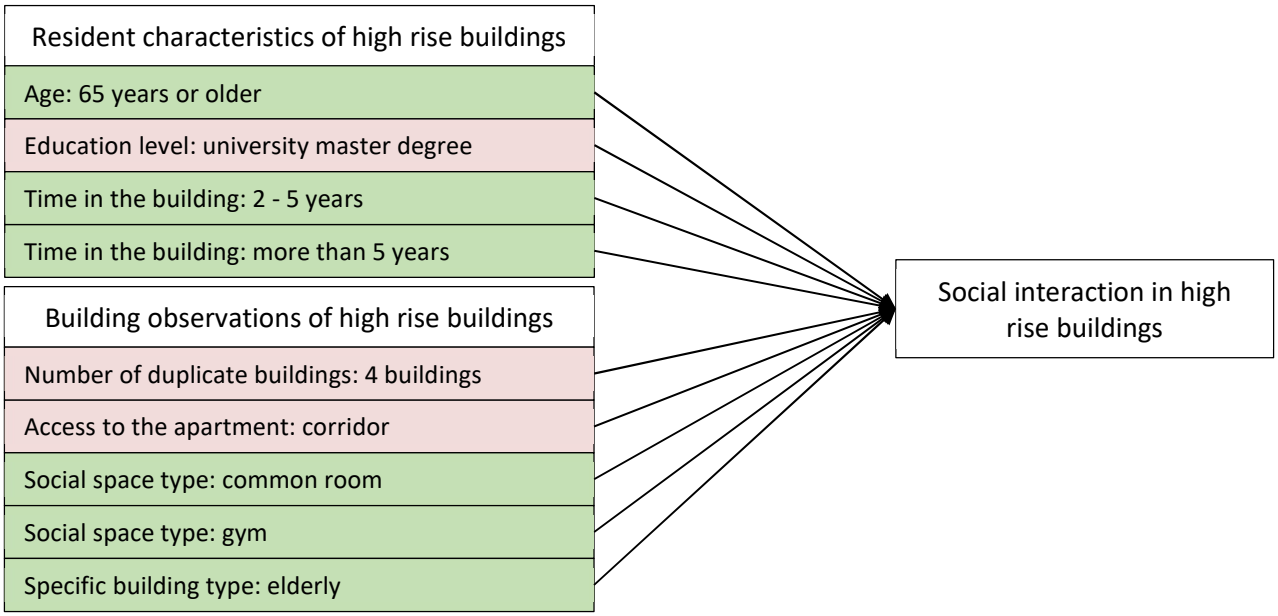


Figure 11. Regression model for social interaction.

6.3. Social satisfaction analysis

Only the independent variables with a significant relationship with social satisfaction are included in the social satisfaction regression analysis. This leaves 12 independent variables that are added to the regression analysis as predictors. These variables are age, birth region, time in the building, home ownership, number of floors, number of apartments, shape of the building, access to the apartment, social space availability, social space type, plinth activities, and specific building type. The results of the regression analysis are valid if the assumptions are met. Afterwards, the results of the regression analysis will be further explained.

Check of the assumptions
The results of the regression analysis for social satisfaction are only valid if the assumptions of independence of observations, homoscedasticity, normality, and multicollinearity are met. The Durbin-Watson value is used to test the independence of observations. For this analysis, the Durbin-Watson value is 1.944, which is between 1.5 and 2.5. It can therefore be noted that there is an independence of observations. A scatterplot of the analysis can be used to test the homoscedasticity, which is shown in Appendix VII. The scatterplot does not show a clear pattern so the assumption is met. Appendix VII also displayed the P-P plot, which can be used to check the normality of the analysis. The P-P plot is close to linear, so this assumption is also met. Finally, the multicollinearity is tested with the VIF values, which need to be below 10. For this analysis, the VIF values are between 1.000 and 1.065. Therefore the last assumption is met and the results of the regression analysis are valid.

6.3.1. Results of the analysis

The results of the multiple regression analysis for the social satisfaction score are displayed in Table 14. The adjusted R^2 value for this model is 0.128. Therefore, the regression model explains 12.8% of the variance of social satisfaction in high rise residential buildings. The social satisfaction regression analysis ran for three steps to create the model. The F-ratio in the ANOVA table of the regression analysis tests the goodness of fit for the data. All three steps are significant, with each a p-value of 0.000. This means that the independent variables statistically significantly predict social satisfaction in the building and that the regression model is a good fit for the data.

Table 14. Multiple regression model for social satisfaction.

Model	Unstand. Beta	Stand. Beta	t	Sig.
(Constant)	4.637		19.069	0.000**
Birth region: Netherlands	1.302	0.253	4.937	0.000**
Home ownership: owner-occupied dwelling	0.724	0.143	2.796	0.005**
Social space availability: yes	0.831	0.187	3.761	0.000**

*** Significant at the 0.01 level* * *Significant at the 0.05 level*

Three independent variables have a positive and significant relationship with the social satisfaction score in the regression analysis. The predictor of birth region: Netherlands has the strongest influence on social satisfaction with a standardized Beta-value of 0.253. The regression model for social satisfaction is displayed in Figure 12. The positive relationships with social satisfaction in high rise residential buildings are shown in green.

Birth region: Netherlands has a positive influence on social satisfaction. This corresponds with the findings in the literature research (van Dijk, et al., 2013). Owning the residence also has a positive effect on the attachment to the building. The residents are more likely to create a community in the building (Völker, et al., 2007). Finally, the availability of a social space has a positive influence on social satisfaction. Having a social space is positive for the social networks of the residents. Yuen and Yeh (2011) found that residents feel encouraged to socialize in a space that is designed with that goal in mind.

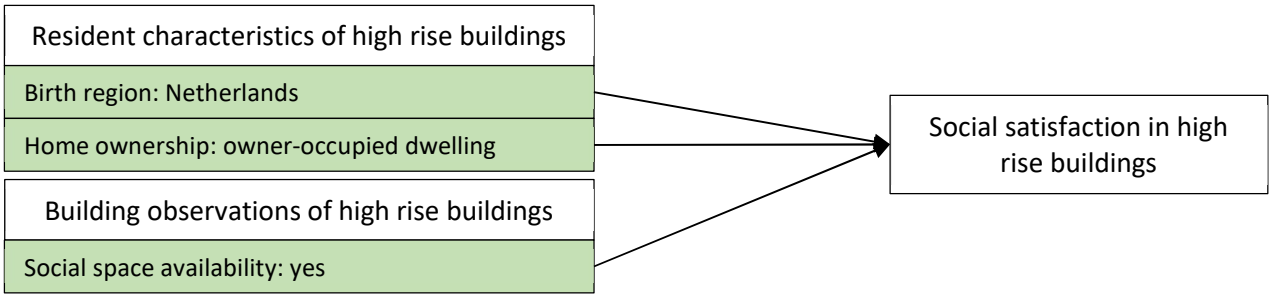


Figure 12. Regression model for social satisfaction.

6.4. First social cohesion analysis

The first multiple regression analysis for the dependent variable social cohesion will only include the significant independent variables. Therefore, 20 independent variables are added to the regression analysis as predictors. These variables are quality transitional areas, usage transitional areas, car availability, age, health status, birth region, education level, time in the building, home ownership, number of floors, number of apartments, shape of the building, number of duplicate buildings, number of entrances, access to the apartment, social space availability, social space type, plinth activities, location of the mailboxes, and specific building type. Before the results and model of the analysis are explained, the regression assumptions have to be checked to see if the results are valid.

Check of the assumptions
The four assumptions of independence of observations, homoscedasticity, normality, and multicollinearity have to be checked. The results of the regression analysis are only valid is all the assumptions are met. The Durbin-Watson value for this regression is 2.165, which is between 1.5 and 2.5. Therefore, the assumption of independence of observations is met. The scatterplot and P-P plot for the analysis are shown in Appendix VII. The scatterplot does not show a pattern and the P-P plot is close to the linear line. Homoscedasticity and normality of the regression analysis are therefore met. Finally, the VIF values of the multicollinearity need to be below 10. The values for this analysis are between 1.000 and 2.087 and thus all the assumptions are met. To conclude, the results of the multiple regression analysis for social cohesion are valid.

6.4.1. Results of the analysis

The results of the multiple regression analysis for the dependent variable social cohesion are shown in Table 15. The adjusted R^2 value of this model is 0.446. So, the model explains 44.6% of the variance of social cohesion in high rise residential buildings. The analysis ran through 21 steps to produce the multiple regression model for social cohesion. The goodness of fit of the model for the data is analyzed with the F-ratio in the ANOVA table of the regression analysis. All 21 steps of the regression analysis are significant, with a p-value of 0.000 for each of the models. This means that the independent variables statistically significantly predict the social cohesion score in the building. Therefore, the regression model is a good fit for the data.

Table 15. First multiple regression model for social cohesion.

Model	Unstand. Beta	Stand. Beta	t	Sig.
(Constant)	49.556		17.192	0.000**
Quality transitional areas	1.557	0.127	2.968	0.003**
Usage transitional areas	1.320	0.096	2.383	0.018*
Car availability: yes	-2.988	-0.107	-2.265	0.024*
Time in the building: more than 5 years	6.403	0.210	4.289	0.000**
Home ownership: owner-occupied dwelling	7.463	0.240	4.297	0.000**
Number of apartments: more than 150	-7.752	-0.268	-4.816	0.000**
Shape of the building: squarish	-3.347	-0.123	-2.582	0.010**
Number of duplicate buildings: 2 buildings	8.824	0.117	2.646	0.009**
Number of duplicate buildings: 4 buildings	-9.230	-0.141	-2.834	0.005**
Number of duplicate buildings: 5 buildings	-23.817	-0.131	-3.217	0.001**
Number of entrances: 4 entrances	-15.257	-0.118	-2.838	0.005**
Social space type: common room	18.690	0.404	8.943	0.000**
Social space type: gym	14.283	0.156	3.608	0.000**
Plinth activities: social space	5.399	0.080	1.951	0.052~
Plinth activities: storage	-3.342	-0.108	-1.975	0.049*
Location of the mailboxes: outside	-4.707	-0.171	-3.114	0.002**
Specific building type: elderly	14.489	0.296	6.632	0.000**

*** Significant at the 0.01 level* * *Significant at the 0.05 level* ~ *Significant at the 0.10 level*

In the model, 16 independent variables have a significant relationship with the social cohesion score. Eight of these have a positive influence, while the other eight have a negative influence on the social cohesion in the building. Additionally, social space availability: yes and age: 65 years or older were significant during on of the 21 steps of the model but were removed from the model because they were no longer significant. With the removal of these two variables, five other variables are added to the model. Of all predictors, social space type: common room has the strongest influence on social cohesion with a standardized Beta-value of 0.404.

The regression model for social cohesion in high rise residential buildings is visualized in Figure 13 to provide a clear view of the positive and negative significant relationships. Positive relationships are shown in green and negative relationships are shown in red. The quality and usage of the transitional areas in the building have a positive influence on social cohesion in high rise residential buildings. These places of interaction add to the social cohesion of the residents. The transitional areas are a necessary design aspect of a building but have a positive effect on the social cohesion score of the resident (Turkington, et al., 2004). This collaborates with the findings by Verhage (2021), who also found that the perceived quality and usage of transitional areas in the building affect social cohesion.

Furthermore, time in the building: more than 5 years and home ownership: owner-occupied dwelling have a positive effect on social cohesion. Living longer in the building and owning the home adds to the feeling of belonging to the building. This adds to the place attachment of the resident to the high rise residential building (Lewicka, 2005). The sense of community is also higher for these residents (Ellaway, et al., 2001). In addition, the type of social space and the presence of a social space in the plinth have a positive effect on social cohesion. A specifically designed space for socializing in the building increases the opportunities for social connections between the residents (Völker & Flap, 2007).

Some variables do have a negative effect on social cohesion in the building. Access to a car limits the connections of the resident with the neighbors in the building. Van den Berg et al. (2015) also found that a car decreases the amount of local social connections. A bigger building leads to more anonymity among neighbors. More entrances to the building or more duplicate buildings also minimize the number of connections within the building. There are fewer opportunities for socialization between residents of high rise residential buildings due to multiple places of interaction (Bafna, 2003). In addition, the location of the mailboxes: outside leads to fewer connections within the building. It is not an inviting environment to socialize with neighbors (Yuen & Yeh, 2011).

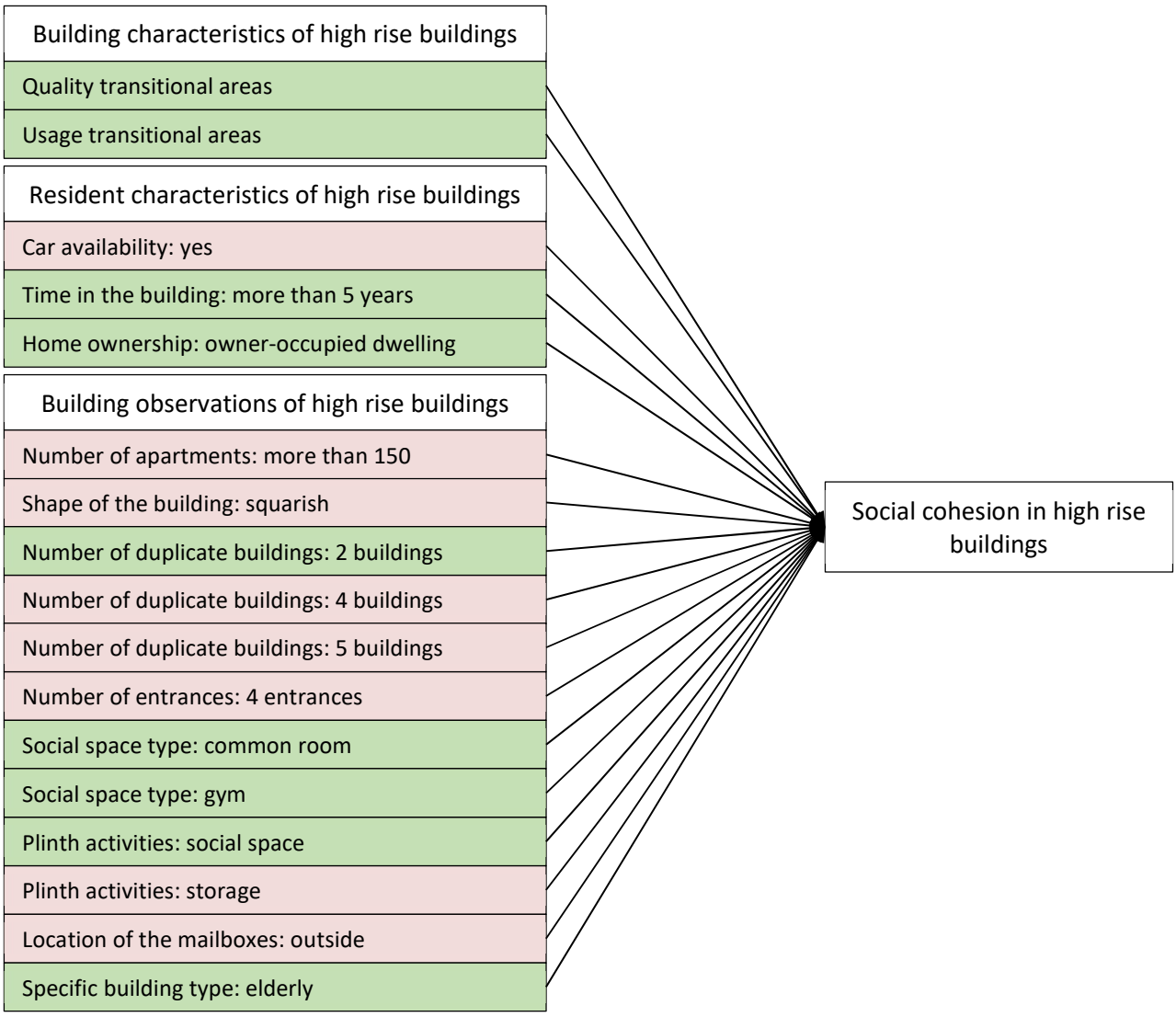


Figure 13. First regression model for social cohesion.

6.5. Second social cohesion analysis

This research does not only focus on the relationships between each dependent variable and their independent variables. The relationship between the dependent variables also has to be taken into account, which is why a fourth regression analysis is performed. The interactions of the residents influence social cohesion in the building. Social networks are one of the five dimensions of social cohesion which focus on the social interactions of the residents in a community (Dekker & Bolt, 2005; Forrest & Kearns, 2001; Kearns & Forrest, 2000). Therefore, the dependent variables social interaction and social satisfaction are added to the predictor group for the social cohesion score.

This results in 22 variables that are added to the social cohesion regression analysis as predictors. These variables are quality transitional areas, usage transitional areas, car availability, age, health status, birth region, education level, time in the building, home ownership, number of floors, number of apartments, shape of the building, number of duplicate buildings, number of entrances, access to the apartment, social space availability, social space type, plinth activities, location of the mailboxes, specific building type, social interaction, and social satisfaction. First, the assumptions have to be checked to see if the results are valid. The results and regression model are explained afterwards.

Check of the assumptions
The four assumptions of independence of observations, homoscedasticity, normality, and multicollinearity have to be checked again with this analysis. The Durbin-Watson value is 2.060, which is between 1.5 and 2.5. Therefore the independence of observations is met. The scatterplot and P-P plot for this analysis are shown in Appendix VII. The scatterplot does not show a pattern and the P-P plot is close to a linear line. The assumptions of homoscedasticity and normality are therefore met. At last, the multicollinearity is tested with the VIF values, which need to be below 10. For this analysis, the VIF values are between 1.000 and 1.922 which means that the assumption is met. To conclude, the results of this combined multiple regression analysis are valid.

6.5.1. Results of the analysis

The results of the final regression analysis are shown in Table 16. The adjusted R^2 value for this model is 0.612, so the model explains 61.2% of the variability of the dependent variable social cohesion. The combined regression analysis ran through 14 steps. The F-ratio in the ANOVA table of the regression analysis tests the goodness of fit for the data. All 14 steps are significant, with each a p-value of 0.000. This means that the independent variables and the other dependent variables as predictors significantly predict the social cohesion score and that the regression model is a good fit for the data.

Table 16. Second multiple regression model for social cohesion.

Model	Unstand. Beta	Stand. Beta	t	Sig.
(Constant)	20.004		8.076	0.000**
Social interaction score	1.575	0.492	12.457	0.000**
Social satisfaction score	1.184	0.192	5.333	0.000**
Quality transitional areas	0.952	0.078	2.176	0.030*
Usage transitional areas	1.505	0.110	3.262	0.001**
Car availability: yes	-2.424	-0.087	-2.235	0.026*
Age: 35 - 64 years old	2.981	0.097	2.456	0.015*
Age: 65 years or older	6.913	0.205	4.478	0.000**
Health status: very good	2.858	0.096	2.810	0.005**
Home ownership: owner-occupied dwelling	2.892	0.093	2.177	0.030*
Shape of the building: squarish	-2.383	-0.088	-2.381	0.018*
Number of duplicate buildings: 5 buildings	-15.629	-0.086	-2.539	0.012*
Number of entrances: 4 entrances	-10.467	-0.081	-2.395	0.017*
Social space availability: yes	3.625	0.132	3.621	0.000**
Social space type: common room	7.907	0.171	4.194	0.000**

*** Significant at the 0.01 level* * *Significant at the 0.05 level*

The multiple regression model for the combined analysis has 14 variables that have a significant relationship with the social cohesion score. Four of these variables have a negative influence on social cohesion, while the other ten have a positive effect on social cohesion in the building. The social interaction score has the strongest relationship with the social cohesion score with a standardized Beta-value of 0.492.

The regression model for the second analysis of social cohesion in the building is shown in Figure 14. This provides a clear view of the positive and negative relationships with the social cohesion score. The positive significant relationships are shown in green and the negative significant relationships are shown in red. The negative effect of ownership of a car can limit the connections with the neighbors in the building (van den Berg, et al., 2015). Furthermore, more duplicate buildings and more entrances lead to fewer opportunities for connections between the residents (Bafna, 2003).

Both the other dependent variables as predictors have a positive effect on social cohesion in the building. These relationships are also very strong. Social interaction has the strongest relation with social cohesion and social satisfaction has the second strongest relationship. The quality and usage of the transitional areas also have a positive effect on the social cohesion score. The transitional areas are always used to enter the residence. These places of interaction can add to the social connections of the residents (Turkington, et al., 2004). This also collaborates with the findings by Verhage (2021).

In addition, age influences social cohesion. The age of the resident can affect the social connections in the building (van Dijk, et al., 2013), which is especially true for older residents (van den Berg, et al., 2015; van den Berg, et al., 2016). Owning a home also adds to the feeling of belonging to the building (Völker, et al., 2007). Furthermore, the availability of a social space in a building, especially a common room, has a positive effect on the interactions between the residents (Gehl, 2011; Völker, et al., 2007). This has a positive influence on the social cohesion score of the resident.

Most interestingly are the differences between the regression model for social cohesion with only the independent variables in Figure 13 and the second social cohesion regression model below in Figure 14. Adding social interaction and social satisfaction as predictors for the social cohesion score changes the model significantly. Both social interaction and social satisfaction are added to the model and have a strong positive relationship with social cohesion in high rise buildings. The other variables that are added to the model are age: 35 - 64 years old, age: 65 years or older, health status: very good, and social space availability: yes. Inadvertently, this means that some variables have been removed. These are time in the building: more than 5 years, number of apartments: more than 150, number of duplicate buildings: 2 buildings, number of duplicate buildings: 4 buildings, social space type: gym, plinth activities: social space, plinth activities: storage, location of the mailboxes: outside, and specific building type: elderly.

Eight of the variables are part of both regression models for social cohesion. These are quality transitional areas, usage transitional areas, car availability: yes, home ownership: owner-occupied dwelling, shape of the building: squarish, number of duplicate buildings: 5 buildings, number of entrances: 4 entrances, and social space type: common room. Therefore, it can be concluded that these independent variables have an important relationship, positive or negative, with the social cohesion score.

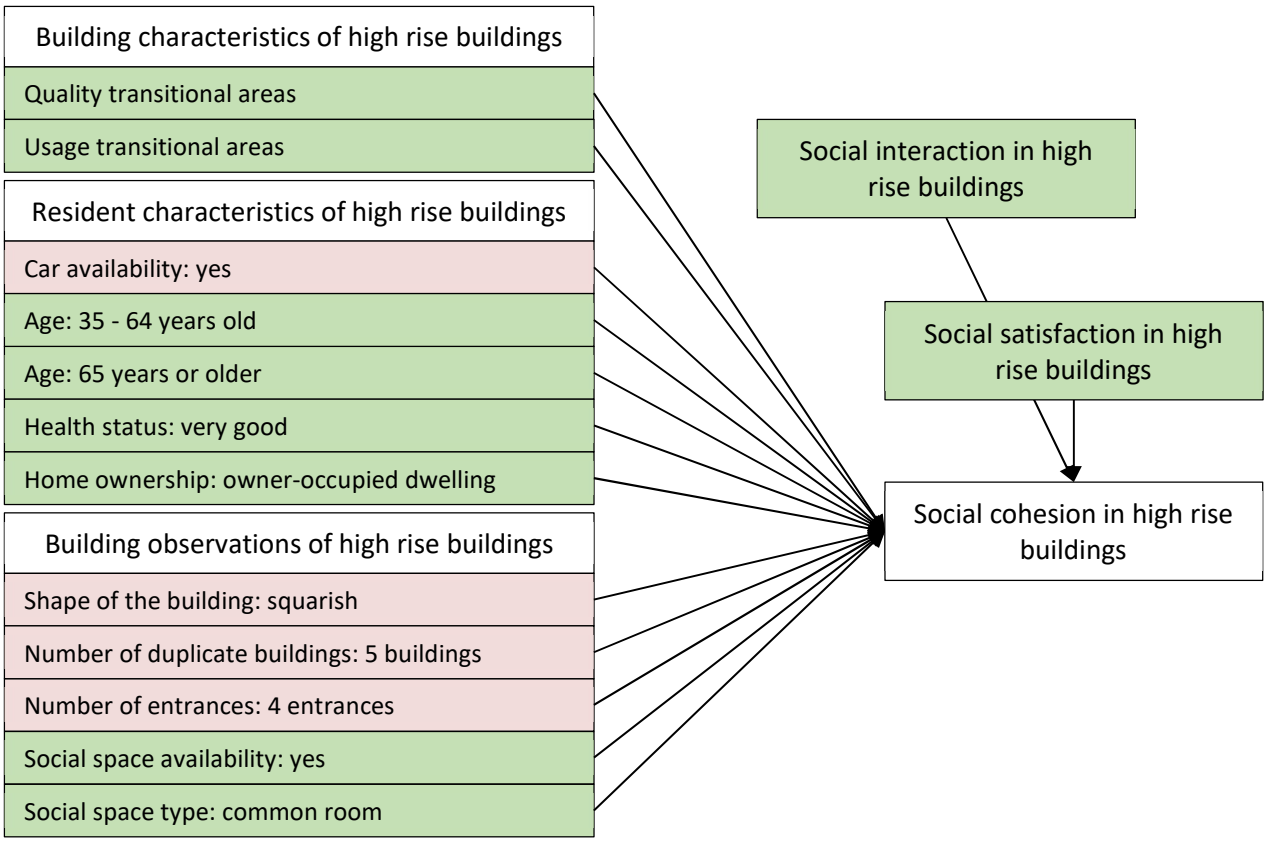


Figure 14. Second regression model for social cohesion.

6.6. Conclusion

Four multiple regression analyses are performed to answer how building characteristics, resident characteristics, and building observations influence social cohesion, social interaction, and social satisfaction in high rise residential buildings. The first three regression analyses only look at one of the three dependent variables and their significant independent variables. The results of these analyses show which independent variables have a positive or negative influence on either social interaction, social satisfaction, and social cohesion. However, the dependent variables also influence each other. Therefore a fourth multiple regression analysis is performed. Social interaction and social satisfaction are part of the social networks of the residents of high rise residential buildings. Social networks are one of the dimensions of social cohesion (Kearns & Forrest, 2000). A second social cohesion regression analysis is performed with the other two dependent variables added as independent variables to the predictor group.

The final regression model for this research is the combination of the second social cohesion model in Figure 14 and the regression models for the social interaction score in Figure 11 and the social satisfaction score in Figure 12. These two dependent variables have a significant influence on the social cohesion score, but there are also independent variables that influence these two dependent variables. This is all put together in the final regression model in Figure 15. This final model is the output of the regression analysis and the final result of this research. The positive significant relationships are shown in green and the negative significant relationships are shown in red.

15 variables have a positive influence on the social cohesion score, but seven variables have a negative influence on social cohesion in high rise buildings. Four variables in the final model have a significant relationship with two of the dependent variables. These are age: 65 years or older, home ownership: owner-occupied dwelling, social space availability: yes, and social space type: common room. All these variables also have a positive influence on the social cohesion score. These characteristics, therefore, have a stronger influence on the social cohesion score in high rise residential buildings.

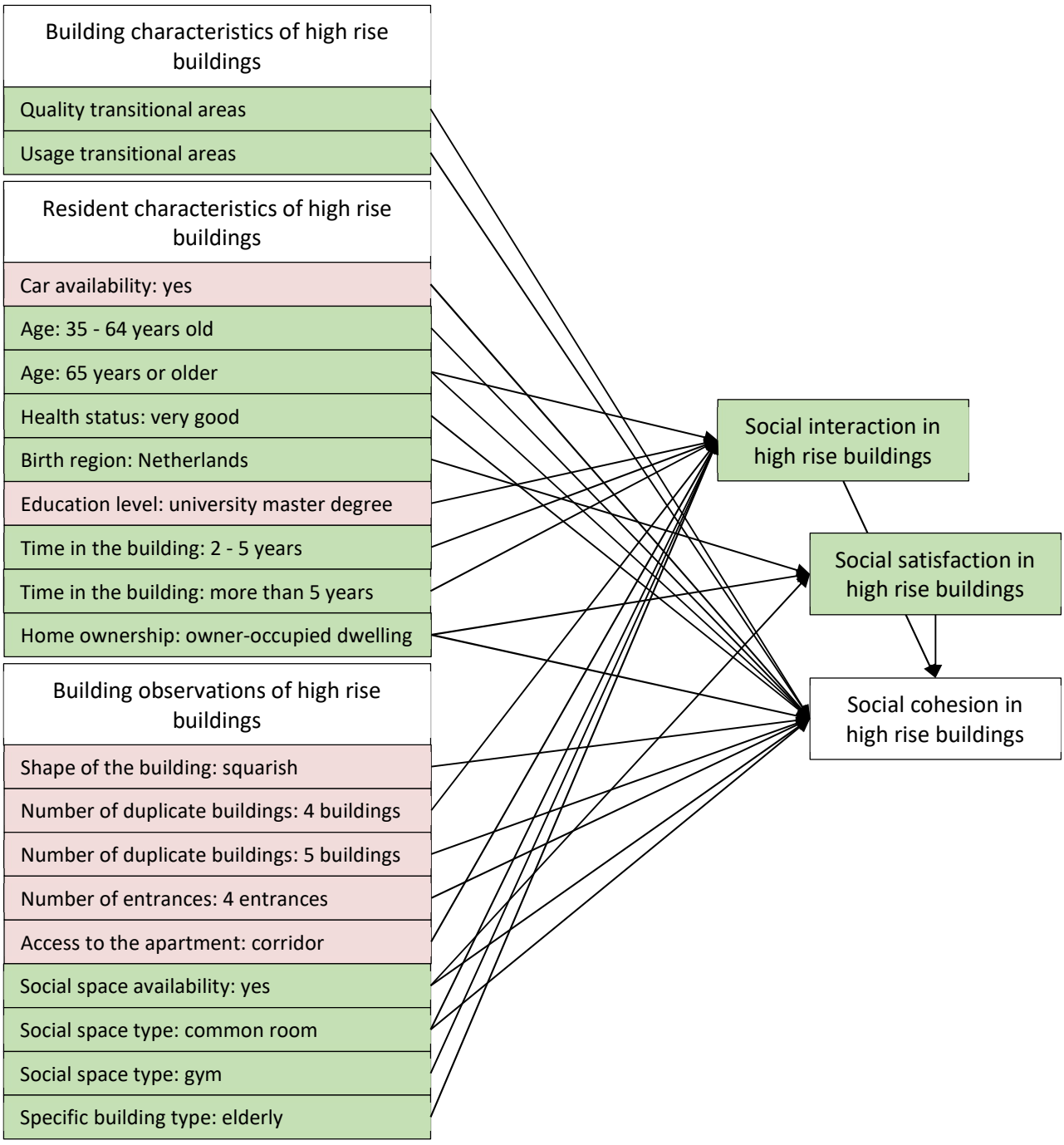


Figure 15. Final model for this research.

7. Conclusion and discussion

This study has focused on how building characteristics, resident characteristics, and building observations influence social cohesion, social interaction, and social satisfaction in high rise residential buildings in Eindhoven. The information obtained during the literature research was added to the conceptual model, which was later adapted into the operational model for this research. Data was collected through a survey among residents of high rise residential buildings. Additional objective observations about these buildings are also done. The survey was distributed to 4414 residents among 44 high rise residential buildings in Eindhoven. This resulted in 355 valid responses, which is an 8.0% response rate. After the recoding of the collected data, the final dataset was statistically analyzed.

The bivariate analyses excluded all variables that did not have a significant relationship. This lead to the performance of regression analyses for each of the three dependent variables: social cohesion, social interaction, and social satisfaction. Taking into account the relationships between dependent variables, a fourth and final regression analysis was performed. These results have all been explained in the previous chapters. The findings of the analyses can be used to improve social cohesion in new high rise residential development. Existing high rise buildings can also adapt, learn, and anticipate problems that can occur based on the results of this research. This chapter explains all the implications of the results of this research. The chapter starts with a conclusion to this research. Afterwards, there will be a discussion about the research and its limitations. The chapter will end with recommendations for this research.

Conclusion
The final model for this research shows that two building characteristics, nine resident characteristics, and nine building observations have a significant positive or negative influence on social cohesion, social interaction, and social satisfaction. Social interaction and social satisfaction also have a strong positive influence on the social cohesion score of residents of high rise residential buildings. This final model can explain 61.2% of the variability of the social cohesion score of the residents. The findings of the regression analyses can be used for new and existing high rise residential buildings.

The quality and usage of the transitional areas have a positive effect on social cohesion in high rise residential buildings. If the quality is low, the social cohesion score of the resident will also be low. New developments should take the design of transitional areas into account. Developers should make an intentional decision about the experience of the residents of these places. If the transitional areas of exiting buildings have low quality, social cohesion in the building will also be low. Improving that aspect of the building will improve the livability of the residents. Small interventions can also prevent lower social cohesion. Every building has a transitional area, so all buildings can be improved on this aspect to increase the social cohesion between the residents.

Older residents of high rise buildings experience higher levels of social cohesion in their building. Most high rise residential buildings are designed for a specific type of resident. It will be beneficial to diversify the age of the residents, to increase the social cohesion within the building. New buildings can be designed specifically with the intention to house different age groups. The owners of existing buildings can implement a policy to diversify the age of the residents to improve social cohesion.

In addition, a longer residence in the building and ownership of the apartment have a positive influence on the social cohesion score. This strengthens the place attachment of the resident to the high rise residential building. It can be assumed that buildings with rented apartments with a high turnover have therefore a lower social cohesion. Developers should be taking this into account with new high rise residential buildings and stimulate social cohesion in another way. If the social cohesion is lower in exiting high rise buildings, this might be the reason. A policy to diversify the type of home ownership can boost the social cohesion of the residents.

Furthermore, the presence of a social space in the building and the specific type of social space are very important for the experienced social cohesion and interactions. If there is a common room available, it invites the residents to have more interactions with each other. This leads to stronger social cohesion in the high rise residential building. New developments should implement a social space in the building to secure a higher social cohesion between the residents. Exiting high rise buildings without a social space will have a lower social cohesion score for the residents. However, anticipating this lower social cohesion can be good. Other implementations can be done to improve social cohesion. Knowing why social cohesion is lower is the first step in improving social cohesion for the residents.

Some variables have a negative influence on the social cohesion score of the resident of high rise residential buildings. If the resident has a car available, they will have fewer social interactions with their neighbors. Reducing the amount of parking availability for the building can reduce car ownership. Facilitating other ways of transport will also help with the reduction of car ownership. This can be implemented in new and existing high rise residential buildings. In addition, residents with a university master degree also experience less social cohesion in their building. Different types of apartments for different types of residents will provide diverse residents in the building. This can prevent lower social cohesion in the building.

Furthermore, a building with four or five duplicate buildings also leads to fewer moments for social interactions. This is the same if the high rise residential building has a lot of entrances. All these building aspects decrease the opportunities for interactions between the residents. If the design of the building is squarish and the access to the apartment is a corridor, the social cohesion score of the building is also lower. Multiple entrances to the building are convenient but will decrease social cohesion. Implementing other aspects to increase social cohesion can help with that. It is also better if there are not multiple buildings in new developments, as it also decreases social cohesion. New high rise residential buildings should be designed with one main entrance and building and should not be too elongated. If that is the case, social cohesion will already be lower. Than other implementations need to be done to still provide social cohesion among the residents of the high rise residential building.

