Smart living studio
homes for elderly and retired people

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Award date:
2013

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Graduation report

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Preface

In the brief, I thank the municipals of Eindhoven and my supervisor. They had introduced some retired and elderly people for me to get contacts with. Thanks to all the elderly people that I had interviewed and they give me inspirations for my design. Thanks to my supervisors help me to get ideas and to complete the project. During the process, I endeavor to understand the essence of architectural design. This is the question I had asked myself for seven years. I didn't answer this question yet. But I tried to experience life. In my opinion, "architecture is life". I hope that I can enjoy the beauty of life and make better design in the future.

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Chapter 1 Introduction

1.Aging population

The world now is facing a stiff demographic change. The aging population booms dramatically and the average age of the population increases with it, particularly in industrialized countries. Between 2100 and 2300, the population between the 65 and 80 is estimated to increase by 24% to 32% and the 80's or above will double from 8.5% to 17%. Besides, the UN Department of Economic and Social Affairs Population Division predict that life expectancy will increase from the range of 46-89 years to 66 -93 years along this century (Maire, Eric, Daniel, & Jean-Yves, 2009). This demographic change will cause the raise of age-related diseases growth. In Netherland, every 100 persons over 65 years old, the summed prevalence of chronic disease is 134 (A.A.M. van Vliet, 2000). It's also predicted that there will be a decline in total women fertility. Consequently the ratio of the young to the elder is expected to drop from 9:1 to 4:1 in 2050 (Maire, Eric, Daniel, & Jean-Yves, 2009) and the number of care workers are falling down. As a result, most of industrialized countries are facing the challenge that the health care demand and costs are increasing incredibly (the US and Germany spent about 13% of their national income on health care).

Furthermore, senior people have a strong desire to stay in their own houses, instead of being institutionalized in nursing homes. One of the concerns is the lack of individual's own privacy, the feeling of control, the sense of belonging to a community, freedom, self-reliance and self-independence. Only when the health condition becomes the prior issue for someone may he choose to live in care facilities. Comparably, people who stay at their own house will have the sense of security within the familiar neighborhood; could maintain family visit and friendship with neighbors; have the possibilities to keep all the favorite furniture, possession and collections (Judith, Virginia, Ganesh, & Mathew, 2004). That's the reason that elderly people prefer to stay longer and age at their own house. Therefore, the need for efficient health care delivery and administration together with the elder people's desire for independence, leads to the concept "aging-in-place".

2. Smart Home enable aging-in-place

The Centre for Disease Control defines aging in place as

"the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level." (Centers for Disease Control and Prevention, 2009)

Nowadays, most of the technological and architectural developments try to realize this concept by providing living environments that deliver home care and help people live independently. All the developments can be categorized into two main groups: home modifications and smart homes. Modifying the physical environment of homes is an affordable strategy. Adding toilet and tub grab bars, making the walkway slippery-resistant, replacing stairs with ramps, providing adequate lighting, etc..., all belonged to the first category. Masi Mohammadi had invented a DCA-Wall system that integrates domotic devices into home environment, improving the ease and comfort for the people who uses those smart technologies (M.Mohammadi & P.A. Erkelens, 2010) . Another trend of realizing aging-in-place is the design of smart home. The term smart home or intelligent home introduces the concept of networking devices and equipment in the house. In relation to the field of healthcare for elder people, the term can be described

as “assistive technology”, ”telemedicine”, ”telehealth” or “gerontechnology”. Many systems have been developed in Europe to this respect. In the UK, an assisted interactive dwelling house has been design for frail elderly. A sensor system assesses vital signs and activity. The University of Ostrava in the Czech Republic has developed a smart apartment to study individual activities with infrared sensors (Maire, Eric, Daniel, & Jean-Yves, 2009). In Netherlands, the Smartest House, which is designed by Philips, make use of the same principles.

Not all the applications or devices in those projects are the same; however they share in common the following features:
•Safety and security: access control, intruder alarm, smoke alarm, automatic lighting at night, automatic cooker switch off and etc.
•Care: active person alarm, passive person alarm, authorized access to the apartment for the care worker and etc.
•Comfort: automatic lighting, automatic screens and curtains and etc (Ad van Berlo, 2002).

The development of Smart Home aims to promote inhabitants’ health conditions at their own houses and represents the idea of therapeutic care. It demonstrates its advantages recently. But it is also noticeable that certain problems arise such as elderly people’s poor understanding of these systems, the loss of privacy and security, distrust due to malfunction and excessive care information (Quynh, Hoang, & Tony Barnett, 2012). It is criticized that these innovative development are more likely to be market-driven. Furthermore the constant reliance of these technologies may also cause other potential problems. Fears arose that smart technologies may make us unhealthy. Geographer Ellsworth Huntington cautioned in the 1940s that

“perfecting an environment dominate by climate control may mean that we cease to increase our physiological adaptation to environmental conditions.” (Marsha, 2002)

Smart technologies make the life of people easier. But at the same time, it ages younger body faster by minimizing the effort to conquer the barriers between people and living environment. Therefore, what in earth is health?

3.Architecture and health

According to WHO, the health is defined as

“a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” (World Health Organization, 1948)

As far as I think, the pursuit of health and the quality of life is a request for pleasure. Especially for aged and retired people who are free from the constraint of work and family and reached the year for permanent recreation and leisure. Not only physical illness should be released, like chronic disease and body impairment through accident, but also mental stress should be addressed, including anxiety and loneliness. Moreover, preventative care is, at the same time of great importance to inhabitants. Therefore, although Smart Home contributes to improve the efficiency of health care delivery and provide convenience to users, the home cannot be merely treated as a health care house.

It is the architects’ and all the designers’ responsibility to reconsider how living environment could promote the health of elderly people by both the means of therapeutic and preventative care. Herman Hertzberger said

“to live in a young building may keep them young.” (Herman)

when he finished his deign De Overloop house for the elderly in Almere. A healthy housing could also keep habitant healthy.

In this report, the general question: “how living environment can help elderly and retired people to maintain and prompt their health” will be explored. In chapter 2, three points: physical activity, social inclusion, independent living and aging-in-place will be discussed. From the author’s perspective, these three points are closely related to the health of senior inhabitants in living environment. This research is also the fundamental for the housing design, which will be present in the rest parts of the report.

Chapter 2 Architecture and health of elderly people

Nowadays, scholars and officials had already put emphasis on achieving independence in living environment and aging-in-place for senior and retired inhabitants. A set of building codes were invented such universal design, accessibility guidelines, etc. These codes and regulations had set up basic principles for senior housing design. Another concept - active aging is proposed recently. From my point of view, this concept can be fulfilled by encouraging physical activity and social interaction at the same time. The reason and method will be discussed in the following sections.

1.Physical activity

1.1 Effective way of promoting health

Plenty of research indicated that physical activity is an effective way to prevent leading chronic diseases, including type 2 diabetes, cardiovascular disease and some other disease like CHD, colon cancer. It plays an important role in reducing the risk of getting high blood cholesterol level, obesity, hypertension some other unhealthy statue (Nina, 2003). It protects elderly people from physical and cognitive decline. Regular lifestyle activity helps elderly people maintain their strength, balance ability and mobility, enabling them to enjoy their daily living independently and maintain their social networks. Besides those physical benefits, it also promotes the mental health of elderly people.

"In terms of mental health, exercise relieves anxiety and depression, contributes to improved self-confidence, self-concept and self-esteem and more generally, enhances well-being." (Nina, 2003)

Physical activity was proven to be a form of preventative care, both physically and mentally. Ideally, 30 minutes moderate intensive physical exercise can be beneficial for adults. In addition, different kinds of activities associated with strength, flexibility and balance of a person are needed for elderly group (British Heart Foundation, 2007). But this doesn't mean it is a daunting task because any form of daily activity can be physical exercise, such as walking, climbing stairs, gardening, housework and taking groceries. A research found that those who climbed at least 20 floors per week had a 20% lower risk of stroke or death from all causes (Craig, Anjali, Gayle, & Sharon, 2005).

However, because technological development had made the modern lives much easy and convenient, people with all age range would have tendency to lead a sedentary lifestyle. Television watching, computer use, reliance on private automobile transportations, labor-saving household devices, and elevators are the contributors to sedentary lifestyle. Although most people know the benefit of physical activity, few of them put it into practice. Actually, their wish to take exercise will be influenced by their earlier life experience, martial statue and the living environment. But a crucial determining factor is that they are not interested in exercising. Little research revealed the architecture's role in encouraging physical activity among older adults. It is potential to explore how people are motivated to exercising in living environment.

1.2 Case studies

During September 15, 2012 to February 24, 2013, an exhibition "Imperfect Health – The Medicalization of Architecture" had been hold by Canadian Center for Architecture. Together with New York City's Active Design Guideline, an idea was presented that architecture, urban and landscape design should be integrated into public health policy and encourage individuals to take the responsibilities of themselves and live actively.

People are now experiencing a rapid change in what they eat, drink and how they move. In

American, fast food and private automobile transportation become the main choice that people make. Furthermore, due to the change of working method, the contemporary life is mostly sedentary and happened in indoor environment. Physical movement and exercise is excluded from part of daily life. The inactive lifestyle and eating habit make the obesity an epidemic in American. The economic burden on health care section is growing. Cost from insurance, fuel expensed and decreased productivity are far-reaching consequences.

Policies were made to change the situation and one strategy is called "active design". In the guideline, mix-used land, walkability of neighborhoods, cycling infrastructure, open spaces and recreational facilities were emphasized. Officials and urban planners aimed to create various opportunities for citizens to participate in physical activity in daily routines and also intended to increase the accessibility to these places. For the building design, they suggested to encourage daily use of stairs, which may be achieved by designing a prominent and appealing environment. Strategies including designating daily use of stair, location and dimension of stairs, attractive stair environment, stair prompt signs were explored. The idea was that, besides the designated space, physical activity could be incorporated into the organization and design of space. As a result people would take exercise unconsciously. There are some recently developed projects that follow the active design guideline. One is 41 Copper Square, and Via Verde Housing Development is another one.

•41 Copper Square:
In 41 Copper Square, architects design an atrium with central stairs in the middle, which reaches the full height of the building. It is also a space for social interaction and encounters for students (Figure1). In the entrance lobby with double floor height, the 20-foot wide ground stairs goes up to a lounge space which is also double-floor high, overlooking the city (Figure 2). Sky lobbies, seminar rooms, seating areas, these meeting places are organized around the central stair and are connected by sky bridges (Figure 3). Further step to emphasis the strategy of active design is the use of skip-stop elevators. Those elevators only serve the first, fifth and eighth floor. Student want to get to other floor have to take the stair in the atrium. At last, the atrium is enclosed by an innovative steel lattice construction, giving esthetic value to the circulation space. The whole idea is that the users would rely on stairs as the way of vertical transportation. In this way, physical activity is encouraged by stair climbing and increased opportunities for social encounters in the atrium.

•Via Verde Housing Development:
In Via Verde Housing project, a series of green spaces and recreational facilities are design to encourage inhabitant to initiate exercise. The housing features consecutive public roof gardens, which provide opportunities for dwellers to participate in gardening activities in collaborate way (Figure 4). Rain water is collected for growing the fruits and vegetables. Mix use is another theme of this development. Fitness center, bicycle storage place and outdoor space are programmed on the ground level (Figure 5). Also people with different level of income are mixed. By living together, people who have the sedentary lifestyle may be stimulated by active people.

1.3 The level of participation in physical activity in European countries

New York's Active Design Guideline is the most recent survey on how to encourage physical activity through urban and building design. But it is based on the situation of America. Moreover, these design policies are mainly focused on the design of public space, especially offices. For working class, daily trip to office is an incentive.

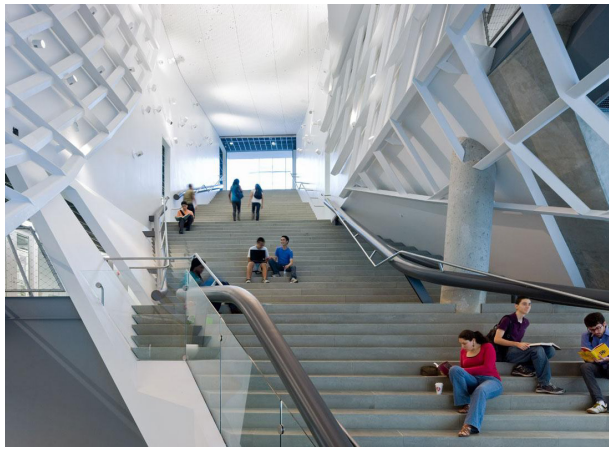


Figure 1 The atrium with central stair. From http://www.archdaily.com/40471/the-cooper-union-for-the-advancement-of-science-and-art-morphosis-architects/

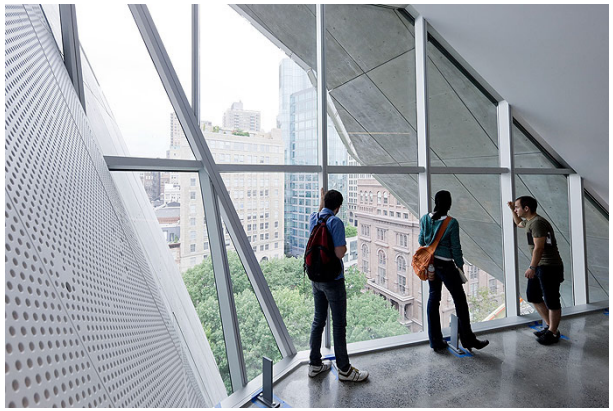


Figure 2 Lounge. From http://www.ad.ntust.edu.tw/grad/think/HOMEWORK/University/101_2_Contemporary_Architecture/c%E7%B5%84/41%20cooper%20union/index.html

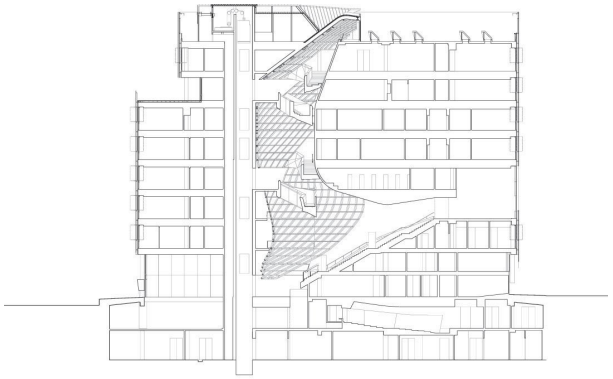


Figure 3 Sections. From http://www.archinnovations.com/featured-projects/academic/morphosis-41-cooper-square-in-new-york-city/

Figure 4 Via Verde Housing. From http://www.city-data.com/forum/new-york-city/286289-beyond-via-verde-green-center-south-38.html#b

Therefore, to designate stair for daily routine is quite significant and necessary. However, what are the designing strategies should be adopted to stimulate exercise for elderly and retired people?

First of all, the level of elderly people's participation in exercise should be investigated. Since the project is going to be located in Netherland, only the people from Netherland will be discussed. For the aged group from 55-69, 50% of men take physical activity on a regular basis and the figure for women is 43% (TNS Opinion & Social, 2010). The reasons for elderly people to be inactive include marital statue, the income level and environment, etc. 20% of people who live alone do not have any physical activity. People with financial problems also have lower level of engagement in physical activity. Furthermore, due to the reliance of technology, these figures of inactive people may increase in the future. Therefore, it is worthwhile to think about how to encourage the potentially inactive senior people.

1.4 Motivation

Geelen and Soons adapted an equation for motivation. It consisted of four factors (Edward, Jeffrey, & Greg, 2004)

Motivation=(Perceived Chance of Success*Perceived Importance of the goal)/(Perceived Cost*Inclination to Remain Sedentary)

Reviewing the survey on sports and physical activity, 43 percent of people responded that they take physical activities for improving their health while 26 percent aimed to improve fitness. Most of people already know the importance of the goal (especially for elderly people because the health become a main issue). But less people think it is for relaxation and fun (26%) and much less thinks it is to be with friends (9%) (TNS Opinion & Social, 2010). It seems that the motivation for most of them is "to improve their health". But actually, social embeddedness and playful persuasion can be one of the prime motivators for exercise (Janienke, Tilde, Vero, Stine, Mark, & Ben, 2013). Some smart technologies try to achieve this goal. A good example of interactive and socially active game is Piano Stairs. It is a stair that could make music when a person walks on it, which motivates people to take the stair to have fun with colleagues. In addition, this can also explain why people prefer to walk outdoor that to exercise at home (Jiska, Marcia, James, & Jack, 2004). There is a chance to see and meet different people and have a potential to experience interesting events. Therefore, the goal itself can be attractive and socially supported. The goal could be going to a nice destination, to communicate with friends or daily routines, while physical activity could be a mean. In this way, elderly people could initiate physical activity easily and unconsciously.

The perceived chance of success relates to the self-efficacy of elderly people. Fear of falls, feeling of not being able to conquer environmental hazards and social decline will lower the level of self-efficacy among elderly people. Another point is that senior inhabitants will consider how much effort they will put to achieve the goals. This is associated with health condition of individuals. For instance, if the activity takes too long without the opportunities to rest, elderly people with health decline or chronic disease may encounter fatigue and pain easily. This would in turn reduce their engagement in exercise. Another aspect of cost is appearance. Elderly women take less physical activities because some of them think it is not lady-like. Importantly, the cost could also only on perception level. A straight, dull and monotonous walking route with no protections would be conceived long and tiring. Comparably, if people could experience the change of space and activities, the route become short and attractive (Jan Gehl, 2006).

In conclusion, motivating senior residents to initiate physical activity is different from working class. From the author's point of view, the first step is to incorporate physical activity into their daily routines, hobbies or social life. Next step is to make them aware of the benefit of importance of the goal, convince that they could succeed, and reduce their perceive cost. Finally, the general question is how to stimulate physical exercise for elderly and retired people in living environment? The approach will be proposed in detail in the Chapter 4.

2.Social inclusion

Nowadays, researchers are paying more attention to the relationship between social interaction and elderly people's health condition. Broadly viewed, Krause suggest that

"senior people with strong social ties tend to enjoy better physical and mental health than those who don't maintain close relationship with others." (Robbert, Linda, Stephen, Jon, & James, 2005)

2.1 Different kinds of social support

Three kinds of social relationship enhance the lives of older adults in a number of ways:

•Social support. Social support provides assistance to the recipient to be able cope with stress more efficiently. Krause showed that social support from significant others help elder people maintain the sense of meaning in life, a set of values and purposes of life.

•Companionship. Rook point out that everyone want to be fully understood, appreciated and accepted, by sharing their experiences with others. This feeling of self-worth is bolstered in the process of communicating with companions. Because this relationship is voluntary, whereas the relationship between relatives is based on the sense of obligation, the person feels highly estimated. Besides, this relationship also reminds elder people that they are still meaningful and productive members of society. Usually, establishment of companionship is based on the sharing of mutual interests and hobbies.

•Weak social ties. They can be an important resource of informational support. Due to the anonymity, low accountability and diversity of views, this relationship will exert a huge influence on elder people's health. A special form of weak social ties is the performing of volunteer work and reciprocal support, which is uniquely significant for senior people. (Robbert, Linda, Stephen, Jon, & James, 2005)

Social relationships have far-reaching consequences for the health and well-being of aging population. Additionally friendship and neighbourhood are greatly important for elder people as their mobility is reduced (Julie, Allen, James, & Morton, 2012). Taking this into consideration, interventions should be designed to help new inhabitants build the three kinds of social relationships between neighborhoods. Now, most of assisted living or co-housing designs have been done, so far, in organizing daily living as communal activities, such as cooking, eating among many others (Sookyoung, Alan, Agneta, & Hearyung, 2007). Another trend is to stimulate intergenerational interaction. HWKN designed the BOOM Community in Palm Springs where retired priests will be hired to educate the young, although it was not implemented. There are other programs that encourage elder people live actively and stimulate intergenerational interaction as well (Arjen, 2011). If we want to design more effective interventions, then we are required to know how new relationship are formed, especially companionship and social weak ties (this can be the departure point of friendship). Another aspect is the relevance of empowering senior inhabitants to organize activities autonomously (Pia, 1998).