Finally, the social interaction score and social satisfaction score have a strong positive influence on the social cohesion score of the resident. There is a correlation between the three dependent variables. If social cohesion is high, social interaction and social satisfaction are also likely to be high. This is the same for the low score. If social cohesion is low, social interaction and social satisfaction are probably also low. Improving one of the aspects will lead to an improvement for all of them. Adjustments explained before can be made to new and exiting high rise residential buildings to increase social cohesion.

Discussion and limitations

The study was performed in Eindhoven and the results are valid for this city. However, the findings should still be useful for high rise residential buildings in other cities. Furthermore, the methodology of this research is applicable to all cities in the Netherlands. New research can be performed in a different city to test the findings of this study.

There are also limitations to the results of this research. One limitation could be the accessibility of the survey for elderly of technically challenged residents, especially when age is an important factor to determine social cohesion, interaction, and satisfaction in high rise residential buildings. The survey was made as simple as possible but was only available online. An option for a paper survey or an interview might result in a higher response rate. This could be applied in further research.

The data collection was also impeded by the no answer option in the survey. In further research, this should be changed in the survey. The survey should be made as simple as possible to prevent different interpretations of the questions. Each question should have as few answer options as possible. In addition, open questions could be added to collect more information about the social spaces and activities in the building. To present a clear definition of what residents identify as a social space.

Recommendations

Practically, developers and owners of the building can implement the above mentioned changes to increase social cohesion in new and existing high rise residential buildings. This is especially useful for Eindhoven, which is on the verge of a high rise boom. Securing a livable environment for the residents will increase the popularity of living in high rise residential buildings. The most popular type of house is still a single family house, but there is not enough space to only create that type of dwelling. Apartments have to be more desirable and a livable environment is a key to that.

Further research could focus on the user based design of high rise residential buildings. How each type of user has different wishes for a livable environment in their building. Additional research could also give more attention to the specific design of the transitional areas and social areas in a high rise residential building. These two design aspects of the building have a positive effect on the social cohesion in the building. Go more into depth about the different types of designs, which is related to the space syntax. Another option is to collect even more specific information about the building. Knowing everything about the building might give other insides why one high rise building has a higher social cohesion than another.

All the findings can be used for new high rise developments and to secure a livable environment for the residents. High rise buildings are a main part of city development and will not disappear. High rise buildings will only be successful if they are designed with a livable environment in mind and to provide connections between the residents of the high rise residential buildings.

Bibliography

Ahmed, N. O., El-Halafawy, A. M. & Amin, A. M., 2019. A Critical Review of Urban Livability. *European Journal of Sustainable Development,* 8(1), pp. 165-182.

Allpro, 2020. *De skyline van Eindhoven wordt een paar iconen rijker.* [Online]
Available at: https://www.allpro.nl/skyline-eindhoven-verrijkt-met-nieuwe-projecten/
[Accessed 6 December 2021].

Amick, D. J. & Kviz, F. J., 1975. Social alienation in public housing: The effect of density and building types. *Ekistics,* 39(231), pp. 118-120.

Aw, S. B. & Lim, P. I., 2016. The provision of vertical social pockets for better social interaction in high-rise living. *Planning Malaysia: Journal of the Malaysian Institute of Planners,* 14(4), pp. 163-180.

Bafna, S., 2003. Space Syntax. A brief introduction to its logic and analytical techniques. *Environment and Behavior,* 35(1), pp. 17-29.

Buckner, J. C., 1988. The Development of an Instrument to Measure Neighborhood Cohesion. *American Journal of Community Psychology,* 16(6), pp. 771-791.

CBS, 2021. *Dashboard bevolking.* [Online]
Available at: https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking
[Accessed 13 September 2021].

CBS, 2022. *Nieuwe indeling bevolking naar herkomst.* [Online]
Available at: https://www.cbs.nl/nl-nl/longread/statistische-trends/2022/nieuwe-indeling-bevolking-naar-herkomst
[Accessed 12 August 2022].

Chile, L. M., Black, X. M. & Neill, C., 2014. Experience and expression of social isolation by inner-city high-rise residents. *Housing, Care and Support,* 17(3), pp. 151-166.

Cortese, D., 2018. *Race for the Skies: Chicago vs. New York.* [Online]
Available at: https://www.theb1m.com/video/race-for-the-skies-chicago-vs-new-york
[Accessed 17 March 2021].

Cortese, D., 2019. *Why Europe Doesn't Build Skyscrapers.* [Online]
Available at: https://www.theb1m.com/video/why-europe-doesnt-build-skyscrapers
[Accessed 17 March 2021].

De Jaegher, H., Di Paolo, E. & Gallagher, S., 2010. Can social interaction constitute social cognition. *Trends in Cognitive Sciences,* 14(10), pp. 441-447.

Deckelmann, D., 2021. *What Is the Likert Scale, and How Do I Use It?.* [Online]
Available at: https://livecusurvey.com/likert-scale-definition/
[Accessed 5 April 2021].

Dekker, K. & Bolt, G., 2005. Social cohesion in post-war estates in the Netherlands: Differences between socioeconomic and ethnic groups. *Urban Studies,* 42(13), pp. 2447-2470.

Dekker, K. & van Kempen, R., 2004. Large housing estates in Europe: current situation and developments. *Journal of Economic & Social Geography,* 95(5), pp. 570-577.

Doevendans, C. H., 2005. Hoogbouw tussen permanentie and hype, een ethische benadering. *SerVicE_ Magazine,* 12(2), pp. 19-20.

Ellaway, A., Macintyre, S. & Kearns, A., 2001. Perceptions of Place and Health in Socially Contrasting Neighborhoods. *Urban Studies,* 38(12), pp. 2299-2316.

Eurostat, 2015. *People in the EU: who are we and how do we live?,* Luxembourg, Luxembourg: European Union.

Forrest, R. & Kearns, A., 2001. Social Cohesion, Social Capital and the Neighborhood. *Urban Studies,* 38(12), pp. 2125-2143.

French, S. et al., 2014. Sense of community and its association with the neighborhood built environment. *Environment and Behavior,* 46(6), pp. 677-697.

Gehl, J., 2011. *Life Between Buildings. Using Public Space.* Washington, Washington DC, USA: Island Press.

Gemeente Eindhoven, 2021. *Stationsgebied 'Knoop XL'.* [Online]
Available at: https://www.openeindhoven.nl/stationsgebied-knoopxl
[Accessed 9 February 2022].

Google My Maps, 2022. *Google My Maps.* [Online]
Available at: https://www.google.com/maps/d/?hl=nl
[Accessed 13 January 2022].

Google, 2021. *Google Maps.* [Online]
Available at: https://www.google.nl/maps/@51.4424832,5.4887767,14z
[Accessed 6 December 2021].

Gratis QR, 2021. *Gratis QR code maken.* [Online]
Available at: https://gratisqrcode.nl/
[Accessed 6 December 2021].

Helleman, G. & Wassenberg, F., 2004. The renewal of what was tomorrow's idealistic city. Amsterdam's Bijlmermeer high-rise. *Cities,* 21(1), pp. 3-17.

Ho, R., 2014. *Handbook of Univariate and Multivariate Data Analysis with IBM SPSS.* Second ed. Boca Raton, Florida, USA: Taylor & Francis Group.

Kadaster, 2021. *3D Basisvoorziening.* [Online]
Available at: https://3d.kadaster.nl/basisvoorziening-3d/
[Accessed 6 December 2021].

Kadaster, 2022. *Basisregistratie Adressen en Gebouwen (BAG).* [Online]
Available at: https://bagviewer.kadaster.nl/lvbag/bag-viewer/#
[Accessed 24 January 2022].

Kearns, A. & Forrest, R., 2000. Social Cohesion and Multilevel Urban Governance. *Urban Studies,* 37(5-6), pp. 995-1017.

Kent State University, 2022. *SPSS Tutorials.* [Online]
Available at: https://libguides.library.kent.edu/SPSS/home
[Accessed 19 May 2022].

Krantz, B., Öresjö, E. & Priemus, H., 1999. *Large scale housing estates in North-West Europe: Problems, interventions and experiences.* Delft, The Netherlands: Delft University Press.

Laerd Statistics, 2020. *Everything you need to complete your data analysis.* [Online]
Available at: https://statistics.laerd.com/features-overview.php
[Accessed 19 May 2022].

Lewicka, M., 2005. Ways to make people active: The role of place attachment, cultural capital, and neighborhood ties. *Journal of Environmental Psychology,* 25(4), pp. 381-395.

LimeSurvey, 2021. *A survey on the living environment in a high rise building.* [Online]
Available at: https://tueindhoven.limequery.com/295426?newtest=Y&lang=en
[Accessed 6 December 2021].

McLeod, S., 2019. *Likert Scale Definition, Examples and Analysis.* [Online]
Available at: https://www.simplypsychology.org/likert-scale.html
[Accessed 5 April 2021].

Ministerie BZK, 2018. *Ruimte voor Wonen. De resultaten van het WoonOnderzoek Nederland 2018,* Den Haag, The Netherlands: Het ministerie van Binnenlandse Zaken en Koninkrijksrelaties.

Ministerie BZK, 2022. *Bouwbesluit Online 2012.* [Online]
Available at: https://rijksoverheid.bouwbesluit.com/
[Accessed 13 January 2022].

Modi, S., 2014. Improving the social sustainability of high-rises. *Council on Tall Buildings and Urban Habitat Journal,* pp. 24-30.

PBL, 2016. *Cities in Europe. Facts and figures on cities and urban areas,* The Hague, The Netherlands: PBL Netherlands Environmental Assessment Agency.

PBL, 2021. *Wonen na de verkiezingen. Het woningtekort wordt in de regio opgelost. ,* The Hague, The Netherlands: PBL Planbureau voor de Leefomgeving.

PNGKey, 2021. *Vector Building Skyscraper High - Vector Internet Illustration.* [Online]
Available at: https://www.pngkey.com/maxpic/u2q8o0t4i1y3t4q8/
[Accessed 15 January 2021].

Rogge, N., Theesfeld, I. & Strassner, C., 2018. Social sustainability through social interaction - A national survey on community gardens in Germany. *Sustainalibity,* 10(4), pp. 1-18.

Scribbr, 2022. *Statistiek voor Beginners | 5 Stappen & Voorbeelden.* [Online]
Available at: https://www.scribbr.nl/category/statistiek/
[Accessed 19 May 2022].

SeniorenPunt, 2022. *Woon- en zorglocaties.* [Online]
Available at: https://www.seniorenpunt.nl/aanbod/
[Accessed 23 September 2022].

Stichting Hoogbouw, 2020. *Hoogbouw in Nederland 2020,* Rotterdam, The Netherlands: Stichting Hoogbouw.

Sugiyama, T., Leslie, E., Giles-Corti, B. & Owen, N., 2008. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships?. *Journal of epidemiology and community health,* 62(9), pp. 1-6.

Swales, J. M. & Feak, C. B., 2012. *Academic Writing for Graduate Students: Essential Skills and Tasks.* Third ed. Ann Arbor, Michigan, USA: University of Michigan Press.

Theeuwen, M., 2018. *Nieuwe skyline van Eindhoven: hoogbouw-explosie in aantocht.* [Online]
Available at: https://www.ed.nl/eindhoven/nieuwe-skyline-van-eindhoven-hoogbouw-explosie-in-aantocht~a178e862/
[Accessed 25 January 2022].

TU/e, 2022. *Privacy and Ethics.* [Online]
Available at: https://www.tue.nl/en/our-university/library/rdm/rdm-themes/privacy-and-ethics/
[Accessed 9 March 2022].

Turkington, R., van Kempen, R. & Wassenberg, F., 2004. *High-rise housing in Europe. Current trends and future prospects,* Delft, The Netherlands: DUP Science.

United Nations, 2018. *World Urbanization Prospects 2018.* [Online]
Available at: https://www.un.org/development/desa/pd/news/world-urbanization-prospects-2018
[Accessed 13 September 2021].

United Nations, 2022. *World population to reach 8 billion on 15 November 2022.* [Online]
Available at: https://www.un.org/en/desa/world-population-reach-8-billion-15-november-2022
[Accessed 7 September 2022].

van den Berg, P. E. W., Arentze, T. A. & Timmermans, H. J. P., 2015. A multilevel analysis of factors influencing local social interaction. *Transportation,* 42(5), pp. 807-826.

van den Berg, P. E. W., Kemperman, A. D. A. M., Uytdewillegen, C. G. J. & Weijs-Perrée, M., 2016. Loneliness, residential environment, mobility, and ICT-use among elderly. *Gerontechnology,* 15(Supplement), p. 147s.

van den Berg, P. E. W. & Timmermans, H. J. P., 2015. A multi-level path analysis of social networks and social interaction in the neighborhood. *Region,* 2(1), pp. 55-66.

van Dijk, H. M., Cramm, J. M. & Nieboer, A. P., 2013. Social cohesion as perceived by community-dwelling older people: The role of individual and neighbourhood characteristics. *International Journal of Ageing and Later Life,* 8(2), pp. 9-31.

van Soomeren, P., 2020. *Hoogbouw: Leren van Beheren.* [Online]
Available at: https://www.service-studievereniging.nl/magazine/artikel/hoogbouw-leren-van-beheren/
[Accessed 21 April 2021].

Verhage, S., 2021. *The impact of the living environment on the local social life of high-rise residents,* Eindhoven: Eindhoven University of Technology.

Völker, B. & Flap, H., 2007. Sixteen Million Neighbors: A Multilevel Study of the Role of Neighbors in the Personal Networks of the Dutch. *Urban Affairs Review,* 43(2), pp. 256-284.

Völker, B., Flap, H. & Lindenberg, S., 2007. When are neighborhoods communities? Community in Dutch Neighborhoods. *European Sociological Review,* 23(1), pp. 99-114.

Wilkinson, D., 2007. The multidimensional nature of social cohesion: psychological sense of community, attraction, and neighboring. *American Journal of Community Psychology,* 40(3-4), pp. 214-229.

Yuen, B. & Yeh, A. G. O., 2011. *High-Rise Living in Asian Cities.* Dordrecht, The Netherlands: Springer Science+Business Media B.V..

Appendix

Appendix I: List of figures and tables

List of figures

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Appendix II: Survey in English

Language:

English - English | Change the language

A survey on the living environment in a high rise building

How do high rise residents experience their social and physical living environment in a high rise building?

This survey has been created at the University of Technology Eindhoven and is a part of a research into the social cohesion and interaction in high rise residential buildings. The aim of the research is to get a better insight into how building characteristics and resident characteristics affect the social cohesion and interaction in high rise buildings. As a resident of a high rise building, it would be very appreciated if you take **5 minutes** of your time to fill in this survey.

You need to give your permission to participate in this research and to continue with the survey. The policy below will give you more details about the research and the data collection. Please read this information carefully and accept the policy before continuing with the survey.

There are 18 questions in this survey.

To continue please first accept our survey data policy.
Show policy ☐

Survey data policy

What is the survey about?

This survey had been created by researchers of the faculty of the Built Environment of the University of Technology Eindhoven and is a part of a research into the social cohesion and interaction in high rise residential buildings. The aim of the research is to get a better insight into how building characteristics and resident characteristics affect the social cohesion and interaction in high rise buildings. The survey will answer how the high rise residents experience their social and physical living environment in a high rise building. This will be used in answering the research question.

Who can take part in the survey?

The target group for the survey are residents of a high rise residential building. You are part of this target group, which is why you have been asked to participate in this survey.

How long will it take?

The survey takes about 5 minutes to complete.

Do I have to take part?

No, participating is entirely voluntary. If you do take part in the survey, you will have to accept to survey data policy.

What data does the survey collect?

In the survey you will be presented with questions about your experience with the physical characteristics of your building and your social contact and relations with your neighbors. The survey also includes some background questions (e.g. gender, age, education level, income, postal code and current living situation). This will be used for comparing the different resident groups.

There are no good of bad answers to these questions. You can stop the survey at any time you want.

What happens to the data?

The research will collect and process several personal data, for example on your socioeconomical background (salary range, age, gender, etc.). The collection, processing and analysis of your answers and the storage of the data is necessary to be able to answer the scientific questions this study is researching and to publish the results. We ask for your permission to process and store your data for these purposes. All data is stored on servers of the Eindhoven University of Technology. For the storage of personal data additional measures are taken that are described below:

Confidentiality of your data

To protect your privacy, your data is pseudonymized with an encryption key and by allotting a code of numbers and characters to each participant. This way the information that might identify you is removed from the dataset that will be used for the research. Data can only be traced back to you by using the encryption key. This key is safely stored by the local research department and this key is strictly separated from the research data that is used for the analysis. The encryption key is solely available to the researcher Sara Noordenbos and her direct supervisors: Pauline van den Berg and Stephan Maussen. Additionally, the encryption key will be destroyed at the end of the research, making re-identification of personal data through use of the key impossible. The data from the survey will also be merged into group categories which makes retracing data from the survey to specific individuals near impossible. The combination of these measures ensures that research data will not be retraceable to you in scientific reports and publications about the research, and that the data used in this research is exclusively available in anonymized form.

Exclusive data will also be merged to group level, analyzed and published for scientific purposes, like scientific articles and reports. No individual responses in the survey will be made public. The data will be exclusively used for scientific purposes. Because collected data is merged to group level, it cannot be traced back to you in reports and publications about the research.

All information will be treated confidentially in accordance with the requirements by AVG. The TU/e privacy policy can be found at: https://www.tue.nl/storage/privacy/.

Risks in participation in this research?

A risk is personal data unwantedly made public. But this risk is minimal due to the implementation of pseudonymization and at the end of the research anonymization of the data. Because the encryption key and your pseudonymized data are stored separately, the chance of your personal data leaking is small.

Who can I contact if I have queries or concerns about the survey?

In case of any questions, please send an email to Sara Noordenbos: s.noordenbos@student.tue.nl. If you have complaints about this research, you can contact Pauline van den Berg (p.e.w.v.d.berg@tue.nl) or Stephan Maussen (s.j.e.maussen@tue.nl). You can report irregularities regarding the scientific integrity to the TU/e counselors.

Permission and Informed Consent

Before participating in scientific research it is important for participants to know that participating is entirely voluntary and we need your permission to have you partake in the research and to process the data that you give us by filling in the survey. Please read the statements below carefully. If you agree with these statements, you can give your permission at the end of this page. If you do not agree, you can close the survey.

By participating in this research I agree to the following:

- I have read and understood the information about this research. I have had, if necessary, the opportunity to ask questions to the researchers that are conducting this research. I understand that I am free to contact the researcher with questions about the research in the future.

- I participate voluntarily on this survey and understand that I can refuse to answer or stop the survey at any given moment, without having to give any reason.

- I consent the usage and storage of the information that I provide in this survey for the purpose of the research into the social cohesion and interaction in high rise buildings.

- I understand that all personal information that could identify me (e.g. name, e-mail address, postal code, etc.) is processed confidentially and will not be shared with third parties.

- I understand that the information that I provide cannot be traced back to me through reports and scientific publications about this research.

- I consent to the storage of anonymized information from the survey in data-archives, so that this may be used for future research in the field of city planning.

- I have read and understand the statements on this page and I agree to all these statements.

Please select one of the following options:

Accept Close

Building characteristics

This section is about your building and the social spaces and traffic areas in the building.

What is your postal code including letters (no space)?

Please fill in 4 numbers and 2 letters.

Indicate how much you agree or disagree with the following statements about the **social spaces in your building**. Social spaces are places where people come together intentionally and places for recreation. Think of a shared garden, roof terrace, seating areas, and such.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	No answer
I am satisfied about the quantity of social spaces in my building	○	○	○	○	○	○
I am satisfied about the quality of the social spaces in my building	○	○	○	○	○	○
The social spaces in my building are frequently used	○	○	○	○	○	○
I feel safe in the social spaces in my building	○	○	○	○	○	○

Indicate how much you agree or disagree with the following statements about the **traffic areas in your building**. Traffic areas are transitional areas in the building. Think of entrances, corridors, elevators, and such.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	No answer
I am satisfied about the quality of the traffic areas in my building	○	○	○	○	○	○
The traffic areas in my building are frequently used as places to stay	○	○	○	○	○	○
I feel safe in the traffic areas in my building	○	○	○	○	○	○

Social interaction in the building

This section is about your social interactions between you and your neighbors.

How often are you in the following situations?

	(Almost) never	1 time per month	2-3 times per month	1 time per week	2-5 times per week	(Almost) daily	No answer
How often do you greet your neighbors in social spaces in your building (e.g. shared garden, roof terrace, seating areas)	○	○	○	○	○	○	○
How often do you greet your neighbors in traffic areas in your building (e.g. entrances, corridors, elevators)	○	○	○	○	○	○	○
How often do you stop to talk with a neighbor in social spaces in your building (e.g. shared garden, roof terrace, seating areas)	○	○	○	○	○	○	○
How often do you stop to talk with a neighbor in traffic areas in your building (e.g. entrances, corridors, elevators)	○	○	○	○	○	○	○
How often do you have people from your building come over to your home	○	○	○	○	○	○	○
How often do you visit people in your building in their homes	○	○	○	○	○	○	○
How often do you engage in social activities in your building	○	○	○	○	○	○	○

How satisfied are you?

	1 - Very unsatisfied	2	3	4	5	6	7	8	9	10 - Very satisfied	No answer
How satified are you with your social exhanges with the people in your building	○	○	○	○	○	○	○	○	○	○	○

Social cohesion in the building

This section is about your social connections in your building.

To what extent do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	No answer
I feel like I belong to this building	○	○	○	○	○	○
The friendships and associations I have with other people in my building mean a lot to me	○	○	○	○	○	○
If the people in my building were planning something I'd think of it as something "we" were doing rather than "they" were doing	○	○	○	○	○	○
I think I agree with most people in my building about what is important in life	○	○	○	○	○	○
I feel loyal to the people in my building	○	○	○	○	○	○
I would be willing to work together with others on something to improve my building	○	○	○	○	○	○
I like to think of myself as similar to the people who live in this building	○	○	○	○	○	○
A feeling of fellowship runs deep between me and other people in this building	○	○	○	○	○	○
Living in this building gives me a sense of community	○	○	○	○	○	○
Overall, I am very attracted to living in this building	○	○	○	○	○	○
Given the opportunity, I would like to move out of this building	○	○	○	○	○	○
I plan to remain a resident of this building for a number of years	○	○	○	○	○	○
I visit my neighbors (in this building) in their homes	○	○	○	○	○	○

If I needed advice about something I could go to someone in my building	○	○	○	○	○	○
I believe my neighbors (in this building) would help me in an emergency	○	○	○	○	○	○
I borrow things and exchange favors with my neighbors (in this building)	○	○	○	○	○	○
I rarely have neighbors (in this building) over to my house to visit	○	○	○	○	○	○
I regularly stop and talk with people in my building	○	○	○	○	○	○

Household characteristics

This section is about some general characteristics of your household.

What is the composition of your household?

- ○ Single person household
- ○ Couple without resident children
- ○ Couple with resident children
- ○ Single parent household
- ○ Other
- ○ No answer

Does your household have a car available?

- ○ Yes, one car
- ○ Yes, more than one car
- ○ No
- ○ No answer

What is your household's net income?

- ○ Less than €1000 a month
- ○ €1001 - €2000 a month
- ○ €2001 - €3000 a month
- ○ €3001 - €4000 a month
- ○ More than €4001 a month
- ○ I do not know
- ○ No answer

The monthly netto income is the amount that is transferred to your account on a monthly basis. This includes your salary, social benefits, and pension income. If your household has multiple sources of income, please take the sum of these amounts.

Individual characteristics

This last section is about some general individual characteristics.

What is your age?

- ○ 18-24 years old
- ○ 25-34 years old
- ○ 35-44 years old
- ○ 45-54 years old
- ○ 55-64 years old
- ○ 65 years or older
- ○ No answer

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary
- ○ No answer

What is your birth country or region?

- ○ Netherlands
- ○ Europe
- ○ North America
- ○ South America
- ○ Africa
- ○ Asia
- ○ Oceania
- ○ No answer

How would you describe your health?

- ○ Poor
- ○ Fair
- ○ Good
- ○ Very good
- ○ Excellent
- ○ No answer

Which degree have you completed?

- ○ Primary school or less
- ○ MAVO / VMBO / Lower vocational education
- ○ Secondary vocational education
- ○ HAVO / VWO
- ○ Higher professional education / Bachelor's degree
- ○ University master's degree
- ○ No answer

What is your employment status?

- [ ] Employed full-time (36+ hours per week)
- [ ] Employed part-time (12-35 hours per week)
- [ ] Employed part-time (less than 12 hours per week)
- [ ] Student
- [ ] Unemployed
- [ ] Retired

For how many years have you been living in this building?

Only numbers may be entered in this field.

Do you live in an owner-occupied dwelling or in a rented dwelling?

- ( ) Owner-occupied dwelling
- ( ) Rented dwelling
- ( ) No answer

Additional remarks

Do you have any remarks?

Thank you for completing this survey.

Appendix III: Survey in Dutch

Taal:

Nederlands - Nederlands | Taal wijzigen

Een enquête over de leefomgeving in een woontoren

Hoe ervaren bewoners van hoogbouw hun sociale en fysieke leefomgeving in een woontoren?

Deze enquête is gemaakt op de Technische Universiteit Eindhoven en is een onderdeel van een onderzoek naar de sociale cohesie en interactie in residentiële hoogbouw. Het doel van het onderzoek is om beter inzicht te krijgen in hoe gebouwkenmerken en bewonerskenmerken de sociale cohesie en interactie in woontorens beïnvloeden. Als bewoner van een woontoren wordt het zeer op prijs gesteld als u **5 minuten** van uw tijd neemt om deze enquête in te vullen.

U moet uw toestemming geven om deel te nemen aan dit onderzoek en door te gaan met de enquête. In de onderstaande verklaring kunt u meer lezen over het onderzoek en de dataverzameling. Lees deze informatie zorgvuldig door en accepteer de verklaring voordat u doorgaat met de enquête.

Er zijn 18 vragen in deze enquête.

Accepteer eerst onze gegevensbescherming.
Toon verklaring gegevensbescherming ☐

Gegevensbescherming

Waar gaat de enquête over?

Deze enquête is gemaakt door onderzoekers van de faculteit Bouwkunde van de Technische Universiteit Eindhoven en is een onderdeel van een onderzoek naar de sociale cohesie en interactie in residentiële hoogbouw. Het doel van het onderzoek is om beter inzicht te krijgen in hoe gebouwkenmerken en bewonerskenmerken de sociale cohesie en interactie in woontorens beïnvloeden. Het onderzoek beantwoordt hoe bewoners van hoogbouw hun sociale en fysieke leefomgeving in een woontoren ervaren. Dit wordt gebruikt bij het beantwoorden van de onderzoeksvraag.

Wie kan er deelnemen aan de enquête?

De doelgroep van deze enquête zijn bewoners van residentiële hoogbouw. U maakt deel uit van deze doelgroep en daarom bent u gevraagd om mee te doen aan deze enquête.

Hoe lang duurt het invullen?

Het invullen van de enquête neemt ongeveer 5 minuten in beslag.

Is deelname verplicht?

Nee, deelname is volledig vrijwillig. Als u deelneemt aan de enquête, moet u wel de gegevensbescherming accepteren.

Welke data verzamelt de enquête?

In de enquête zult u vragen krijgen over uw ervaring met de fysieke kenmerken van uw gebouw en uw sociale contacten en relaties met uw buren. De enquête bevat ook enkele achtergrondvragen (bijv. geslacht, leeftijd, opleidingsniveau, inkomen, postcode en huidige woonsituatie). Dit wordt gebruikt om de verschillende bewonersgroepen met elkaar te vergelijken.

Er zijn geen goede of foute antwoorden op deze vragen. U kunt de enquête op elk gewenst moment stoppen.

Wat gebeurt er met de data?

Het onderzoek zal ook een aantal persoonlijke gegevens verzamelen en verwerken bijvoorbeeld over uw sociaaleconomische achtergrond (salarisrange, leeftijd, geslacht, enz.). Het verzamelen, verwerken en analyseren van uw gegevens en het opslaan ervan is nodig om de wetenschappelijke vragen die we in deze studie onderzoeken te beantwoorden en de resultaten te publiceren. Wij vragen uw toestemming voor de verwerking en opslag van uw gegevens voor deze doeleinden. Alle gegevens worden opgeslagen op servers van de Technische Universiteit Eindhoven. Voor de opslag van persoonlijke data worden additionele maatregelen genomen die hieronder staan beschreven:

Vertrouwelijkheid van uw gegevens

Om uw privacy te beschermen, worden uw gegevens gepseudonimiseerd met een encryptiesleutel en door een code van cijfers en letters toe te kennen aan elke participant. Op deze manier wordt informatie die u direct kan identificeren verwijderd uit de gegevens die voor het onderzoek worden gebruikt. Gegevens kunnen alleen naar u worden herleid met de encryptiesleutel. De encryptiesleutel blijft veilig opgeslagen in het lokale onderzoeksinstituut en deze sleutel wordt strikt gescheiden gehouden van de onderzoeksgegevens die in het onderzoek worden gebruikt. De encryptiesleutel is alleen toegankelijk voor onderzoeker Sara Noordenbos en haar directe begeleiders: Pauline van den Berg en Stephan Maussen. De encryptiesleutel wordt bovendien aan het einde van het onderzoek vernietigd zodat re-identificatie van persoonlijke gegevens via de encryptiesleutel niet meer mogelijk is. De gegevens uit de enquêtes zullen bovendien worden samengevoegd tot groepscategorieën hetgeen de herleidbaarheid van gegevens uit enquêtes tot individuele personen vrijwel onmogelijk maakt. De combinatie van bovenstaande maatregelen zorgen ervoor dat de onderzoeksgegevens niet tot u te herleiden zijn in wetenschappelijke rapporten en publicaties over het onderzoek en dat de gegevens gebruikt in het onderzoek alleen in geanonimiseerde vorm beschikbaar zijn.

Uitsluitend data zal bovendien worden samengevoegd tot groepsniveau, geanalyseerd en gepubliceerd voor wetenschappelijke doeleinden, zoals wetenschappelijke artikelen en rapporten. Geen individuele antwoorden in de enquête zullen openbaar worden gemaakt. De data wordt uitsluitend gebruikt voor wetenschappelijke doeleinden. Omdat de verzamelde data wordt samengevoegd tot groepsniveau, kan de data niet naar u herleid worden in rapporten en publicaties over het onderzoek.

Alle informatie zal vertrouwelijk worden behandeld in overeenstemming met de vereisten van AVG. Het TU/e privacybeleid kan gevonden worden op: https://www.tue.nl/storage/privacy/.

Risico's bij deelname aan dit onderzoek

Een risico is het ongewenst publiek geraken van persoonlijke data. Echter is dit risico minimaal vanwege de implementatie van pseudonimisering en aan het einde van het onderzoek anonimisering van de data. Omdat de encryptiesleutel en uw gepseudonimiseerde data gescheiden bewaard worden, is de kans dat uw persoonlijke data publiek gemaakt wordt klein.

Met wie kan ik contact opnemen als ik vragen of zorgen heb over de enquête?

Mocht u vragen hebben, stuur een email naar Sara Noordenbos: s.noordenbos@student.tue.nl. Als u klachten heeft over dit onderzoek, neem dan contact op met Pauline van den Berg (p.e.w.v.d.berg@tue.nl) of Stephan Maussen (s.j.e.maussen@tue.nl). U kunt onregelmatigheden met betrekking tot de wetenschappelijke integriteit melden aan vertrouwenspersonen van de TU/e.

Toestemming en Informed Consent

Voor het deelnemen aan een wetenschappelijk onderzoek is het belangrijk dat de deelnemers weten dat deelname volledig vrijwillig is en dat we uw toestemming nodig hebben om deel te nemen aan dit onderzoek en om de informatie die u in deze enquête verstrekt te verwerken. Lees de onderstaande verklaringen aandachtig door. Als u het eens bent met onderstaande verklaringen, dan kunt u onderaan uw goedkeuring geven. Als u het niet eens bent met deze stellingen, kunt u de vragenlijst afbreken.

Door deel te nemen aan dit onderzoek ga ik akkoord met het volgende:

- Ik heb de informatie over dit onderzoek gelezen en begrepen. Ik heb, indien nodig, vragen over het onderzoek kunnen stellen aan de onderzoekers die dit onderzoek uitvoeren. Ik begrijp dat ik vrij ben om contact op te nemen met de onderzoeker met eventuele vragen over het onderzoek in de toekomst.

- Ik doe vrijwillig mee aan deze vragenlijst en ik begrijp dat ik te allen tijde kan weigeren vragen te beantwoorden en kan stoppen met deelname aan deze vragenlijst, zonder opgaaf van reden.

- Ik geef toestemming voor de verwerking en opslag van de informatie die ik in de enquête heb verstrekt ten behoeve van het onderzoek naar de sociale cohesie en interactie in residentiële hoogbouw.

- Ik begrijp dat alle persoonlijke informatie die mij kan identificeren (bijv. naam, e-mail adres, postcode, enz.) vertrouwelijk zal worden behandeld en niet zal worden gedeeld met derden.

- Ik begrijpen dat de informatie die ik verstrek niet naar mij teruggeleid kan worden in rapporten en wetenschappelijke publicaties over dit onderzoek.

- Ik geef toestemming voor de opslag van geanonimiseerde informatie uit de enquêtes in data-archieven, zodat deze kan worden gebruikt voor toekomstig onderzoek op het gebied van stadsplanning.

- Ik heb bovenstaande verklaringen gelezen en begrepen en ben het eens met al deze verklaringen.

Gelieve één van de volgende opties kiezen:

Accepteren | Sluiten

Kenmerken van het gebouw

Dit onderdeel gaat over uw gebouw en de sociale ruimtes en verkeersruimtes in het gebouw.

Wat is uw postcode inclusief letters (zonder spatie)?

Vul alstublieft 4 cijfers en 2 letters in.

Geef aan in welke mate u het eens of oneens bent met de volgende stellingen over de **sociale ruimtes in uw gebouw**. Sociale ruimtes zijn plekken waar mensen bewust samenkomen en plekken voor recreatie. Denk aan een gedeelde tuin, dakterras, zitruimtes, en dergelijke.

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens	Geen antwoord
Ik ben tevreden over de hoeveelheid sociale ruimtes in mijn gebouw	○	○	○	○	○	○
Ik ben tevreden over de kwaliteit van de sociale ruimtes in mijn gebouw	○	○	○	○	○	○
De sociale ruimtes in mijn gebouw worden veel gebruikt	○	○	○	○	○	○
Ik voel me veilig in de sociale ruimtes in mijn gebouw	○	○	○	○	○	○

Geef aan in welke mate u het eens of oneens bent met de volgende stellingen over de **verkeersruimtes in uw gebouw**. Verkeersruimtes zijn overgangsgebieden in het gebouw. Denk aan entrees, gangen, liften, en dergelijke.

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens	Geen antwoord
Ik ben tevreden over de kwaliteit van de verkeersruimtes in mijn gebouw	○	○	○	○	○	○
De verkeersruimtes in mijn gebouw worden veel gebruikt als verblijfsruimte	○	○	○	○	○	○
Ik voel me veilig in de verkeersruimtes in mijn gebouw	○	○	○	○	○	○

Sociale interactie in het gebouw

Dit onderdeel gaat over uw sociale interacties tussen u en uw buren.

Hoe vaak ervaart u de volgende situaties?

	(Bijna) nooit	1 keer per maand	2-3 keer per maand	1 keer per week	2-5 keer per week	(Bijna) dagelijks	Geen antwoord
Hoe vaak begroet u uw buren in de sociale ruimtes in uw gebouw (bijv. gedeelde tuin, dakterras, zitruimtes)	○	○	○	○	○	○	○
Hoe vaak begroet u uw buren in verkeersruimtes in uw gebouw (bijv. entrees, gangen, liften)	○	○	○	○	○	○	○
Hoe vaak stopt u om een praatje te maken met een buur in de sociale ruimtes in uw gebouw (bijv. gedeelde tuin, dakterras, zitruimtes)	○	○	○	○	○	○	○
Hoe vaak stopt u om een praatje te maken met een buur in verkeersruimtes in uw gebouw (bijv. entrees, gangen, liften)	○	○	○	○	○	○	○
Hoe vaak ontvangt u mensen uit uw gebouw in uw huis	○	○	○	○	○	○	○

Hoe vaak bezoekt u mensen in uw gebouw in hun huis	○	○	○	○	○	○	○
Hoe vaak doet u mee aan sociale activiteiten in uw gebouw	○	○	○	○	○	○	○

Hoe tevreden bent u?

	1 - Zeer ontevreden	2	3	4	5	6	7	8	9	10 - Zeer tevreden	Geen antwoord
Hoe tevreden bent u met uw sociale interacties met de mensen in uw gebouw	○	○	○	○	○	○	○	○	○	○	○

Sociale cohesie in het gebouw

Dit onderdeel gaat over uw sociale connecties in uw gebouw.

In hoeverre bent u het eens of oneens met de volgende stellingen?

	Helemaal niet mee eens	Niet mee eens	Neutraal	Mee eens	Helemaal mee eens	Geen antwoord
Ik heb het gevoel dat ik in dit gebouw thuis hoor	○	○	○	○	○	○
Mijn vriendschappen en verbindingen met andere mensen in mijn gebouw betekenen veel voor mij	○	○	○	○	○	○
Als mensen in mijn gebouw iets van plan waren, zou ik het zien als iets dat "wij" gaan doen, in plaats van iets dat "zij" gaan doen	○	○	○	○	○	○
Ik denk dat ik het eens ben met de meeste mensen in mijn gebouw over wat belangrijk is in het leven	○	○	○	○	○	○
Ik voel dat ik trouw ben aan de mensen in mijn gebouw	○	○	○	○	○	○

Ik zou bereid zijn om samen te werken met anderen om iets in mijn gebouw te verbeteren	○	○	○	○	○	○
Ik beschouw mezelf als vergelijkbaar met de andere mensen die in mijn gebouw wonen	○	○	○	○	○	○
Een gevoel van gemeenschap gaat diep tussen mij en de andere mensen in dit gebouw	○	○	○	○	○	○
Wonen in dit gebouw geeft me een gevoel van gemeenschap	○	○	○	○	○	○
In het algemeen voel ik me erg aangetrokken tot het wonen in dit gebouw	○	○	○	○	○	○
Als ik de kans krijg, zou ik uit dit gebouw willen verhuizen	○	○	○	○	○	○
Ik ben van plan om de komende jaren in dit gebouw te blijven wonen	○	○	○	○	○	○
Ik bezoek mijn buren (in dit gebouw) bij hun thuis	○	○	○	○	○	○
Als ik ergens advies over nodig zou hebben, zou ik naar iemand in mijn gebouw kunnen gaan	○	○	○	○	○	○
Ik geloof dat mijn buren (in dit gebouw) me zouden helpen in een noodgeval	○	○	○	○	○	○
Ik leen dingen en wissel gunsten uit met mijn buren (in dit gebouw)	○	○	○	○	○	○
Ik heb zelden buren (in dit gebouw) op bezoek bij mij thuis	○	○	○	○	○	○
Ik stop en praat regelmatig met mensen in mijn gebouw	○	○	○	○	○	○

Huishoudelijke kenmerken

Dit onderdeel gaat over enkele algemene kenmerken van uw huishouden.

Wat is de samenstelling van uw huishouden?

- ○ Alleenwonend
- ○ Koppel zonder inwonende kinderen
- ○ Koppel met inwonende kinderen
- ○ Eenoudergezin
- ○ Anders
- ○ Geen antwoord

Beschikt uw huishouden over een auto?

- ○ Ja, één auto
- ○ Ja, meer dan één auto
- ○ Nee
- ○ Geen antwoord

Wat is het maandelijkse netto inkomen van uw huishouden?

- ○ Minder dan €1000 per maand
- ○ €1001 - €2000 per maand
- ○ €2001 - €3000 per maand
- ○ €3001 - €4000 per maand
- ○ Meer dan €4001 per maand
- ○ Weet ik niet
- ○ Geen antwoord

Het maandelijkse netto inkomen is het bedrag dat maandelijks op uw rekening wordt gestort. Dit is inclusief uw salaris, sociale uitkeringen en pensioen. Indien uw huishouden meerdere inkomens heeft, dient u deze bij elkaar op te tellen.

Persoonlijke kenmerken

Dit laatste onderdeel gaat over enkele algemene persoonlijke kenmerken.

Wat is uw leeftijd?

- ○ 18-24 jaar oud
- ○ 25-34 jaar oud
- ○ 25-44 jaar oud
- ○ 45-54 jaar oud
- ○ 55-64 jaar oud
- ○ 65 jaar of ouder
- ○ Geen antwoord

Wat is uw geslacht?

- ○ Man
- ○ Vrouw
- ○ Non-binair
- ○ Geen antwoord

Wat is uw geboorteland of gebied?

- ○ Nederland
- ○ Europa
- ○ Noord Amerika
- ○ Zuid Amerika
- ○ Afrika
- ○ Azië
- ○ Oceanië
- ○ Geen antwoord

Hoe zou u uw gezondheid omschrijven?

- ○ Slecht
- ○ Matig
- ○ Goed
- ○ Zeer goed
- ○ Uitstekend
- ○ Geen antwoord

Welke opleiding heeft u afgerond?

- ○ Basisschool / lagere school
- ○ MAVO / VMBO / lager beroepsonderwijs (LBO)
- ○ Middelbaar beroepsonderwijs (MBO)
- ○ HAVO / VWO
- ○ Hoger beroepsonderwijs (HBO) / Bachelor diploma
- ○ Universiteit master
- ○ Geen antwoord

Wat is uw arbeidsstatus?

- ☐ Werkende voltijd (36+ uren per week)
- ☐ Werkende part-time (12-35 uren per week)
- ☐ Werkende part-time (minder dan 12 uren per week)
- ☐ Student
- ☐ Werkloos
- ☐ Gepensioneerd

Hoeveel jaren woont u al in dit gebouw?

In dit veld mogen alleen cijfers ingevoerd worden.

Woont u in een koopwoning of in een huurwoning?

- Koopwoning
- Huurwoning
- Geen antwoord

Aanvullende opmerkingen

Heeft u nog opmerkingen?

Bedankt voor uw deelname aan deze enquête.

Appendix IV: Research buildings in Eindhoven

Selected high rise buildings		
Number	**Building**	**Street**
1	Treurenburgstraat	Treurenburgstraat
2	De Hertoghof	Hertog Hendrik van Brabantplein
3	Elzentlaan	Elzentlaan
4	Gerretsonplein	Gerretsonplein
5	Porthos	Winkelcentrum Woensel
6	De Regent	De Regent
7	Vestedatoren	Smalle Haven
8	Winter	Holstraat
9	De Ranken	Cassandraplein
10	De Parade	Dominee Theodor Fliednerstraat
11	Onyx Tower	Victoriapark
12	Mgr. Swinkelsstraat	Monseigneur Swinkelsstraat
13	Anton	Torenallee
14	Badelochstraat	Badelochstraat
15	Apostelflat I	Maurits Lijnslagerstraat
16	Apostelflat II	Kampakker
17	Aurora	De Lismortel
18	Artemis	Venuslaan
19	Grote Graaf	Graaf Adolfstraat
20	Die Fledermaus	Weisshorn
21	De Koppele	De Koppele
22	Messiaenpark	Messiaenpark
23	Philitelaan	Philitelaan
24	Cederlaan	Cederlaan
25	Hartje New York	Gerard Philipslaan
26	Doctor Hermansweg	Doctor Hermansweg
27	De Graaf	Lichtstraat
28	Haasje Over	Veemstraat
29	Andromedaplaats	Andromedaplaats
30	Philips Bedrijfsschool	Kastanjelaan
31	Cornelis Paradise	Frederik van Eedenplein
32	Boschdijk I	Boschdijk
33	Boschdijk II	Boschdijk
34	Houthalenlaan	Houthalenlaan
35	Heeghtakker	Heeghtakker
36	Amandelpoort	Amandelpark
37	Gunsele	Scottlaan
38	Willemsenflat	Generaal Knooplaan
39	Generaal Wicherslaan	Generaal Wicherslaan
40	Kalmoesplein	Kalmoesplein
41	Urkhovenseweg	Urkhovenseweg
42	Vlinderflat	Vuurvlinderstraat
43	Space-S blok 5	Torenallee
44	Trudo Toren	Philitelaan

Not selected high rise buildings		
Number	**Building**	**Street**
45	Bomanshof	Bomanshof
46	Mignot en de Blockplein	Mignot en de Blockplein
47	De Admirant	Emmasingel
48	Klokgebouw	Klokgebouw
49	The Student Hotel	Stationsweg
50	City Tower	Pastoor Petersstraat
51	Victoriapark Lighting	Victoriapark
52	De Muzenberg	Penelopestraat
53	Cliostede	Cliostraat
54	Echternachlaan I	Echternachlaan
55	Echternachlaan II	Echternachlaan
56	De Greide	De Greide
57	Gerard	Torenallee
58	Van Gorkumlaan	Van Gorkumlaan
59	Mortierlaan	Mortierlaan
60	Gloriantstraat	Gloriantstraat
61	Koning Arthurlaan	Koning Arthurlaan
62	Cees van Lienden	Venuslaan
63	Pieter Eiffhuis	Herodotusplein
64	De Hoeve	Imkerstraat
65	Gennep	Herman Gorterlaan
66	Apostelflats III	Maurits Lijnslagerstraat
67	Apostelflats IV	Heuvelakker
68	Apostelflats V	Heuvelakker
69	Apostelflats VI	Venuslaan
70	Luna	De Lampendriessen
71	Venuslaan II	Venuslaan
72	Venuslaan III	Venuslaan
73	Venuslaan IV	Venuslaan
74	Ouverture	Ouverture
75	Vaalserbergweg I	Vaalserbergweg
76	Vaalserbergweg II	Vaalserbergweg
77	De Koppele II	De Koppele
78	De Koppele III	De Koppele
79	De Koppele IV	De Koppele
80	Messiaenpark II	Messiaenpark
81	Pauluskerkplein	Pauluskerkplein
82	Hartje Rio	Frits Philipslaan
83	De Baron	Lichtstraat
84	De Markies	Lichtstraat
85	De Jonkheer	Lichtstraat
86	De Ridder	Lichtstraat
87	De Vorst	Lichtstraat
88	Reinaertlaan	Reinaertlaan
89	Klaartje Donzestraat	Klaartje Donzestraat
90	Kapitein Pulverstraat	Kapitein Pulverstraat
91	Reynhovestraat	Reynhovestraat
92	Kastelenplein	Kastelenplein
93	Schönberglaan	Schönberglaan
94	Hugo de Grootplein	Hugo de Grootplein

95	Aletta Jacobsplein	Aletta Jacobsplein
96	Zernikestraat	Zernikestraat
97	Robert Fruinflat	Fruinlaan
98	Stationsweg	Stationsweg
99	Veldmaarschalk Montgomerylaan	Veldmaarschalk Montgomerylaan
100	Nederlandplein	Nederlandplein
101	Lauwerszeeweg	Lauwerszeeweg
102	Diekirchlaan	Diekirchlaan
103	Beverloweg	Beverloweg
104	Bokrijkstraat	Bokrijkstraat
105	Tempellaan	Tempellaan
106	Orionstraat	Orionstraat
107	Kruisakker	Kruisakker
108	Maalakker	Maalakker
109	Korfakker	Korfakker
110	Wijngaardplein	Wijngaardplein
111	Amundsenlaan I	Amundsenlaan
112	Amundsenlaan II	Amundsenlaan
113	Hudsonlaan I	Hudsonlaan
114	Hudsonlaan II	Hudsonlaan
115	Hudsonlaan III	Hudsonlaan
116	Hudsonlaan IV	Hudsonlaan
117	Heliconstraat	Heliconstraat
118	Thaliastraat	Thaliastraat
119	Euterpestraat	Euterpestraat
120	Galateastraat	Galateastraat
121	Melpomenestraat	Melpomenestraat
122	Castorstraat	Castorstraat
123	Drosserstraat	Drosserstraat
124	Generaal van Nijnattenstraat	Generaal van Nijnattenstraat
125	Generaal van Teynstraat	Generaal van Teynstraat
126	Generaal de Carislaan	Generaal de Carislaan
127	Geldropseweg	Geldropseweg
128	Urkhovenseweg II	Urkhovenseweg
129	Urkhovenseweg III	Urkhovenseweg
130	Vlinderflats II	Vuurvlinderstraat
131	Vlinderflats III	Windevlinderstraat
132	Vlinderflats IV	Spanvlinderplein
133	Vlinderflats V	Bessenvlinderstraat
134	Vlinderflats VI	Bessenvlinderstraat
135	Meerzicht	Meerwater
136	Roland Garros	Meerzand
137	Sixty5	Philitelaan
138	Lux Tower	Philitelaan

Appendix V: Invitation for the survey

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Voor Nederlands, zie andere zijde

A survey into living in a residential tower

Will you help me graduate?

Dear reader,

I would like to invite you to participate in this **survey** about your living environment. This is part of my **graduation research** into the social connections in a residential tower and the influence of the building and its residents. Your participation will take around **5 minutes** and I would really appreciate it.

You can fill in the survey on your computer, phone or tablet via the link or QR code.
https://tueindhoven.limequery.com/295426

Thank you in advance for your participation!

SCAN ME

Sara Noordenbos
Master student Urban Systems & Real Estate
Eindhoven University of Technology
Email: s.noordenbos@student.tue.nl

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

For English, see other side

Een onderzoek over leven in een woontoren

Helpt u mij afstuderen?

Beste lezer,

Ik wil u graag uitnodigen om deel te nemen aan deze **enquête** over uw leefomgeving. Dit is onderdeel van mijn **afstudeer onderzoek** naar de sociale connecties in een woontoren en de invloed van het gebouw en de bewoners. Uw deelname duurt ongeveer **5 minuten** en ik zou het zeer op prijs stellen.

U kunt de enquête invullen op uw computer, telefoon of tablet via de link of QR code.
https://tueindhoven.limequery.com/295426

Alvast bedankt voor uw deelname!

SCAN ME

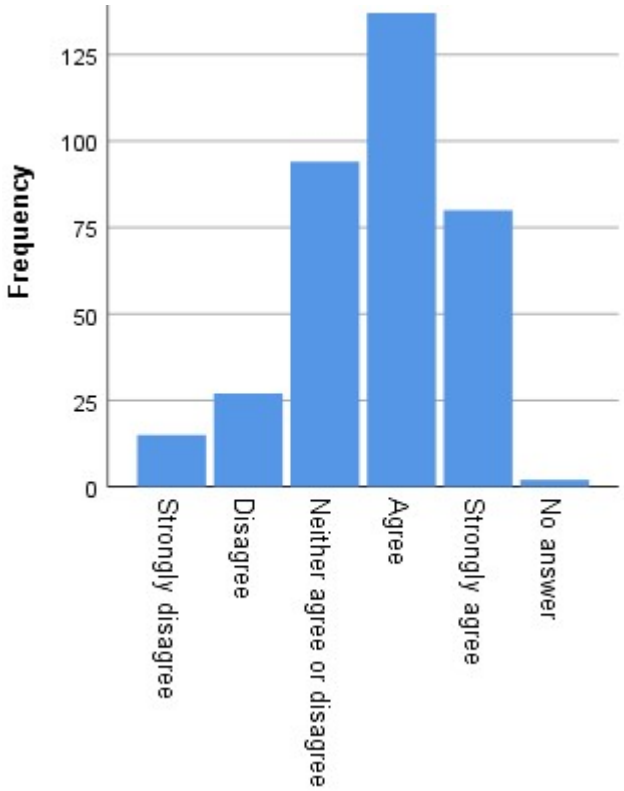
Sara Noordenbos
Master student Vastgoed & Projectontwikkeling
Technische Universiteit Eindhoven
Email: s.noordenbos@student.tue.nl

Appendix VI: Data preparation

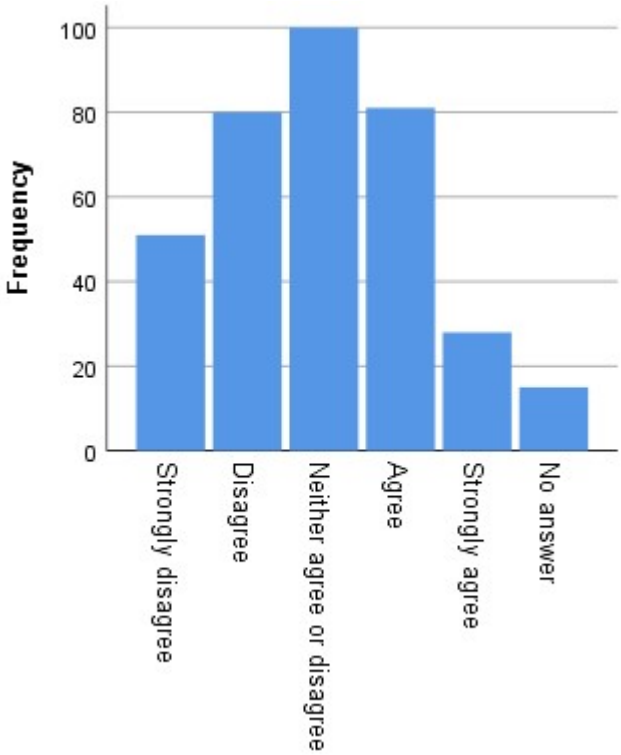
This appendix describes the recoding and preparation of the data for each variable for the analyses. The data is divided into six sections: social cohesion, social interaction, social satisfaction, building characteristics, resident characteristics, and building observations. An overview of the data preparation for this research is shown in chapter 4.

Social cohesion

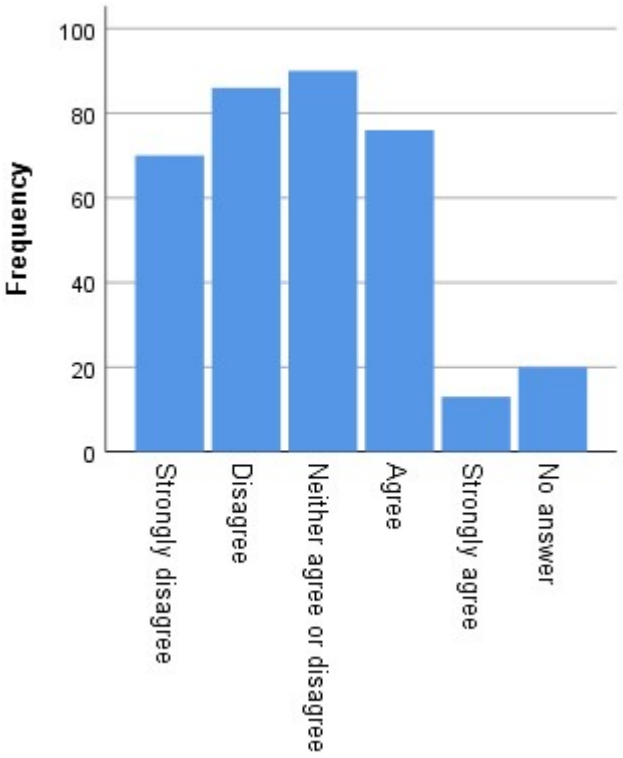
The social cohesion score is comprised of 18 questions. Below, bar charts for each question are shown. After the recoding of the no answers, the level of measurement of these questions is interval with five groups.



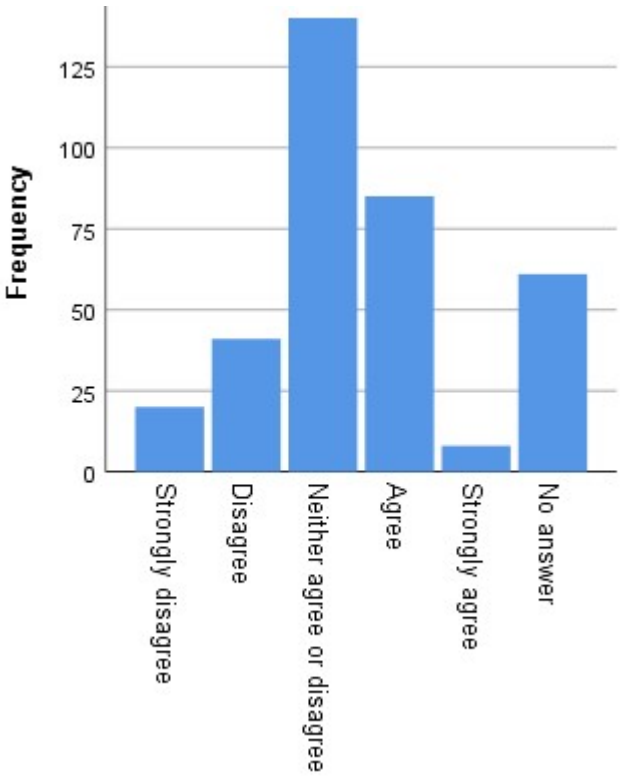
Question 1: I feel like I belong to this building.



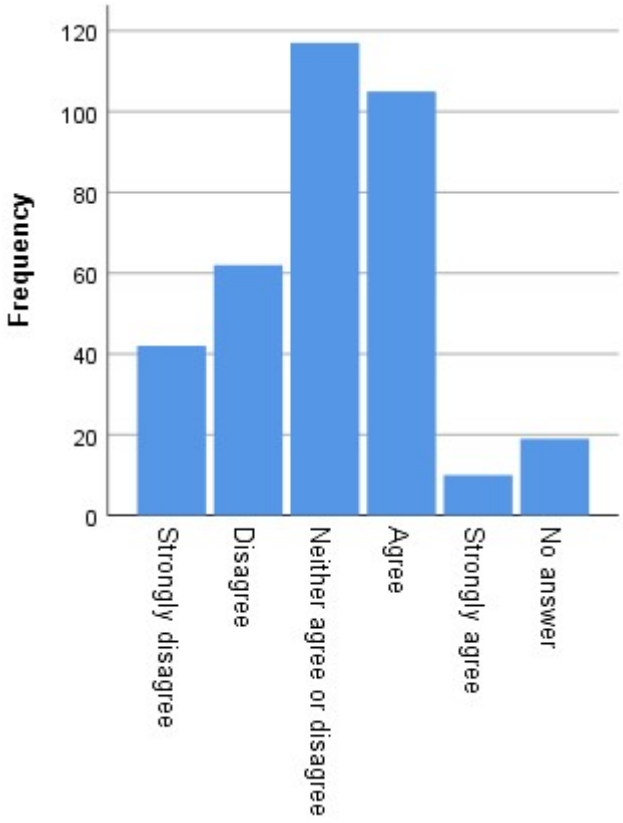
Question 2: The friendships and associations I have with other people in my building mean a lot to me.



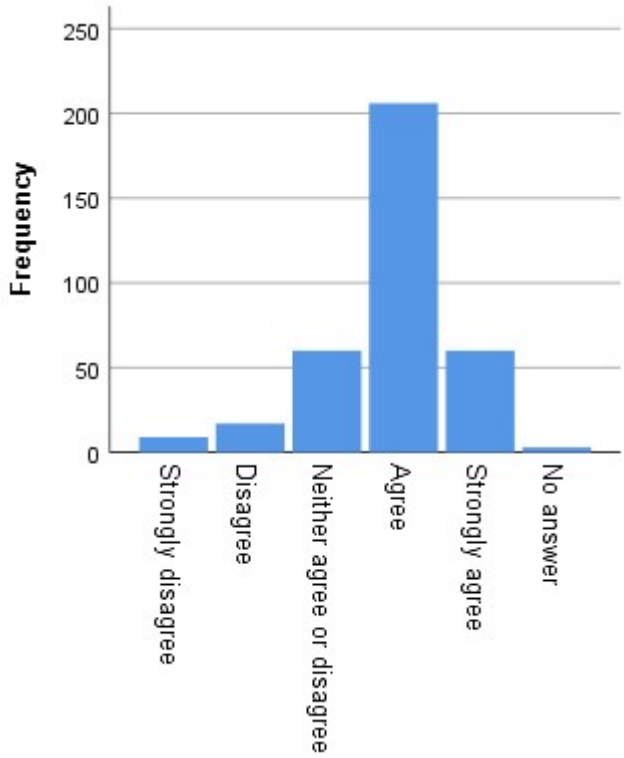
Question 3: If the people in my building were planning something I'd think of it as something "we" were doing rather than "they" were doing.



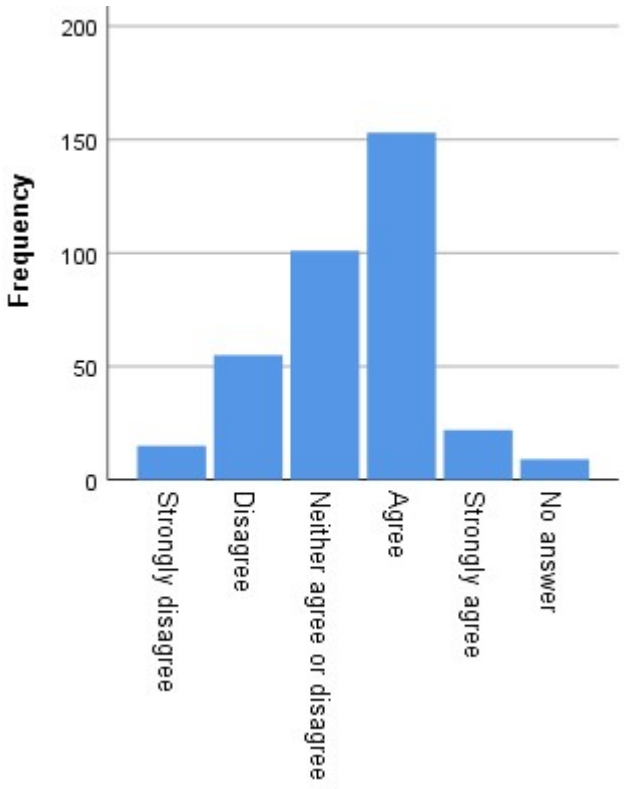
Question 4: I think I agree with most people in my building about what is important in life.



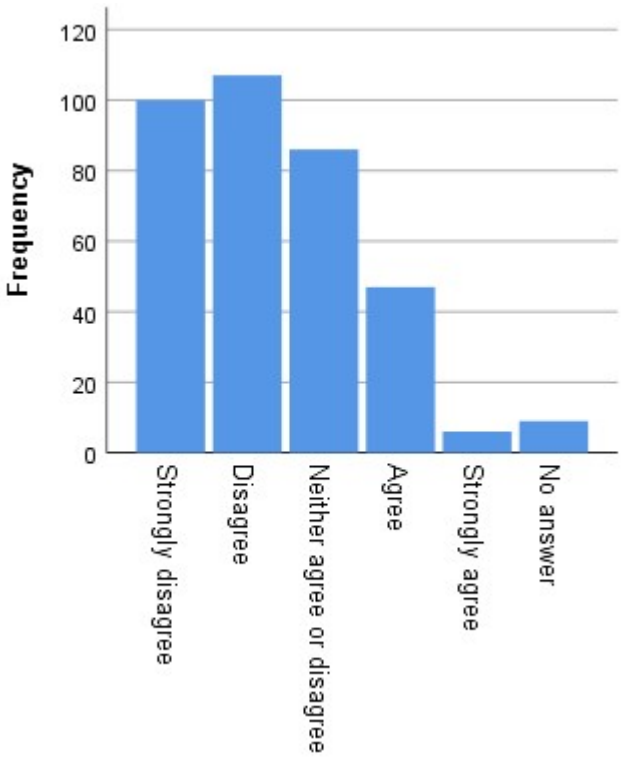
Question 5: I feel loyal to the people in my building.



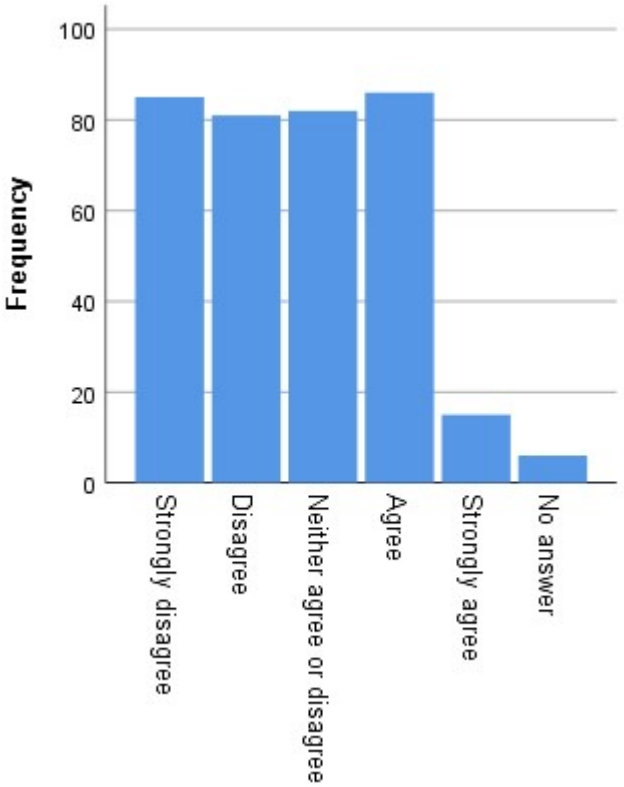
Question 6: I would be willing to work together with others on something to improve my building.



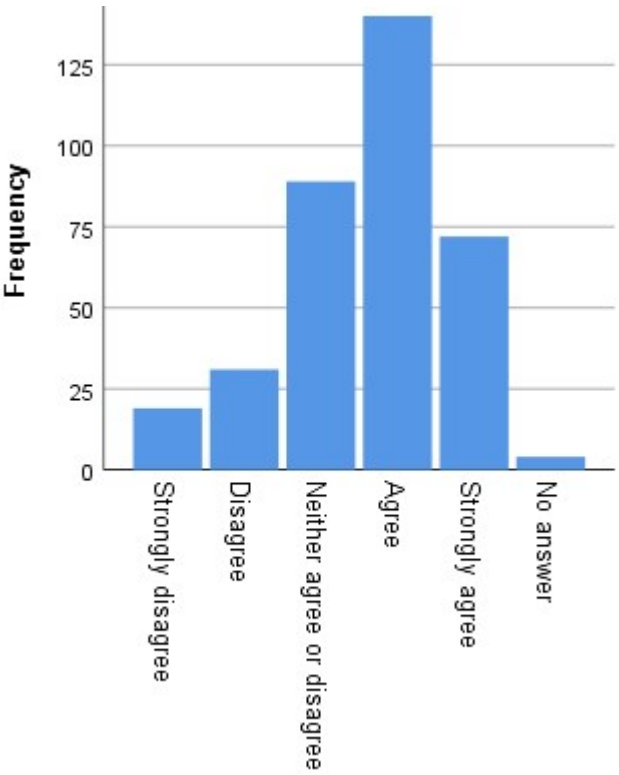
Question 7: I like to think of myself as similar to the people who live in this building.



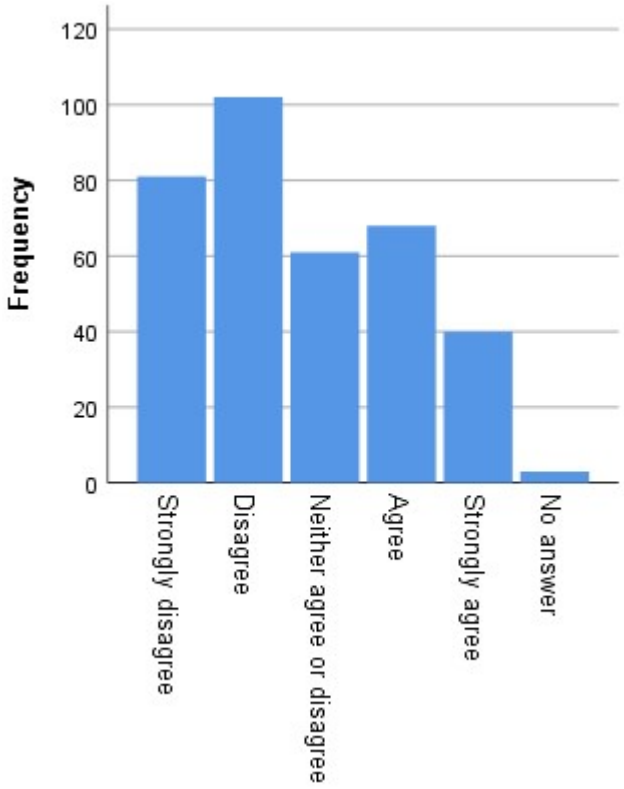
Question 8: A feeling of fellowship runs deep between me and other people in this building.



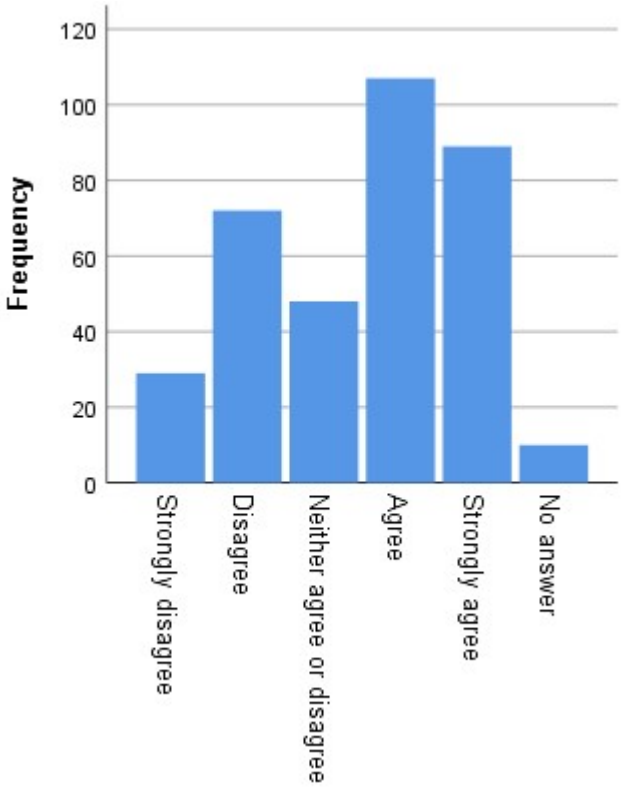
Question 9: Living in this building gives me a sense of community.