Figure 5 Via Verde Housing. From http://www.bustler.net/index.php/article/2013_riba_lubetkin_prize_shortlists_three_international_buildings/

Figure 6 De Plussenburgh. From http://www.arquitecturablanca.com/obrasP/de-plussenburgh-rotterdam-ijsselmonde_67_900.html

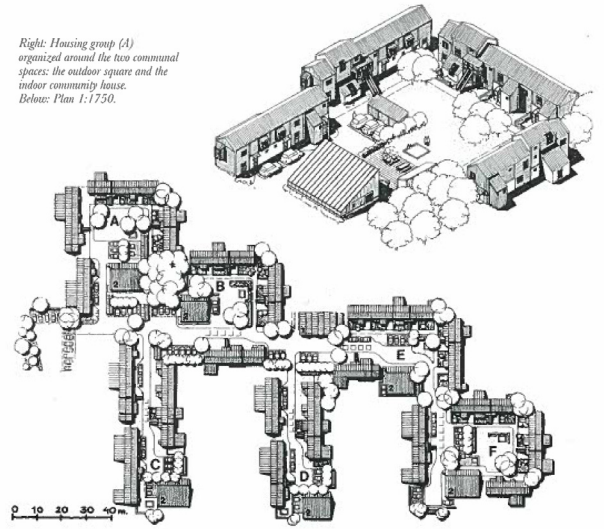


Figure 7 Danish cooperative housing project Tinggarden. From *Life between building.*

2.2 The importance of greater community

From a broad perspective, the concept of integration to community enables elder people to be engaged with society, instead of segregating them on "senior" communities. Due to the fact that elder people stay more active through physical exercises and continue their professional roles through volunteering, mentorships or as board members of a group (Perkins Eastman Research Collaborative, 2011). Recently, a majority of senior living projects provide services, amenities and programs that invite members of a wider community. The mix-used complex offers possibilities for senior inhabitants to be active volunteers. In addition, easy access and shorter walking distances to public spaces and special services, help inhabitant to keep engaged. The project De Plussenburgh in Rotterdam added a communal leisure space on the ground floor (Figure 6). It created a new image and building type that other generations could easily identified. The concept keeps residents in meaningful social roles that prevent loneliness and isolation.

2.3 Spaces and social structure

In the previous sections, it is discussed that different forms of social activities for senior residents are needed. Indeed, the living environment should also be designed to support different social activities. A series of space where residents can have different level of social contacts should be established: individual could enjoy their own time in bedroom and balcony; a living room and also balcony is used for close friends and relatives; communal spaces for a group of residents who live in proximity; indoor or outdoor facilities for the whole community; and finally the public programs for the whole neighborhood. In addition, communal space with well-designed transition zones permits gradual movements from smaller groups and spaces to larger ones, from private to the more public spaces, giving greater feeling of security and stronger sense of belonging to the community. The establishment of social and spatial structure allows residents to get desired social contacts and make it possible to know the neighbors better (Jan Gehl, 2006).

The relationship between social structure and space indicates that living environment should provide opportunities for dwellers to have various form of social contacts. For instance, communications between companions are based on common interests and meaningful activities, like gardening and football watching, etc. Contacts with strangers are mostly happened on the level of "hear and see" at first. Then it could develop into the level of conversation by participating in one same activity (Jan Gehl, 2006). Clear distinction between social spaces is needed to help elderly inhabitants establish better social connections.

One good example of establishing extinctive social structure in residential community is Danish cooperative housing project Tinggarden (Figure 7). The whole community is divided into six sub groups with an average of fifteen households. Each group is centered by a communal facility and front door courtyard. In addition, there is a large community center for the whole housing complex which locates besides the main street. The hierarchical divisions of social spaces – dwellings, dwelling groups, community and whole neighborhood – is motivated by strengthen the community.

This section had discussed about senior people's needs for different form of social connection and the need for integrating to greater community. Social connection is crucial to help elderly people establish their role as productive members in the society, not the burden. Then the question for this point is how can living environment reflect social structure and help elderly people establish social connection in the neighborhood.

3. Independent living and aging-in-place

It is known that the capacity to age in place would affect senior residents' mental health and forced relocation is closely related to the health decline of them (Fange & Ivanoff, 2009). It is necessary to help elderly people maintain their health at their own house as long as possible. Aging-in-place is all about independence.

3.1 The meaning of independence

Today, elder people prefer to perform daily activities independently and try to find satisfaction in their remaining abilities. Their attitude toward life is changing and they want to demonstrate their determinations of taking care of their own needs and resisting unnecessary dependence on others. For them, independent living means:

•Self-reliance. Although health declines with aging process, senior residents, even the ones with disabilities, want to retain the valued meaning of self-reliance, often by reducing their expectations.

•Continuity of identity. Continuing to do daily tasks help to minimize the stigma of physical deficiencies and avoid the feeling of frailty.

•Meaningful activity. Being independent is meaningful for retired senior people who were used to being busy with their jobs.

•Social role. Performing volunteer activities contributes to the feeling of independence while retaining a valued role within their social environment.

•Maintenance of physical abilities. By active exercising, inhabitants try to maintain or even promote physical capabilities.

•Autonomy. Senior people want to avoid being overwhelmed by caregivers and independence empowers the feeling of control.

•Resist unnecessary dependency. Self-care allows the elder avoid certain stress of dependency and feeling of burdensome.

•Reciprocity. Mutual support between friends reminds senior people that they are still productive and meaningful to one another.

Kaufman (1986) reported that loss of independence contributes to feelings of worthlessness and low self-esteem for elder people and staying independently allowed them to repair their damaged perception of themselves (Mary, Molly, Frank, Carole, Sharon, & Bess, 2004). Therefore, helping senior inhabitants maintaining independence at home becomes an important criterion for improving the quality of elder people's life.

Stineman et al (2007) suggested that, whereas physiological factors set the threshold on functional ability and health, environmental factors set the threshold on the point at which limitations in ability becomes a disability (Steve, 2010). An environment that fits an individual's ability to participate in activities independently will facilitate positive performance and health outcomes. Generally, 5 kinds of activities are associated with environment barriers to independent living:

•Moving to and out of home. Normally stairs on ground floor are obstacles to wheelchair users or inhabitants with reduced balance abilities. Inadequate lighting or the lack of handrails can be a safety hazard as well.

•Mobility in home. Stairs, slippery floors and badly-organized furniture could bother elder people. These barriers in particular account for a large number of fall accidents. Accessibility to the rooms, distance between them, and the dimension of spaces also affect independent living.

•Transfer self-care activities. The bathroom always leads to inconvenience and adverse health events because it is a small space which often is slippery and wet. Often it lacks adequate support for dysfunctional individuals as to lower down themselves to the toilet or the tub.

•Home maintenance. Elder people have less

desire to do home maintenance tasks, compare with person-related activities. The most difficult ones are cleaning (vacuuming, tidying, laundry, etc.) and outdoor remodel (painting, garbage, etc.). Besides, home upkeep, including heating, ventilating or air conditioning could be another bothering task. (Cara, Andrew, Wendy, & Arthur, 2011)

•Outdoor activities. A secure public area is significant for enhancing independence as elder people try to do outdoor exercise to maintain and improve health.

3.2 Home identity

Another benefit of aging-in-place is that elderly residents can maintain their identity. The elderly people tend to encounter a substantial change in their housing condition as they continue to age. This occurrence forces them, in one way or another, to modify and condition their home environment which not being always possible translates into a forced relocation. There is a strong aversion against institutionalization among most of the elder people and forced relocation usually results in significant health decline. Many theorists attribute this phenomenon to the loss of home identity. According to Gallagher (1993),

"One reason our homes are so precious to us and being homeless is so debilitating is taht every time we corss the threshold, we warp ourselves in a cozy, protective mantle of memories that helps sustain our persona" (Laure, 2009)

Importantly, homeless can be in this respect understood not just as the situation where no house is owned but the case where such, does not possess the meaning of home for its owner. What makes a house feel like home? Why individuals, regardless of their age, experience or background, are closely connected to their home environments? Environmental psychologists, including Gustafson, Manzo, Twigger Ross and Uzzell have expressed their views on this issue and formed an idea of home-identity (Laure, 2009). In general, most theorists had defined home identity as the relationship between the inhabitants and the physical and social environments.

In the following paragraph, a brief review on how elder people become attached to objects, places and buildings, is reported:

•Proshansky et al (1983) related self-identity at home to the "environmental past" of the person; a past consisting of places, spaces and their properties which served instrumentally in the satisfaction of person's biological, psychological and cultural needs (Laure, 2009). Home is a place full of possessions and memories which tell you who you are and distinguish oneself from significant others.

•Home is safe and familiar environments where inhabitants can maintain their lifestyles without necessarily having to negotiate with anyone else. Besides it's functional that home is planned, organized and adapted according to one's preferences.

•Home is a place of resource where people have shared history of attachment with their families and friends.

•Home provides a sense of control on urban resources which enhances daily life and contributes to independence.

•Elder people constantly try to challenge themselves, and perform physically and mentally demanding activities to remain their capacities as long as possible. Like doing laundry, climbing the stair, etc (Fange & Ivanoff, 2009).

•The senior inhabitants adopt adaptable strategies in order to perform their daily activities in an easy, comfortable and familiar way.

Theorists have already shown the importance of home environment to elder people and their sense of well-being. However, once elder people move out for receiving better health care, the

loss of identity becomes noticeable. How to help senior dwellers to rebuild their identity in their new environment? One possible solution was given by the artist, Katerina Seda, in the project of "Turn-Key Home/Two in One" in Utrecht. She encouraged elder people to participate in designing process and social meetings; then she collected and reconstructed their recollections of old homes and finally transform or adapt the new environment according to personal preference (Arjen, 2011).

3.3 Design principles for aging-in-place

Independent living and aging-in-place are significant to the health of elderly people. What are the design principles for aging-in-place? In the following section, the principles will be discussed and they are divided into two parts: space requirement and adaptable design.

•Space requirement:

Entrance:
Elderly people with physical limitations may have difficulties in moving in and out of doors, especially for inhabitants with walking aids. They have to open the door while using the other hand to propel the mobility aids. This is also on basis of no packages on their hands. Therefore, a home with a maximum accessibility starts with entrance hall. An entrance space should include a place to put groceries and packages, to drop sunglass or mails and to change their clothes and shoes, before entering the main living space. Enough space is need for people with various physical capacities to easily maneuver and greet people without feeling crowded. The entrance hall with 48 inch minimum width not only gives the feeling of spaciousness, but also allows caregivers to give assistance (Drue & Micheal, 2008).

Living space:
The main living space constitutes the social lives between elderly inhabitants and their relatives. Generous pathway around and into furniture arrangement should be provided. Limiting the barriers into the furniture can help the inhabitants feel welcome to join group conversation easily. When privacy and climate control is not the priority, the hinge door will become unnecessary. Make sure that the trips between each room are easy. Pocket or sliding door could be better choice. Dining room is the traditional gathering space for group conversation and meal. It should be accessible for a group of friends and families without challenge their comfort.

Bedroom:
People's sleep patterns change with the aging process. Some elderly people may wake up several times a night in order to get to bathroom. Therefore, direct connection to the bathroom and clear circulation space is necessary. Homes are places of refuge, and certainly the private space within any home should offer tranquility and relaxation for its residents (Drue & Micheal, 2008). Particularly the bedroom is perceived as the most private and "scared". People could maintain the sense of privacy in bedroom without necessarily closing a door is appreciated. Moreover, dressing is relatively importance morning activity for elderly people. Also closet may be accessed several times per day. The dressing and closet space is a significant part of bedroom and should have enough space to accommodate physical movement and expansion of storage.

Bathroom:
The bathroom always leads to inconvenience and adverse health events because it is a small place which often is slippery and wet. Old bathrooms often lack adequate support for dysfunctional individuals as to lower down themselves to the toilet or the tub. Therefore, safe design could be the basis of bathroom. Ideally, an entrance door with a minimum width of 32 inches could permit an individual to move in and out

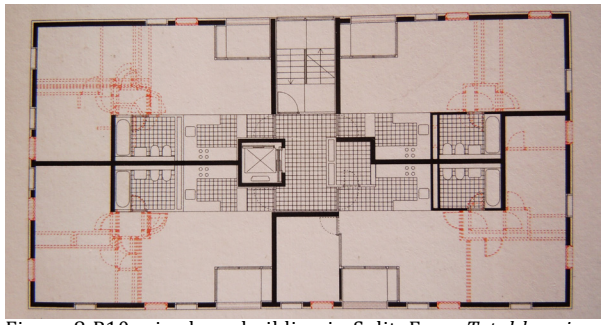


Figure 8 P10 mixed use building in Split. From *Total housing - alternatives to urban sprawl.*

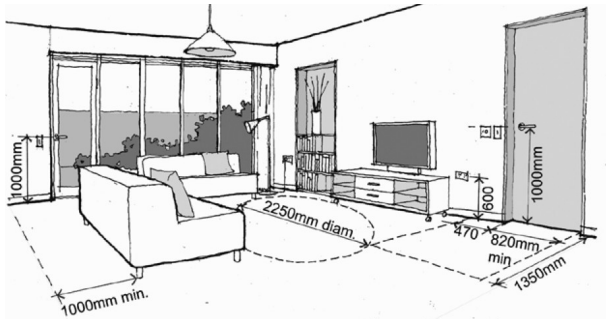


Figure 9 From *Your Home - Technical manual, Fourth Edition*

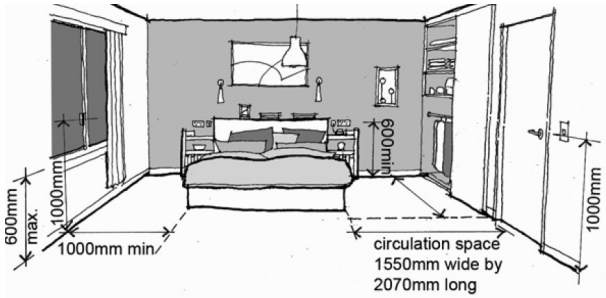


Figure 10 From *Your Home - Technical manual, Fourth Edition*

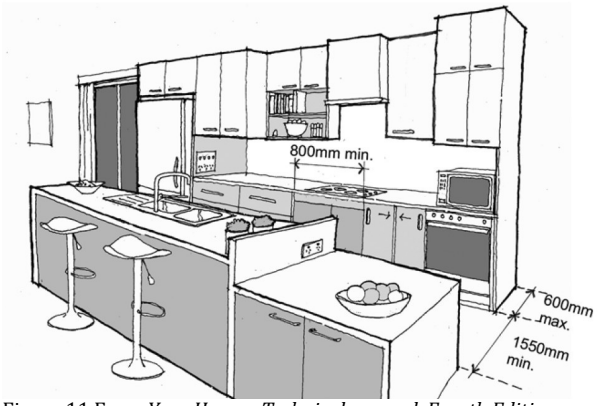


Figure 11 From *Your Home - Technical manual, Fourth Edition*

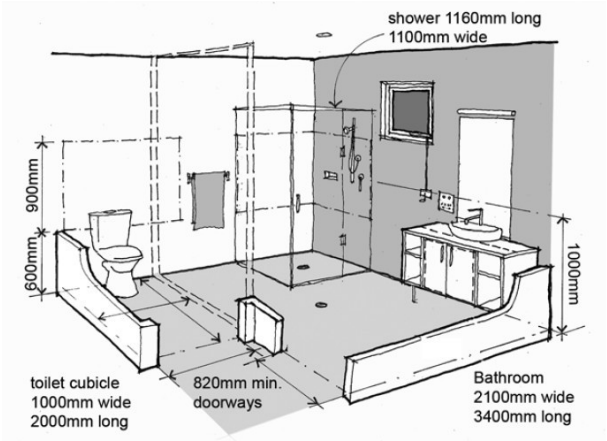


Figure 12 From *Your Home - Technical manual, Fourth Edition*

without any challenge (Drue & Micheal, 2008). Additional room would be beneficial to change the dangerous situation. For instance, the room should accommodate future installation of grasp bars, seat in shower and bath tub and wheelchair use.

•Adaptable design:
Another criterion for aging-in-place is adaptable use of space. An adaptable house should be able to respond effectively to change the inhabitants' need without requiring costly and energy intensive alternation (Chris, Geoff, Caitlin, & Paul, 2010). Elderly people expect to live in their own house as long as possible and their lifestyle may change during the lifetime. For instance, some elderly people still want to keep their professional role after retirement and endeavor to be a productive member to the society. But later he may quit his "second life job" and the working spaces are no longer necessary. Architects should anticipate those changes and make flexible use of space. One example of adaptable design is p10 mixed use building in Split. For each housing unit, only structural core, facade and wet spaces (bathroom and kitchen) were designated. Residents could participate in the design phase to decide the amount and positions of other architectural elements (Figure8) (Albert, Actar, & Tihamer, 2010). It is also possible to alter the layout of home at a low economic cost.

Furthermore, every individual will experience temporary or permanent change in their physical capacities during their life time. This may be caused by accident, injury, illness or just health decline associated with aging process. As a result, limitations in mobility vision and hear capacities will affect them to perform activities of daily living, which would eventually challenge their independence. An approach to address this problem is Universal Design. Universal house is useable by as many people as possible without the need for specialization. It constitutes lightening design, interior design and dimensions of spaces (Figure9-Figure12).

4. Brief summary

In this chapter, 3 points that are closely related to the physical and mental health of elderly people in living environments are discussed. From the author's point of view, independent living and aging-in-place are the basic need of senior and retired people. Encouraging physical activities and social interactions are the crucial factors of active aging. The housing design should incorporate all these three points. In the following chapters, a design proposal with detailed solution will be present.

Chapter 3 Location

Figure 13 From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 14 From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

In the following chapters, a design of retired and elderly housing will be proposed in details. Before that, in this chapter, the author is going to give a brief introduction of the location. The points: the reason of selecting the location, the infrastructure of the site and the surrounding environment will be discussed.

1. The selection of location

First of all, this project is proposed to be built in Netherlands. In accordance with the previous research, there are two important criteria for selecting the location: promoting social connectivity and encouraging physical activities.

•Social connectivity:
As far as I think, the house should be located in the place that residents could enjoy great convenience of easy access to urban resources, including recreational facilities, grocery shops and supermarkets, restaurants, pharmacies, healthcare services, etc. This environment will help them to affirm their presence in the community and to reestablish the role of eldership. Besides, in the other direction, there should be a potential to set up some program to invite the residents from local community.

•Physical activities:
Easy access to open space and natural parks is always associated with higher level of elderly people's participation in physical activity (Nina, 2003). Furthermore, natural parks could create an environment with calm and quiet surrounding atmosphere. It is beneficial because of the fresh air, and it also provides opportunities for the residents to get contacts with wild animals. Therefore, in the living environment, including the building and the surrounding environment, residents could feel encouraged to initiate physical activities, and live actively.

Therefore, the ideal location could be in the region with natural environment (potentially suburban areas) and in which there are opportunities to enjoy the great benefit of urban resources. For these reasons, Houten is selected (Figure13 and Figure14). Houten is a commuter town about 9 km southeast of Utrecht. It is famous for its sustainable urban design. Because of the city structure people are encourage to travel by bike and train. Distinctive qualities include green space and water zones through the whole city and numerous of sports filed and recreational centers. It is one of the safest cities in the Netherlands (wikipedia, 1993).