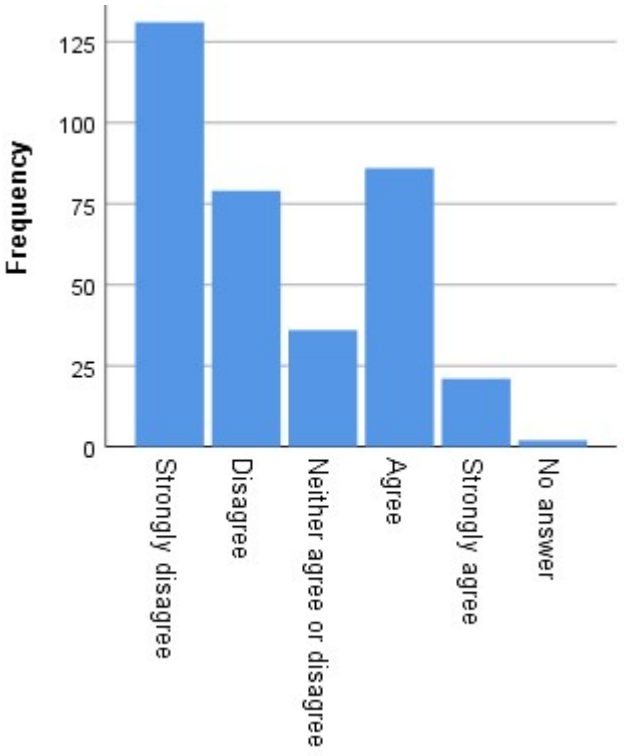
Question 10: Overall, I am very attracted to living in this building.



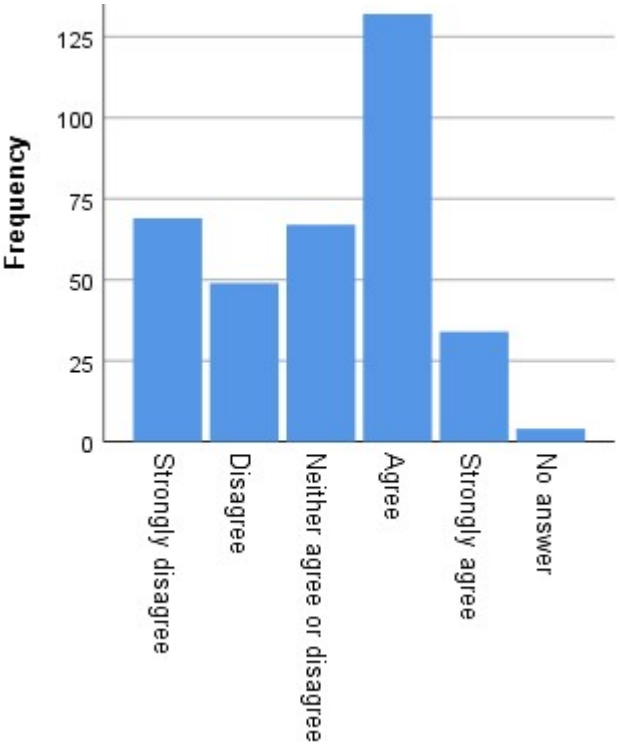
Question 11: Given the opportunity, I would like to move out of this building.



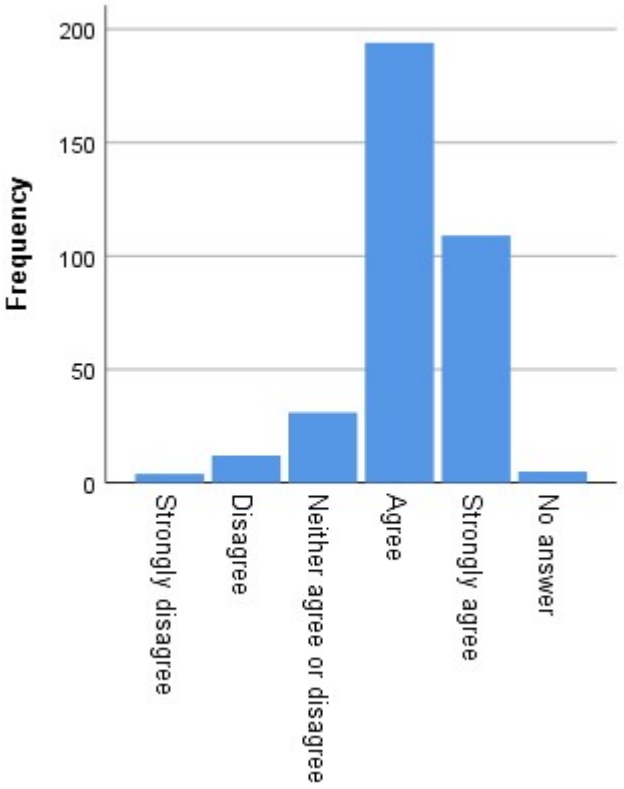
Question 12: I plan to remain a resident of this building for a number of years.



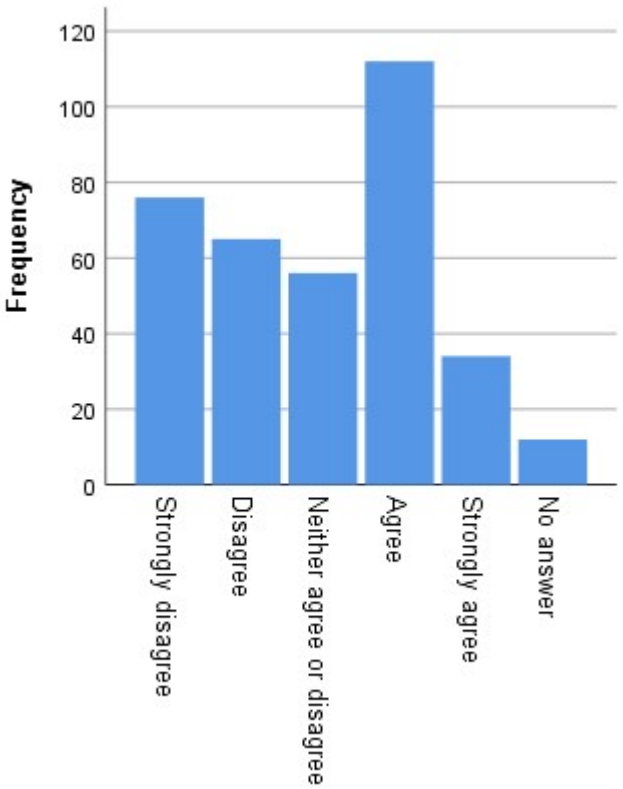
Question 13: I visit my neighbors (in this building) in their homes.



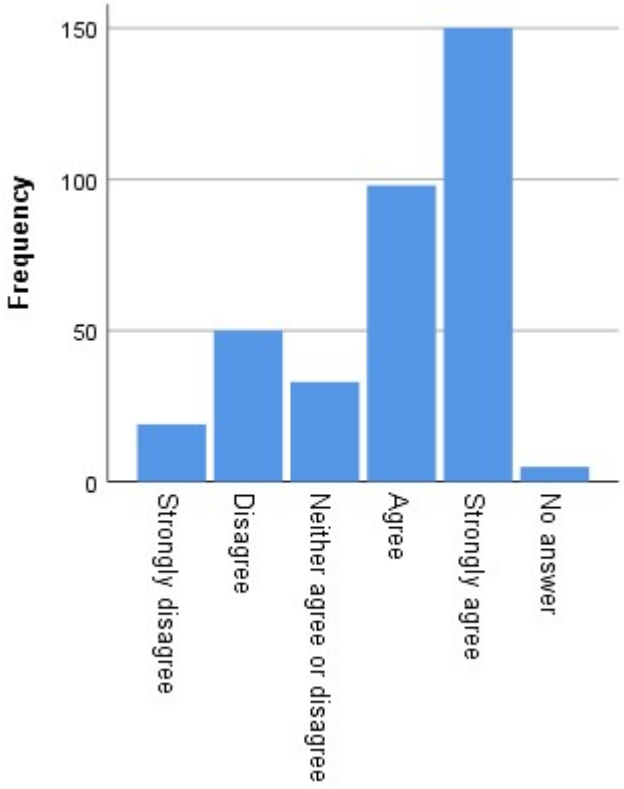
Question 14: If I needed advice about something I could go to someone in my building.



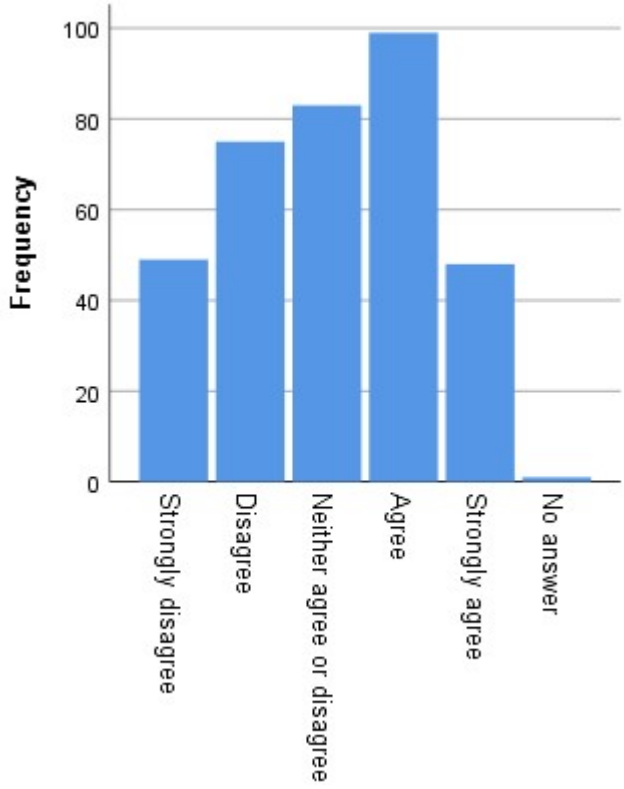
Question 15: I believe my neighbors (in this building) would help me in an emergency.



Question 16: I borrow things and exchange favors with my neighbors (in this building).



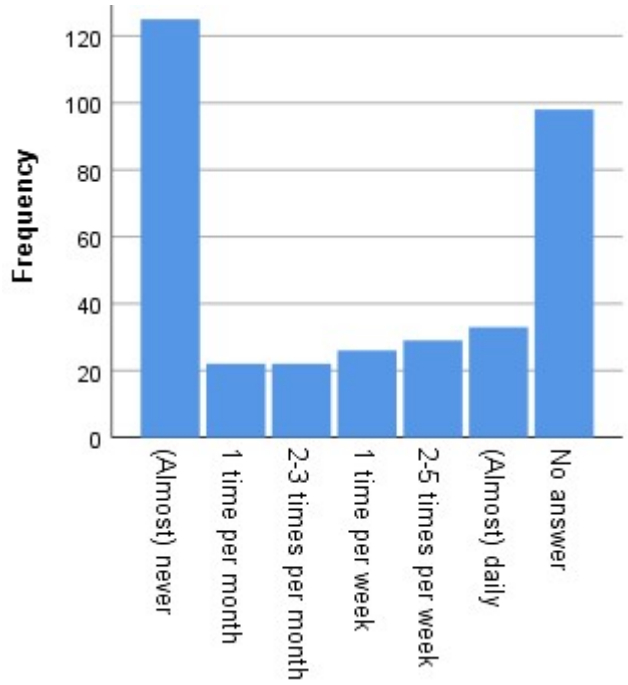
Question 17: I rarely have neighbors (in this building) over to my house to visit.



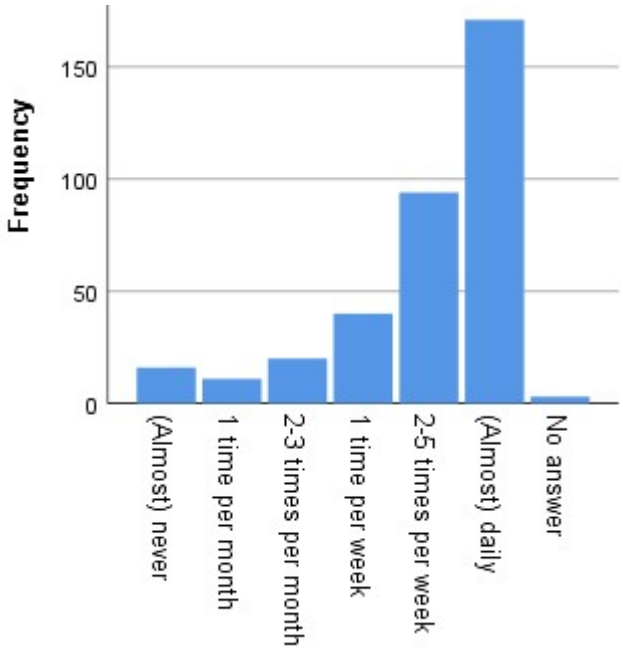
Question 18: I regularly stop and talk with people in my building.

Social interaction

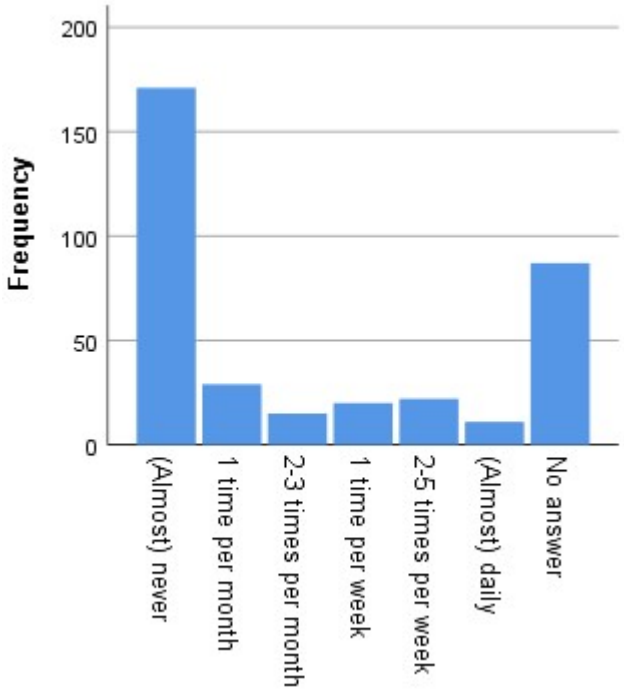
The social interaction score is comprised of seven questions. Below, bar charts for each question are shown. After the recoding of the no answers, the level of measurement of these questions is interval with six groups.



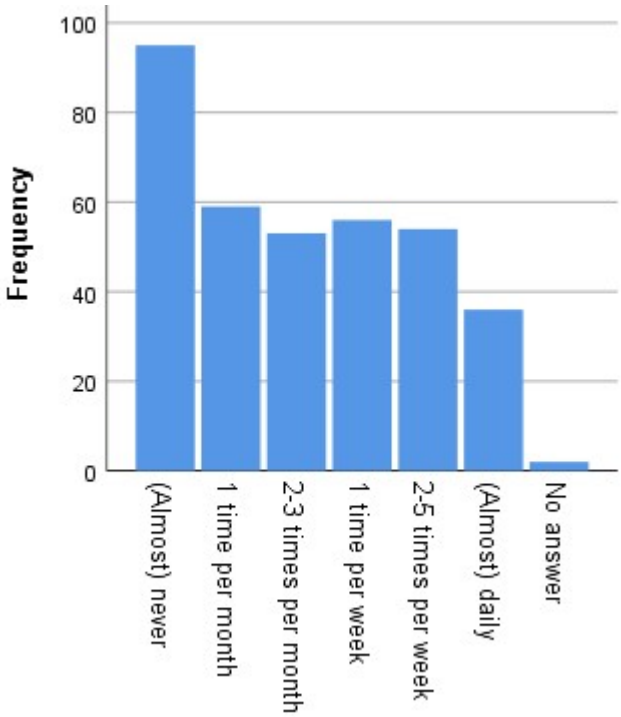
Question 1: How often do you greet your neighbors in social spaces in your building (e.g. shared garden, roof terrace, seating areas)?



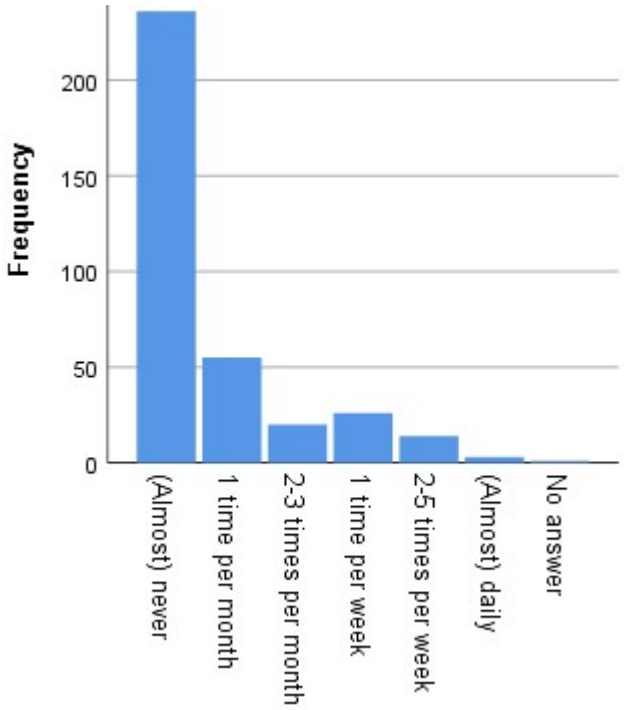
Question 2: How often do you greet your neighbors in traffic areas in your building (e.g. entrances, corridors, elevators)?



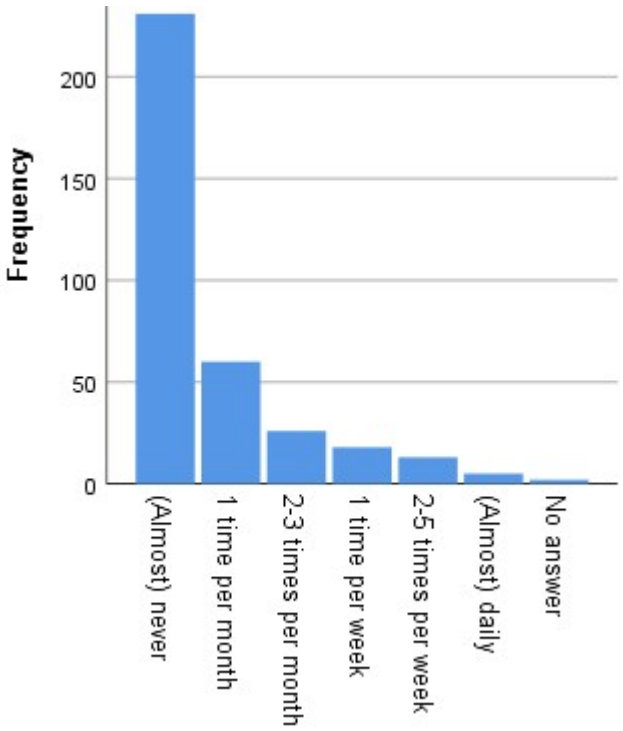
Question 3: How often do you stop to talk with a neighbor in social spaces in your building (e.g. shared garden, roof terrace, seating areas)?



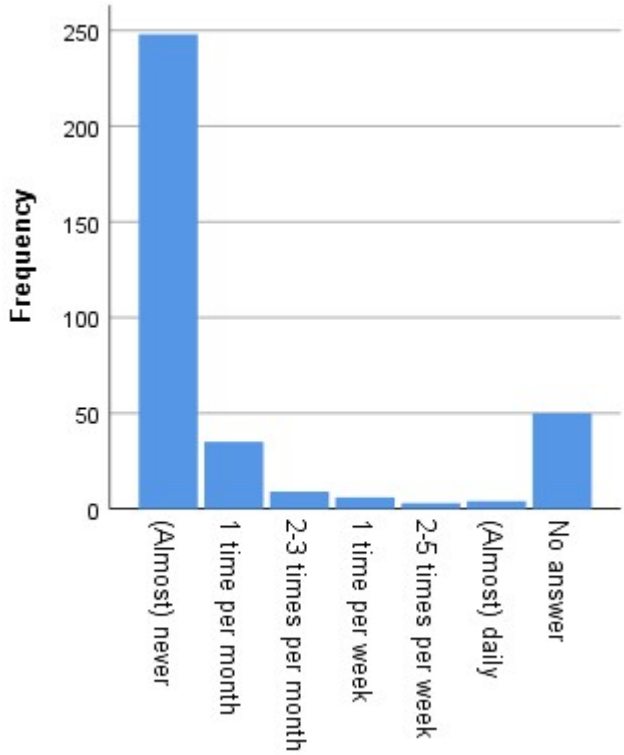
Question 4: How often do you stop to talk with a neighbor in traffic areas in your building (e.g. entrances, corridors, elevators)?



Question 5: How often do you have people from your building come over to your home?



Question 6: How often do you visit people in your building in their homes?

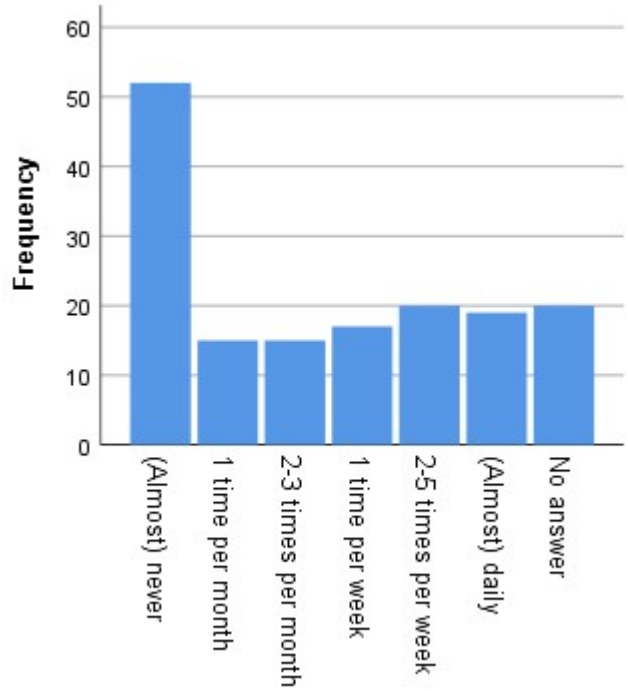


Question 7: How often do you engage in social activities in your building?

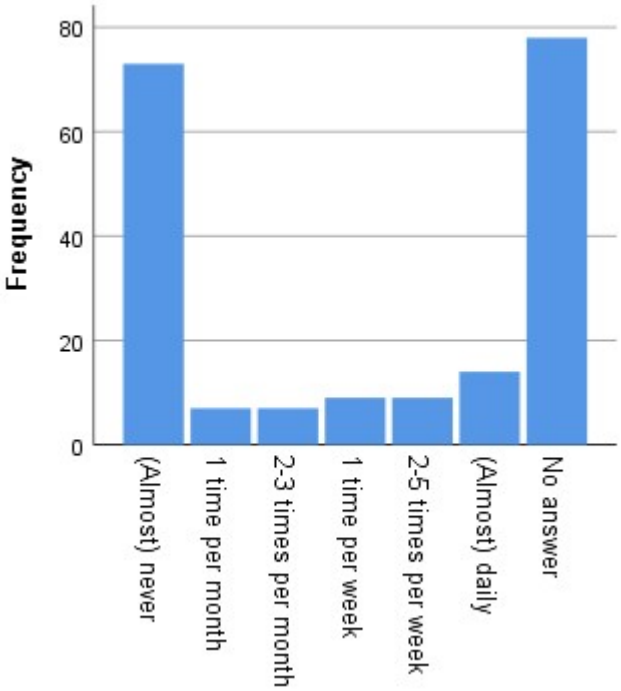
Responses with and without a social space

Questions 1, 3, and 7 have a lot of no answers. For each of these questions, the answers are split into responses from buildings with a social space and buildings without a social space. However, this did not remedy the problems with the data. These questions are therefore excluded from the social interaction score.

Question 1: How often do you greet your neighbors in social spaces in your building?

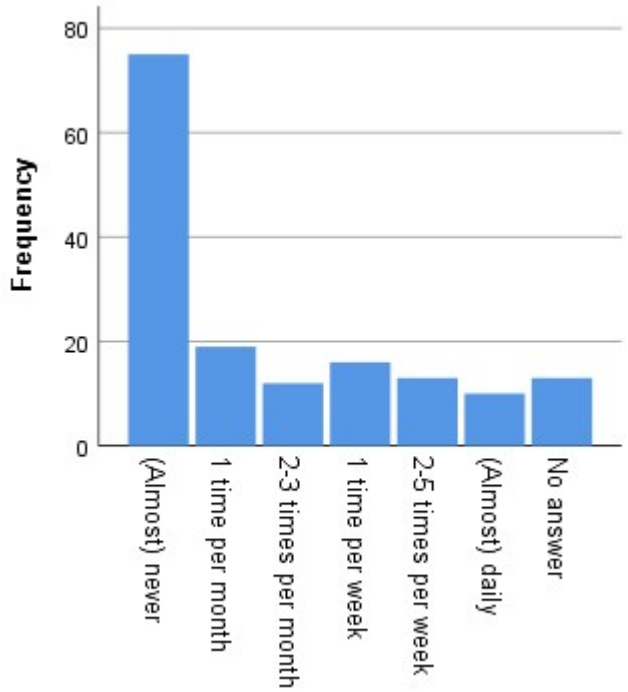


Responses from buildings with a social space.

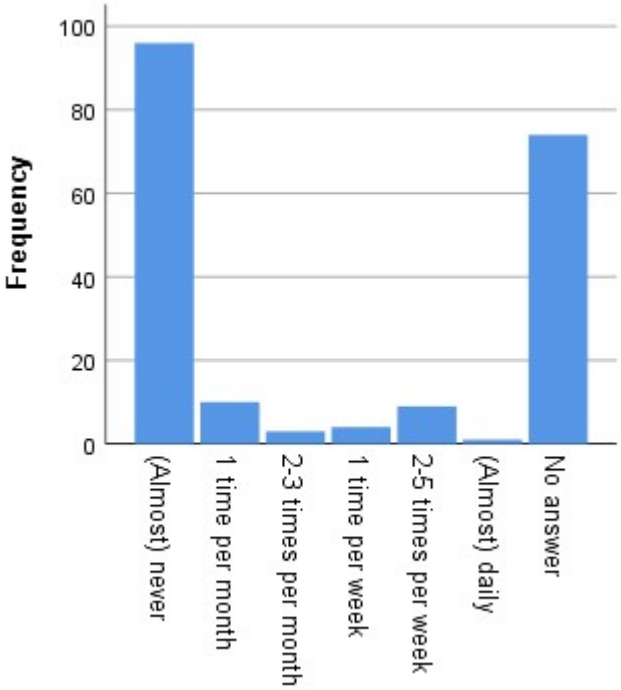


Responses from buildings without a social space.

Question 3: How often do you stop to talk with a neighbor in social spaces in your building?

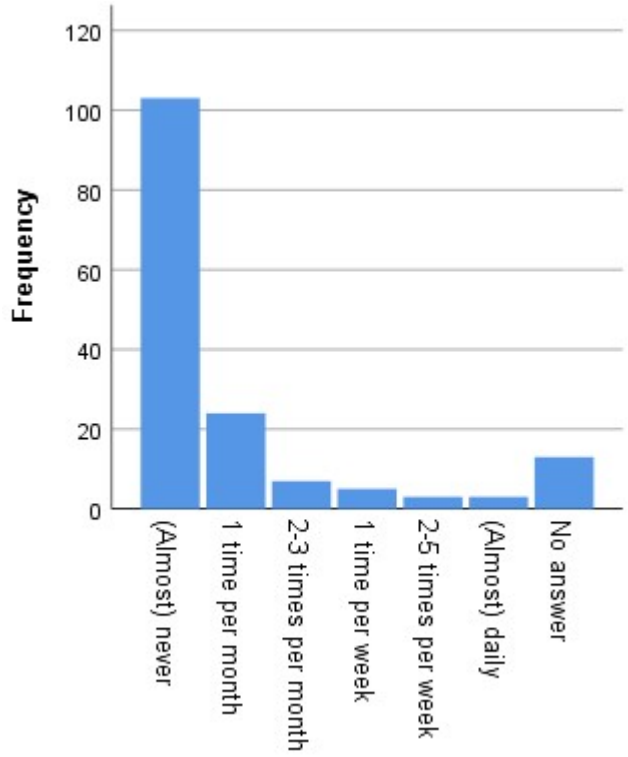


Responses from buildings with a social space.

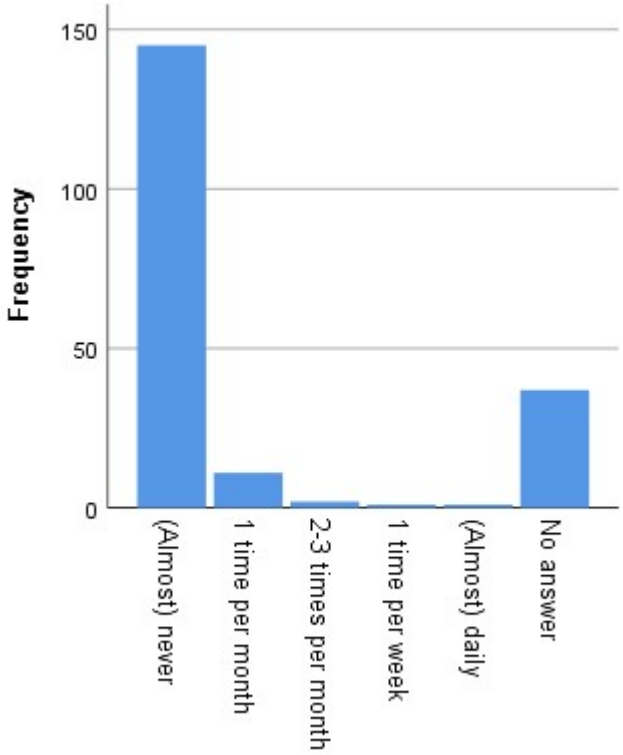


Responses from buildings without a social space.

Question 7: How often do you engage in social activities in your building?



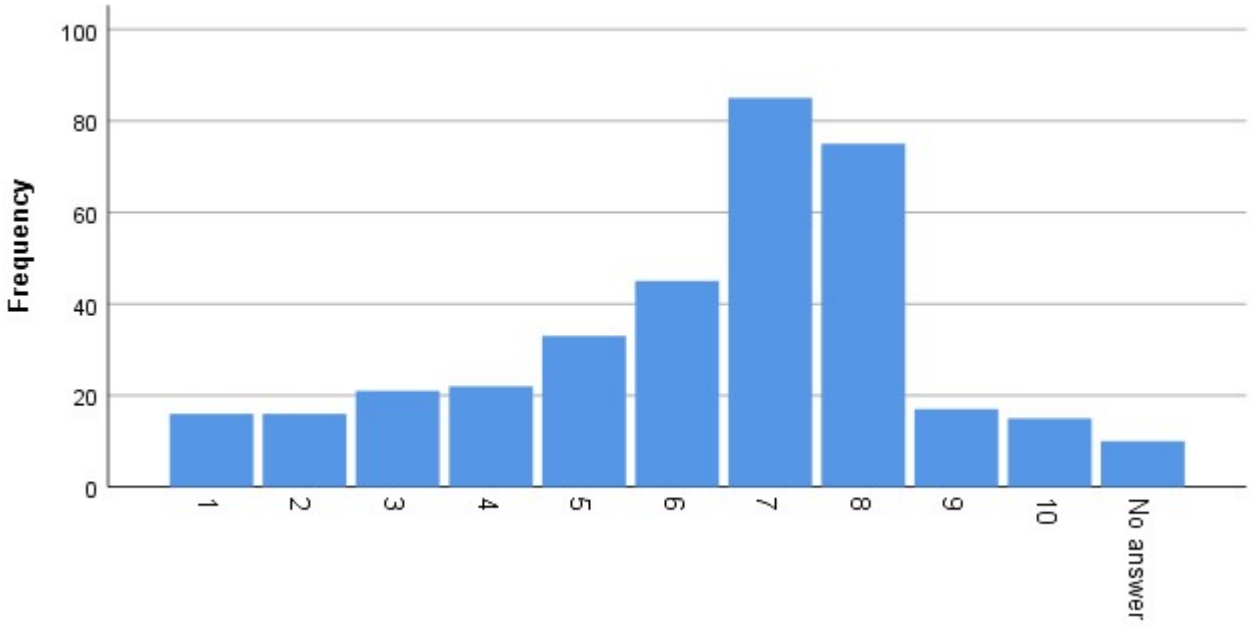
Responses from buildings with a social space.



Responses from buildings without a social space.

Social satisfaction

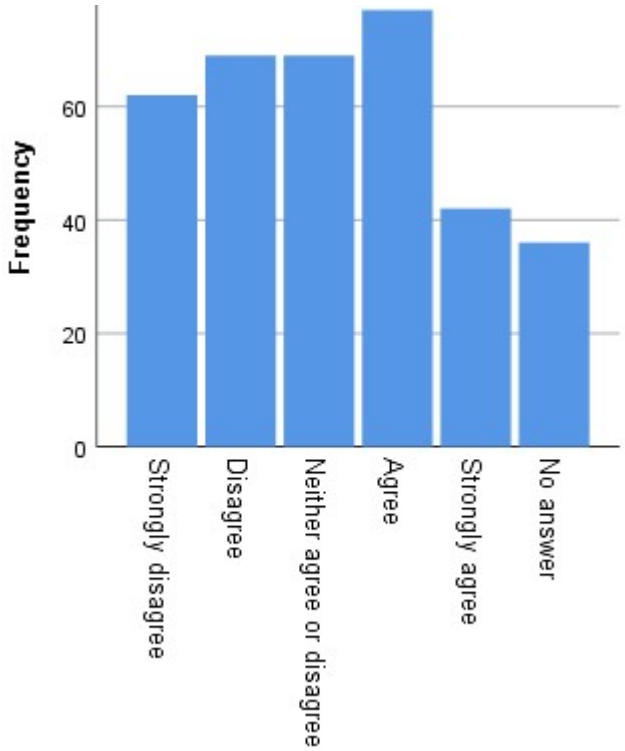
Social satisfaction is asked with one question in the survey. The bar chart for this question is shown below. The measurement level is ratio with eleven groups.



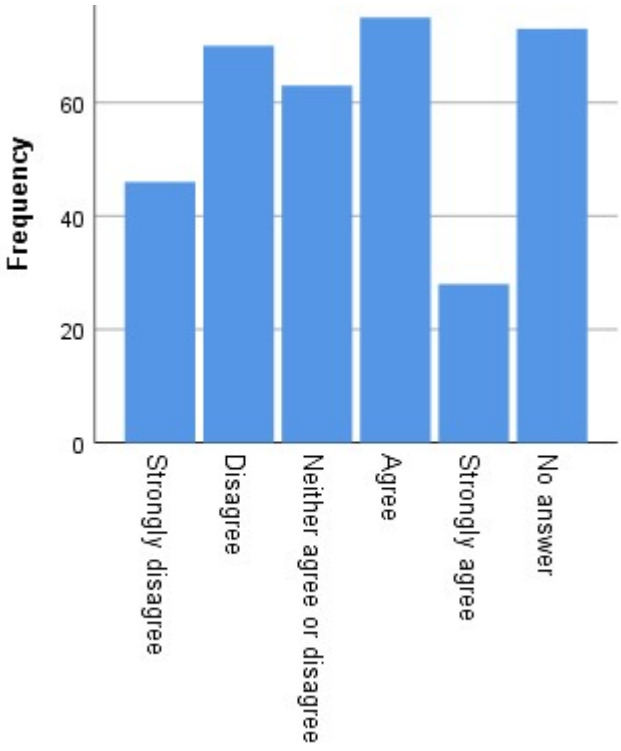
Question: How satisfied are you with your social exchanges with the people in your building?

Building characteristics

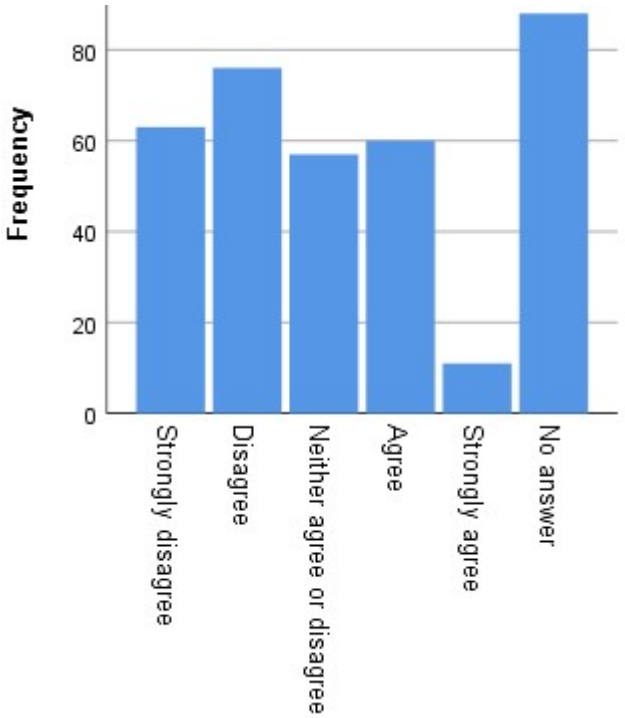
The building characteristics consist of seven questions regarding the social spaces and the transitional areas of the building. For each variable, a bar chart will show the data.



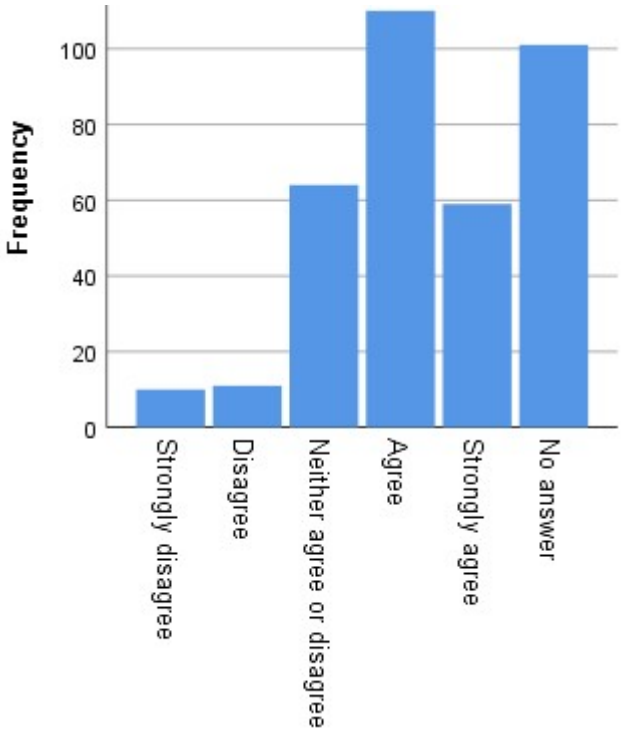
Quantity social spaces: I am satisfied about the quantity of social space in my building.



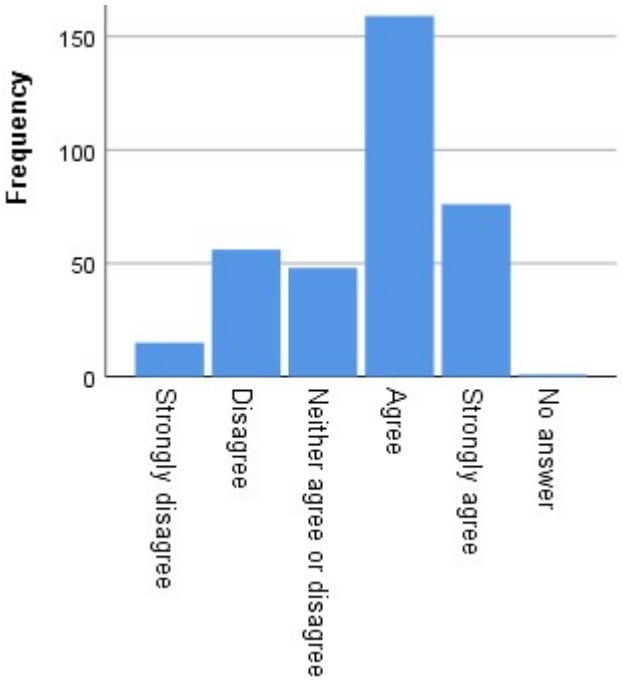
Quality social spaces: I am satisfied about the quality of the social spaces in my building.



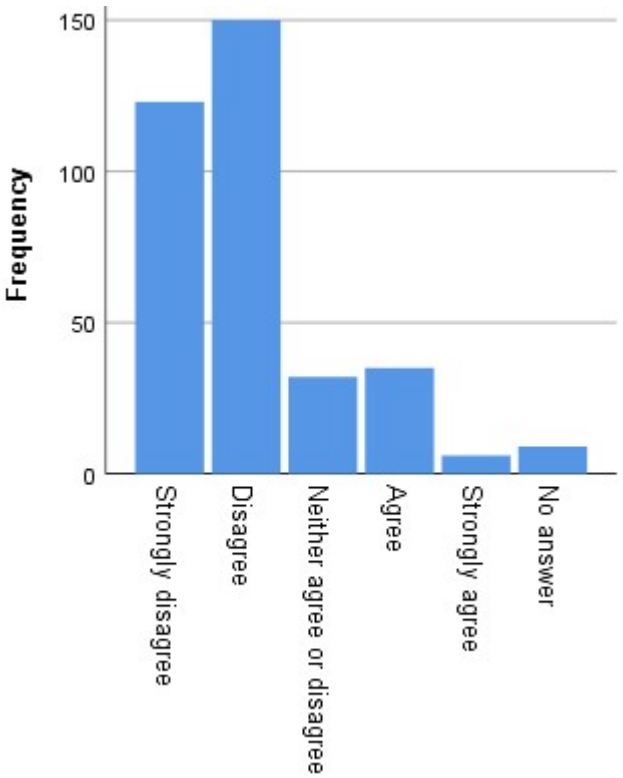
Usage social spaces: The social spaces in my building are frequently used.



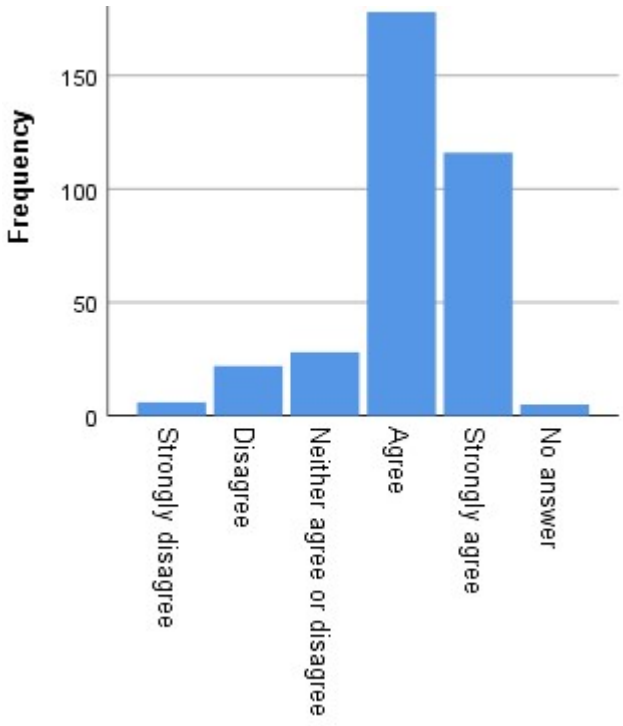
Safety social spaces: I feel safe in the social spaces in my building.



Quality transitional areas: I am satisfied about the quality of the traffic areas in my building.



Usage transitional areas: The traffic areas in my building are frequently used as places to stay.

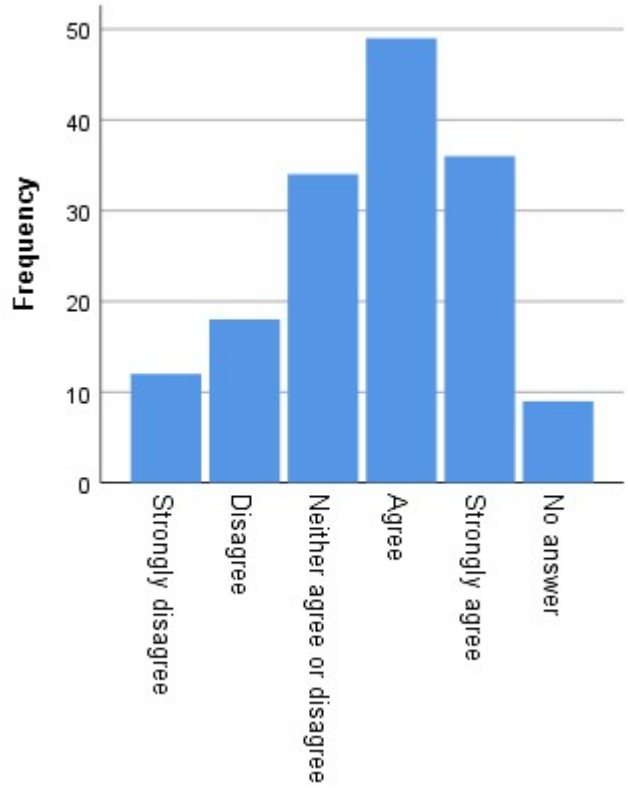


Safety transitional areas: I feel safe in the traffic areas in my building.

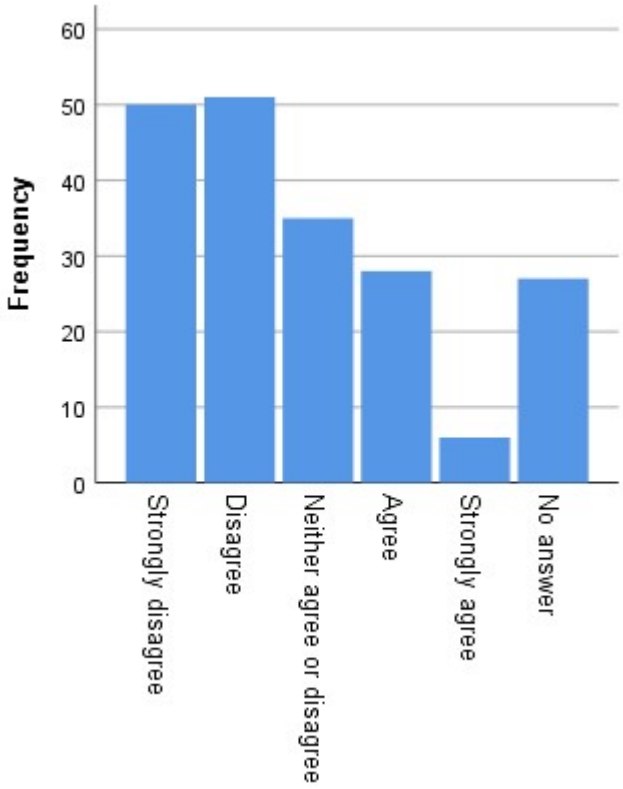
Responses with and without a social space

The four questions regarding social spaces have a lot of no answers. For each of these questions, the answers are split into responses from buildings with a social space and buildings without a social space. However, this did not remedy the problems with the data. These questions are therefore excluded from this research.

Quantity social spaces: I am satisfied about the quantity of social space in my building.

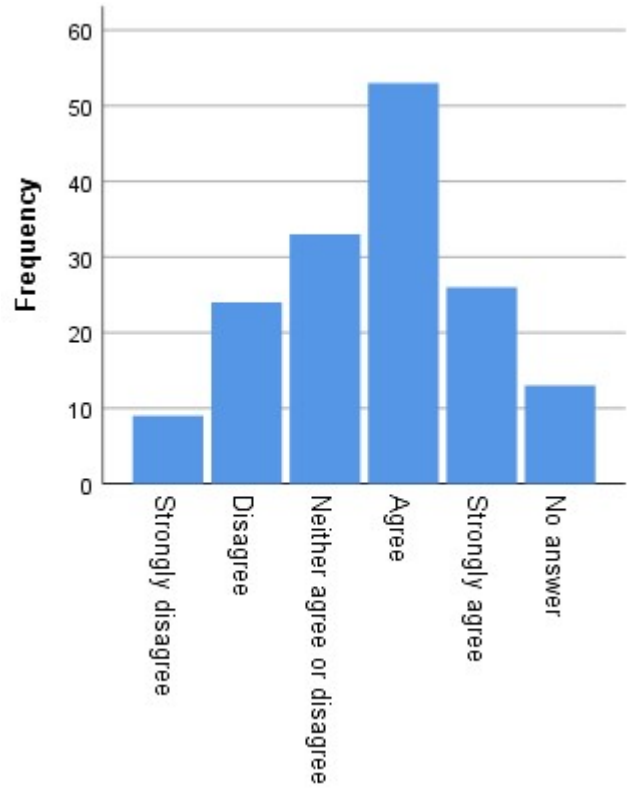


Responses from buildings with a social space.

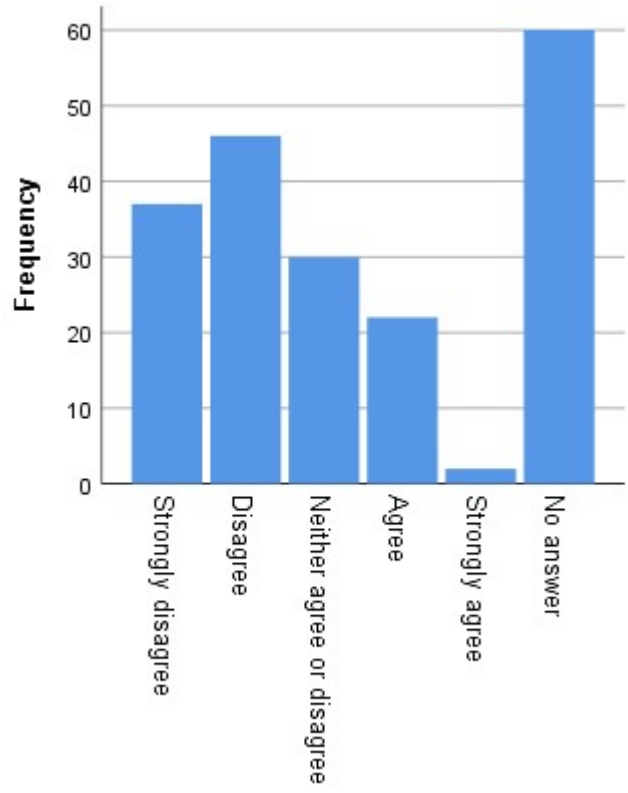


Responses from buildings without a social space.

Quality social spaces: I am satisfied about the quality of the social spaces in my building.

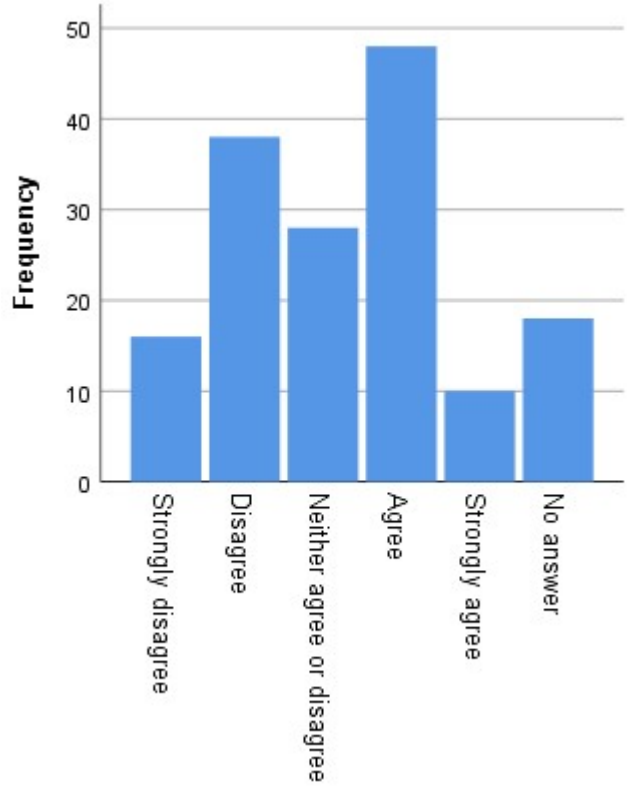


Responses from buildings with a social space.

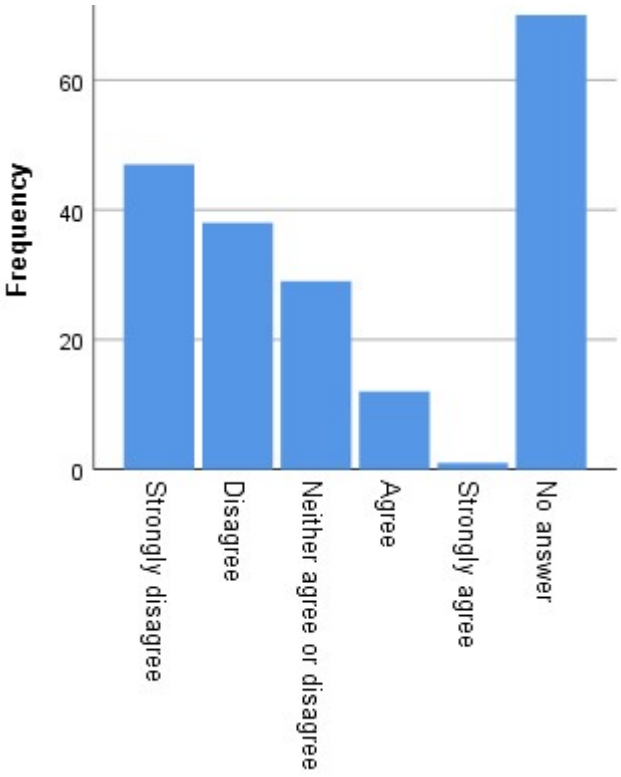


Responses from buildings without a social space.

Usage social spaces: The social spaces in my building are frequently used.

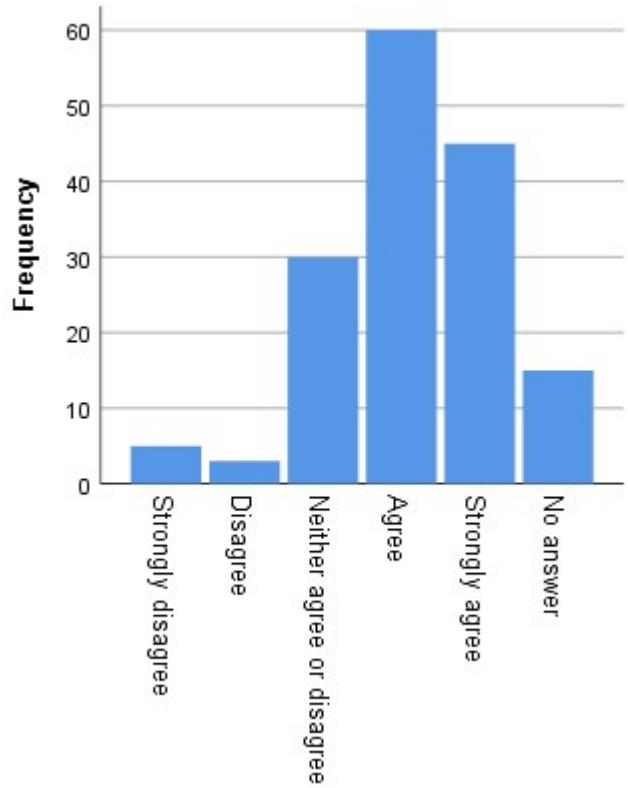


Responses from buildings with a social space.

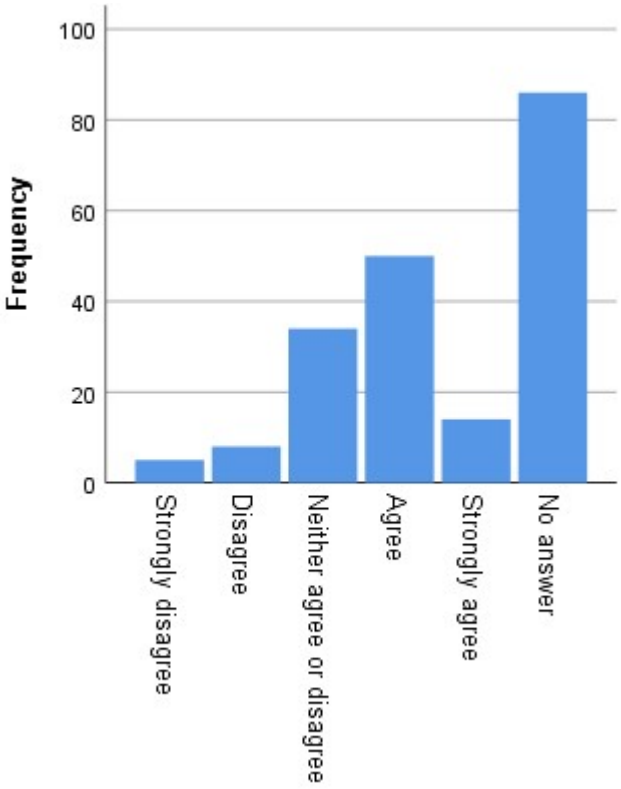


Responses from buildings without a social space.

Safety social spaces: I feel safe in the social spaces in my building.



Responses from buildings with a social space.

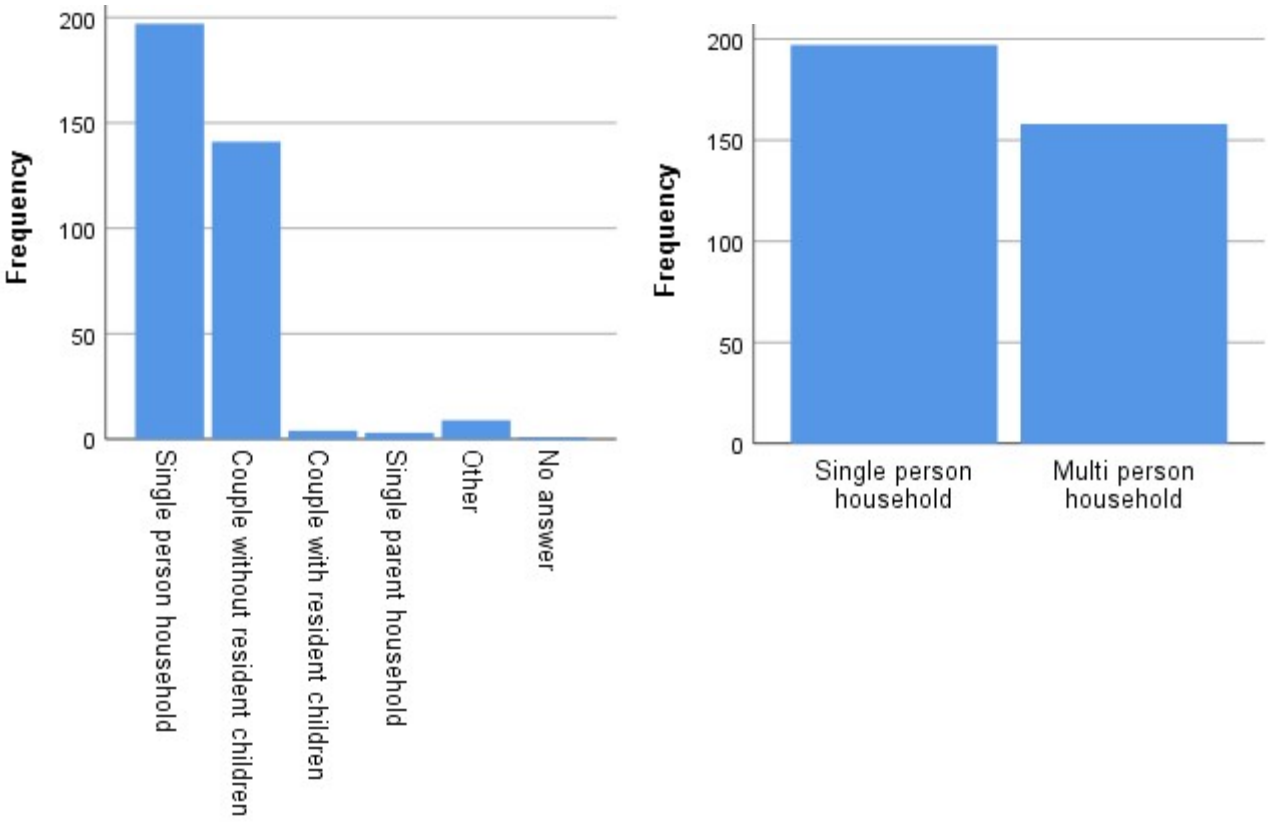


Responses from buildings without a social space.

Resident characteristics

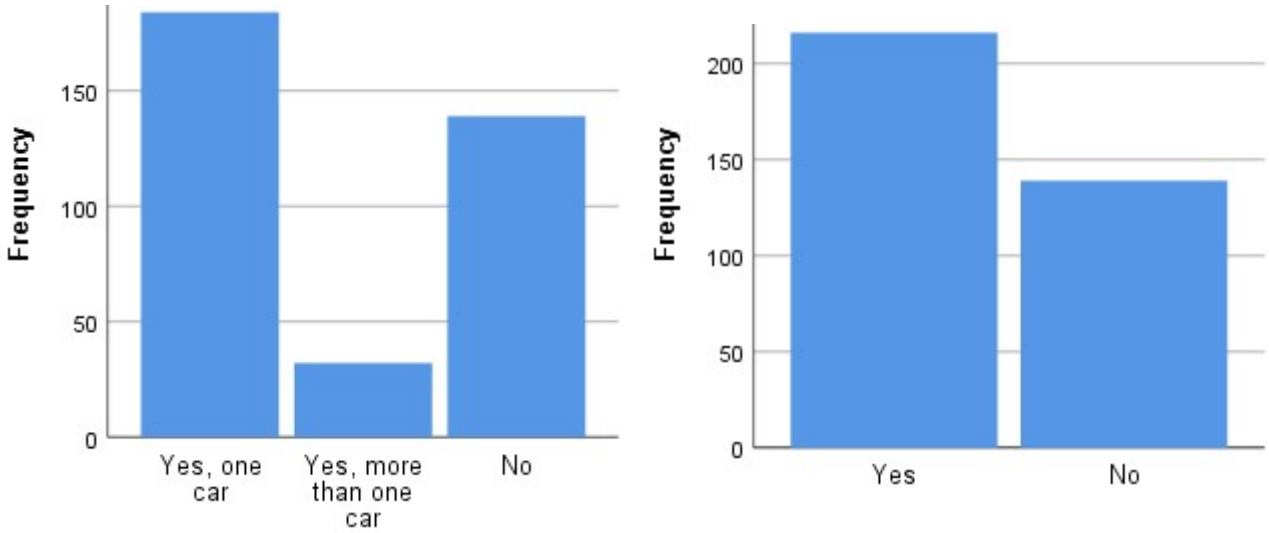
The resident characteristics are individual and household characteristics. Each variable is shown in an original and recoded bar chart. The motivation for the recoding of the variable is also explained.

Household composition
This variable is recoded into two groups: single person household and multi person household. The no answer is recoded into multi person household because it can be assumed that it is not a single person household.



Bar chart for original and recoded household composition.

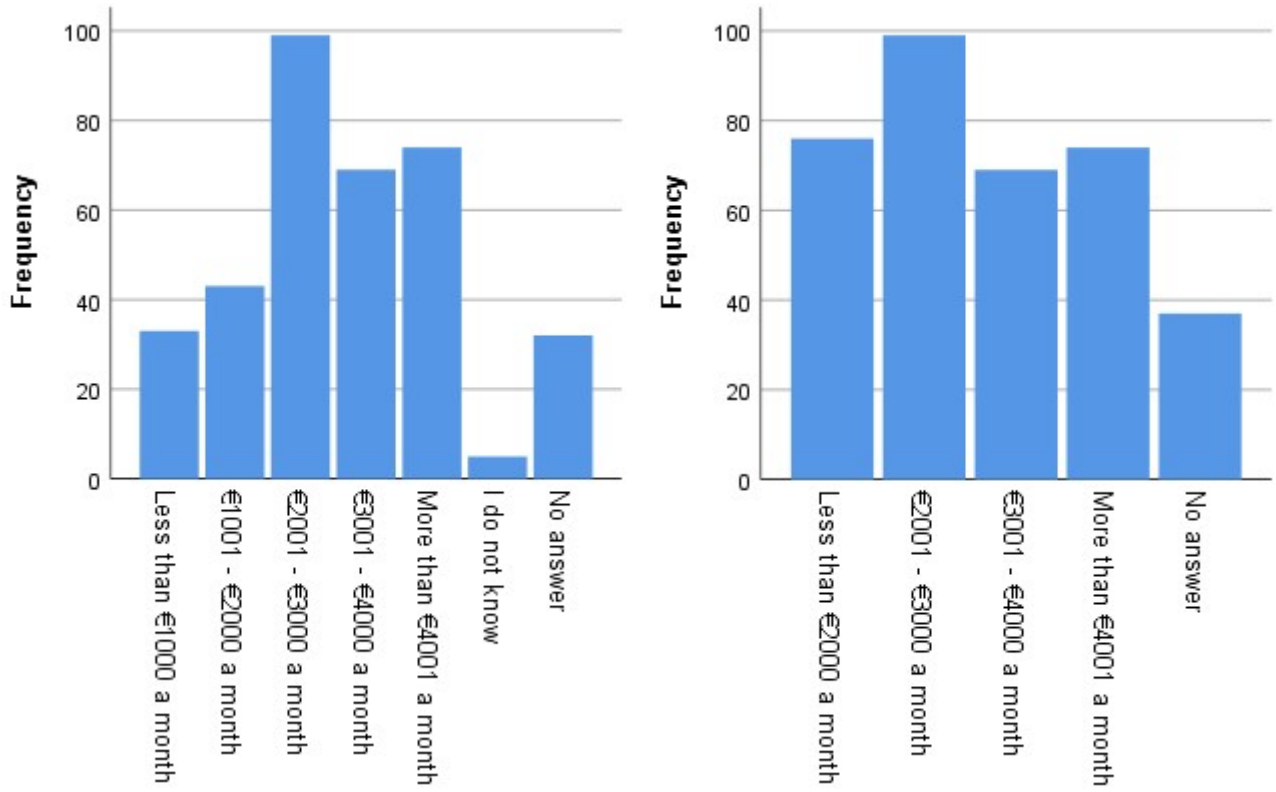
Car availability
This variable is recoded into two groups: yes and no.



Bar chart for original and recoded car availability.

Household income

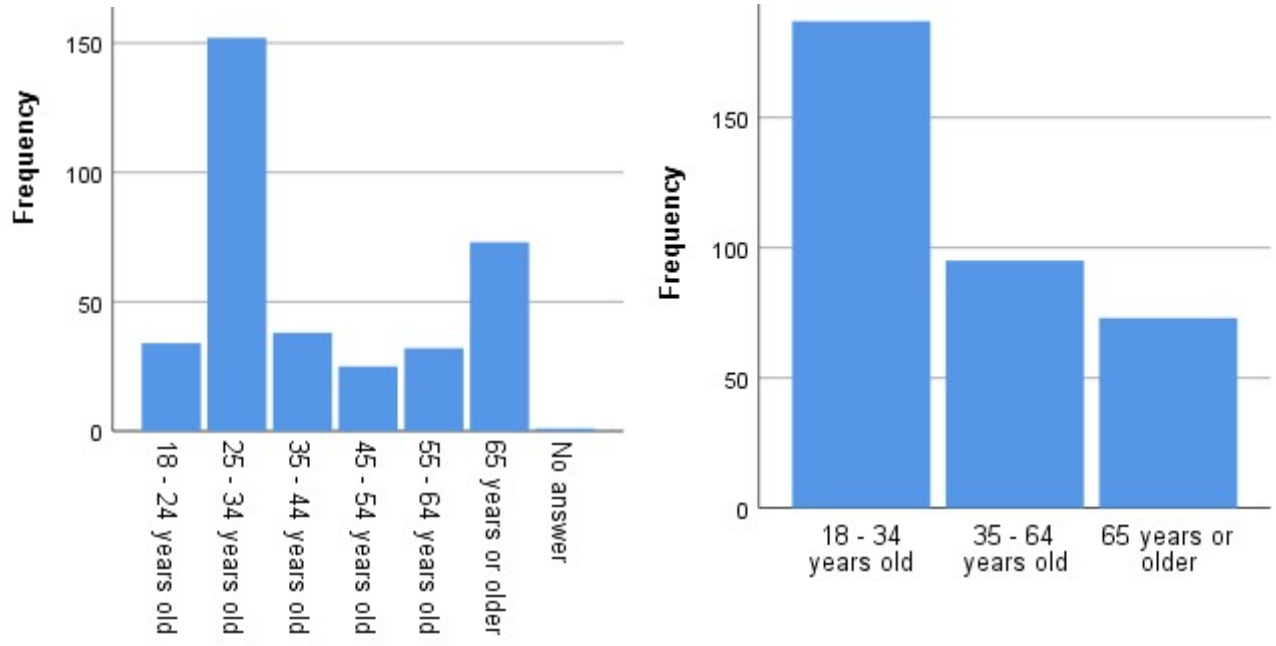
This variable is recoded into five groups: less than €2000 a month, €2001 - €3000 a month, €3001 - €4000 a month, more than €4001 a month, and no answer.



Bar chart for original and recoded household income.

Age

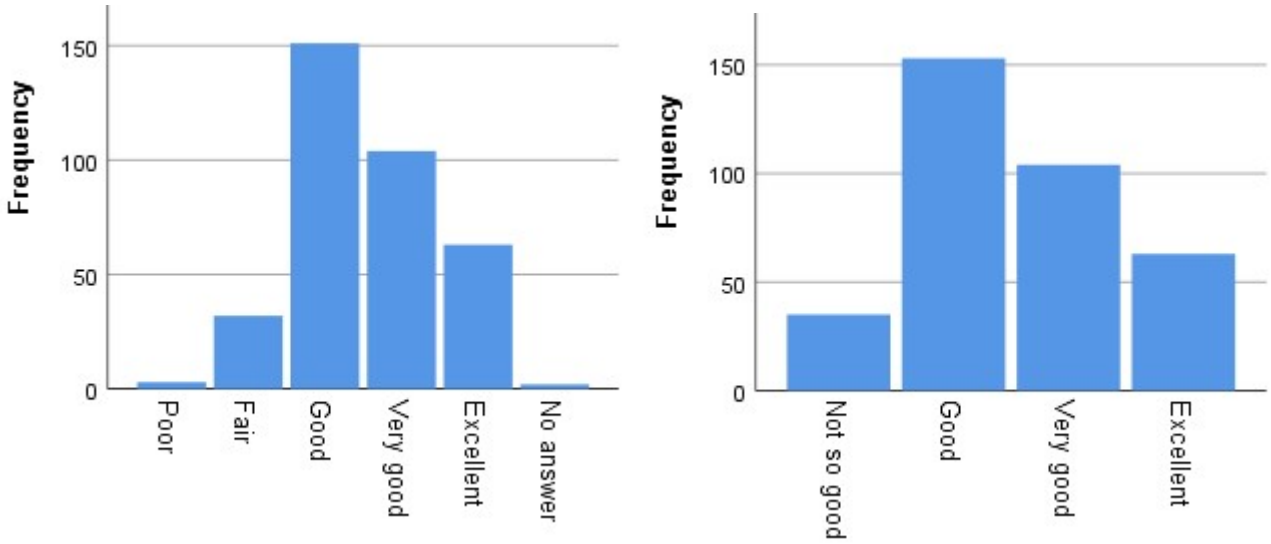
This variable is recoded into three groups: 18 - 34 years old, 35 - 64 years old, and 65 years or older. There is a no answer from building 43. This is recoded into 18 - 34 years old because that is the most likely age of the respondent. It is the average answer for the building and also the most common answer for this question.