Known the location, the next step is to define the target group. As it has been discussed above, people who live alone and with limited income may tend to have sedentary lifestyle and to be inactive. Therefore, the target group is the retired and mostly single elderly people. But the people with physical or mental disabilities who are not able to live independently are not in this scope, because they may need care workers. Therefore, people who want to live actively and independently may like to choose this house to live. In addition, alternatives households (units for double) are offered. From my point of view, this is because mixing different group of people may stimulate people to initiate physical activities, when they observe the active ones doing exercises.

2. Site analysis

The site is located on the peripheral of Houten and is at the end of Imkerspark (illustrate in Figure13 and Figure14). In this section, the situation of the site will be analyzed in five aspects.

•Urban resource and natural environment:
As it is shown in Figure15, the city center is near the train station. Various urban amenities are offered there including grocery shops, healthcare

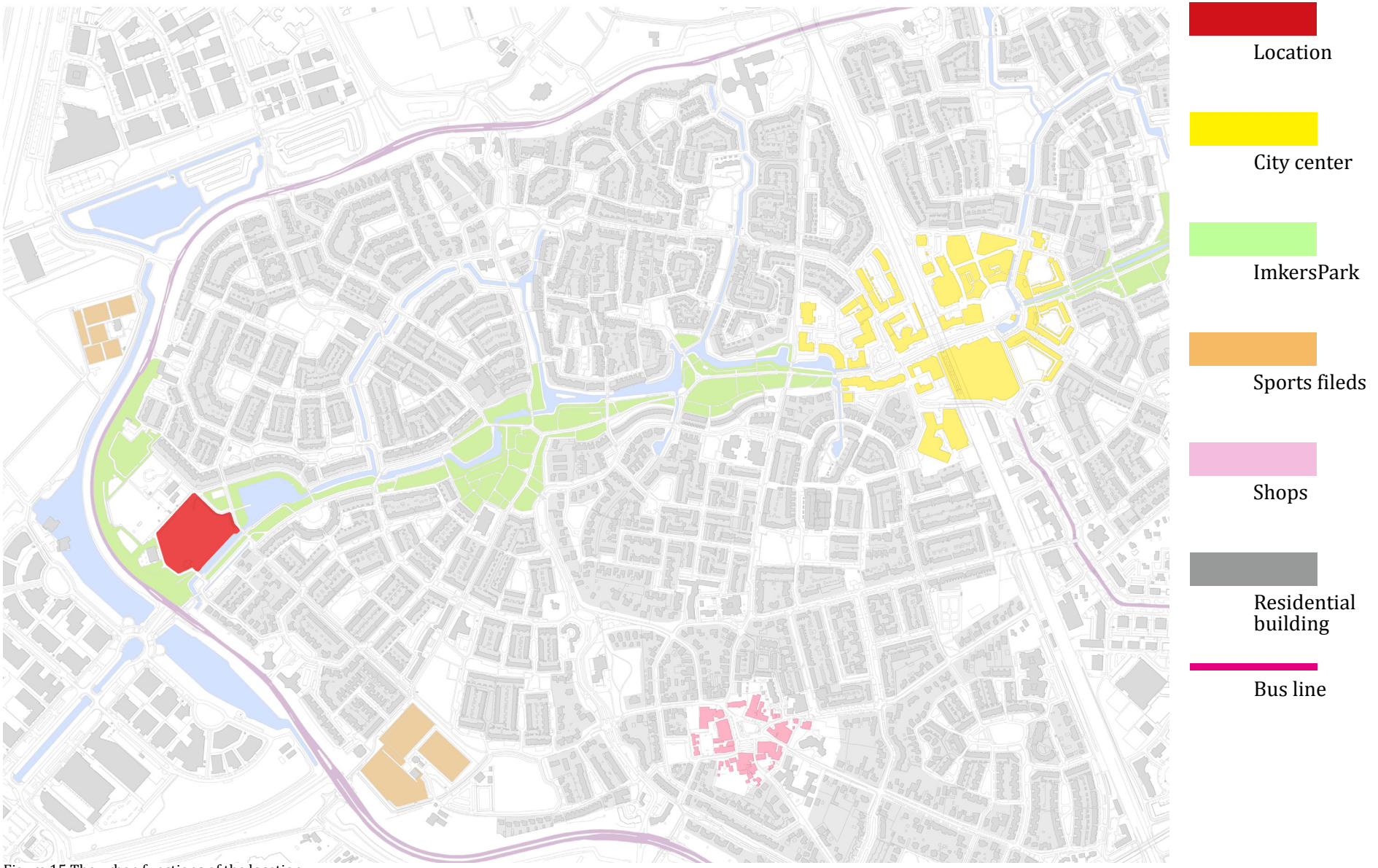


Figure 15 The urban functions of the location

Figure 16 From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 17 From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 18 From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

facilities, fitness center, small library, elderly communal cafes, restaurants and Saturday market, etc. Residents can take the advantages of the nearby public transit (mainly by bus), can walk or cycle through the beautiful Imkerspark to the center. Besides, there are sport fields and supermarket that locate around the site. To a larger scale, it is only 10 minutes trip by train to get to Utrecht. But there is also one disadvantage of the site that most of those urban functions are too much centralized in the center. People from the nearby neighborhood only have a few choices. Therefore, it is possible to set up some programs to invite people from communities in proximity.

The site is located at the end of Imkerspark. It is a place for residents to get contacts with nature and wild animals (Figure16). The park is pedestrian and cyclers friendly and automobiles are not allowed to enter (Figure17). Therefore, this park is a really safe and clam place for senior people. A road for private cars and buses is located on the west side of the site. But a belt of trees diminishes the noise from automobiles (Figure18) and what the inhabitants can only see is green and nature.

•Urban morphology:
A prominent feature of the site is the pattern of cycling and walking route, which is defined by the surrounding building blocks (Figure19). Pedestrians and cyclers will have nice experience when they are walking there.

•Transportation systems:
Automobile vehicles are only encouraged to use on the periphery of Houten. The inner city is well adapted to pedestrian and cyclers and the car speed is control by speed hump. Especially the park and center is not allowed for automobile to enter. Moreover, the cycling routes are interweaving and intricate and lead people to various open green spaces. Bus station is near

Figure 19 The lake in proximity is the open space for the neighborhood

Figure 20 The park is used for skiing. From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 22 Event for the reuse of plastic 2012. From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 21 The park is also the super market. From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

Figure 23 The burned wood, after Chrismas. From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

the site on the southwest side. The public transit will go through the border or go to the center or the city, which will help senior inhabitants to reach to any location of the city.

•Open park for special event:
The lake in proximity is an open space for special events (Figure19). In winter, the space will be used as park for skiing (Figure20). Sometimes it will be used as a supermarket (Figure21) or the outdoor space for holding some exhibition (Figure22). Besides, the location itself is also a gathering space for the local community at some festivals (Figure23). As a matter of fact, a large amount of people from the local neighborhood will come to the site on a special date. Also there are people walking there on their space times. Therefore, the site is a place with potential to program some urban functions and invite local people to use.

3. Summary

According to the research, the urban environment of this project should promote social connectivity and motivate physical activity for elderly people. It indicates that the location should have the benefit of both urban resource and natural environment. Some aspects such as economic cost and regional customs are not the scope of this project. Therefore, Houten is selected as the location of the project. The site has been evaluated and the target group has been defined. Together with research on senior users' requirement, they will provide the scientific base for the design of the housing project. In next chapter, the concept of the design will be explained.

Chapter 4 Concept design

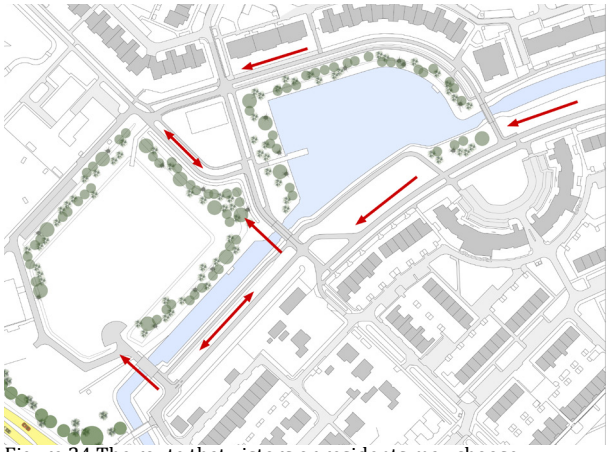


Figure 24 The route that vistors or residents may choose.

The concept design is based on the previous research. The general question is

• how living environment can help elderly and retired people to maintain and prompt their health?

Subsidiary research questions will be answered, including:

• how to stimulate physical exercise for elderly and retired people in living environment?
• how can living environment reflect social structure and help elderly people establish social connection in the neighborhood?
• how can living environment enable residents to live independently and aging-in-place?

Figure 25 The change of urban space. From https://maps.google.nl/maps?q=houten&ie=UTF-8&hl=zh-CN

1. Urban morphology and building typology

Before going to explain the design of building, the site design and building typology will be discussed first in this section.

• Urban morphology:
The site is located in the open space. People from local communities will go to the open space casually or on a special date. The majority of visitors or residents would choose to come from the east side (from city center) (Figure24). They will pass through Imkerspark and experience a sudden change of urban space. If there is a building on the site, it will catch people's eyes when they enter this open space (Figure25). And then, they can wander around the space, following the route. From my point of view, this prominent urban feature should be considered. Designer should incorporate this aspect of environment into the design of site and building and try to provide people with nice experience when they pass through or going to the building.

Another aspect is that the heights of surrounding buildings are ranged from three to four floors' high. The building should be design at similar height to create an atmosphere of a harmonious neighborhood. Additionally, in this height, senior dwellers' physical movements will be emphasis on horizontal level. In this way, people are encouraged to take stairs instead of elevators.

• Building typology:
In a typical multistory house, the vast majority of outdoor activities are "coming and go" traffic, because only a "narrow" corridor is at the front of their doors. Normally, for privacy issues, there is no window near the corridor. There are few opportunities for stationary activities. Inhabitants would rather stay and watch television if they know it is dull and nothing happens outside (Jan Gehl, 2006). Particularly

for older people, if the only possibility to have social activities is to go down to the public space without knowing what is happening in the housing, they will stay inactively. Therefore, from the author's perspective, there should be a communal space that is connected to each floor. Every resident can have social communication and things to do directly in front of their houses. In addition they will have a chance to experience the activities inside their homes if the front door space is proper designed with windows. At last, social space could be designed as circulation space so that they are integrated into one comprehensive activity zone, creating more opportunities for social encounters.

Based on these two points, the first step - urban design is developed (Figure26 and Figure27). Firstly, the building and site can be seen as the continuation of the routing systems. Following the existing fabric, it creates paths that lead people to or go through buildings. Then the whole green field is divided into seven smaller courtyards by these paths. These small courtyards will be designed with different themes, including outdoor sports filed, collective garden, playground for kids and landscape. Together with the park, visitors and residents can experience the change of living space, communal activity zone and different green space when passing through this area. Furthermore, because of the "S" shape, the community is divided into two groups and each group is centered by a communal space. The communal spaces are linked with households on each floor and are located in front of most units (Figure28).

The two communal spaces are connected with outdoor public courtyard and also open to the parks (Figure29). They feature a more public character. While the public spaced are front-door located, the bedroom and balconies are facing to the park or landscape. Residents can look into these green spaces in their own house without too much disturbance from public activity. In addition, they can also see people doing different things only in distance. It will enable them to enjoy quite environment and at the same time maintain their privacy (Figure30). In this way, senior residents could experience different sceneries on each side of their houses.

Figure 26

Master plan

1. Playground for children
2. Outdoor sports filed
3. Residential entrance
4. Public entrance
5. Imkerspark

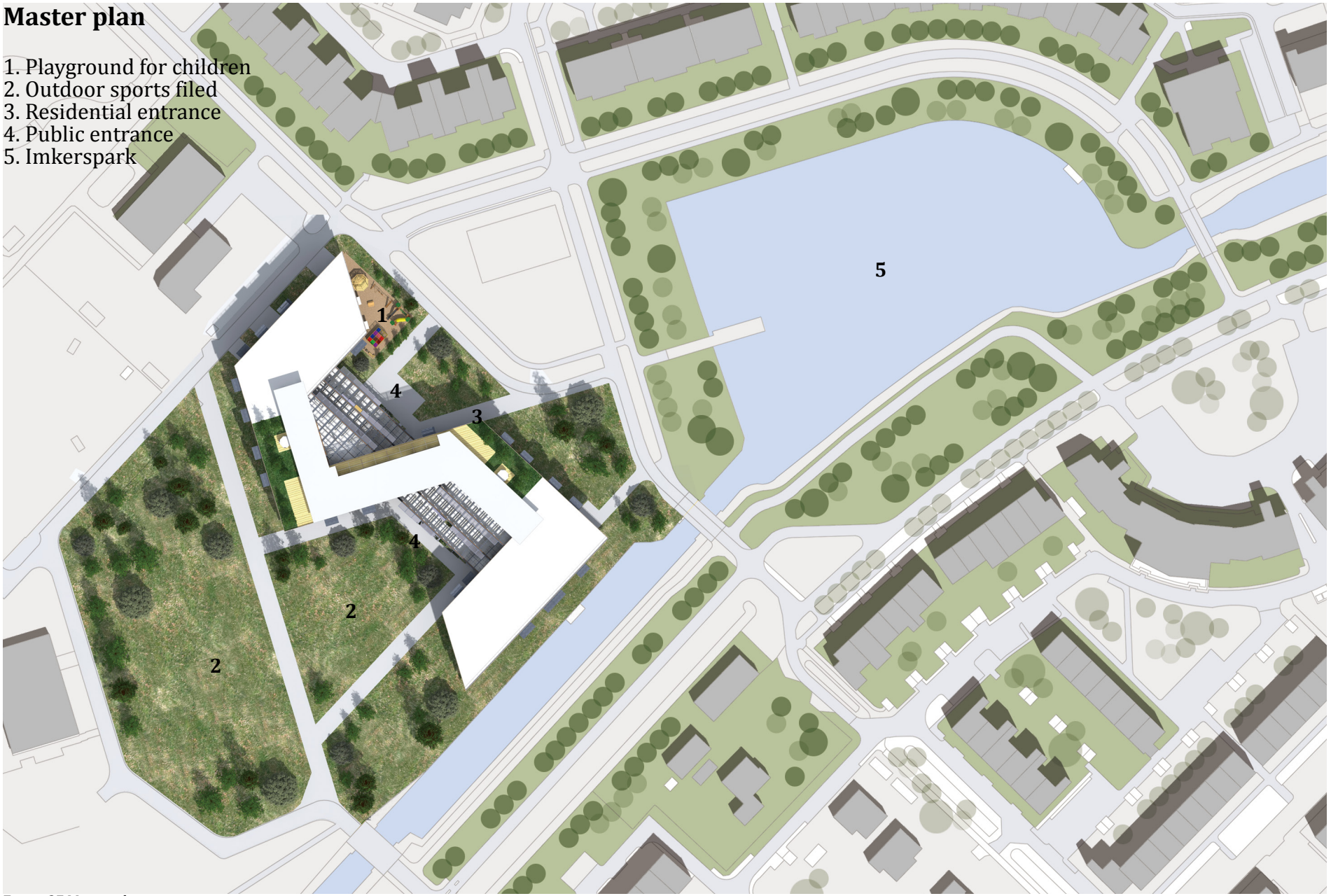


Figure 27 Master plan

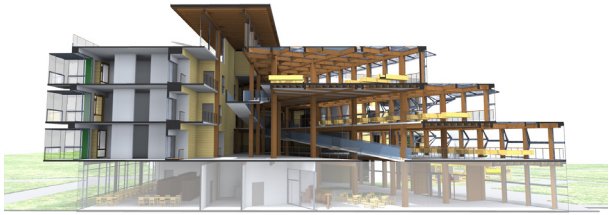


Figure 28 The communal space and living spaces

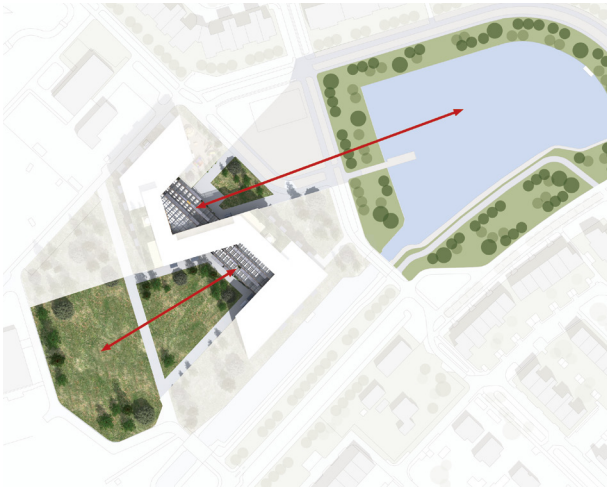


Figure 29

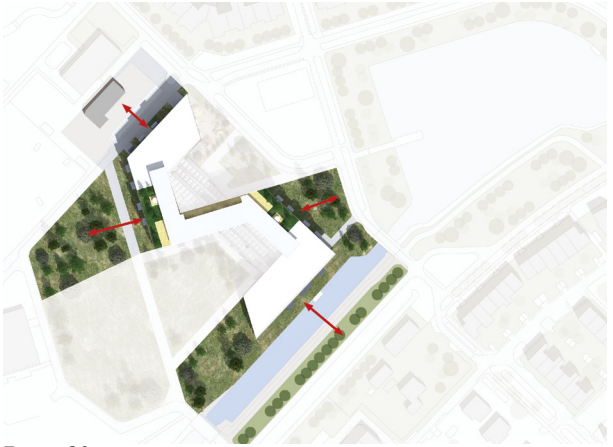


Figure 30

2. Encourage physical activity

The selection of the site is based on the principle of stimulating physical activities for potentially inactive senior residents on the urban level. However, elderly people are more sensitive to weather than the young. Frequent rain will make the walking paths in the park slippery. Low temperature will make the people uncomfortable, etc. In those cases, elderly dwellers may lose their motivation to initiate exercise. It is suggested that thirty minutes of moderate exercise per day is beneficial. At least similar effect should be achieved. Therefore, the author suggests that a weather-proof indoor environment is required to persuade residents to exercise on a daily basis. The general strategy will be to incorporate physical exercise into daily routines.

Figure 33 The entrance hall for the mail box is also the coffee bar

2.1 Daily routine

During the research sessions, the author had taken some interviews with the retired people in Eindhoven (the author is not permitted to publish their names). In the conversation, all of them had expressed that they usually woke up early in the morning, but took a long shower and dressed themselves afterwards. Then it came to the important part of their daily routines – morning reading. It is really significant for almost all the elderly people because it is the way to get contacts with the outside world after working life. In the apartment of Son en Breugel, all the residents had also agreed to write a mail to the housing agency. They suggested the social workers to put lounge chairs and tables in the mail rooms so that they can take conversations right after getting newspapers. After lunch, they would do their personal hobbies. One of them expressed that he would like to have some time with friends, whether to cycle or to climb mountains. Another person tended to make some models or provide volunteer work at his working room. Everyone would like to do his own interest and hobby in the afternoon. But the morning reading is the common activity for elderly residents. Therefore, the author adopted a strategy – incorporating physical activity into the morning trip to mail box. The scenario is shown in the Figure31 and Figure32. Resident (the red one) will go through communal spaces and to the mail box (entrance), which is located on the ground floor in the center of the whole building. The entrance will be design as a place for coffee and social interaction (Figure33). Besides, there is also a sky bar on top of the building. Residents can benefit the best view to the natural park in the bar. However, both the interviewees said that they would like to travel to mail box through elevator, which is also the choice that most of elderly residents would make. Therefore, why will inhabitants choose to take the stairs and go through the communal space? The approach will be proposed in next two sections.