Bar chart for original and recoded age.

Health status

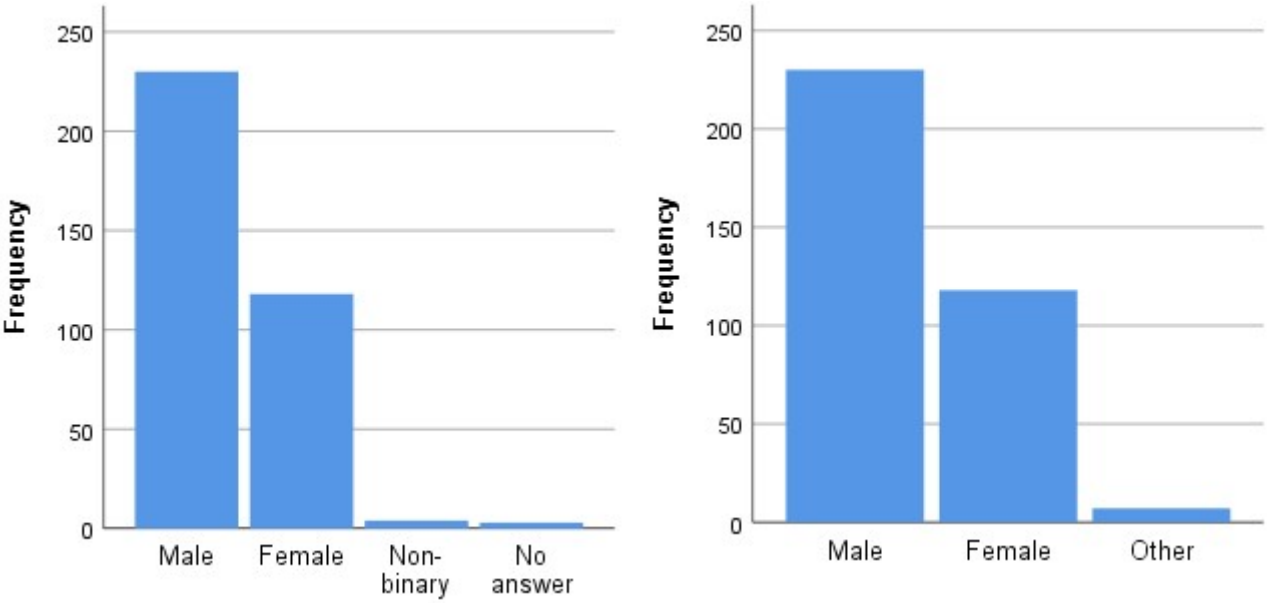
This variable is recoded into four groups: not so good, good, very good, and excellent. There are two no answers from buildings 14 and 43. Both are recoded into good. It is the most common answer to this question and also the average of the buildings.



Bar chart for original and recoded health status.

Gender

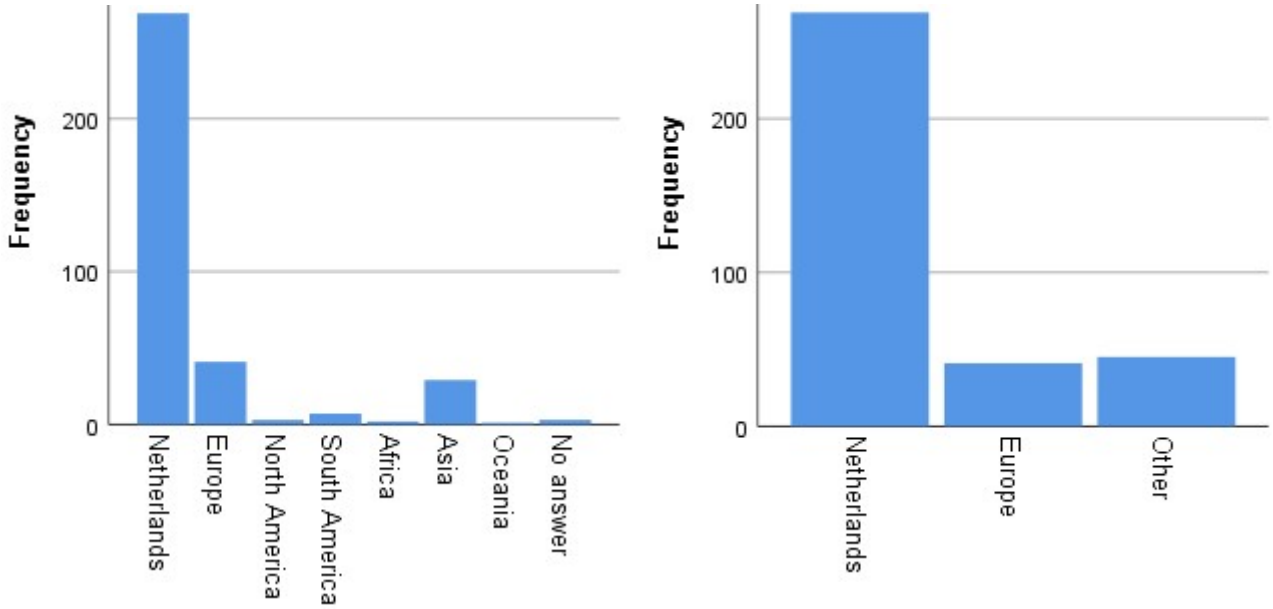
This variable is recoded into three groups: male, female, and other. The no answers are recoded into other.



Bar chart for original and recoded gender.

Birth region

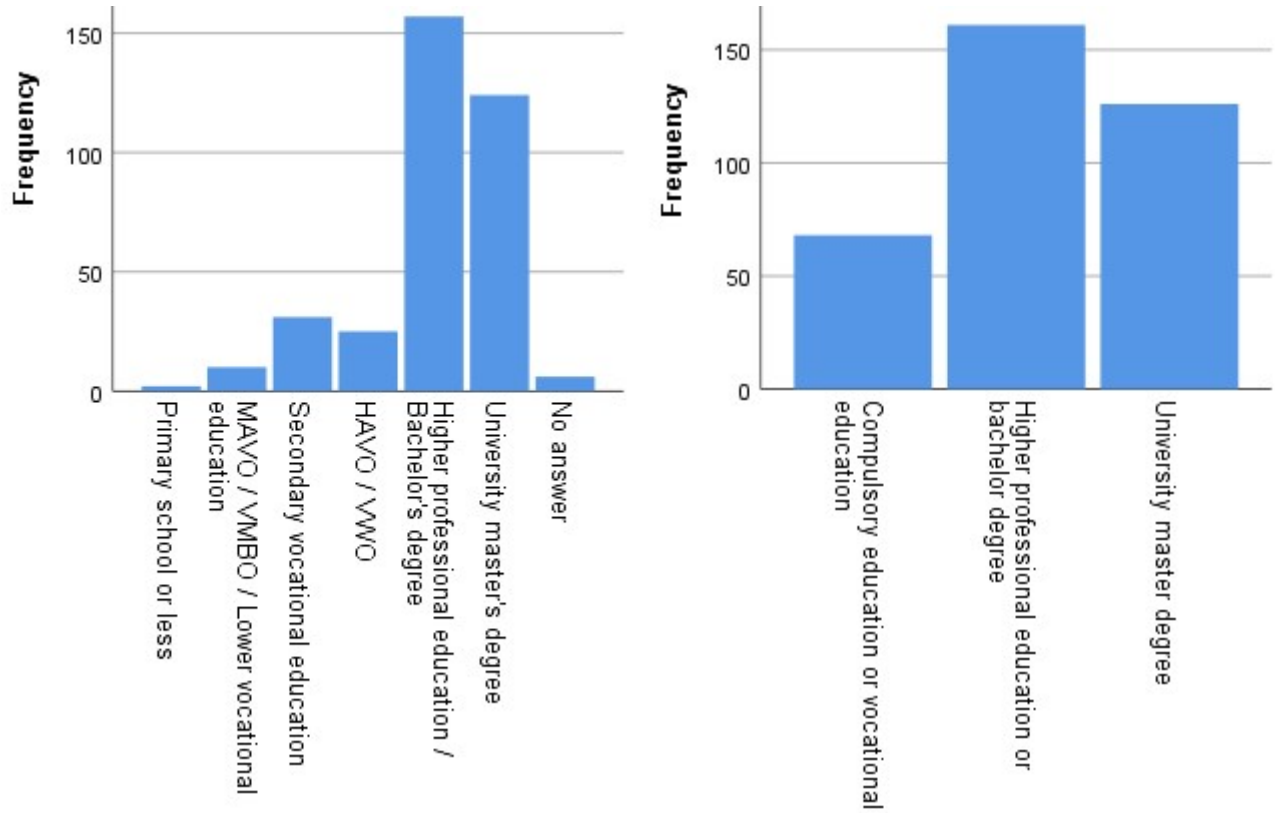
This variable is recoded into three groups: Netherlands, Europe, and other. The no answers are recoded into other.



Bar chart for original and recoded birth region.

Education level

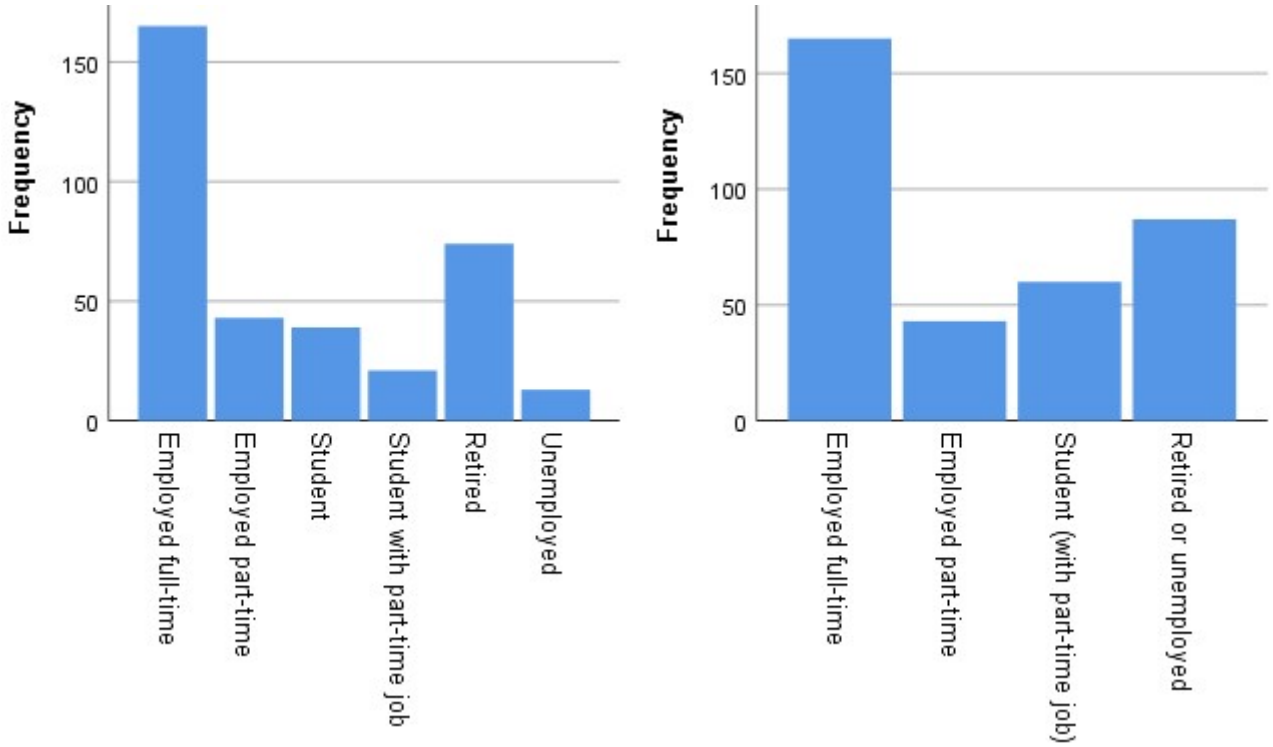
This variable is recoded into three groups: compulsory education or vocational education, higher professional education or bachelor degree, and university master degree. There are six no answers from buildings 4, 10, 30, 31, 36, and 41. Four answers are recoded into higher education and two answers are recoded into master degree. This is based on the average of the building answers and the most common answer to the question.



Bar chart for original and recoded education level.

Employment status

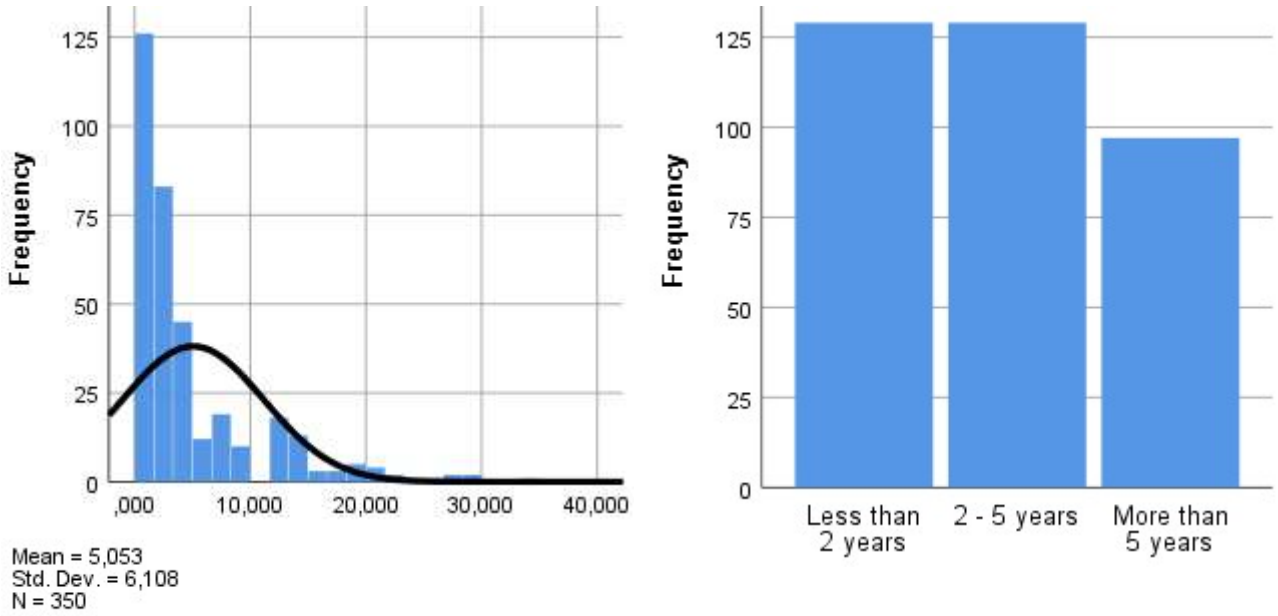
This variable is recoded into four groups: employed full-time, employed part-time, student (with part-time job), and retired or unemployed.



Bar chart for original and recoded employment status.

Time in the building

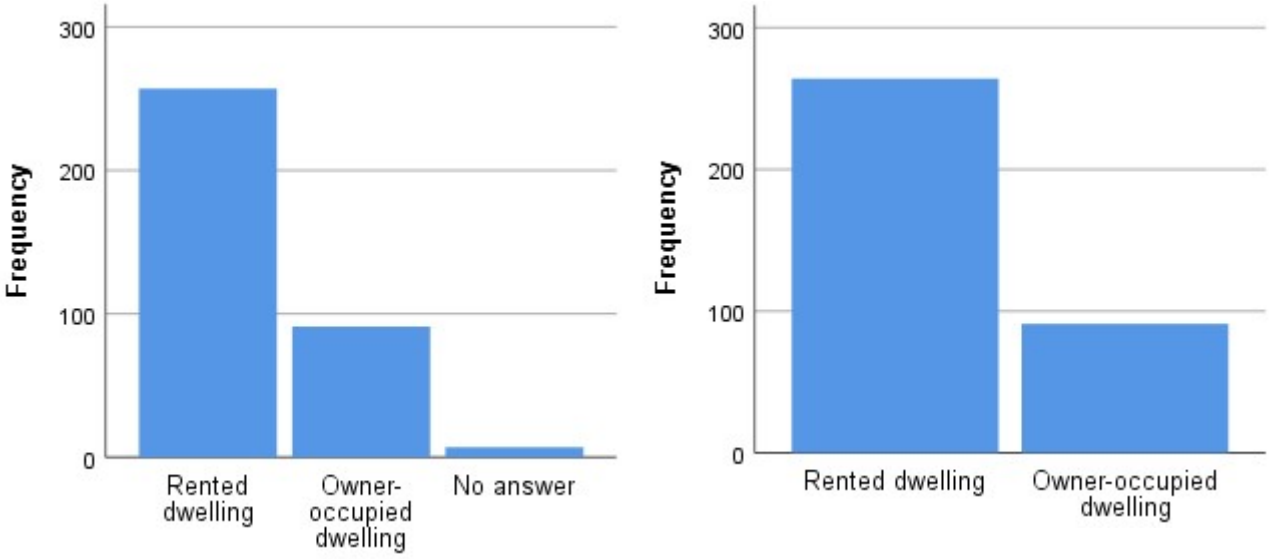
This variable is recoded into three groups: less than 2 years, 2 - 5 years, and more than 5 years. There are five missing answers from buildings 3, 26, 30, 31, and 32. Two are recoded into less than 2 years, one is recoded into 2 - 5 years, and two are recoded into more than 5 years. This is based on the average of the other answers for the building, the composition of the residents, and the age and refurbishment of the building.



Histogram for original and bar chart for recoded time in the building.

Home ownership

This variable is recoded into two groups: rented dwelling and owner-occupied dwelling. There are seven no answers from buildings 1, 6, 23, 25, 28, and 30. Based on the building observations and the average of the building, all seven responses are recoded into rented dwellings. This is also the most common answer to this question.

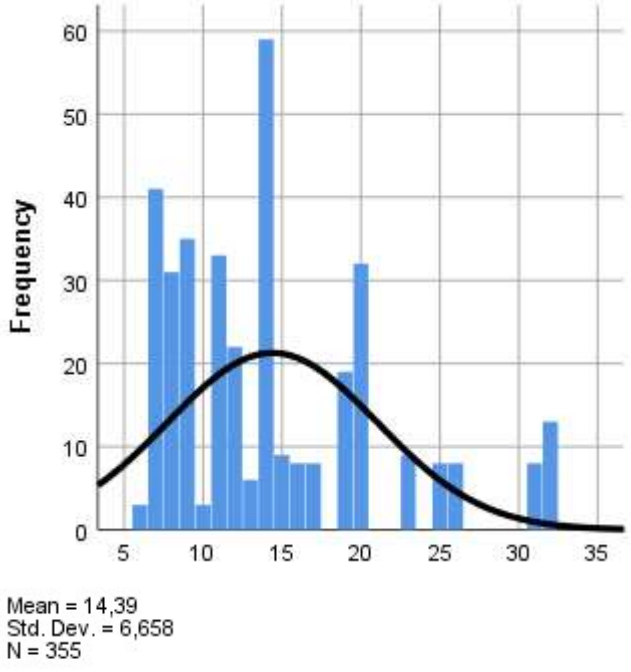


Bar chart for original and recoded home ownership.

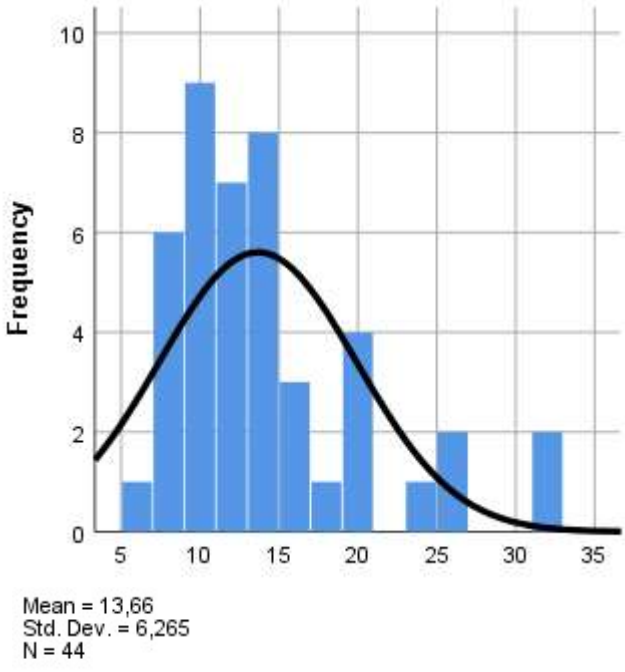
Building observations

The building observations are collected per respondent and per building. For each variable, bar charts show the collected data for all 355 responses and all 44 buildings. All the building observations are combined in Table 5 during the data description in section 4.6.

Number of floors

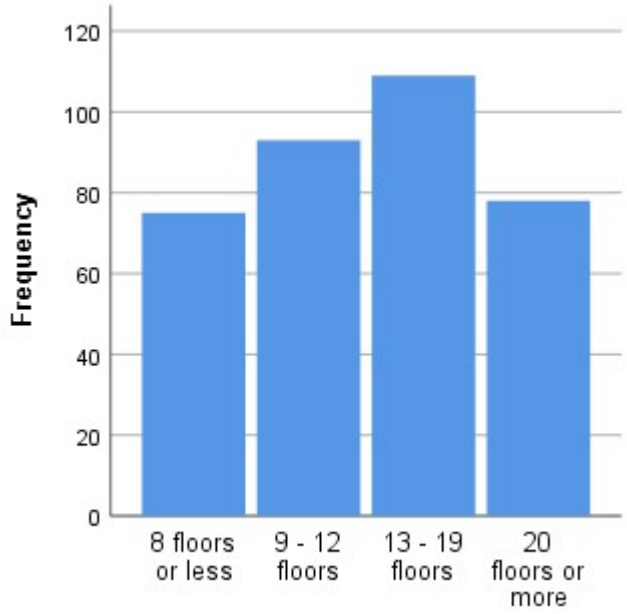


Histogram for original number of floors for all responses.

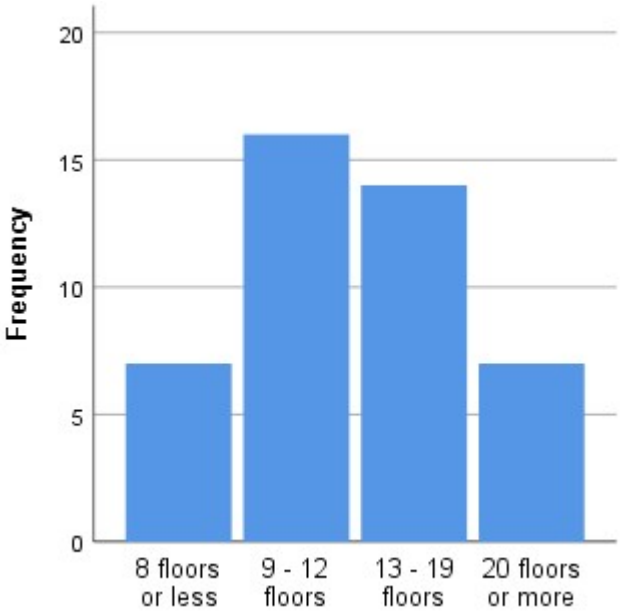


Histogram for original number of floors for all buildings.

Recoded number of floors

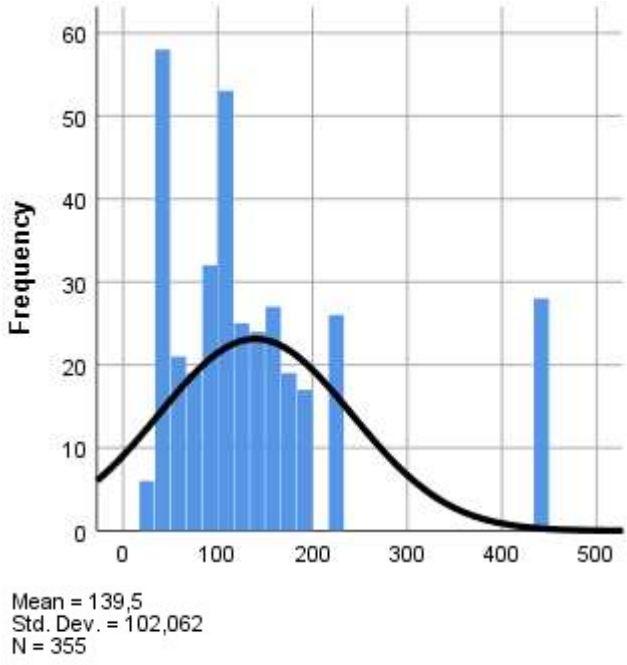


Bar chart for recoded number of floors for all responses.

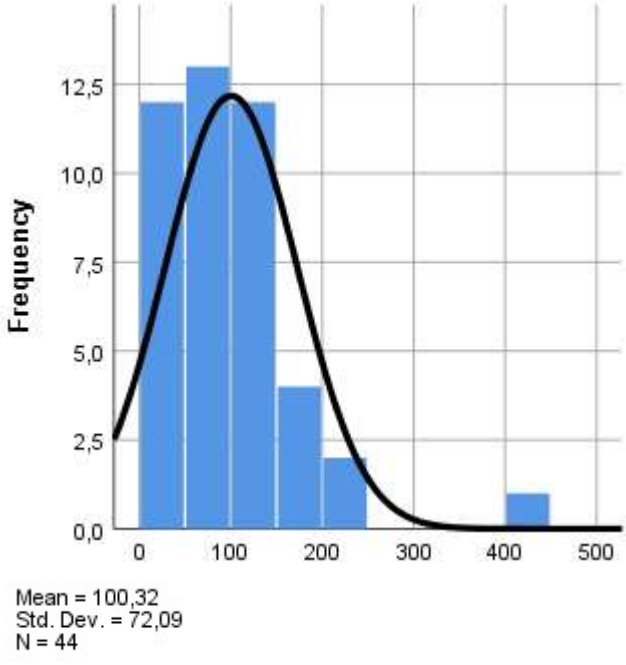


Bar chart for recoded number of floors for all buildings.

Number of apartments

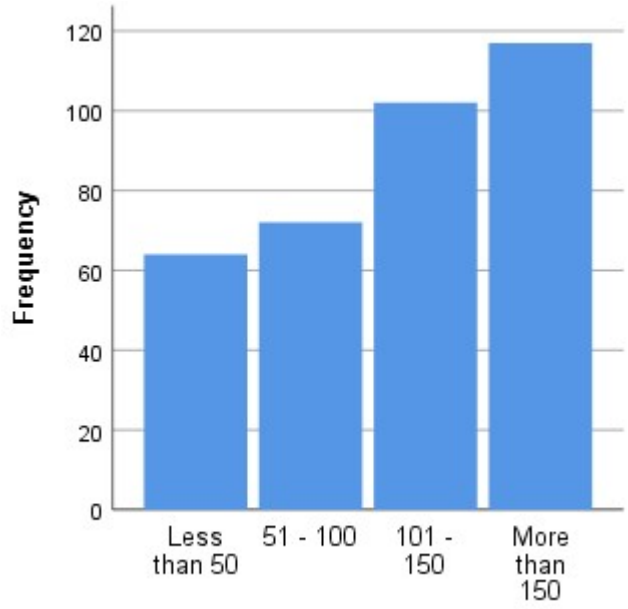


Histogram for original number of apartments for all responses.

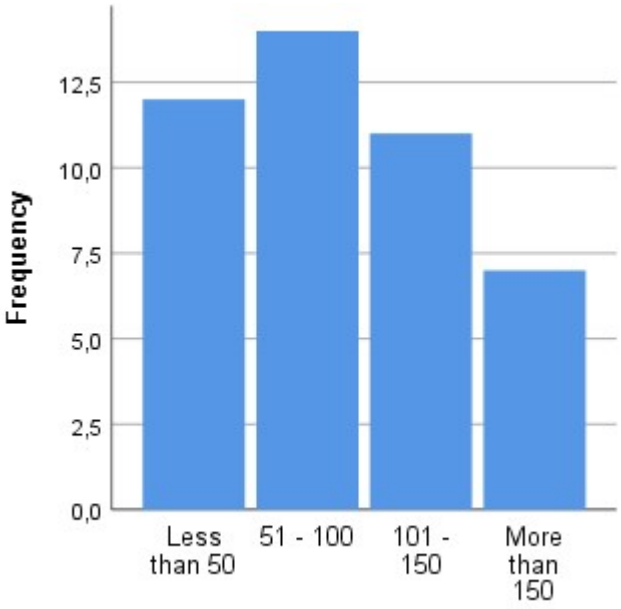


Histogram for original number of apartments for all buildings.

Recoded number of apartments

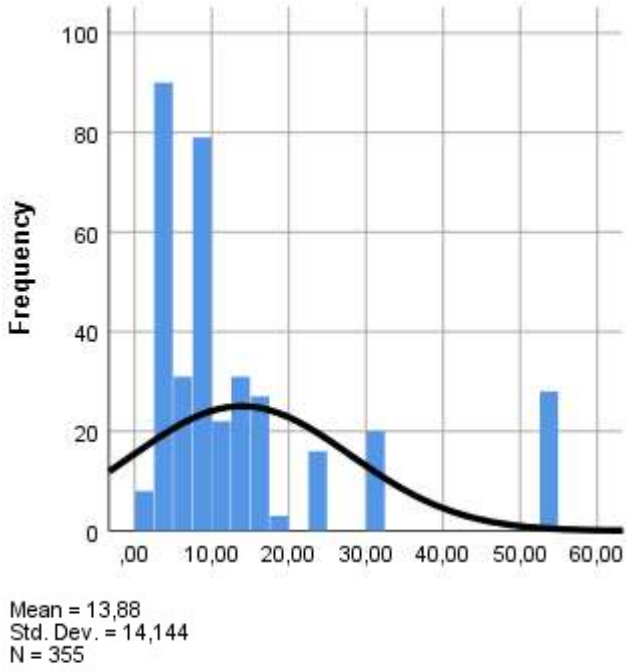


Bar chart for recoded number of apartments for all responses.

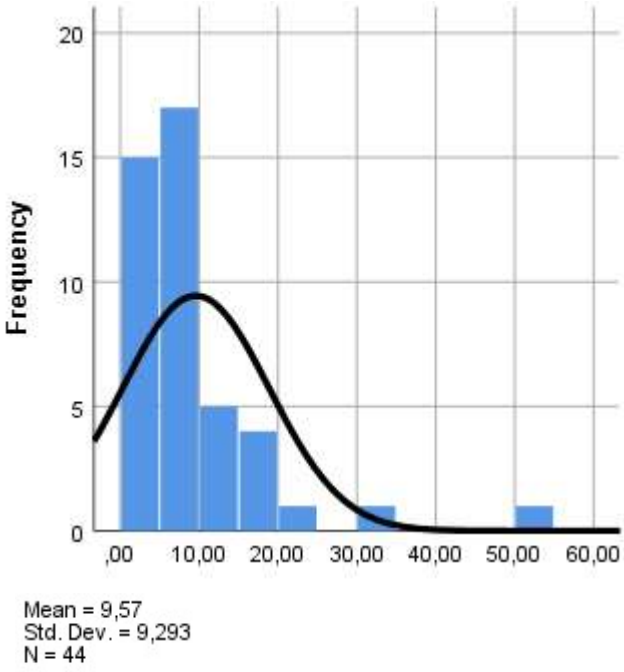


Bar chart for recoded number of apartments for all buildings.

Apartments per floor

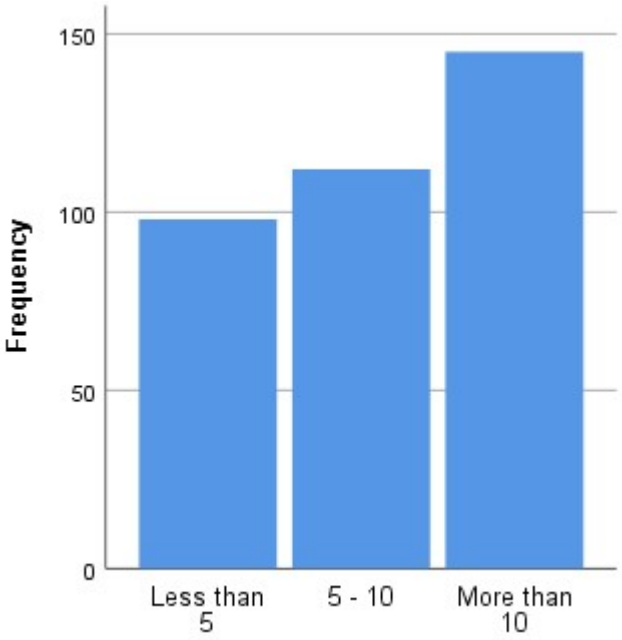


Histogram for original apartments per floor for all responses.

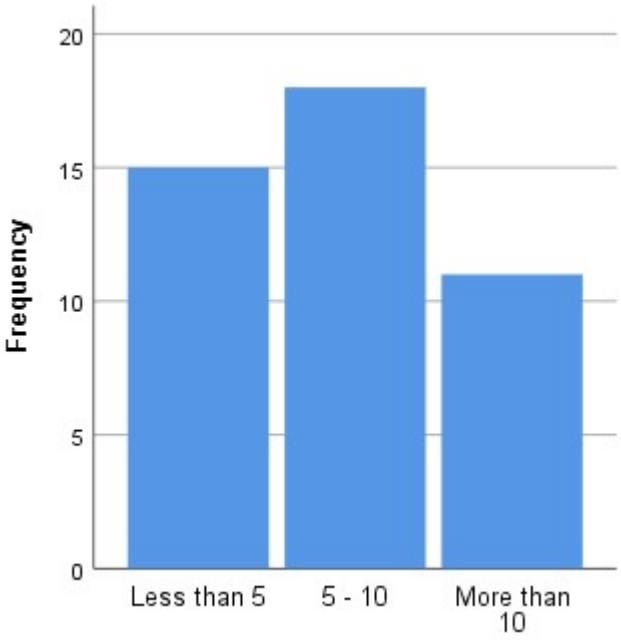


Histogram for original apartments per floor for all buildings.

Recoded apartments per floor

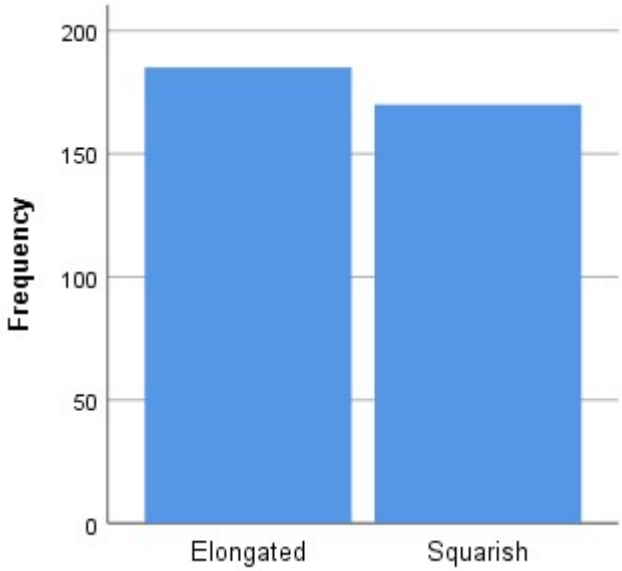


Bar chart for recoded apartments per floor for all responses.

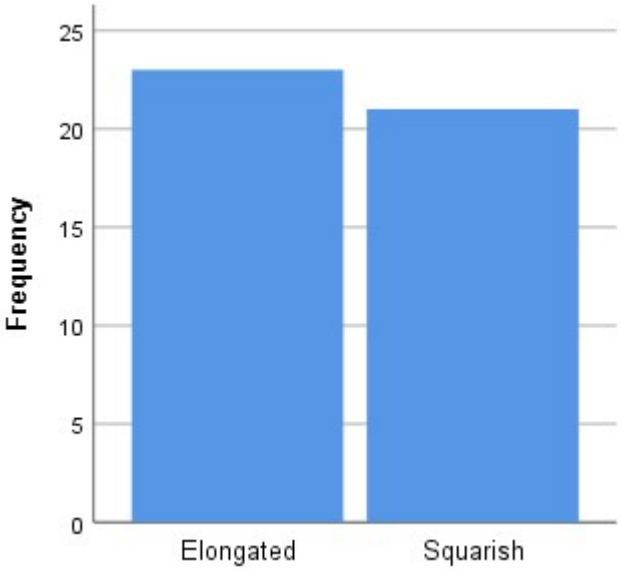


Bar chart recoded apartments per floor for all buildings.

Shape of the building

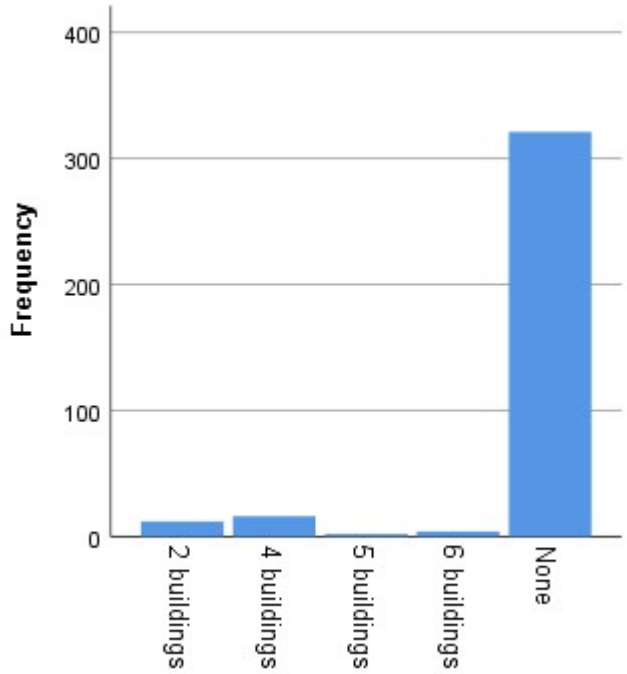


Bar chart for shape of the building for all responses.

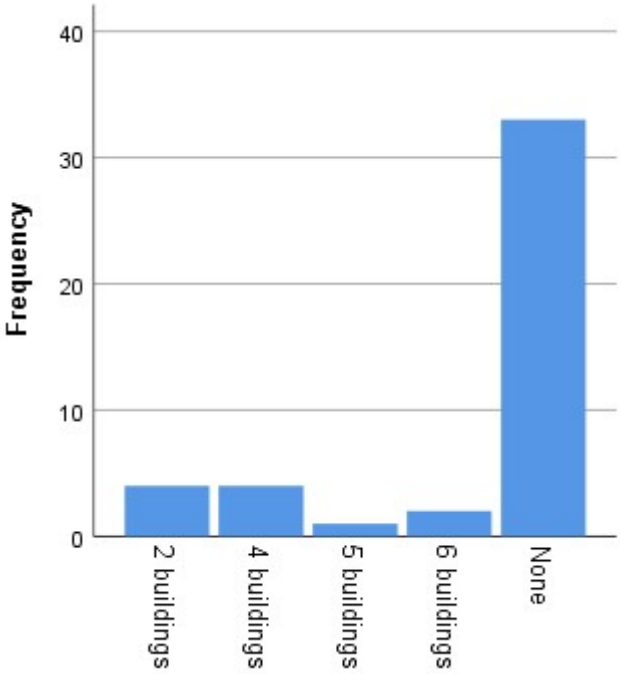


Bar chart for shape of the building for all buildings.

Number of duplicate buildings

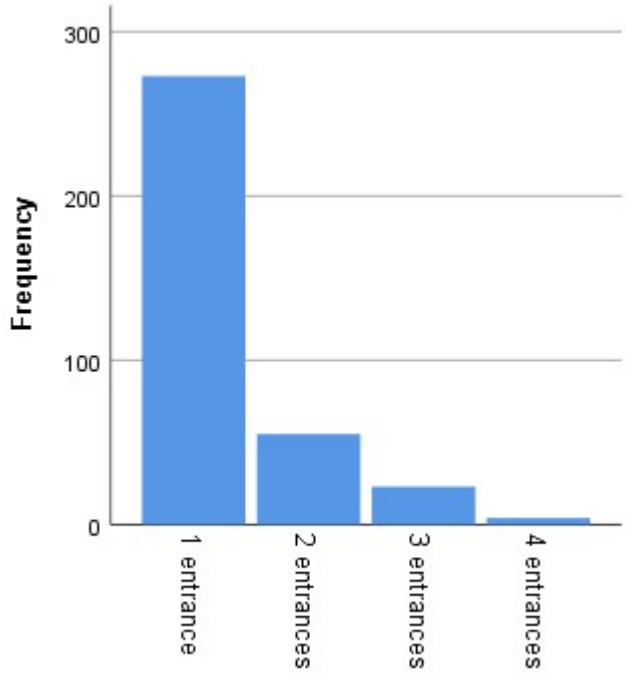


Bar chart for number of duplicate building for all responses.

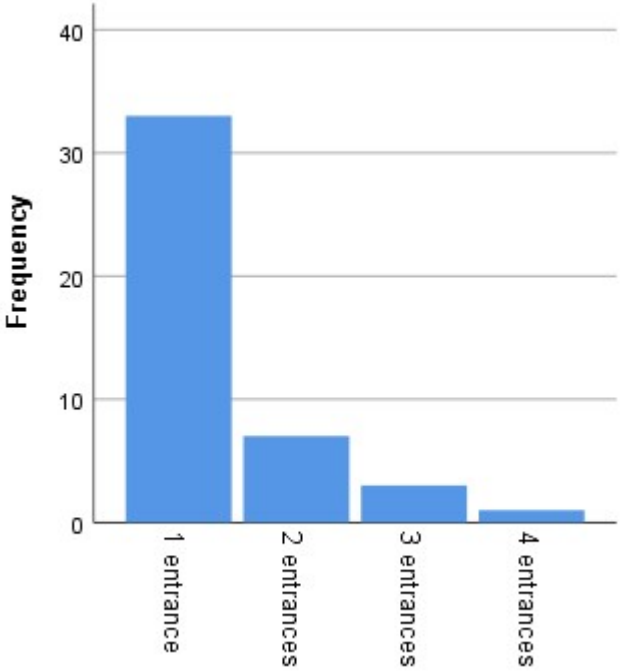


Bar chart for number of duplicate buildings for all buildings.

Number of entrances

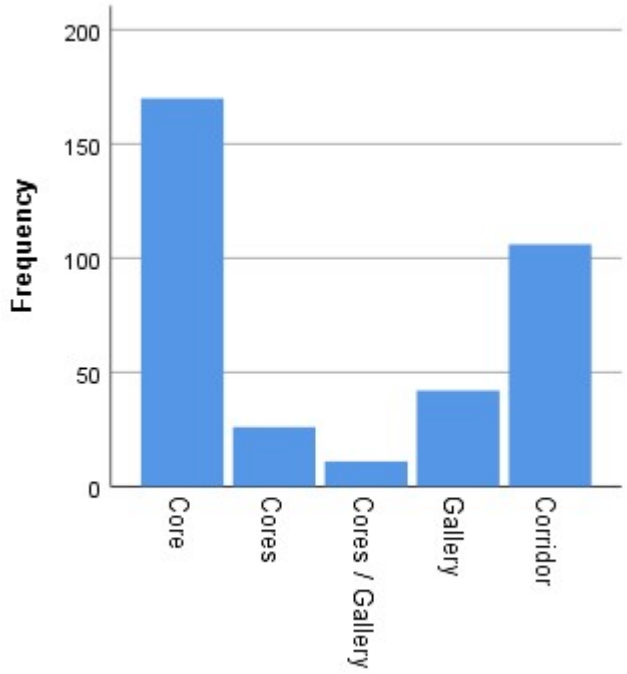


Bar chart for number of entrances for all responses.

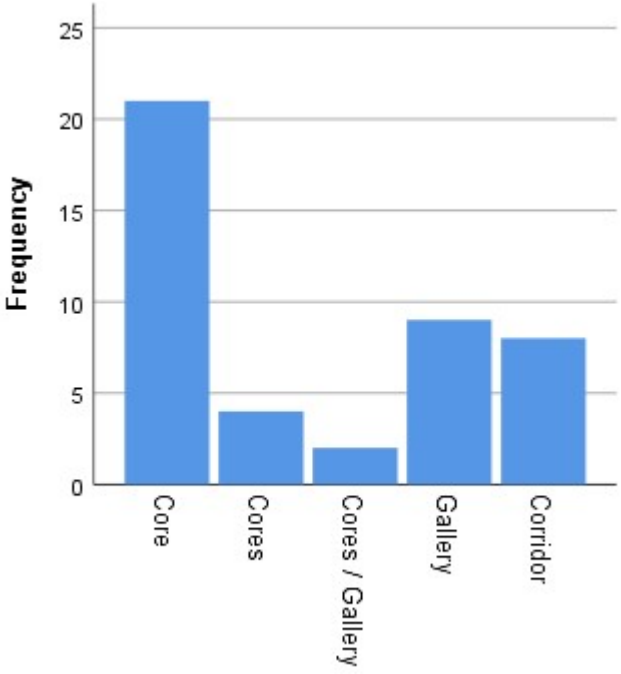


Bar chart for number of entrances for all buildings.

Access to the apartment

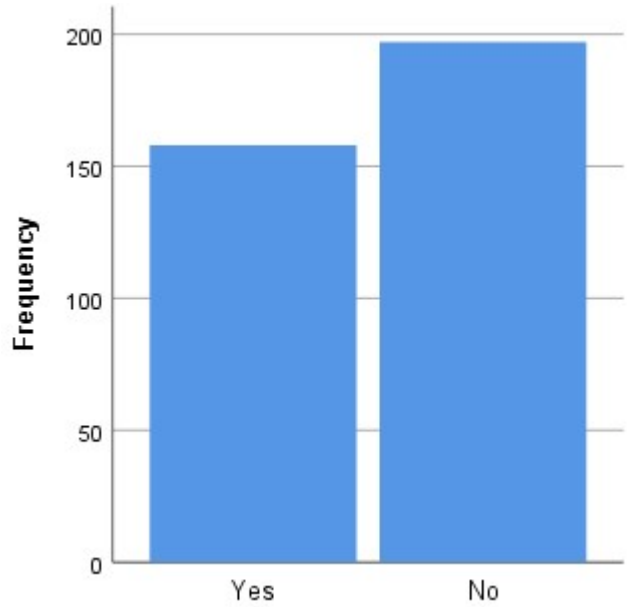


Bar chart for access to the apartment for all responses.

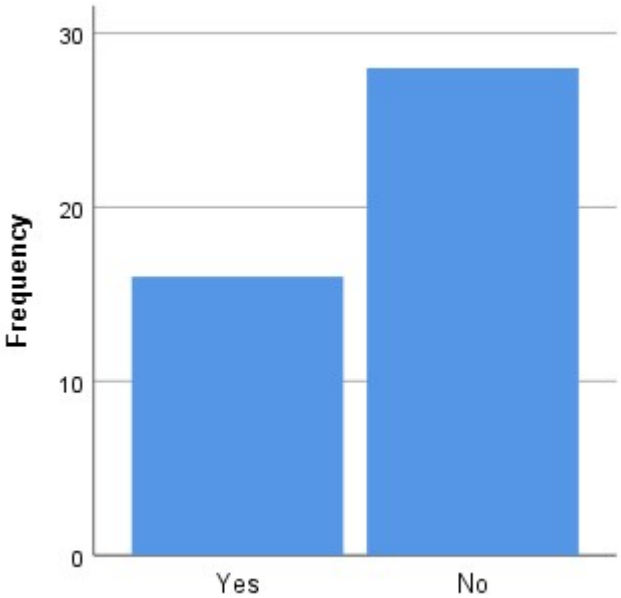


Bar chart for access to the apartment for all buildings.

Social space availability

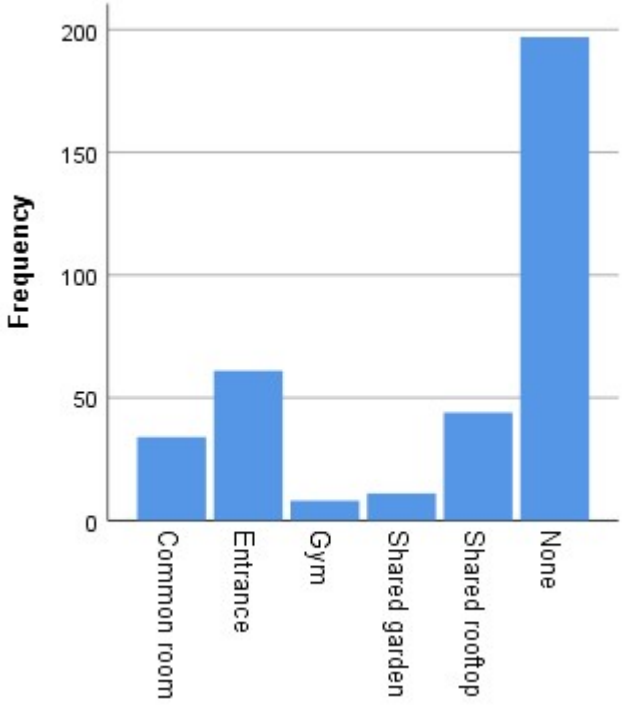


Bar chart for social space availability for all responses.

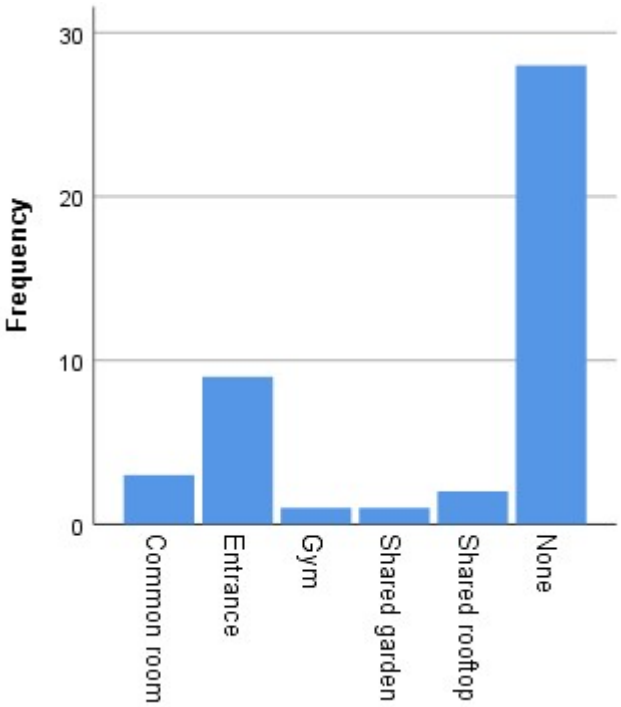


Bar chart for social space availability for all buildings.

Social space type

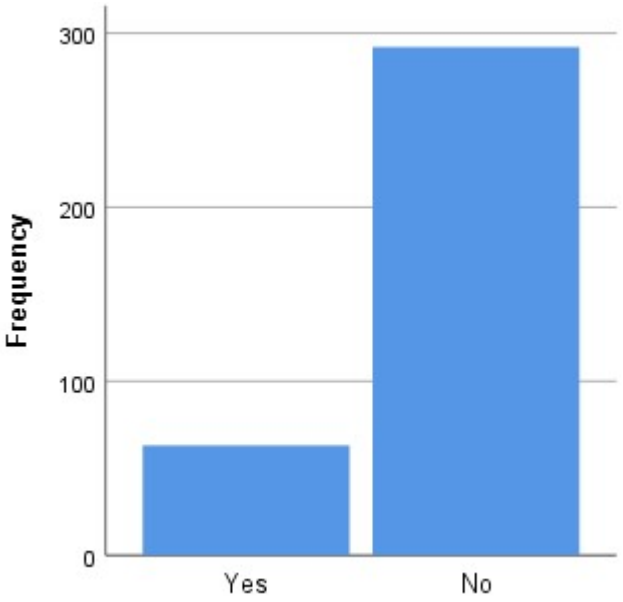


Bar chart for social space type for all responses.

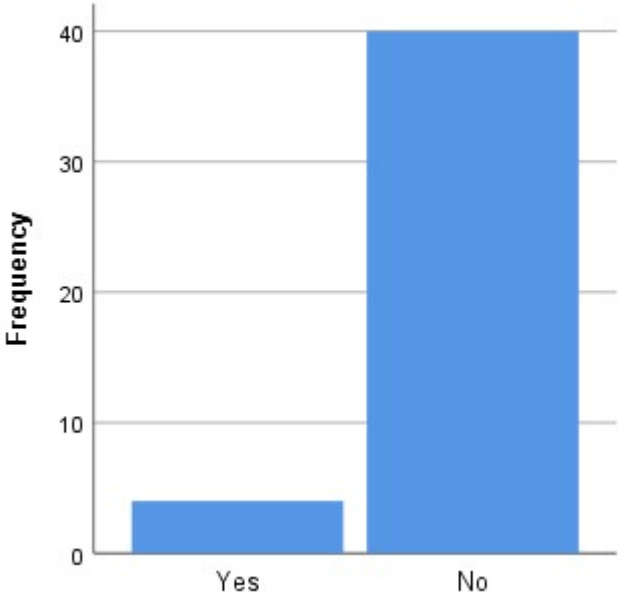


Bar chart for social space type for all buildings.

Online facilities availability

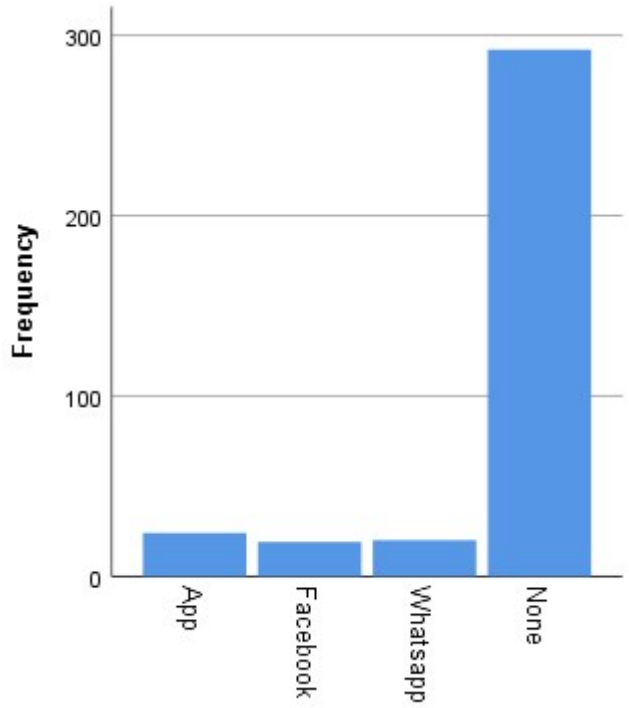


Bar chart for online facilities availability for all responses.

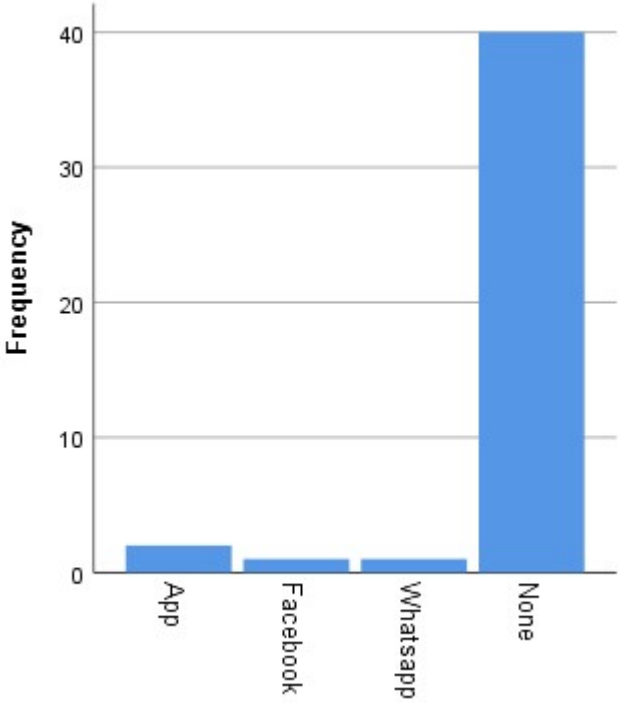


Bar chart for online facilities availability for all buildings.

Online facilities type

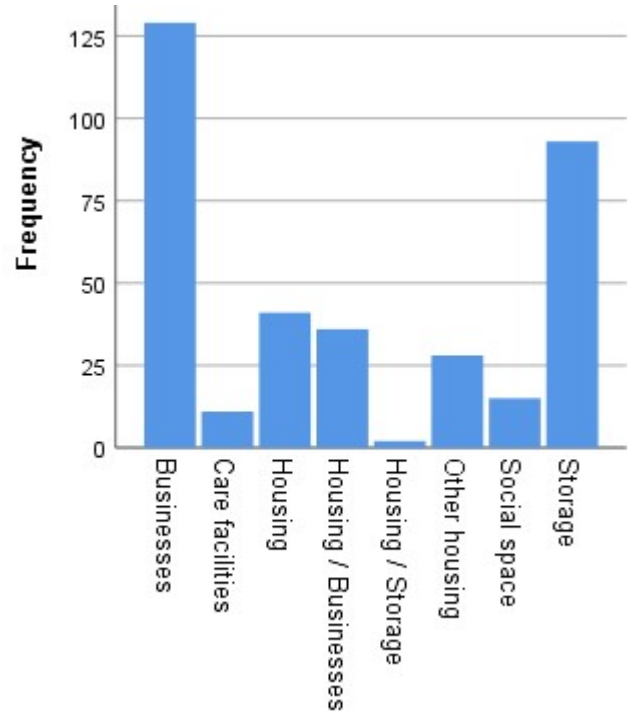


Bar chart for online facilities type for all responses.

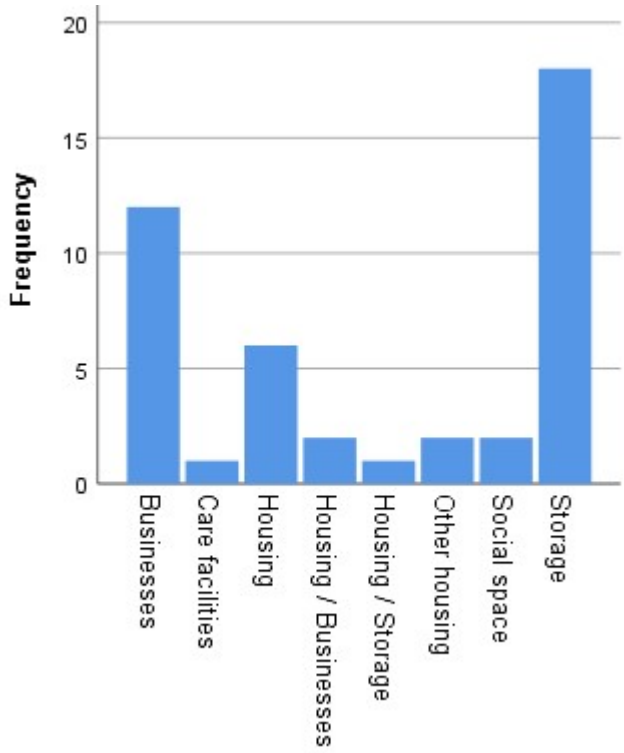


Bar chart for online facilities type for all buildings.

Plinth activities

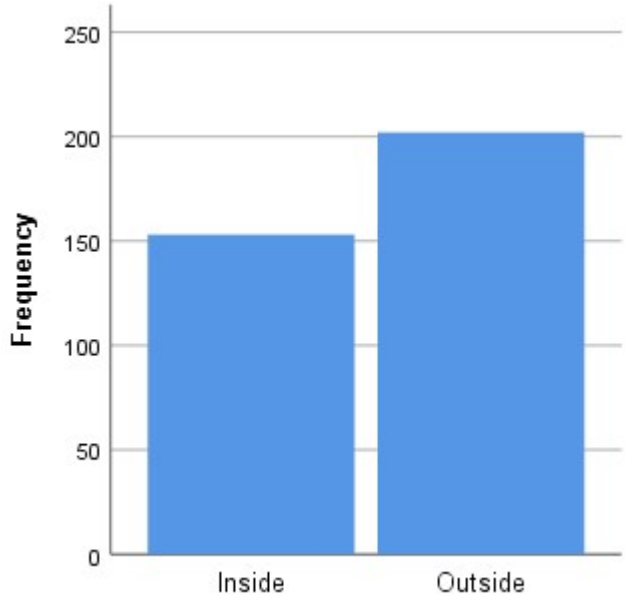


Bar chart for plinth activities for all responses.

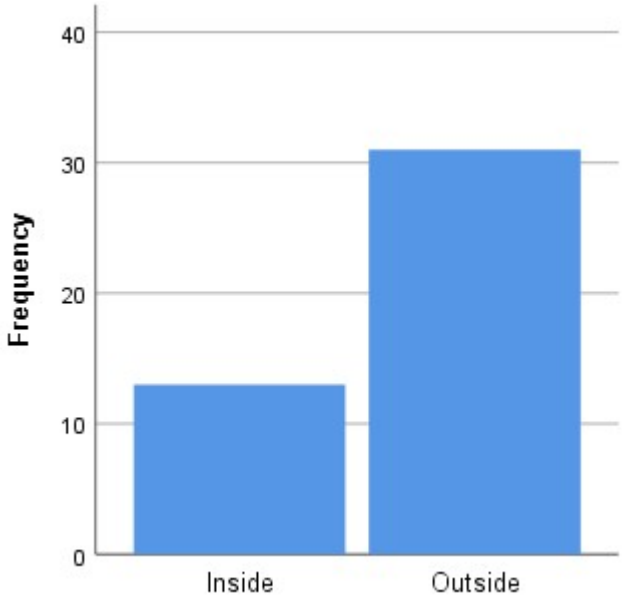


Bar chart for plinth activities for all buildings.

Location of the mailboxes

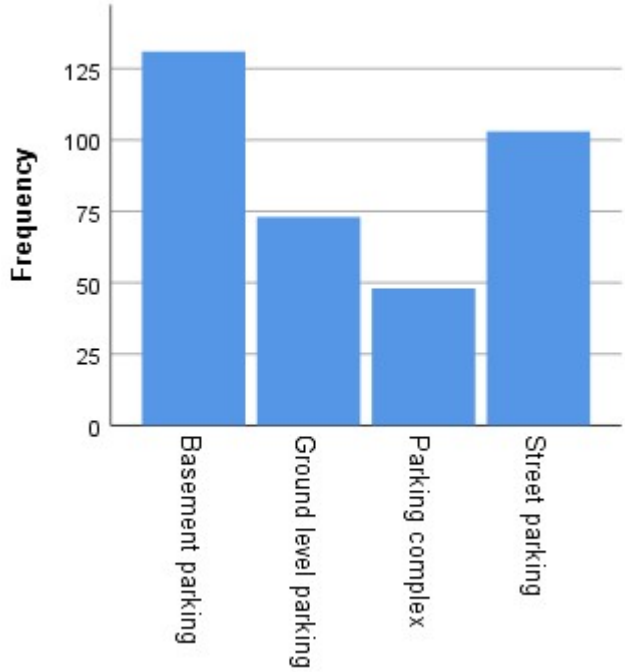


Bar chart for location of the mailboxes for all responses.

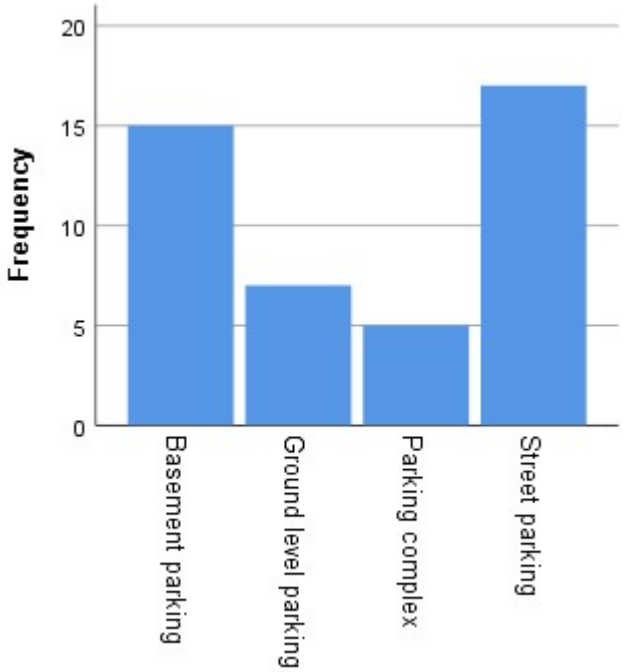


Bar chart for location of the mailboxes for all buildings.

Car parking facilities

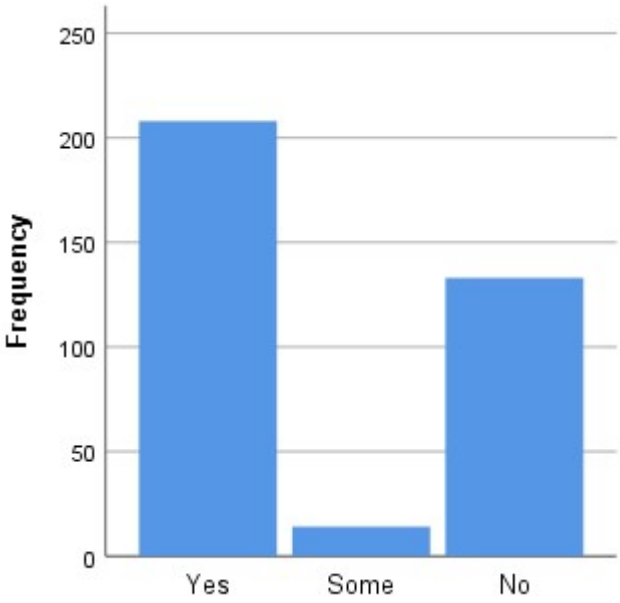


Bar chart for car parking facilities for all responses.

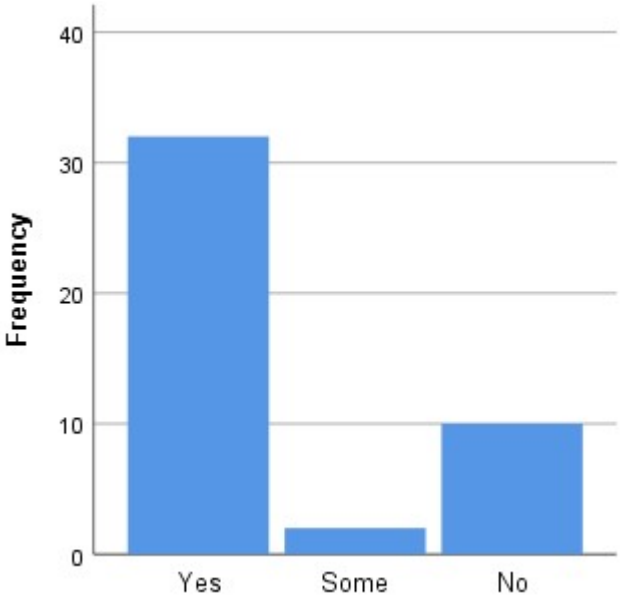


Bar chart for car parking facilities for all buildings.

Private balconies

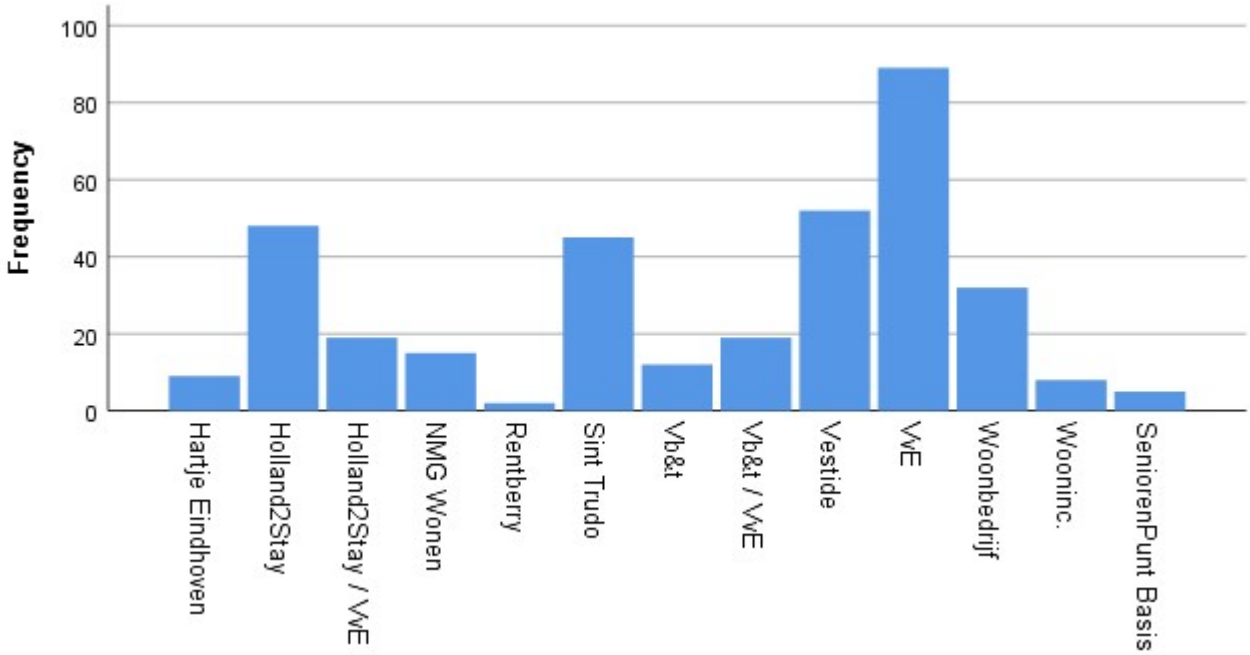


Bar chart for private balconies for all responses.