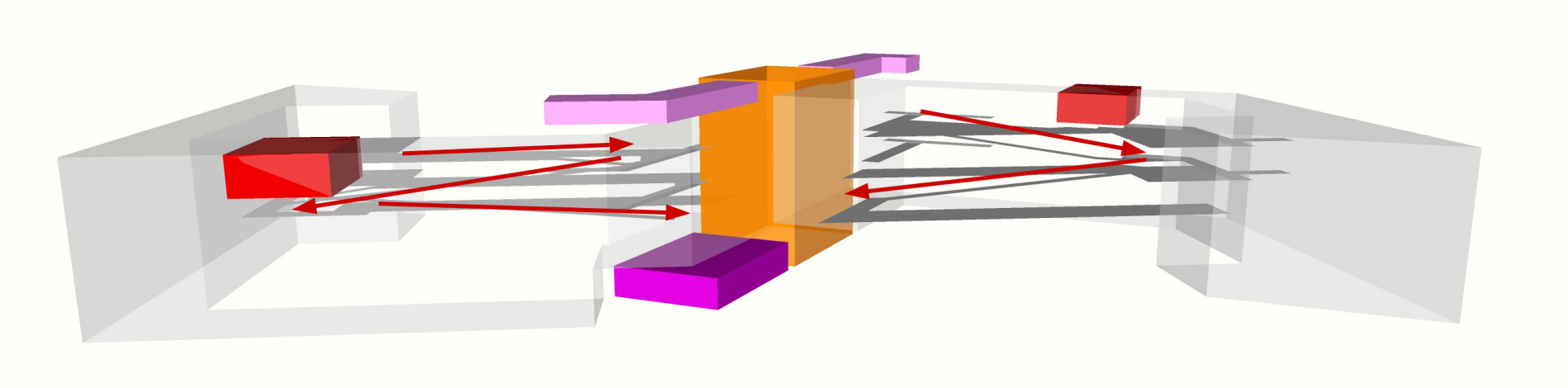


Figure 31

Figure 32

Figure 34 The communal space for allotment garden.

2.2 Allotment garden

The approach is to allocate allotment gardens to communal spaces (Figure34 and Figure 35). Every individual can have an approximately 10 m2 space for growing his own fruit or vegetables. The reason to adopt this strategy to motivate residents is that the allotment gardens were associated with increased level of physical activity at all ages (Agnes, 2010). The benefit of gardening is obvious – getting food at lower economic cost. In order to take the full advantages of the gardens, a storage space is programmed on ground floor where residents can sell the products to local community or exchange with neighbors. The communal gardens will constitute a prominent character of the building and exhibit to the whole neighborhood (Figure36). Besides, visitors entering the building will also benefit from nice microclimate provided by indoor plants. Therefore, the idea is that the garden will not only serve for the inhabitants themselves, but also to the society. The senior people's social role will also be strengthened.

The communal garden is organized as a gallery space (Figure37). Ramps connect every floor and directly lead people to the place of mail box. When someone is going through the ramps, he can see others irrigating the garden or harvesting. The gardening in collective space is also a social activity for all the residents.

Figure 35

Figure 36 The garden is the main character of building and exhibit to the neighborhood.

Figure 37 The interior space of communal garden.


Figure 38 The rest space near the communal garden

2.3 Minimize the effort

Social scientist Heywood had researched on the factors that influence the elder people's decisions about remaining in their own homes and moving to alternative housing. It is noticeable in the report that their attitudes towards gardens are changing with aging process. Some elderly people may appreciate moving to the house with a smaller garden, even no garden (Judith, Virginia, Ganesh, & Mathew, 2004). There is no question that the maintenance of the garden becomes the challenge for them. Ground levels bed presents the biggest problems as elderly people have difficulties in bending or stooping in a long time. Another challenge is that the inappropriate scale of garden makes it inaccessible and elderly people will consume too much energy to maintain.

Hydroponics technologies can be applied to solve these two problems. In the systems, the reservoir for water and nutrients is placed on the ground level. The bed is raised into height of 80 centimeters. The operation is also not difficult – only turns the pumps on. Then the water and nutrients will be dripped into the plants (SIMPLY HYDROPONICS and ORGANICS, 1992). This system only requires a space with the width of 80 centimeters. Therefore, the garden can be accessible from both sides. In this way, the effort of maintenance is reduced and users are only required to take care of leaves and harvesting. In addition, rest spaces and room for hygiene are organized beside the gardening space (Figure38). Residents can talk with neighbors after gardening.

In conclusion, the concept is to motivate residents to go through the communal garden to the lounge for morning reading. Walking through ramps, stair climbing and gardening are the forms of balance, flexibility and strength exercise. The whole process will consume some time and similar effect of 30 minutes moderate exercise on a daily basis will be achieved.

3. Promoting social connection

3.1 Inviting people from greater community

The benefit of integrating elderly residents into greater community had been discussed before. But visitors can also disturb their lives. Therefore, who will be invited and what kind of program will be set up should be deliberately considered. In my opinion, only meaningful activities should be introduced in this project. Three functions are proposed – sports and recreational center, childcare and library. Locating indoor and outdoor recreational and sports facilities in proximity of house will increase elderly people's participation in physical activity (British Heart Foundation, 2007). Another strategy is to create an intergenerational environment by introducing children and students. A collective garden is located near the playground of childcare facility,

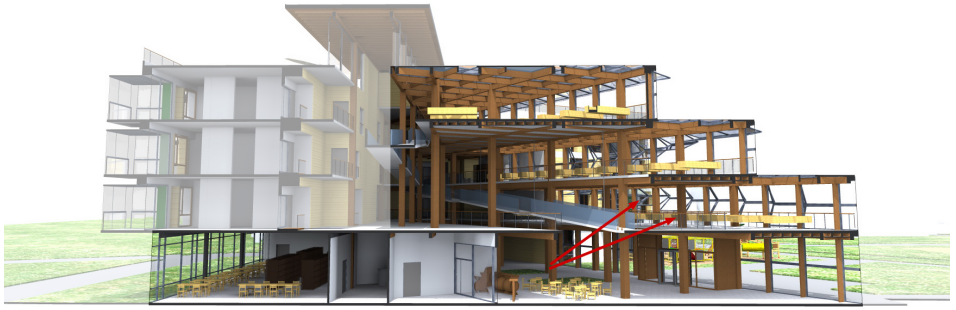


Figure 40

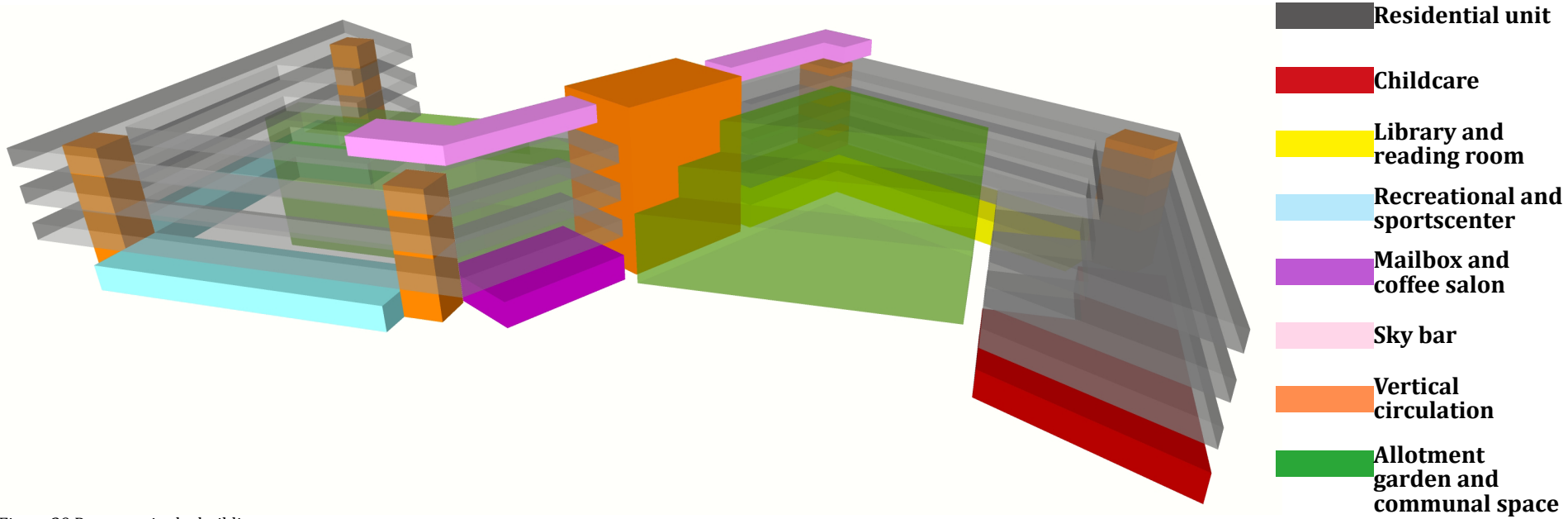


Figure 39 Programs in the building.

Figure 41

Figure 42

where senior can volunteer to teach the kids the knowledge of gardening or just watch them play. Residents can also choose to go to the library or the cafe nearby, where they can communicate with students or other aged groups.

In the scheme, sports and recreational facilities are located in the south part of the building, while childcare and library are positioned at north. This will give two distinctive atmospheres to the community: educational and recreational (Figure39). A collective space is located at the center of each part. This space is an exhibition space, where people can see the gardens of seniors' community (Figure40). Two cafes serve for all the visitors and residents in these two spaces (Fig41 and Fig42). One is located in the communal space in the north part while the other is located at south the part. The collective space creates possibilities to have various forms of social activities. Elderly people can communicate with different people from aged group, while having coffee with students or watching football game with younger visitors coming for sports together.

3.2Social structure

Different forms of social activities are supported in this building. It is necessary to establish a clear spatial boundary between greater community, seniors' community, dwelling group and each unit. The most public lives are happened on the ground floor. Local visitors can only see the seniors' community but cannot enter the house without permissions (Figure43). The entrance is in the center of the building. A stair case in the entrance space goes up to the top of the building, leading to the sky bar. Together with the sky bar, the entrance (also the lounge for morning reading) can be the gathering space for all the residents. Then, two communal gardens are served for each dwelling group. This is also the place where residents could communicate with their neighbors and see various public activities (Figure44, Figure45 and Figure46). Before entering each unit, residents can reach to the front door space. The space is one meter deep and approximately four meters wide. This is the social buffering zone between individual unit and communal gardens. At last, the bedroom and balcony of every home are oriented toward natural environment and landscape (Figure47). The sequence of space could reflect the social structure and residents can choose the desired form of social contacts.

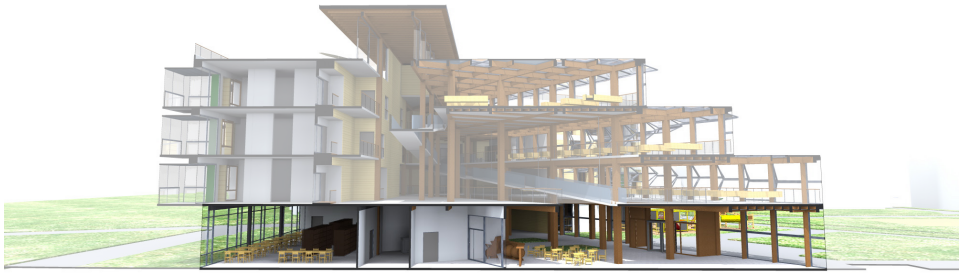


Figure 43 Space for the public.

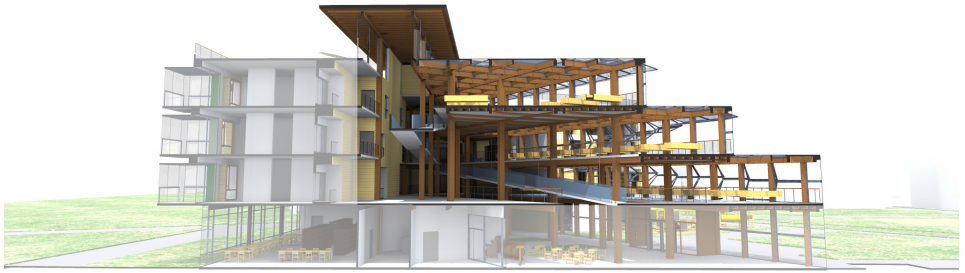


Figure 44 The communal space for all the residents.

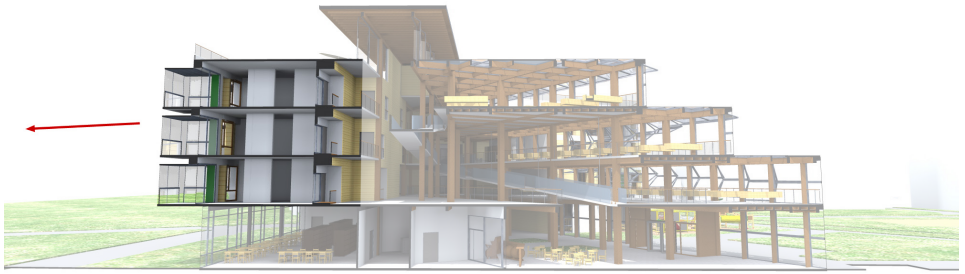


Figure 47 Private units.

Figure 45 Residents can see the ourdoor activities when they are in the communal gardens.

Figure 46 Residents can see the children playing when they are in the communal gardens.

4. Independent living

4.1 Building material

By using appropriate material for the internal communal space, a warm and cozy environment could be provided. Repeatedly using white materials, including plaster and concrete, are not the ideal solution, because it may potentially create an environment that reminds people of care institutions. Steel is another choice. Actually, most of green house for gardening is constructed by steel, from the economic and structural efficiency point of view. But from the users' point of view, the natural material – wood would be the best choice for elderly people. Timber columns and beams, with allotment gardens, will produce an atmosphere like a forest. Monotonous use of materials will be avoided. Different wood products will be applied to construction and decoration part. Another benefit of using this natural material is that they do not produce harmful chemicals. Only the coating or the glue (if glulam is used as the structure element) will make little emissions. But with proper design, this negative effect can be controlled.

4.2 Corridor

Except from the central stair in the entrance hall, there are five alternative staircases. The corridor is divided into five small pieces (Figure48). Rest places are connected to corridors, which will make residents experience the change of space when they come or go out of their homes. Between corridor and each household, a buffering space is left undecorated, where resident can use as a temporary storage space and make their own decorations (Figure49).

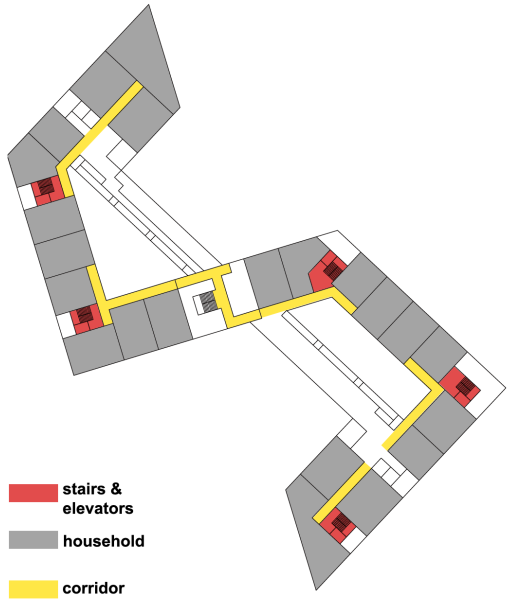


Figure 48

Figure 49 The corridors

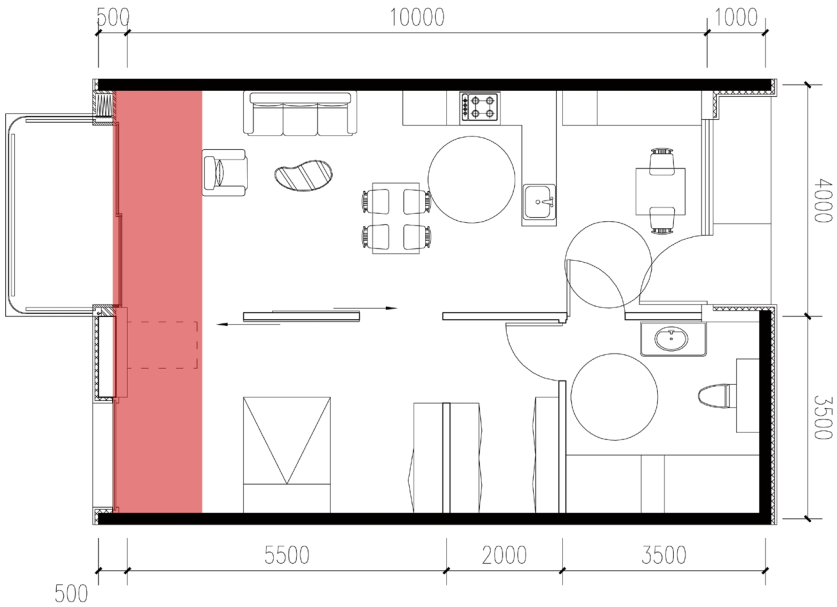


Figure 50 The red zone represents the activity space near windows.

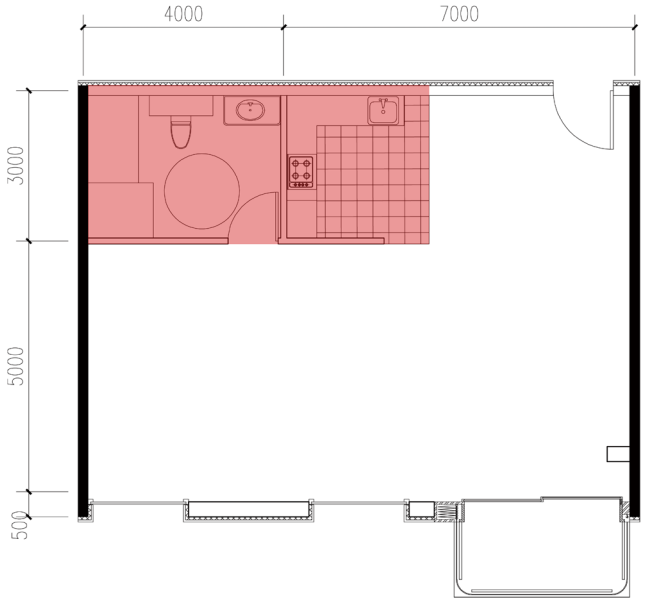


Figure 51 The red zone represents wet spaces.