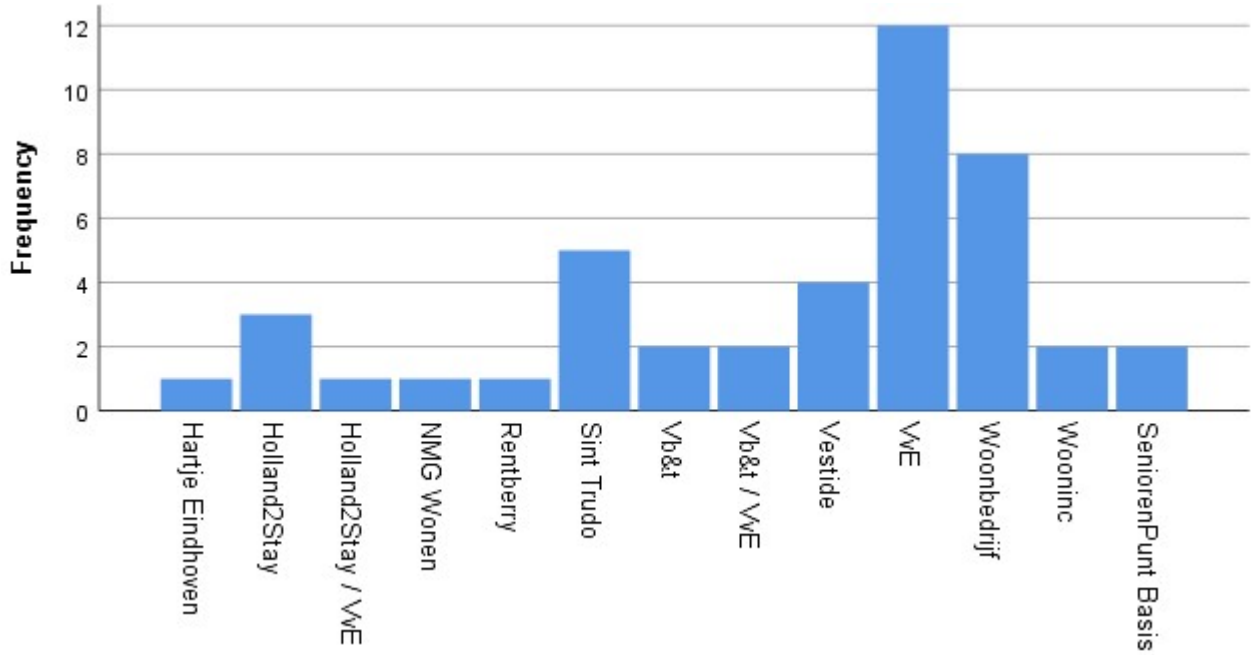


Bar chart for private balconies for all buildings.

Owner of the building

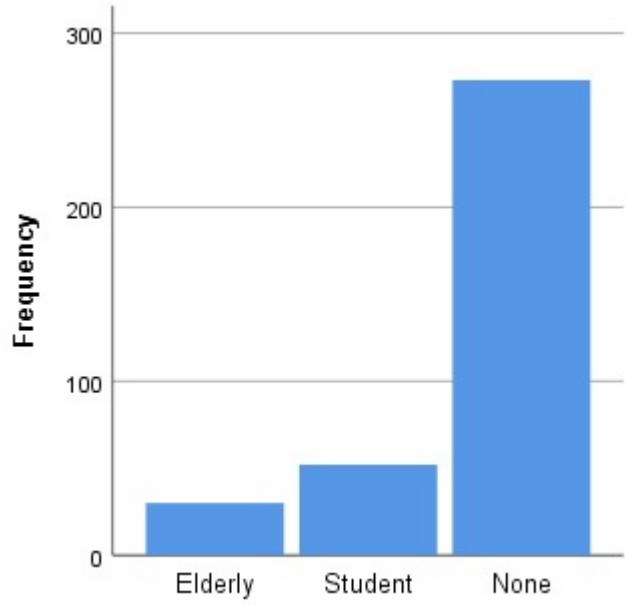


Bar chart for owner of the building for all responses.

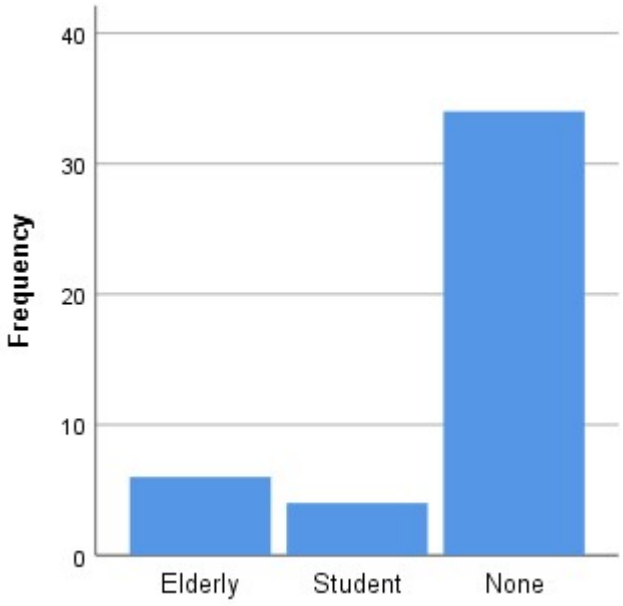


Bar chart for owner of the building for all buildings.

Specific building type



Bar chart for specific building type for all responses.

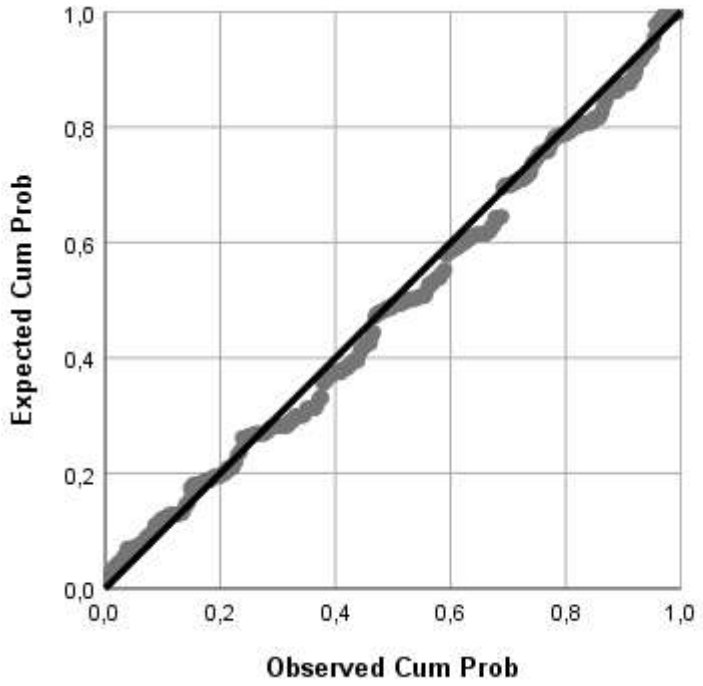


Bar chart for specific building type for all buildings.

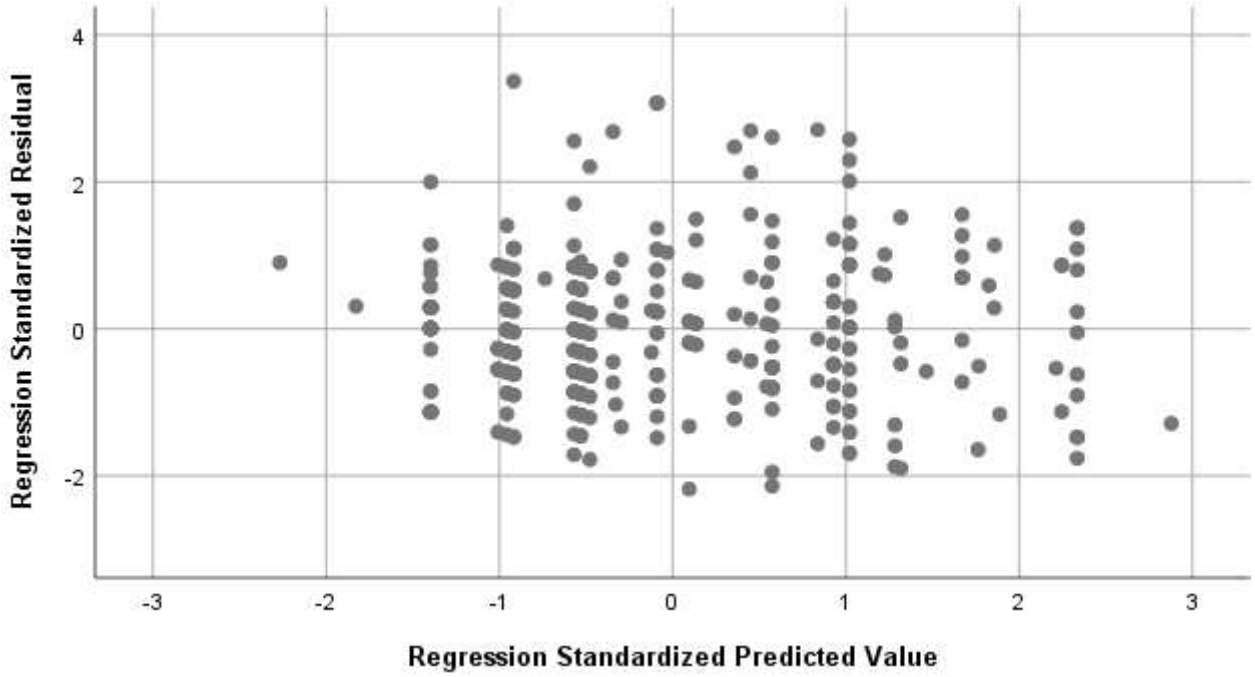
Appendix VII: Regression analyses

This appendix shows the scatterplots and P-P plots of all four multiple regression analyses. The assumptions of homoscedasticity and normality are checked with these plots. The scatterplot should not have a clear pattern and the P-P plot should follow the linear line to meet these assumptions.

Social interaction analysis

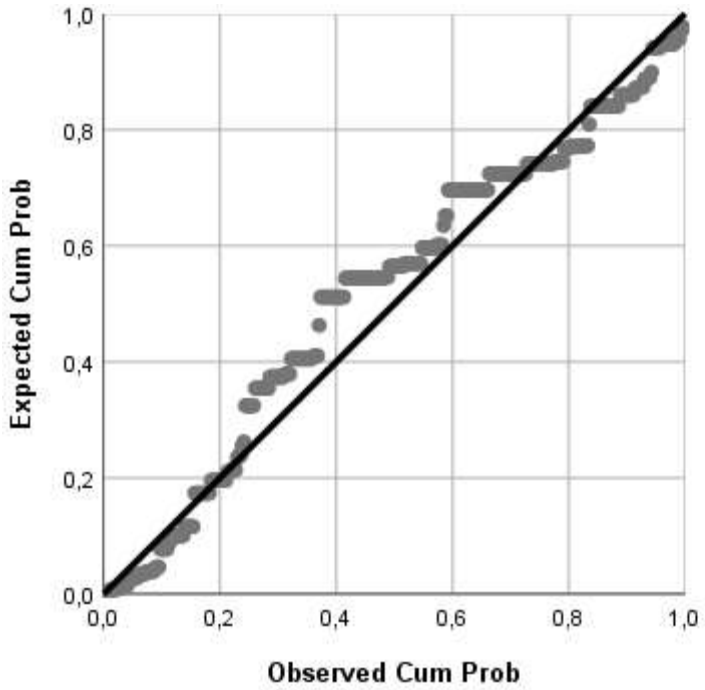


P-P plot for the social interaction regression analysis.

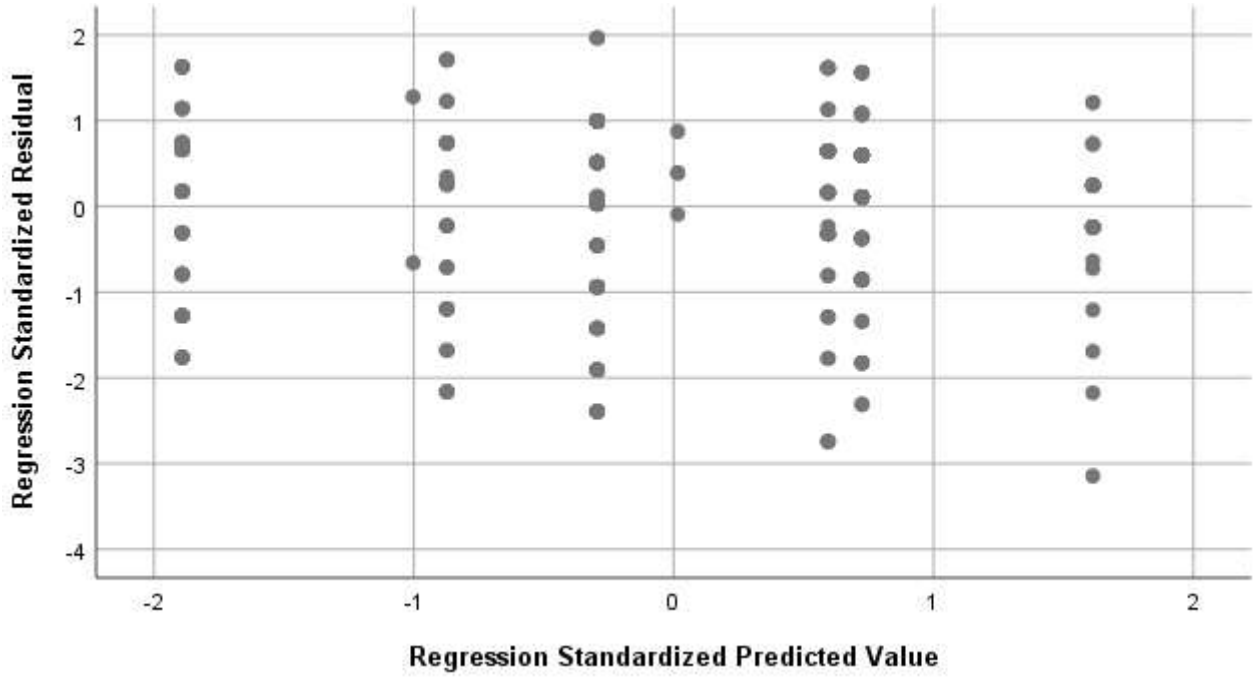


Scatterplot for the social interaction regression analysis.

Social satisfaction analysis



P-P plot for the social satisfaction regression analysis.

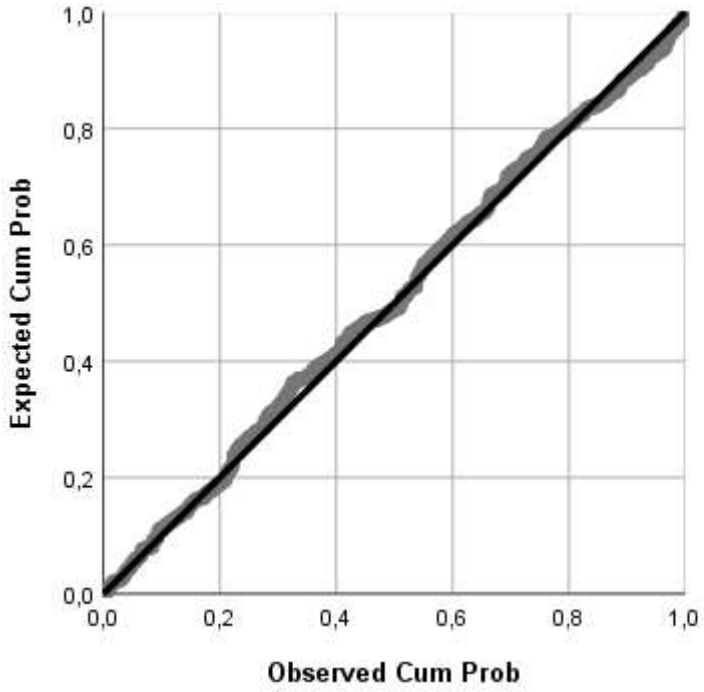


Scatterplot for the social satisfaction regression analysis.

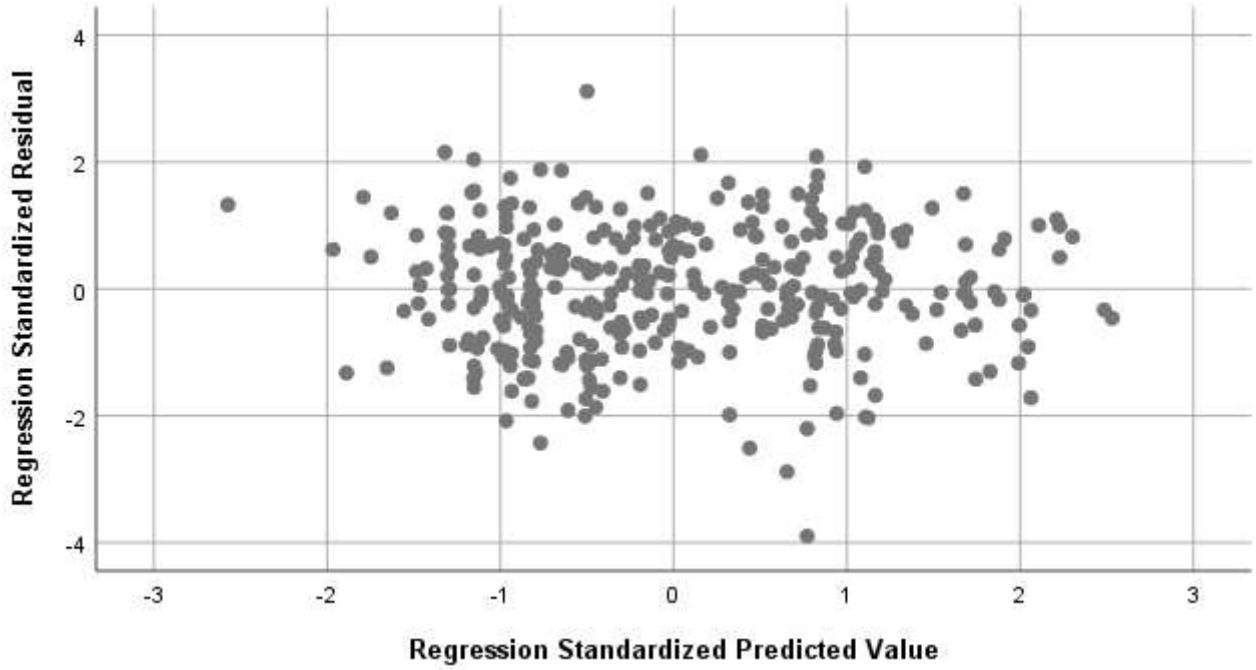
Social cohesion analyses

First social cohesion analysis

The first social cohesion score is analyzed with only the significant independent variables.



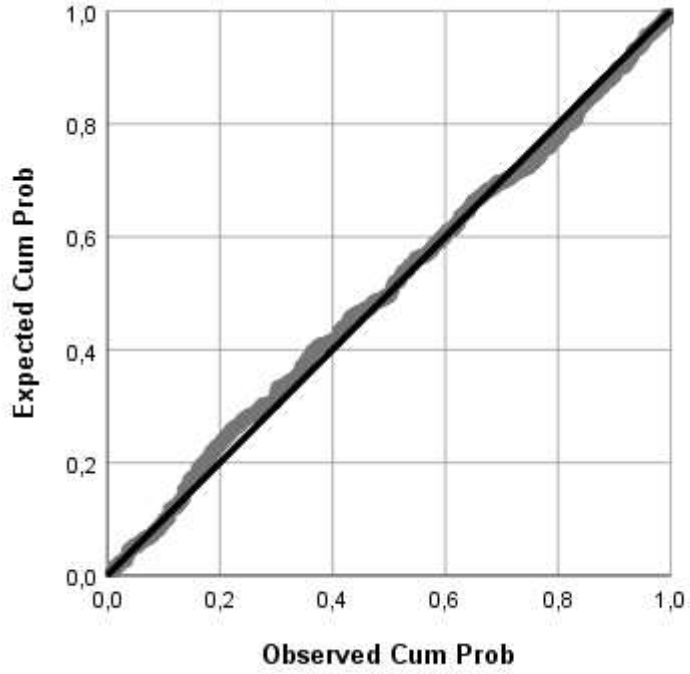
P-P plot for the social cohesion regression analysis with only the significant independent variables.



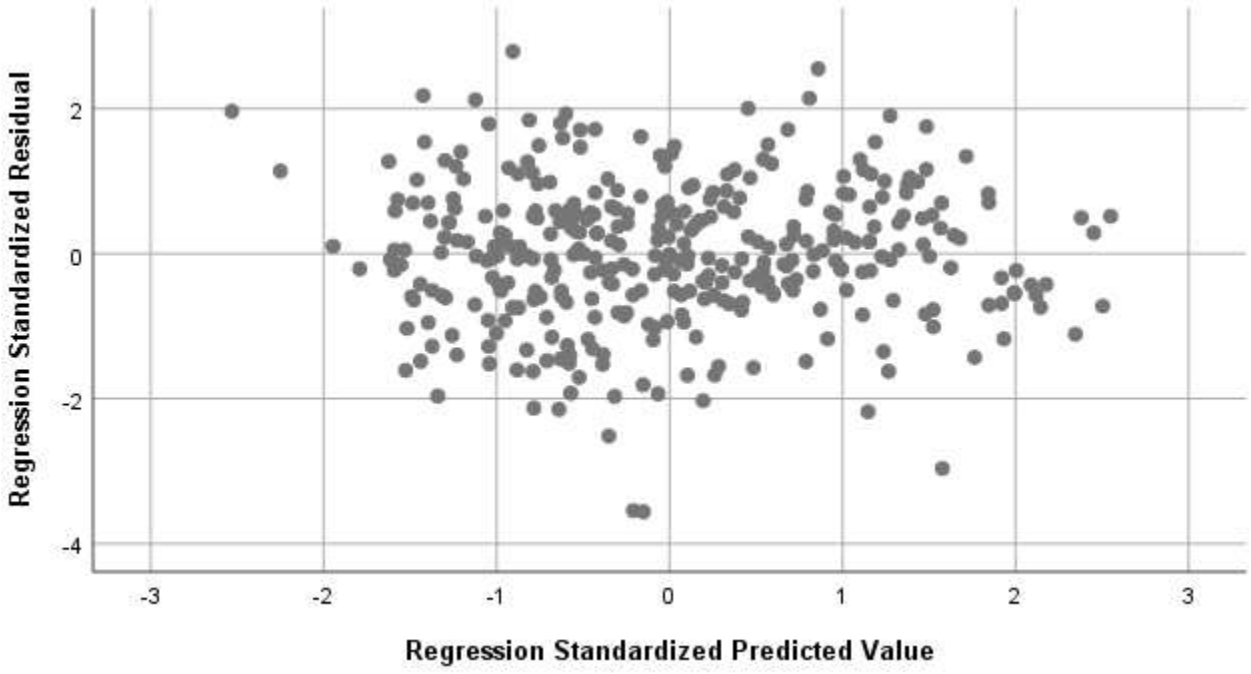
Scatterplot for the social cohesion regression analysis with only the significant independent variables.

Second social cohesion analysis

The second social cohesion score is analyzed with all significant variables, which include the significant independent variables and the significant dependent variables as predicting independent variables.



P-P plot for the social cohesion regression analysis with all significant variables.



Scatterplot for the social cohesion regression analysis with all significant variables.

Appendix VIII: Building information

Building		Address	Impression	Building information	Ownership	Facilities
1	Treurenburgstraat	Treurenburgstraat 303 - 455 5613 EA	 	Built in 2019 11 floors 76 apartments Elongated shape 1 entrance Gallery access to the apartment	Apartments are rented Owned by Vb&t	Other housing in plinth Outside mailboxes Basement car parking Private balconies No social spaces
2	De Hertoghof	Hertog Hendrik van Brabantplein 16 - 100 5611 PE	 	Built in 1956 14 floors 175 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Holland2Stay and Owners Association	Other housing in plinth Inside mailboxes Basement car parking Private balconies No social spaces Facebook group for social contact
3	Elzentlaan	Elzentlaan 49 - 135 5611 LJ	 	Built in 1967 12 floors 44 apartments Elongated shape 1 entrance Gallery access to the apartment	Apartments are owner-occupied Owned by Owners Association	Businesses in plinth Outside mailboxes Street car parking Private balconies No social spaces
4	Gerretsonplein	Gerretsonplein 3 - 62 5624 JP	 	Built in 2013 16 floors 60 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Woonbedrijf	Businesses in plinth Outside mailboxes Basement car parking Private balconies No social spaces

5	Porthos	Winkelcentrum Woensel 130 - 237 5625 AG	 	Built in 2006 32 floors 108 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Businesses in plinth Outside mailboxes Basement car parking No balconies Entrance library as social space
6	De Regent	De Regent 22 - 314 5611 HW	 	Built in 2000 31 floors 102 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Vb&t and Owners Association	Businesses in plinth Outside mailboxes Basement car parking No balconies No social spaces
7	Vestedatoren	Smalle Haven 9 - 99 5611 EH	 	Built in 2006 26 floors 46 apartments Elongated shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Businesses in plinth Outside mailboxes Basement car parking Private balconies Gym as social space

8	Winter	Holstraat 1 - 115 5654 BN	 	Built in 2005 16 floors 58 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Woonbedrijf	Storage in plinth Outside mailboxes Basement car parking No balconies Entrance as social space
9	De Ranken	Cassandraplein 20 - 85 5631 BB	 	Built in 2008 17 floors 60 apartments Squarish shape 2 entrances Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Businesses in plinth Outside mailboxes Basement car parking Private balconies No social spaces
10	De Parade	Dominee Theodor Fliednerstraat 151 - 245 5631 MD	 	Built in 2009 19 floors 48 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Elderly housing Owned by Owners Association	Care facilities in plinth Outside mailboxes Car parking complex No balconies Entrance as social space

11	Onyx Tower	Victoriapark 750 - 885 5611 BN	 	Built in 2019 25 floors 136 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Holland2Stay	Housing and businesses in plinth Inside mailboxes Basement car parking Private balconies No social spaces
12	Mgr. Swinkelsstraat	Monseigneur Swinkelsstraat 31 - 101 5623 AP	 	Built in 2008 13 floors 36 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Rentberry	Storage in plinth Outside mailboxes Car parking complex Private balconies No social spaces
13	Anton	Torenallee 62-02 - 72-52 5617 BD	 	Built in 1927 7 floors 148 apartments Elongated shape 1 entrance Corridor access to the apartment	Apartments are rented Owned by Sint Trudo	Businesses in plinth Inside mailboxes Basement car parking No balconies Shared rooftop as social space App for social contact
14	Badelochstraat	Badelochstraat 1 - 159 5625 BA	 	Built in 1969 9 floors 80 apartments Elongated shape 1 duplicate building nearby 2 entrances Gallery access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces

15	Apostelflat I	Maurits Lijnslagerstraat 6 - 148 5625 BK	 	Built in 1972 13 floors 72 apartments Squarish shape 1 duplicate building nearby 1 entrance Core access to the apartment	Apartments are rented Elderly housing Owned by SeniorenPunt Basis	Storage in plinth Outside mailboxes Street car parking Private balconies Entrance as social space
16	Apostelflat II	Kampakker 1 - 107 5625 VC	 	Built in 1974 10 floors 54 apartments Squarish shape 3 duplicate buildings nearby 1 entrance Core access to the apartment	Apartments are rented Elderly housing Owned by SeniorenPunt Basis	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces
17	Aurora	De Lismortel 42-002 - 42-450 5612 AR	 	Built in 2016 14 floors 225 apartments Elongated shape 1 entrance Corridor access to the apartment	Apartments are rented Student housing Owned by Vestide	Social space in plinth Outside mailboxes Street car parking No balconies Entrance as social space
18	Artemis	Venuslaan 305 - 355 5632 HH	 	Built in 1974 10 floors 40 apartments Elongated shape 3 duplicate buildings nearby 2 entrances Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces

19	Grote Graaf	Graaf Adolfstraat 2 - 180 5616 BW	 	Built in 1972 11 floors 90 apartments Elongated shape 3 entrances Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces
20	Die Fledermaus	Weisshorn 1 - 163 5624 NS	 	Built in 2001 9 floors 82 apartments Elongated shape 1 entrance Gallery access to the apartment	Apartments are rented Elderly housing Owned by Woonbedrijf	Housing in plinth Outside mailboxes Ground level car parking Private balconies Jeu de Boules and library as social space
21	De Koppele	De Koppele 399 - 577 5632 LN	 	Built in 1969 11 floors 90 apartments Elongated shape 3 duplicate buildings nearby 1 entrance Gallery access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Inside mailboxes Street car parking Private balconies No social spaces
22	Messiaenpark	Messiaenpark 30 - 66 5653 JS	 	Built in 1996 11 floors 37 apartments Squarish shape 1 duplicate building nearby 1 entrance Core access to the apartment	Apartments are rented Owned by Woonbedrijf	Housing and storage in plinth Outside mailboxes Ground level car parking Private balconies Jeu de Boules as social space

23	Philitelaan	Philitelaan 59-1 - 59-311 5617 AK	 	Built in 2018 20 floors 156 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by NMG Wonen	Businesses in plinth Inside mailboxes Car parking complex Private balconies No social spaces
24	Cederlaan	Cederlaan 20 - 472 5616 SC	 	Built in 2012 7 floors 227 apartments Elongated shape 2 entrances Corridor access to the apartment	Apartments are rented Student housing Owned by Vestide	Housing in plinth Outside mailboxes Ground level car parking No balconies No social spaces Whatsapp for social contact
25	Hartje New York	Gerard Philipslaan 145 - 363 5616 TT	 	Built in 2013 23 floors 110 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Hartje Eindhoven	Social space in plinth Inside mailboxes Basement car parking Private balconies Entrance as social space
26	Doctor Hermansweg	Doctor Hermansweg 2 - 248 5624 HP	 	Built in 1981 9 floors 124 apartments Elongated shape 2 entrances Corridor access to the apartment	Apartments are rented Student housing Owned by Vestide	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces

27	De Graaf	Lichtstraat 2 - 92 / 488 - 578 5611 XA	 	Built in 2003 8 floors 92 apartments Elongated shape 5 duplicate buildings nearby 2 entrances Corridor access to the apartment	Apartments are owner-occupied Owned by Vb&t	Housing in plinth Outside mailboxes Basement car parking Private balconies No social spaces
28	Haasje Over	Veemstraat 5 - 373 5617 AG	 	Built in 2021 20 floors 185 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Sint Trudo	Businesses in plinth Inside mailboxes Street car parking No balconies ‘De Brug’ and ‘Het Nest’ as social space
29	Andromedaplaats	Andromedaplaats 5 - 104 5632 BN	 	Built in 1996 14 floors 100 apartments Elongated shape 3 entrances Core and gallery access to the apartment	Apartments are rented Elderly housing Owned by Woonbedrijf	Housing in plinth Outside mailboxes Ground level car parking Private balconies Entrance and Soos as social space
30	Philips Bedrijfsschool	Kastanjelaan 1-01 - 1-804 5616 LH	 	Built in 1920 8 floors 437 apartments Elongated shape 1 entrance Corridor access to the apartment	Apartments are rented Owned by Holland2Stay	Housing and businesses in plinth Inside mailboxes Ground level car parking No balconies Shared rooftop as social space

31	Cornelis Paradise	Frederik van Eedenplein 25 - 183 5611 KT		Built in 1972 12 floors 158 apartments Elongated shape 1 entrance Corridor access to the apartment	Apartments are rented Owned by Holland2Stay	Businesses in plinth Inside mailboxes Car parking complex Some private balconies No social spaces
32	Boschdijk I	Boschdijk 23 - 129 5612 HA		Built in 1985 7 floors 110 apartments Elongated shape 4 entrances Core and gallery access to the apartment	Apartments are rented Owned by Wooninc	Housing in plinth Outside mailboxes Street car parking Private balconies No social spaces
33	Boschdijk II	Boschdijk 303 - 317 5621 JA		Built in 2004 9 floors 48 apartments Elongated shape 1 entrance Gallery access to the apartment	Apartments are owner-occupied Owned by Sint Trudo	Storage in plinth Outside mailboxes Basement car parking Some private balconies No social spaces
34	Houthalenlaan	Houthalenlaan 13 - 75 5628 PX		Built in 1973 9 floors 32 apartments Squarish shape 1 duplicate building nearby 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Inside mailboxes Street car parking Private balconies No social spaces

35	Heeghtakker	Heeghtakker 18 - 88 5625 SW		Built in 1977 9 floors 60 apartments Elongated shape 3 duplicate buildings nearby 1 entrance Corridor access to the apartment	Apartments are rented and owner-occupied Owned by Owners Association	Storage in plinth Inside mailboxes Street car parking Private balconies No social spaces
36	Amandelpoort	Amandelpark 1 - 114 5632 WX		Built in 2000 6 floors 114 apartments Elongated shape 2 entrances Gallery access to the apartment	Apartments are rented Elderly housing Owned by Woonbedrijf	Housing in plinth Outside mailboxes Ground level car parking Private balconies No social spaces
37	Gunsele	Scottlaan 202 - 280 5623 RD		Built in 1977 15 floors 40 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are owner-occupied Owned by Owners Association	Storage in plinth Outside mailboxes Ground level car parking Private balconies No social spaces
38	Willemsenflat	Generaal Knooplaan 1 - 169 5623 MT		Built in 1982 11 floors 85 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Wooninc	Storage in plinth Inside mailboxes Street car parking Private balconies No social spaces

39	Generaal Wicherslaan	Generaal Wicherslaan 1 - 63 5623 GP		Built in 1970 9 floors 32 apartments Elongated shape 4 duplicate buildings nearby 1 entrance Gallery access to the apartment	Apartments are owner-occupied Owned by Sint Trudo	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces
40	Kalmoesplein	Kalmoesplein 16 - 57 5643 LM		Built in 2007 14 floors 42 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented and owner-occupied Owned by Vb&t and Owners Association	Businesses in plinth Outside mailboxes Basement car parking Private balconies Shared garden as social space
41	Urkhovenseweg	Urkhovenseweg 20 - 244 5641 KH		Built in 1971 14 floors 112 apartments Elongated shape 3 entrances Core access to the apartment	Apartments are rented Owned by Woonbedrijf	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces
42	Vlinderflat	Vuurvlinderstraat 1 - 95 5641 DK		Built in 1968 7 floors 48 apartments Elongated shape 5 duplicate buildings nearby 1 entrance Gallery access to the apartment	Apartments are rented Owned by Woonbedrijf	Storage in plinth Outside mailboxes Street car parking Private balconies No social spaces

43	Space-S blok 5	Torenallee 347 - 565 5617 BS		Built in 2017 14 floors 110 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Student housing Owned by Vestide	Storage in plinth Outside mailboxes Basement car parking No balconies Common room as social space
44	Trudo Toren	Philitelaan 32 - 282 5617 AN		Built in 2021 19 floors 125 apartments Squarish shape 1 entrance Core access to the apartment	Apartments are rented Owned by Sint Trudo	Businesses in plinth Inside mailboxes Car parking complex Private balconies Common room as social space App for social contact