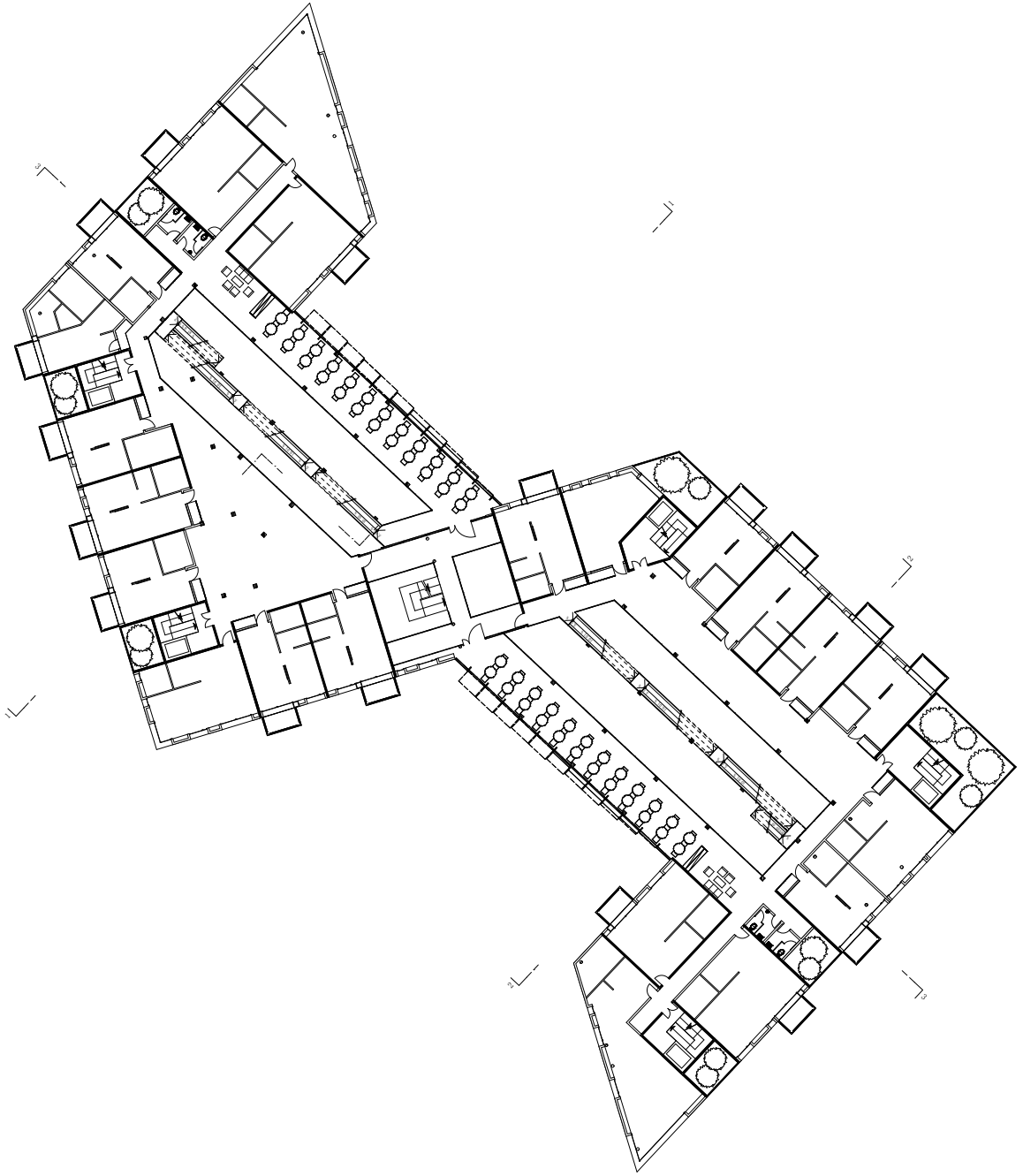
4.3 Household design

Primarily, each household is design with universal dimensions and it can be adapted to wheelchair users. An important feature of all the units is the big bathroom. It can accommodate a shower and bath tub, both with a seat. All the units for single people are placed besides communal gardens. In the entrance hall of those units, a window is designed which faces towards the communal gardens. There is no hinged door between living room and bedroom, which make the maneuver easily and also achieve the flexible use of space. Extra space is designed as “activity zone” beside the windows of living room and bedroom (Figure50). With proper design of furniture, it can be a working or hobby space. But when these activities are no longer needed, the space can be integrated into living room and bedroom, just to make them bigger. A cantilevered balcony is extended out to two meters. The resident can enjoy the best view to natural environment in nice weather. In cold weather, the balcony could be enclosed by ETFE (Ethylene tetrafluoroethylene) curtain. It can be a solar house, making the “activity zone” warmer. For couples, because they may have different requirement on the dimension or number of rooms, the households are designed with the principle of adaptable design. For instance, some couple would like to have a separate master bedroom. Therefore, in those households, only the wet spaces and balcony are designated. Residents can design the position of internal partitions according to their preference (Figure51).

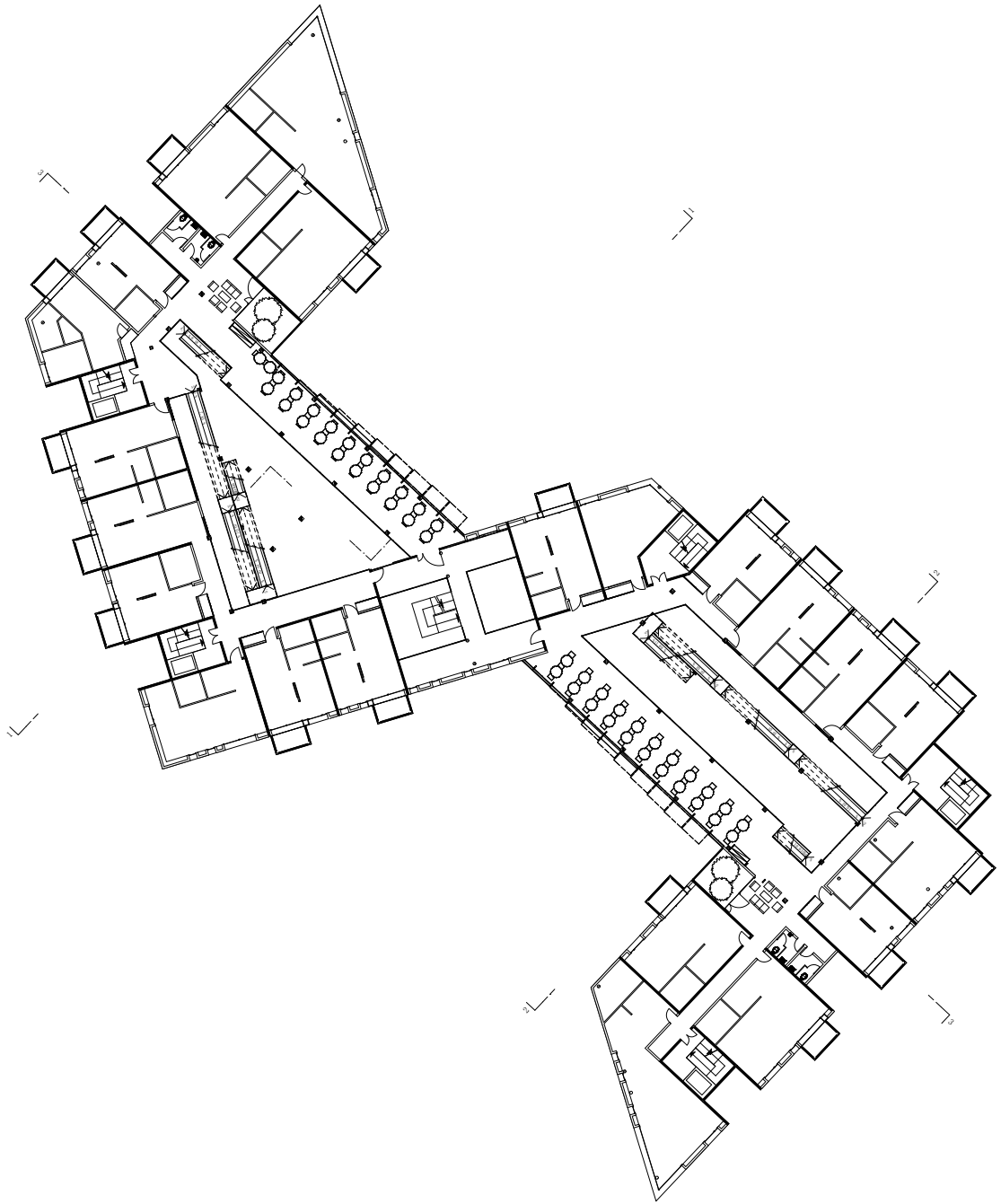
Chapter 5 Architectural design

5.1 Plans:

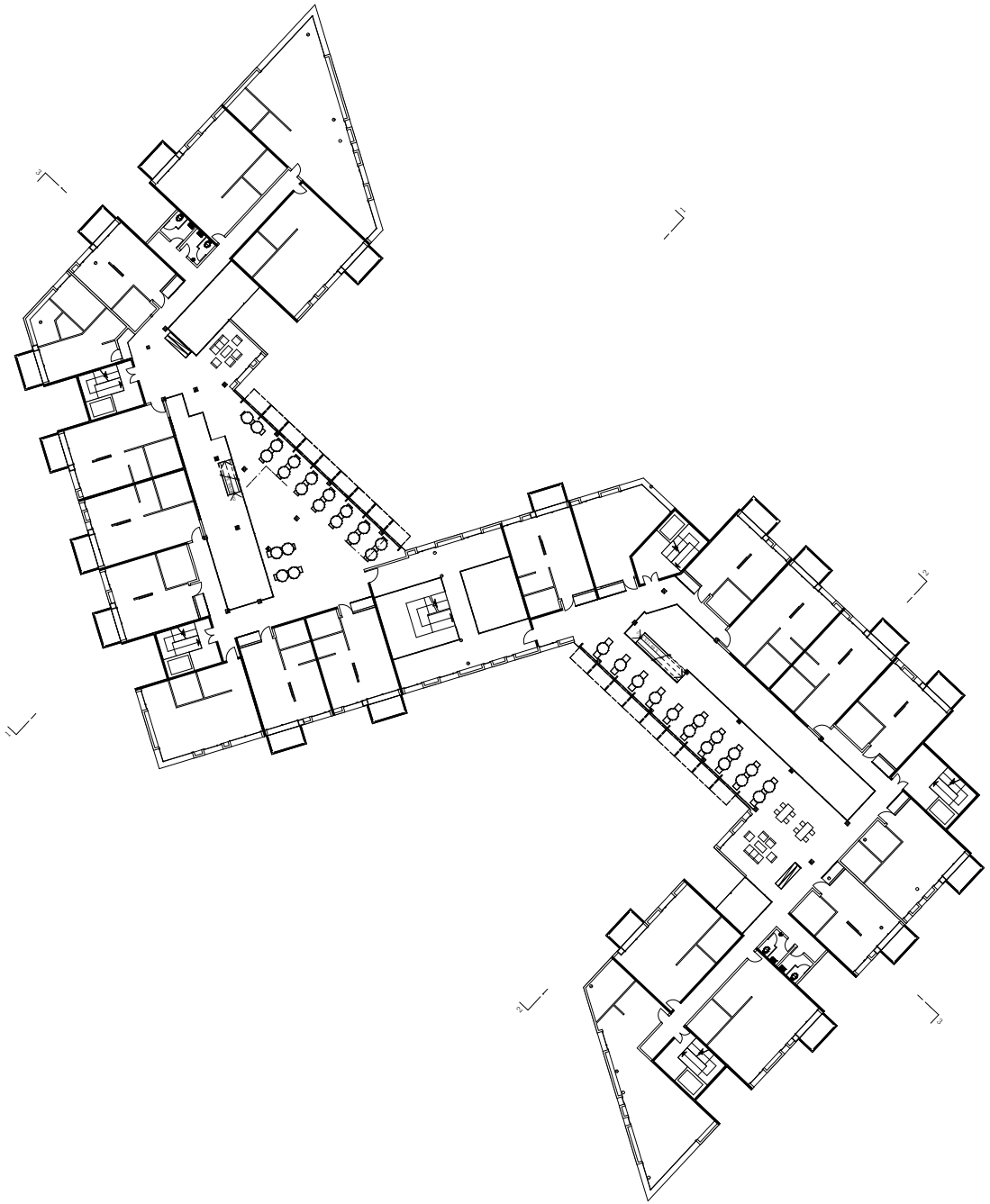
Ground floor



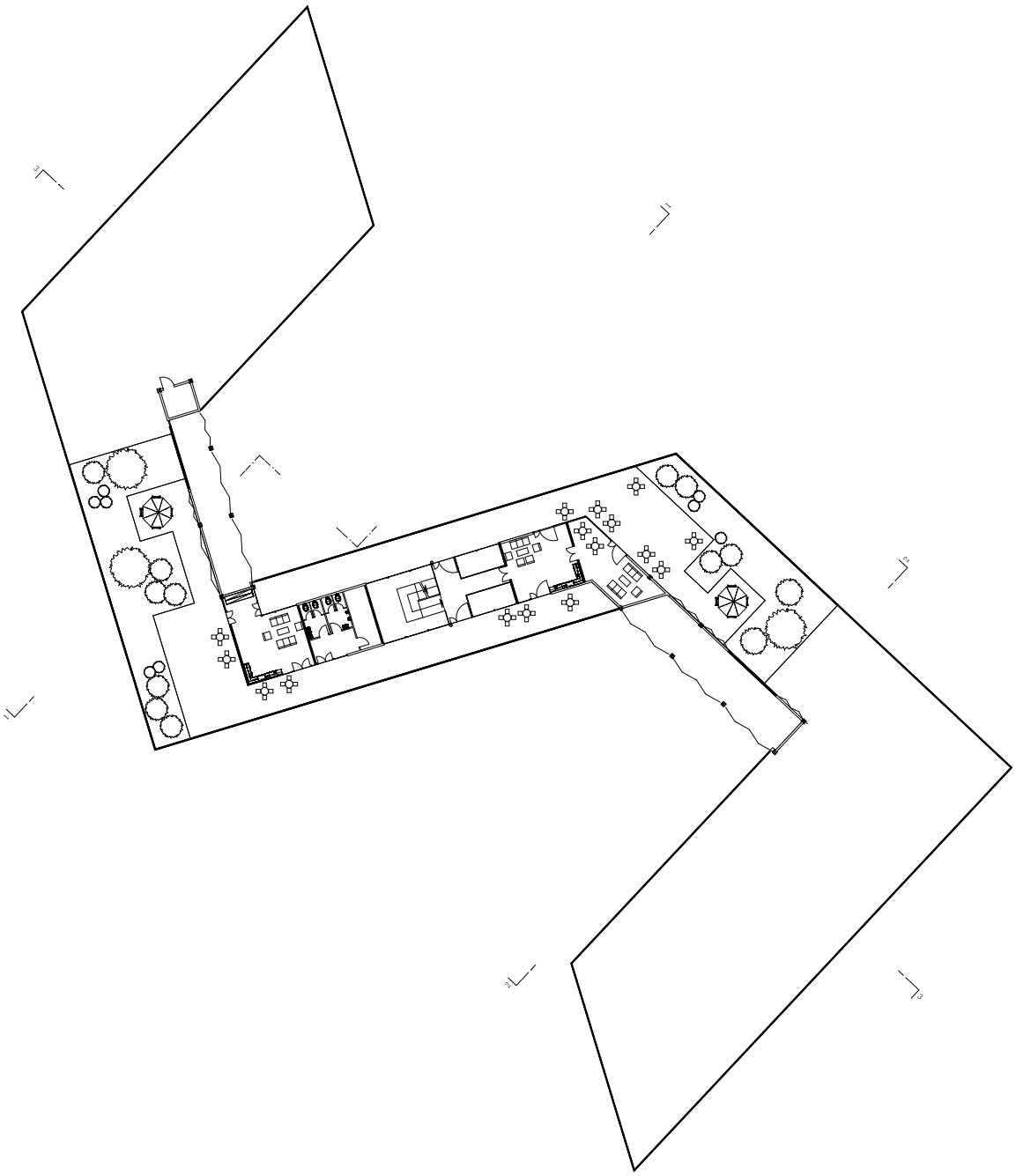
First floor



Second floor

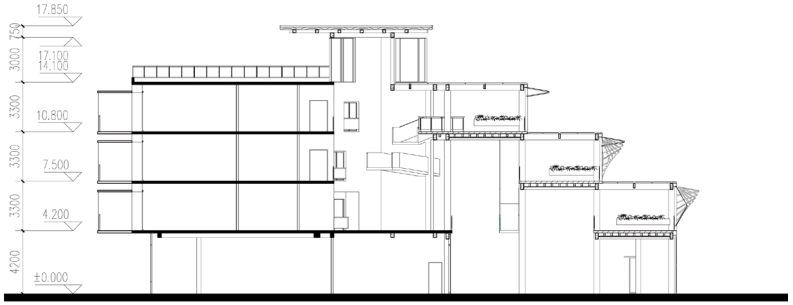


Third floor

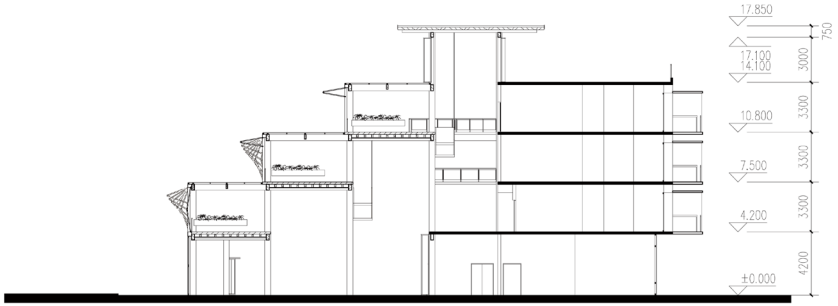


Roof plan

5.2 Sections:



Section 1-1



Section 2-2

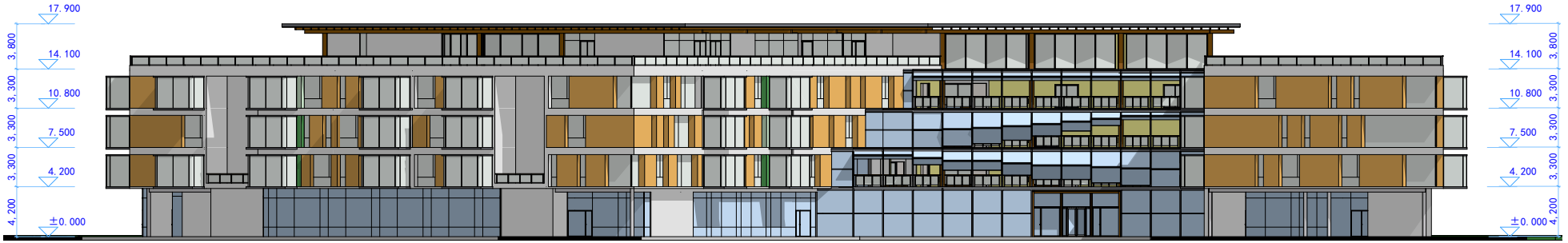
Section3-3

Elevations:

North elevation

East elevation

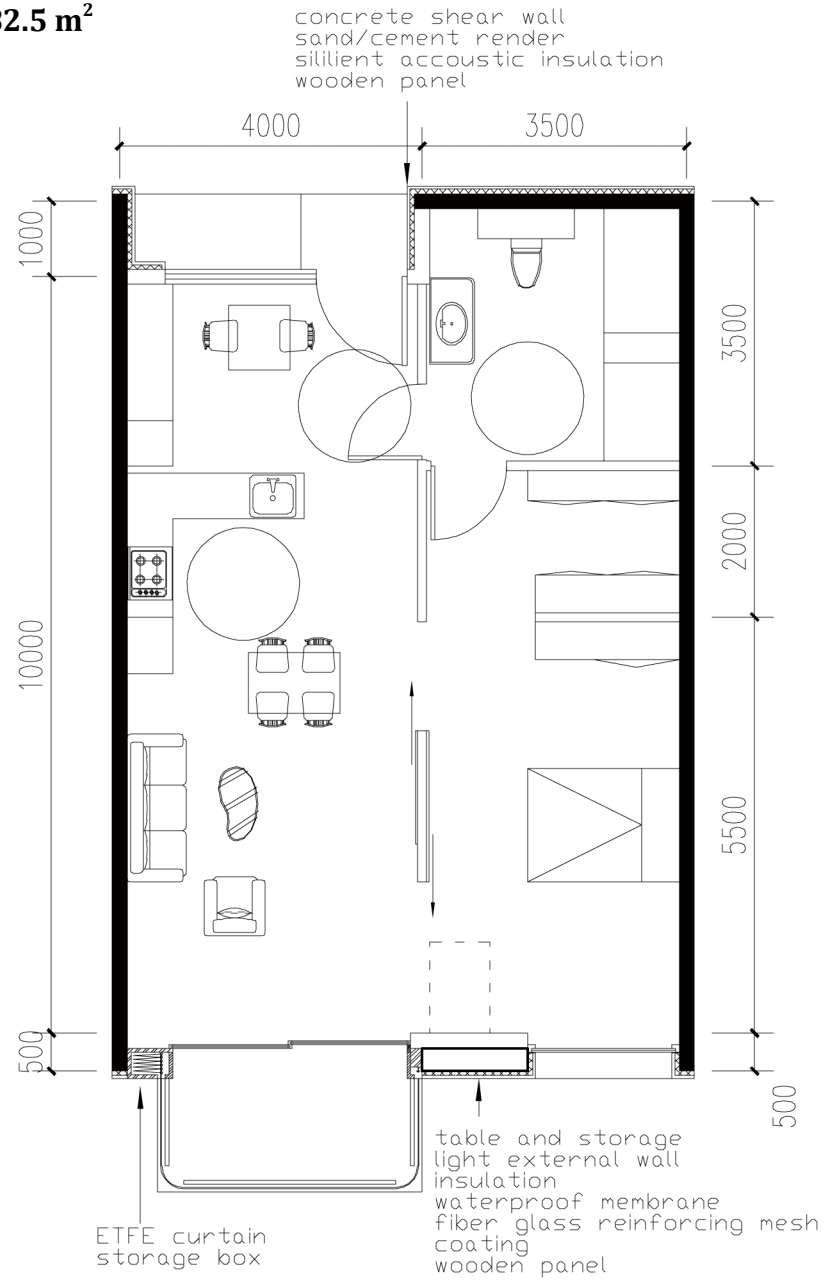
South elevation



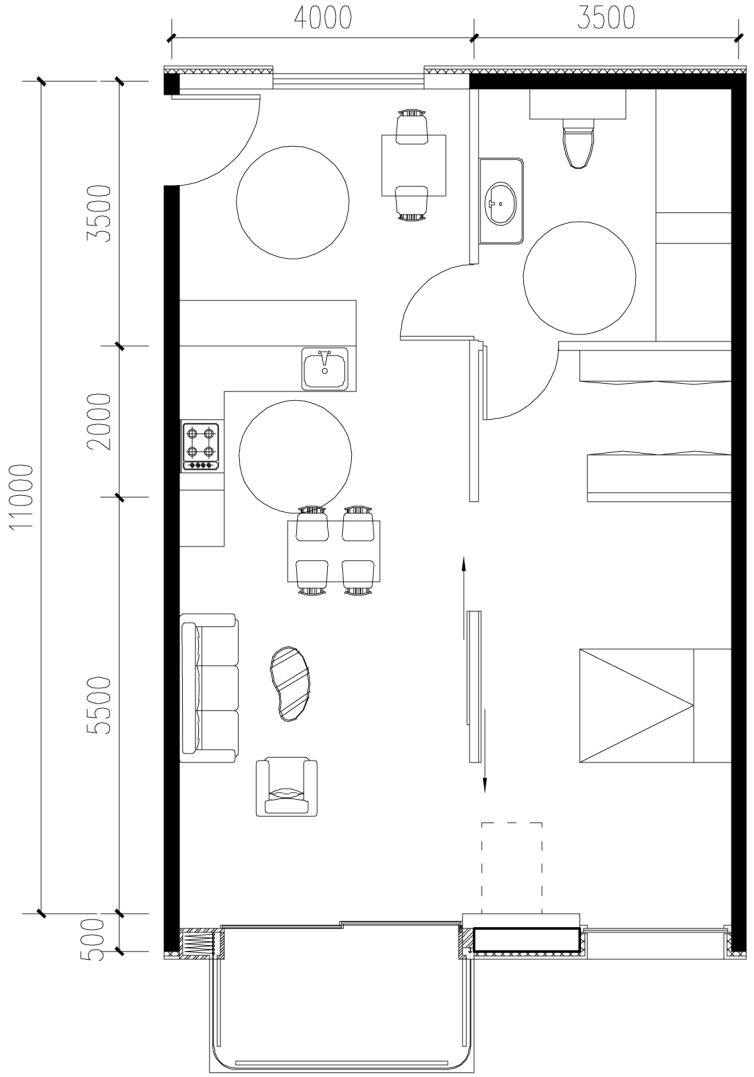
West elevation

5.3 Household layout (the scale is 1:100):

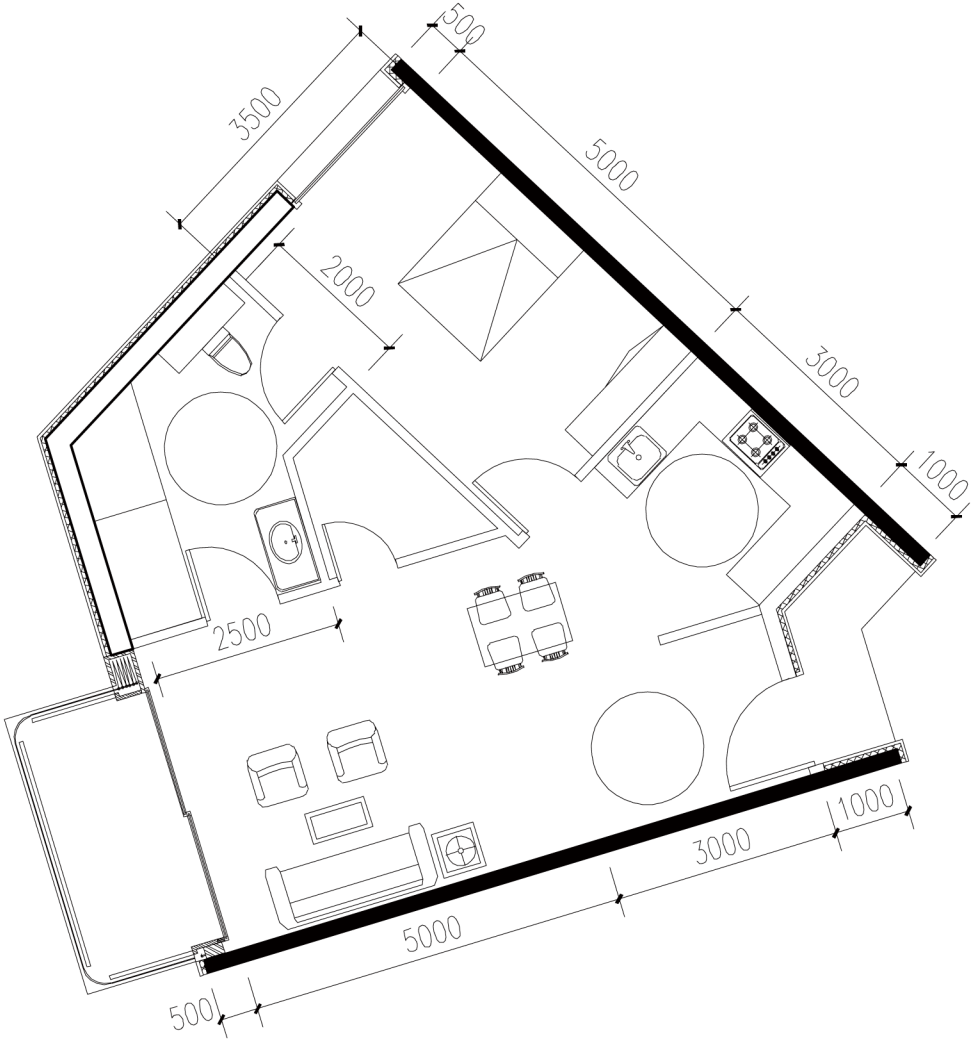
1 82.5 m²



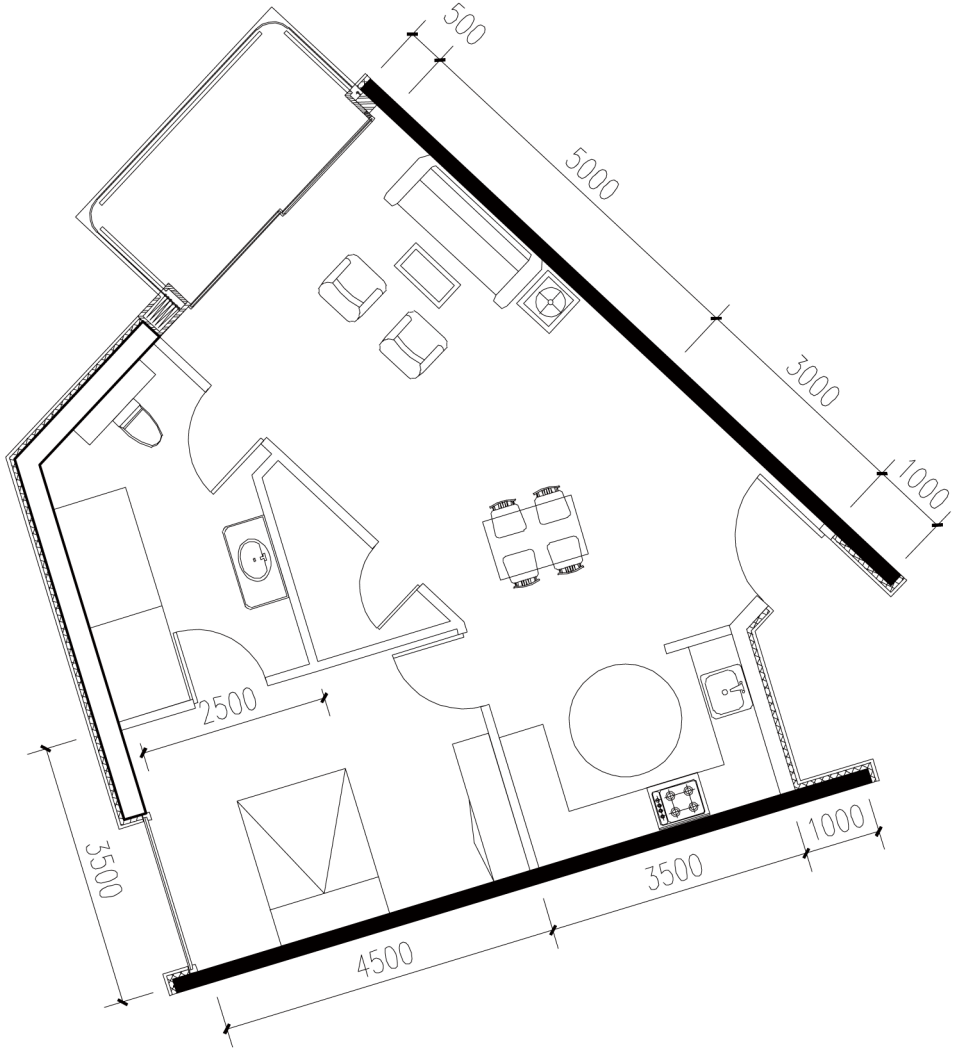
2 82.5 m²



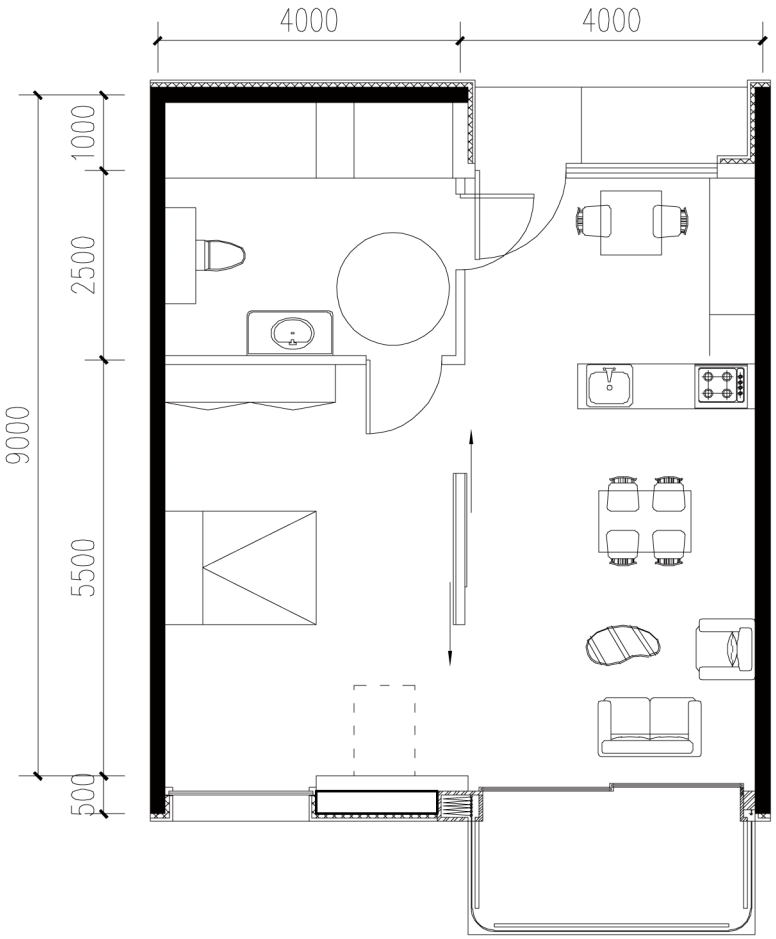
3 74.7 m²



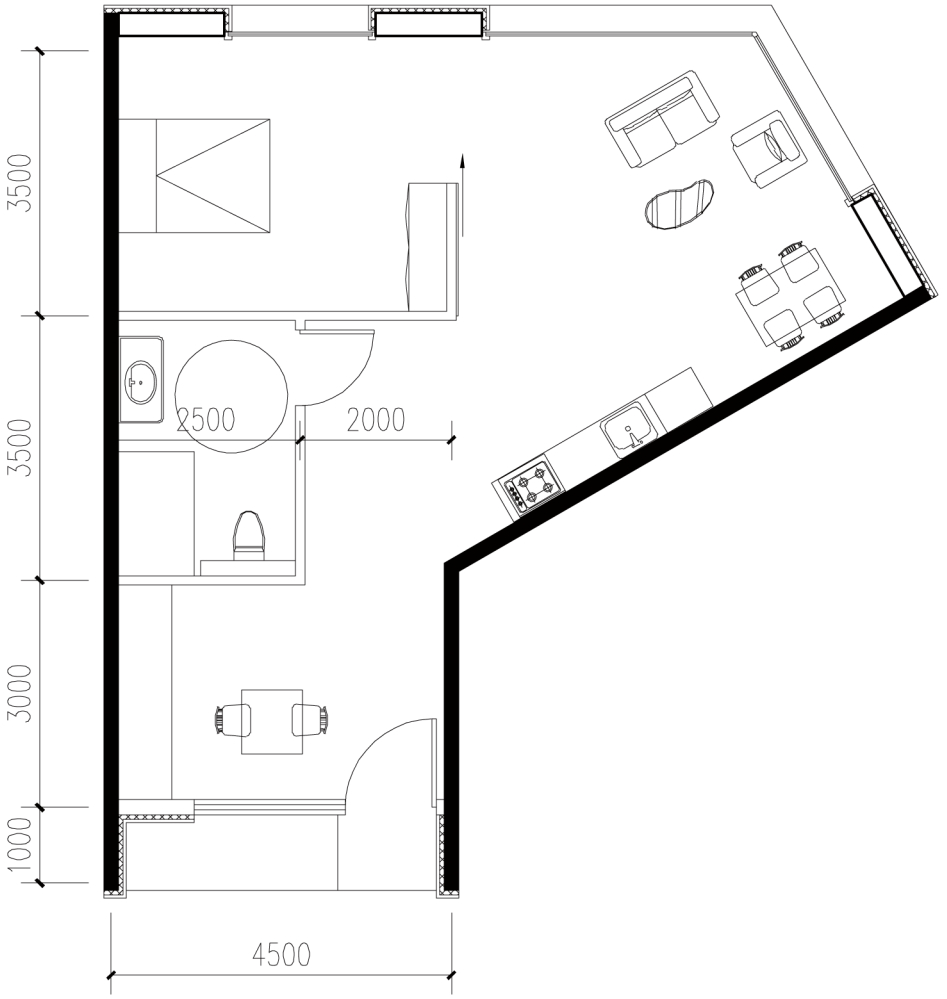
4 74.7 m²



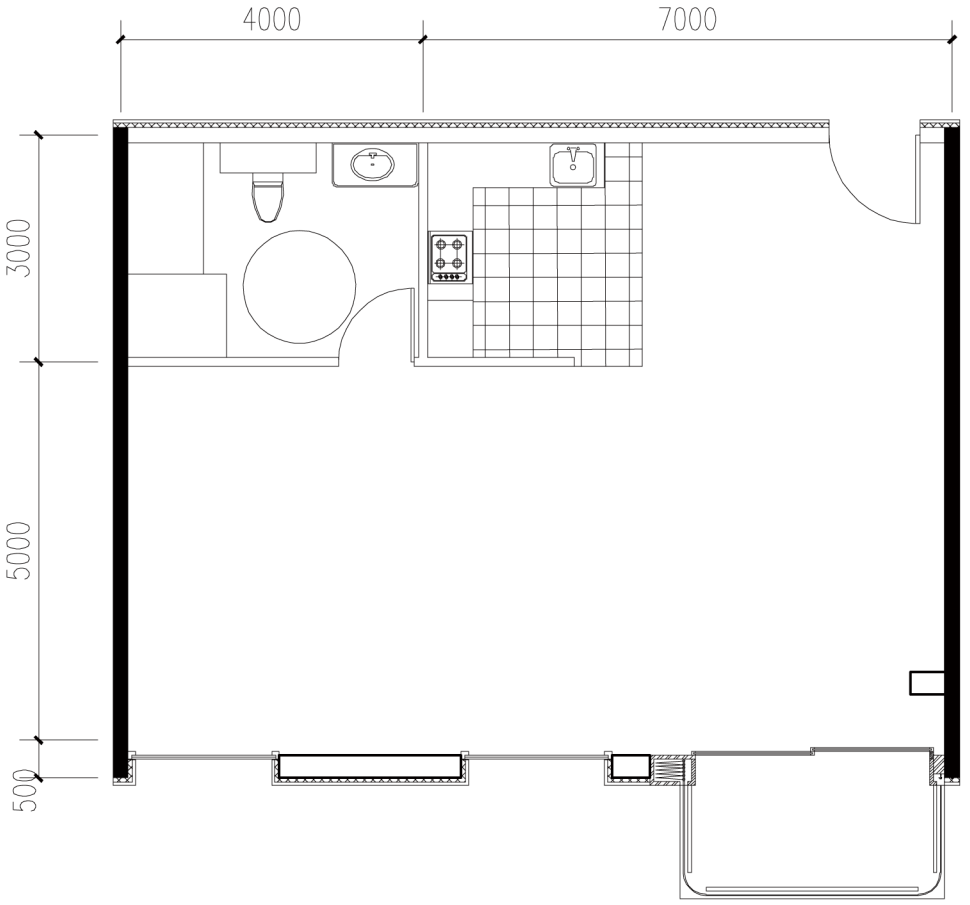
5 67.5 m²



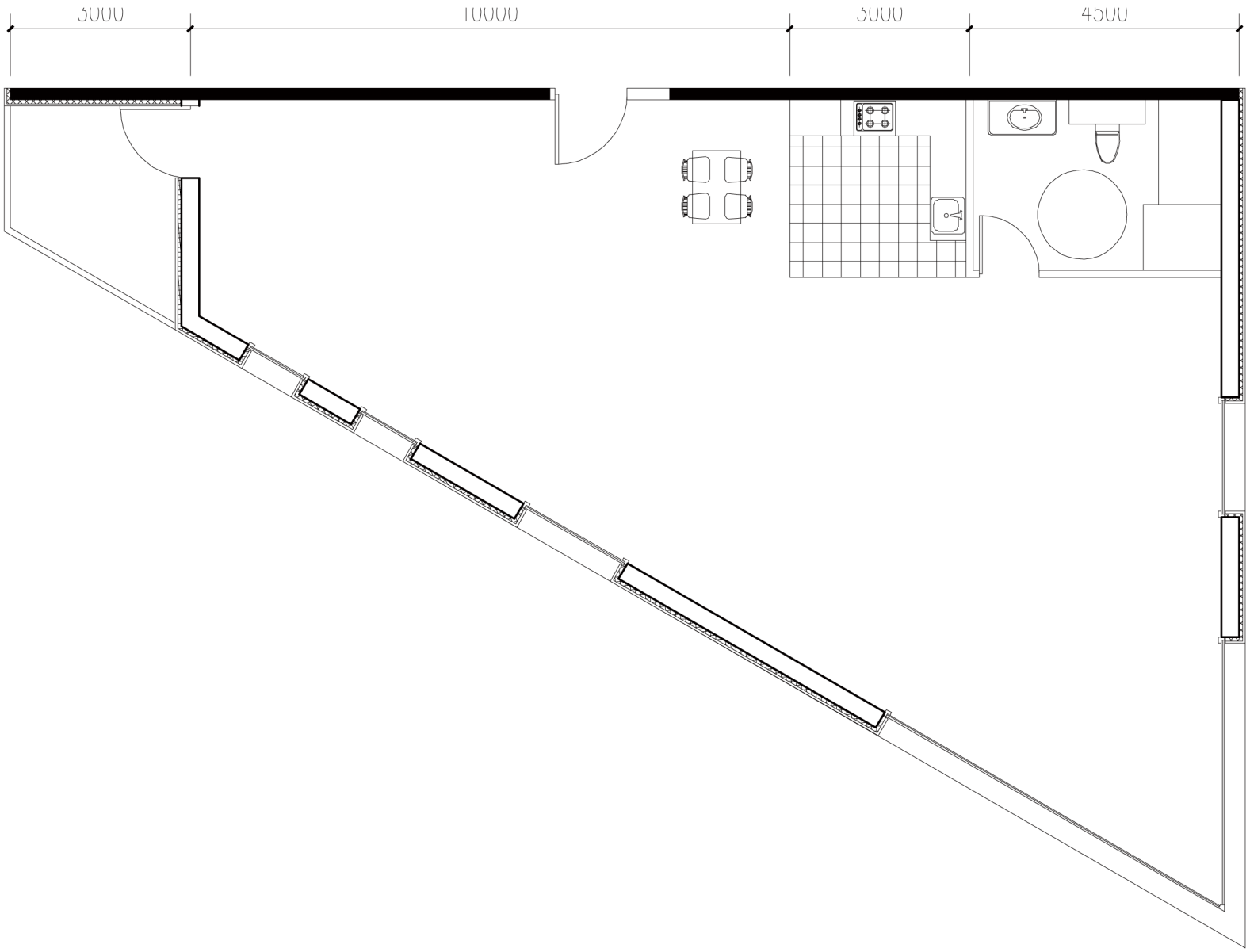
6 78.4 m²



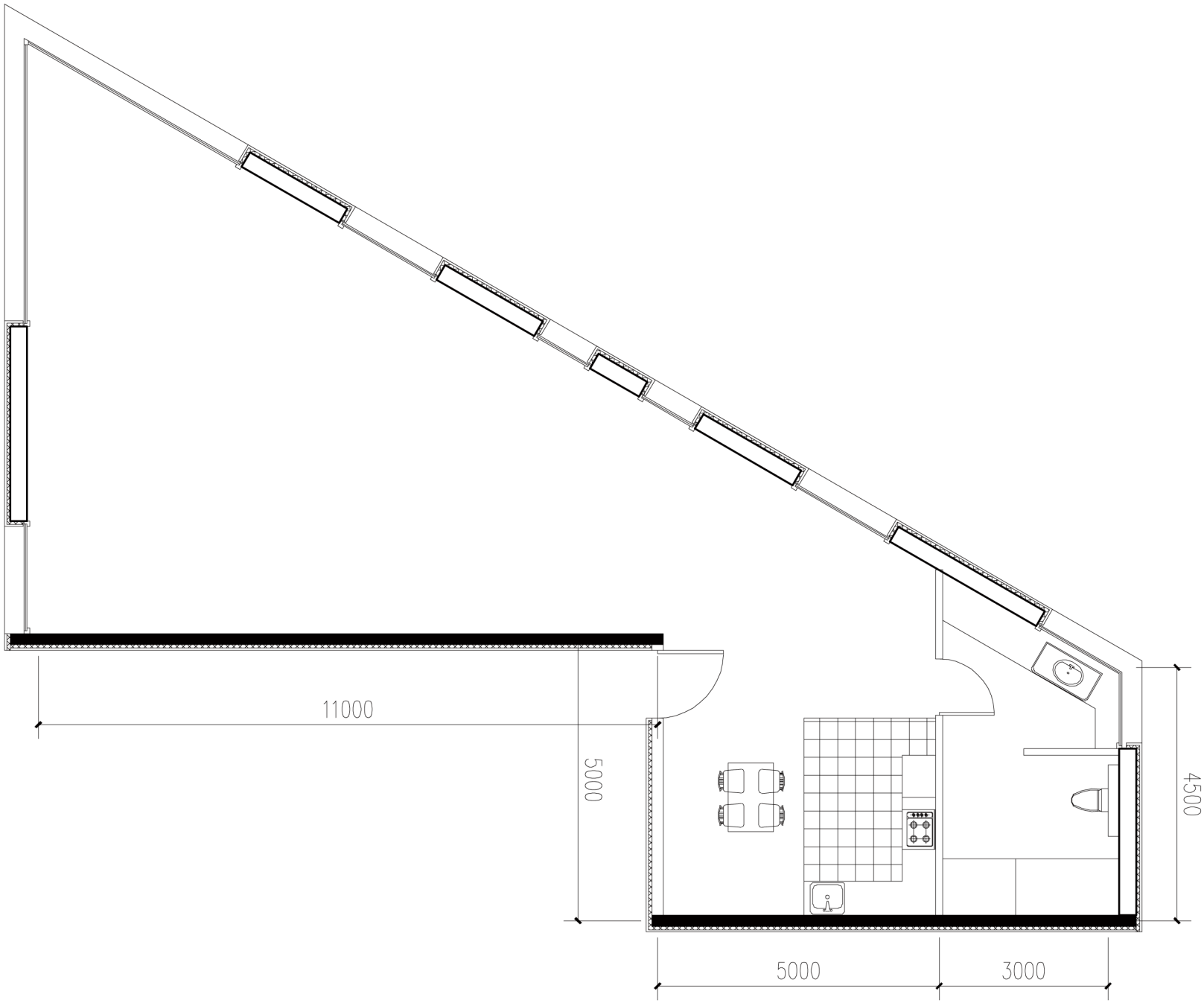
7 88 m²



8 148.7 m²



9 134.7 m²



5.4 Physical model:

5.5 Structural design

The whole building consists of two parts – the living spaces and communal gardens. In the communal garden, timber will be used as the main construction material. In the part of living spaces, all the households are located on the first, second and third floor. Commonly, the width of each unit is 7.5 meters. Frame-shear wall structure is adopted in the living part. But on the ground floor, there is a need for a larger space for the library. In general, the combination of frame shear wall and column-beam frame structure will be used. Five staircases are designed as structure cores to stabilize the whole building. Then, the timber structure will be connected to the concrete block (Figure52, Figure53 and Figure54). From the economic point of view, the span between timber columns is normally 5.4 meters. Glulam beams can spans up to 7 meters. It can be produced with any length but long spans may need other types of structural element such as trusses. For continuous beam, the ratio between the span of columns (l) and the height of beam (h) is 1/25 to 1/20. The ratio between the height and width (b) of beam is 4 to 8. Beams deeper than about 6b require special bracing to avoid lateral instability (Hans & Vahik, 2009).

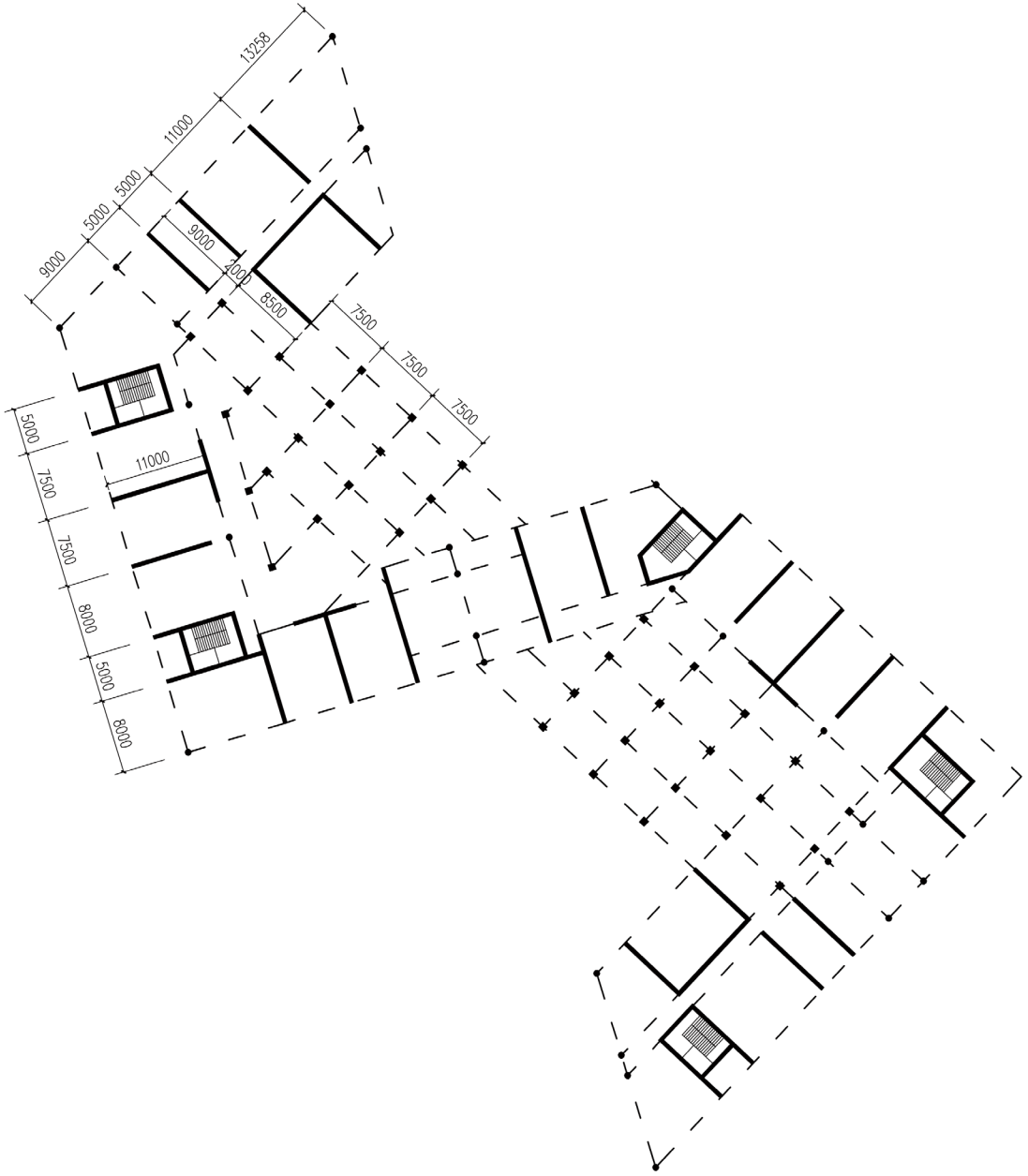


Figure 52 The structural plan

Figure 53

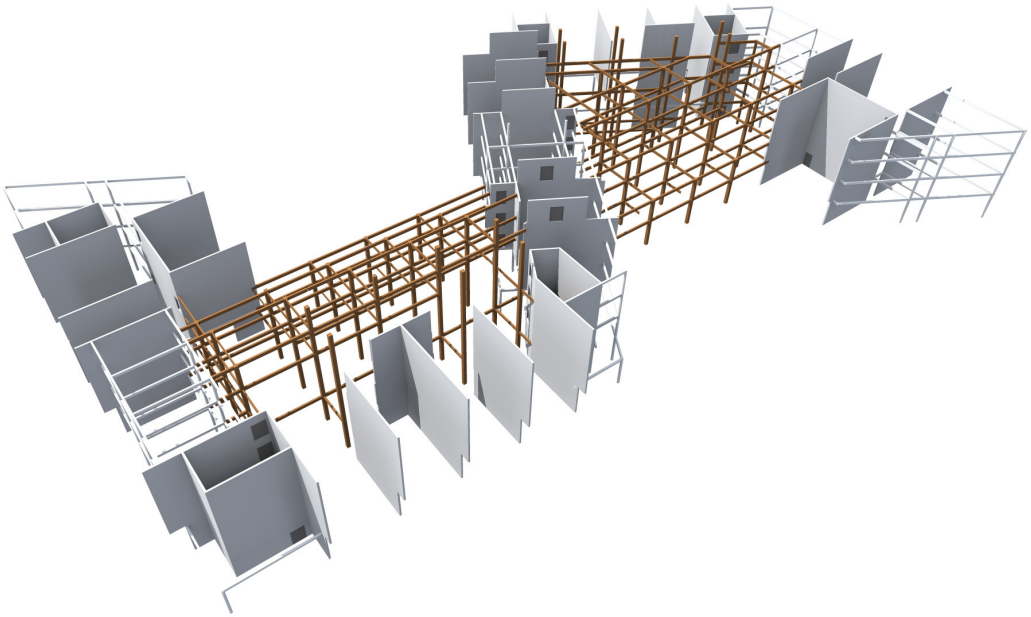


Figure 54 Structure of the building

5.6 Greenhouse design

Three points are important for indoor plants – sunlight, shading (temperature control) and ventilation. One of the greenhouses is southwest oriented, while the other one is east oriented. There will not be enough sunlight in the later one in spring, autumn and winter. As a result, skylight is utilized as the sunlight resource. A terraced form is used for the part of communal garden to maximize the use of skylight (Figure56). In this way, the greenhouse is downsized to personal scale. Each individual will have a garden with 5 meters in length, 2.5 meters in width (according to the span of structure) and 3.3 meters in height (Figure55). It helps every gardener to get the maximum sunlight from sky and offers an opportunity for personal control on the climate. A shading system is installed to prevent glare and overheating in summer. It is placed at the exterior of the top windows and facade for better performance in preventing overheating (Figure58). Windows can be folded in vertical direction (Figure59). In the exterior of façade, the shading system is installed on the top glass panel. So, when the window is opened for ventilation purpose, it will also create top shading like canopy. Because the communal garden is designed as an exhibition, this shading system will not influence the visual connections between the exterior and interior. The glass panel is as the same width as the every individual garden, that's 2.5 meters. In the facade, the glass system will reflect the individual unit from both inside and outside (Figure57). Artificial lighting system is anyway needed as a complementary light resource.

Figure 55 The area for each individual.

Figure 56

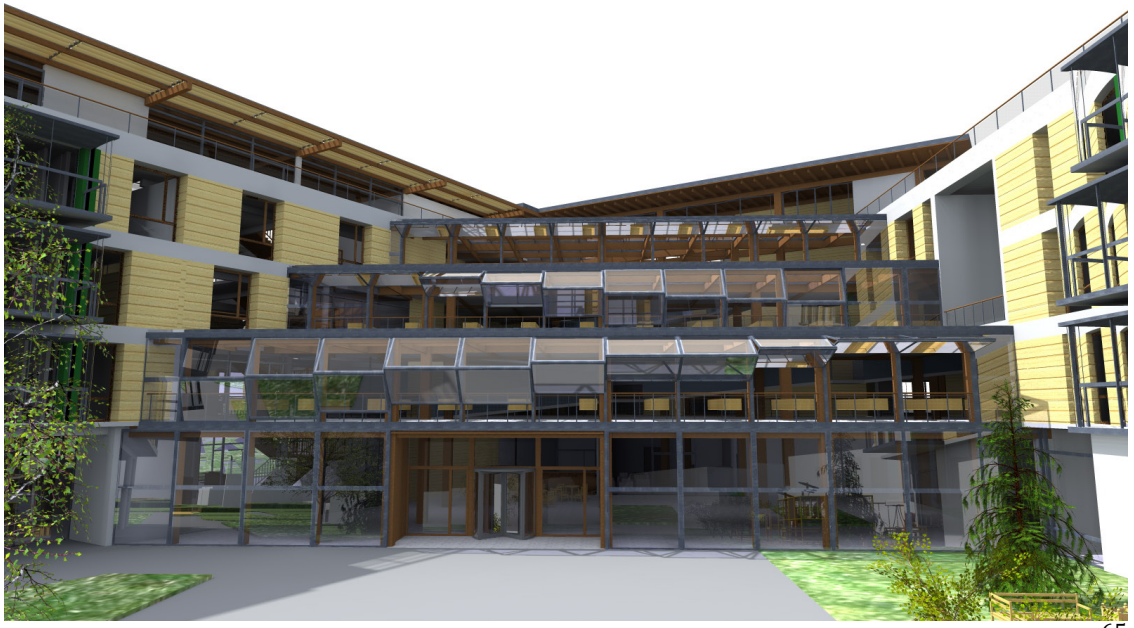


Figure 57

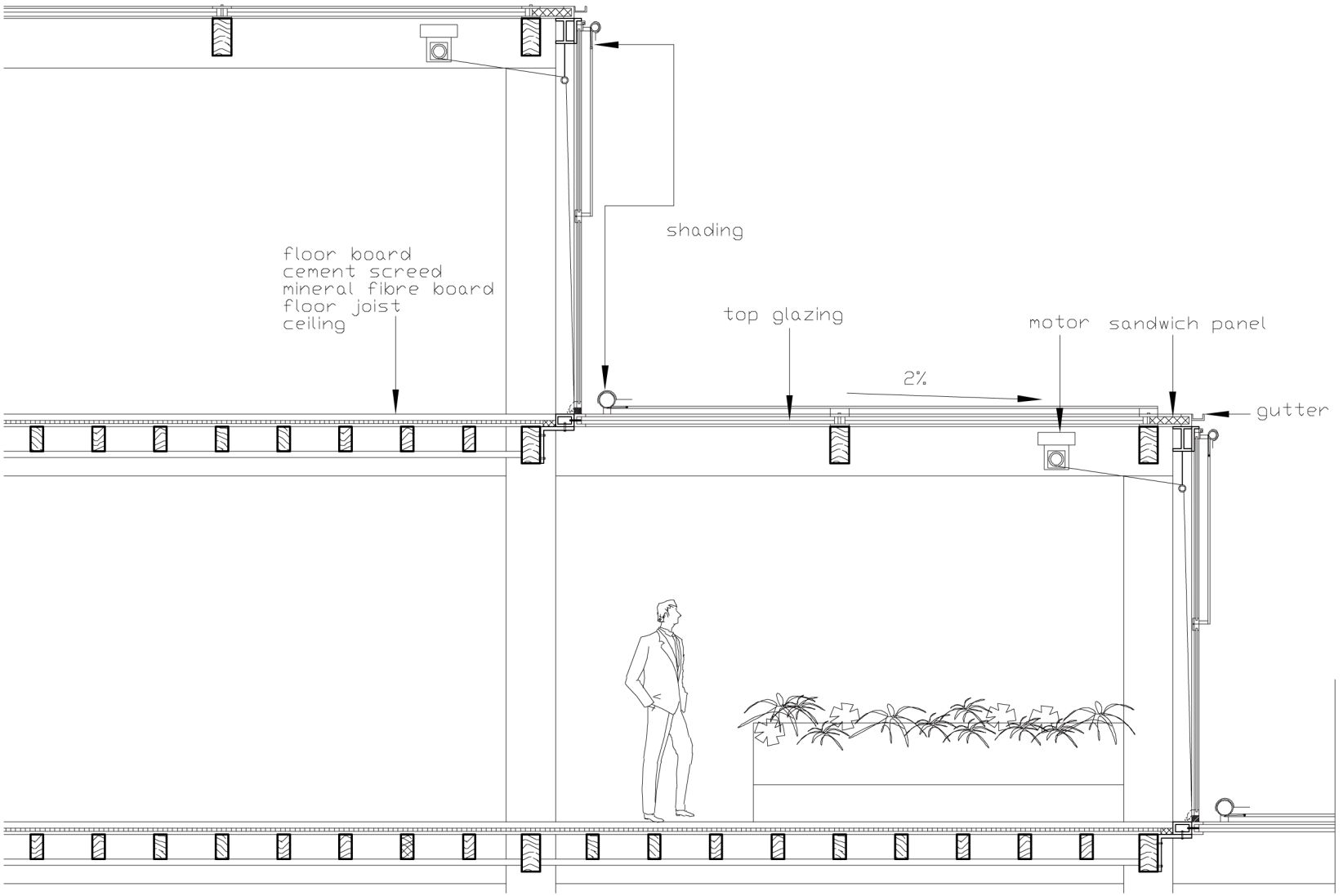


Figure 58 Details of the facade.

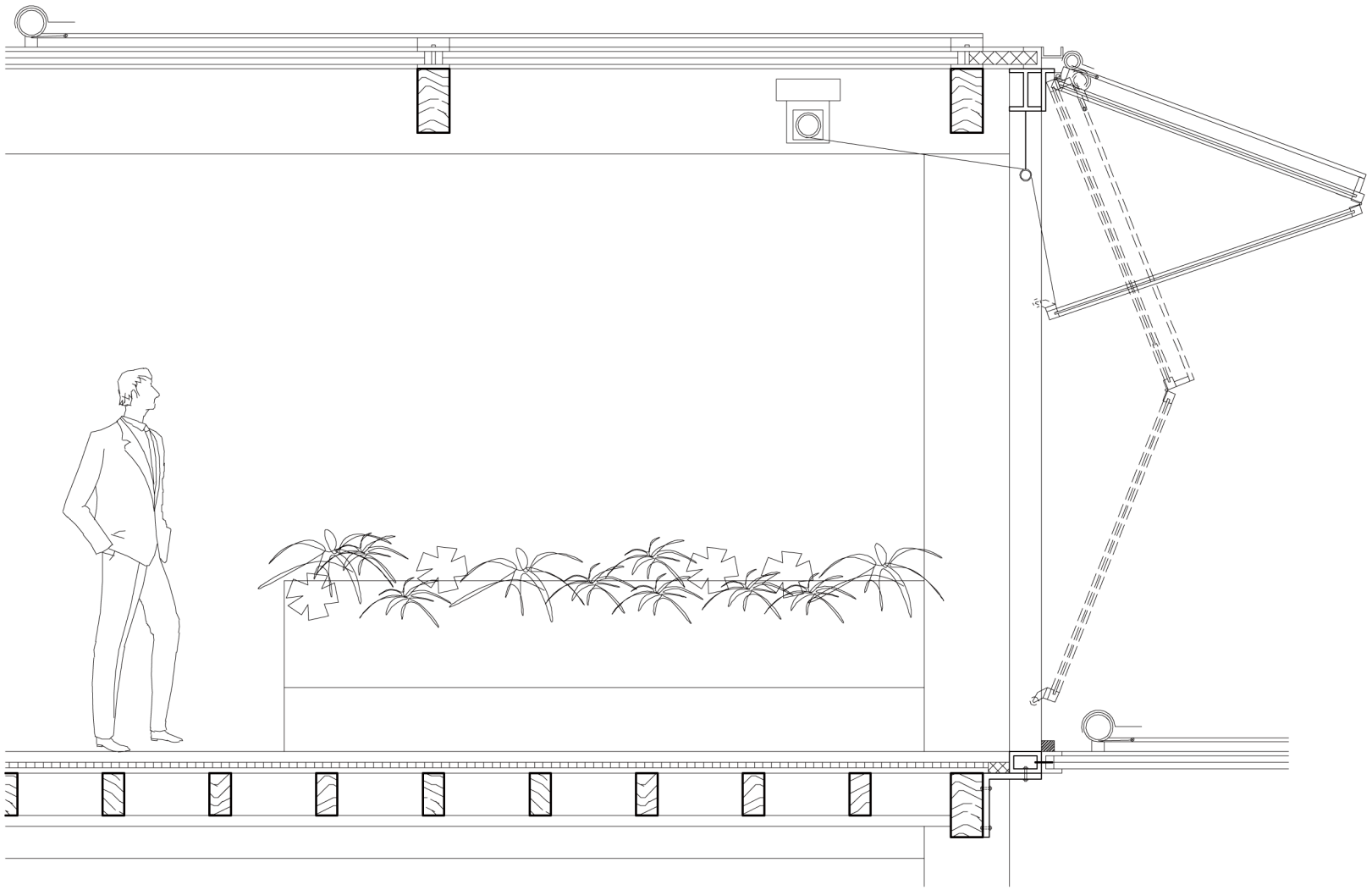


Figure 59 The window can be fold in vertical direction.

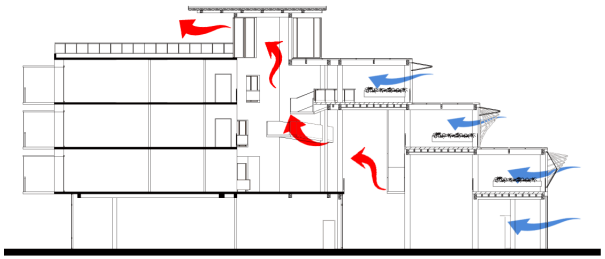


Figure 60 Stack effect in the building

Because of organization of spaces and dimension of the building, it is difficult to use cross ventilation for the greenhouse. Stack effect can be a good alternative natural ventilation strategy to prevent overheating in summer. An extra floor on top of the building will increase the airflow rate inside the greenhouse (Figure60 and Figure61). Additionally, the extra space can be used as sky bar (Figure62 and Figure63) and residents can also meet on the roof, enjoying the best view to the surrounding natural environment.

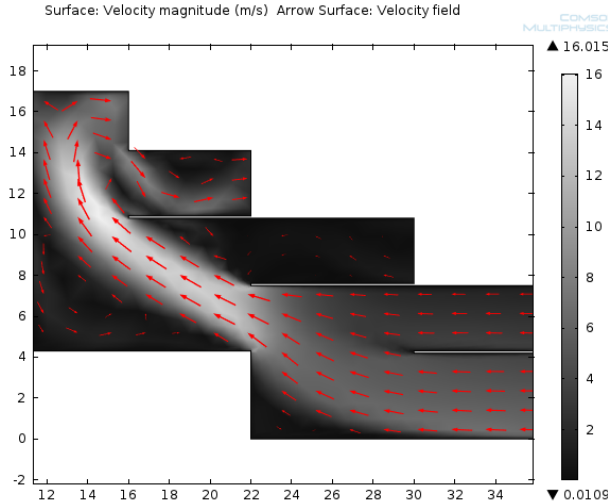


Figure 61 The stimulation of air flow of the greenhouse

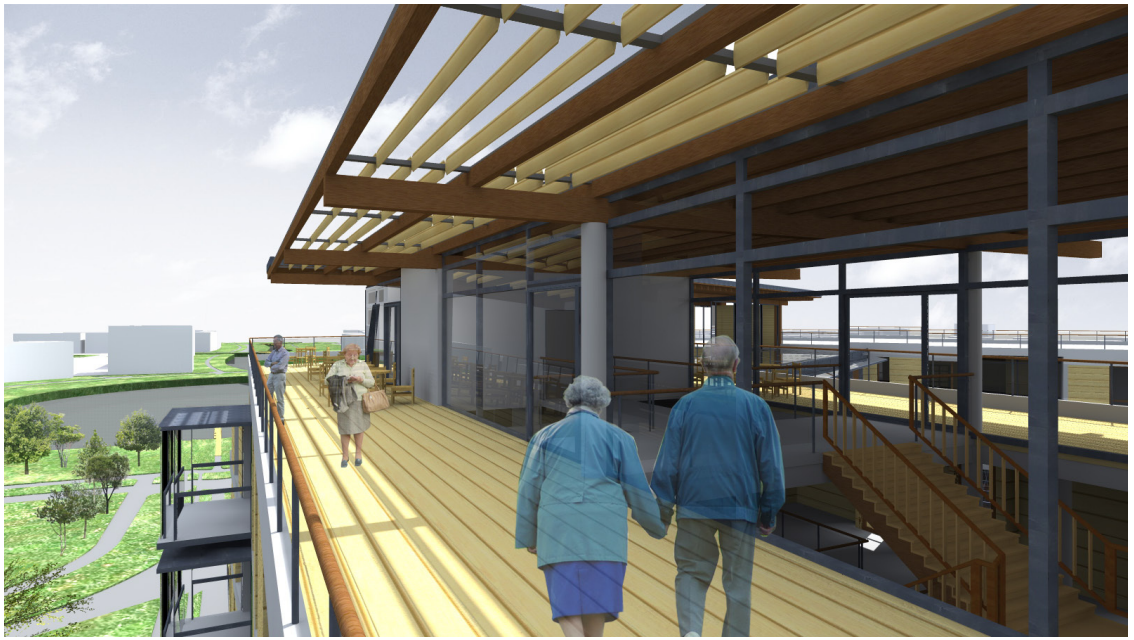


Figure 62

Figure 63

5.7 Balcony details

A weather-proofed envelope may increase the use of balcony in cold weather. The idea is that in summer, the balcony can completely open while it can close (will act as a solar house) in winter. The lightweight ETFE film will be the ideal material. The U-value of the foil is almost the same as a single layered glass. They also have similar transparency. Firstly, this ETFE curtain is stored in the reservoir besides the wall. The reservoir can be opened so the residents can pull the curtain out from inside. The curtain will follow the track on both the top and bottom floor of the balcony (see household layout and Figure64). When it reaches to the other end, it can be hooked, making the curtain stable. The whole balcony is lightweight and it can be cantilevered by using steel frames.

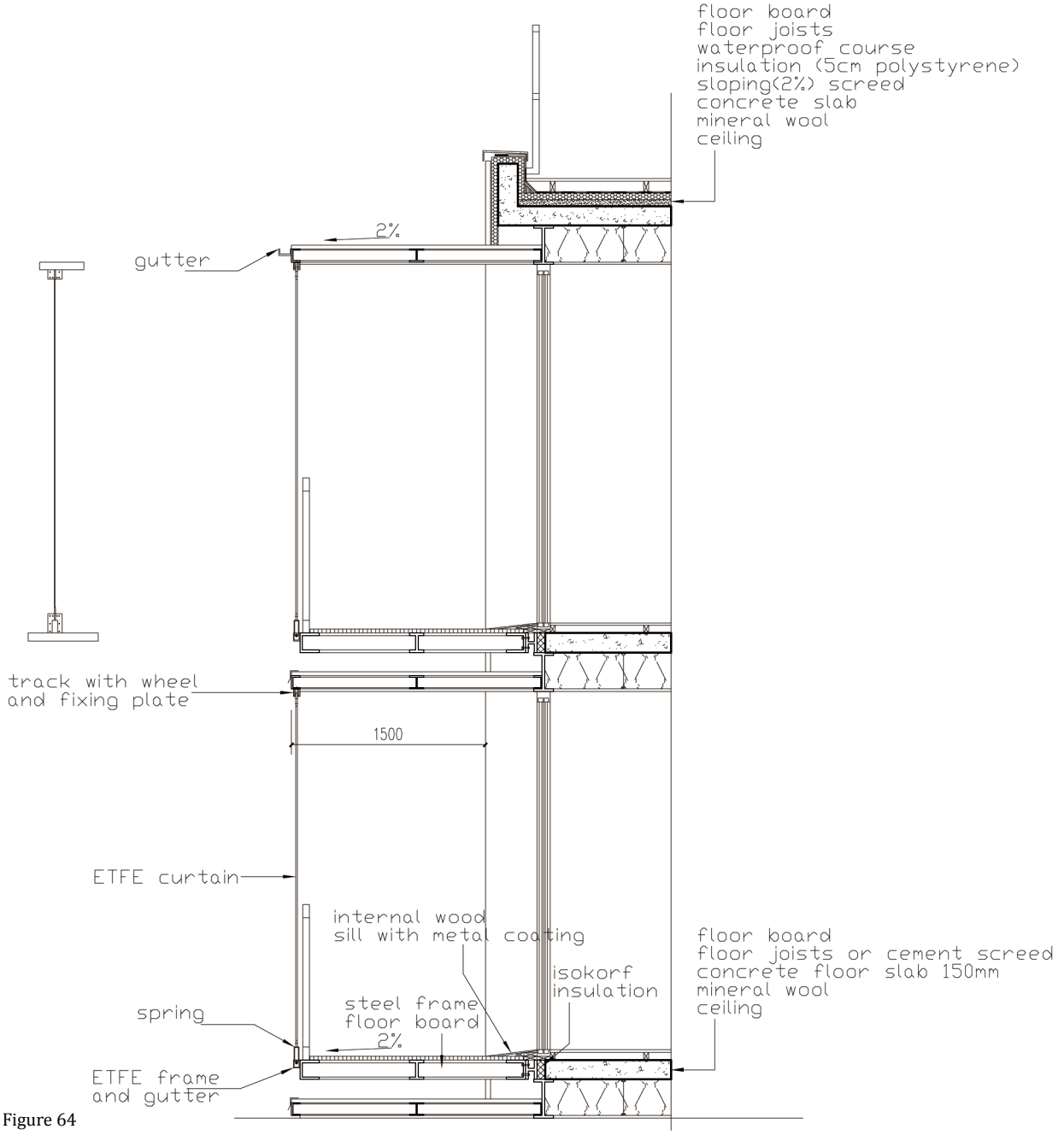


Figure 64

Chapter 6 Conclusion

This project consists of two parts: the research and the design. In the research phase, the requirements of elderly and retired people on their living environments had been investigated. In the author's opinion, independent living, aging-in-place and social connection are three basic criteria for elderly housing. Then the author understood the importance of active aging and explored the relationship between physical activities and elderly housing design.

In the design phase, the main design strategy is to incorporate physical activities into daily routines. The physical activities are envisaged as gardening activities and daily trip to the place of mail box. The method is to design the collective space as a comprehensive zone for social contacts, gardening and circulation.

Finally, near the end of the project, the author tried to evaluate the design strategy and had taken an interview with a retired people and a master student who study user requirements on architecture in the Medical Department of Utrecht University. The brief conclusion of the meeting is that the target group is too specific. People have different hobbies and not that much people would like to have a garden. If there will be more options for people to choose (not merely allotment gardens), the design may be better.

Recently, there are some literatures on the influences of building and urban design on physical activities. But only public buildings and offices were investigated. In this research, the author had worked on how living environment could influence the elderly peoples' participations in physical exercises. It may contribute to the topic of the physical activity and architecture. But it has its limitations. Further research should be done on the lifestyle of elderly people. There is still potential to improve the design.

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Appendix

Plans:

Groud floor	**1:200**
First floor	**1:200**
Second floor	**1:200**
Third floor	**1:200**
Roof floor	**1:200**

Sections:

1-1 section	**1:200**
2-2 section	**1:200**
3-3 section	**1:200**

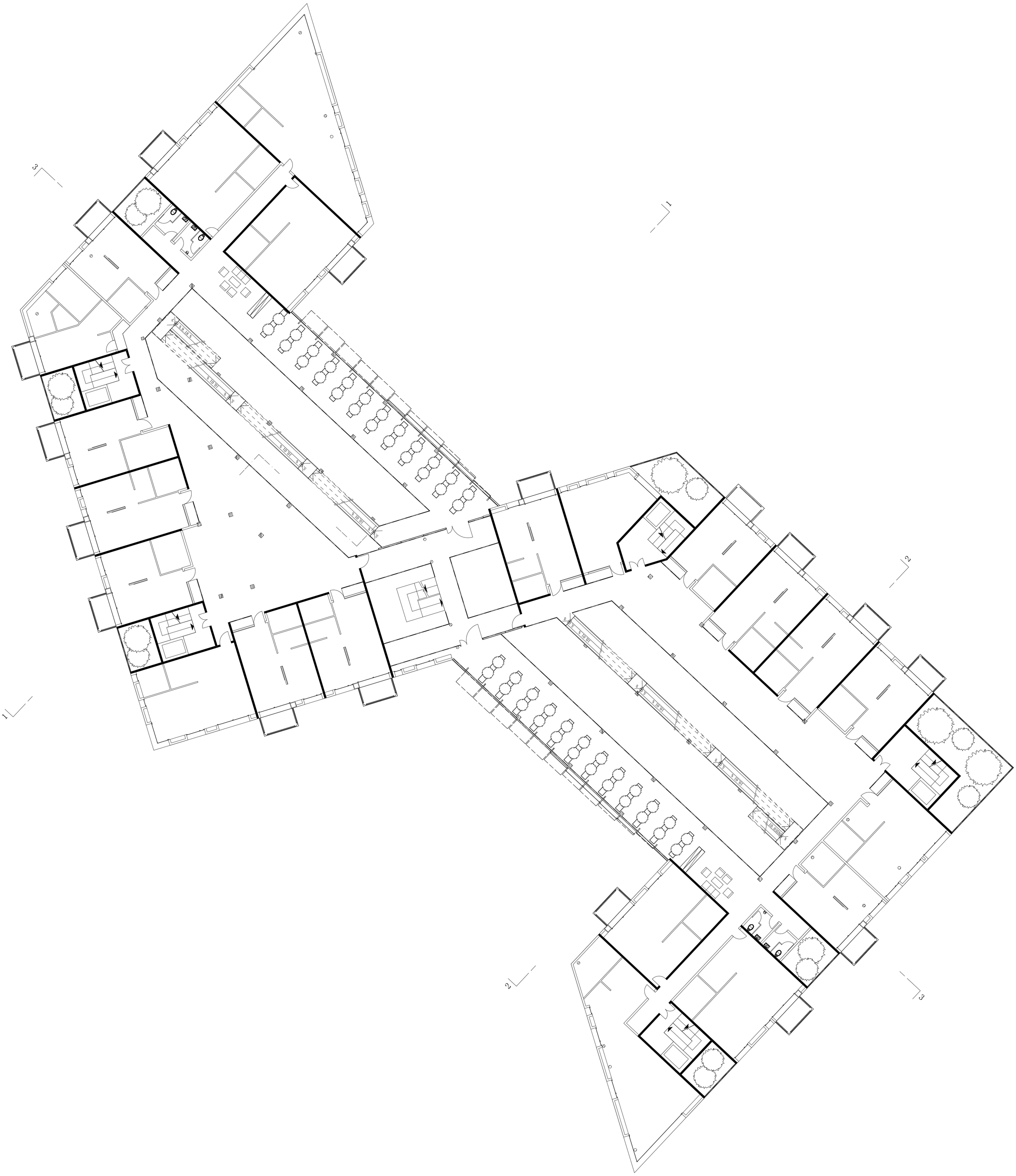
Elevations:

North elevation	**1:200**
South elevation	**1:200**
West elevation	**1:200**
East elevation	**1:200**

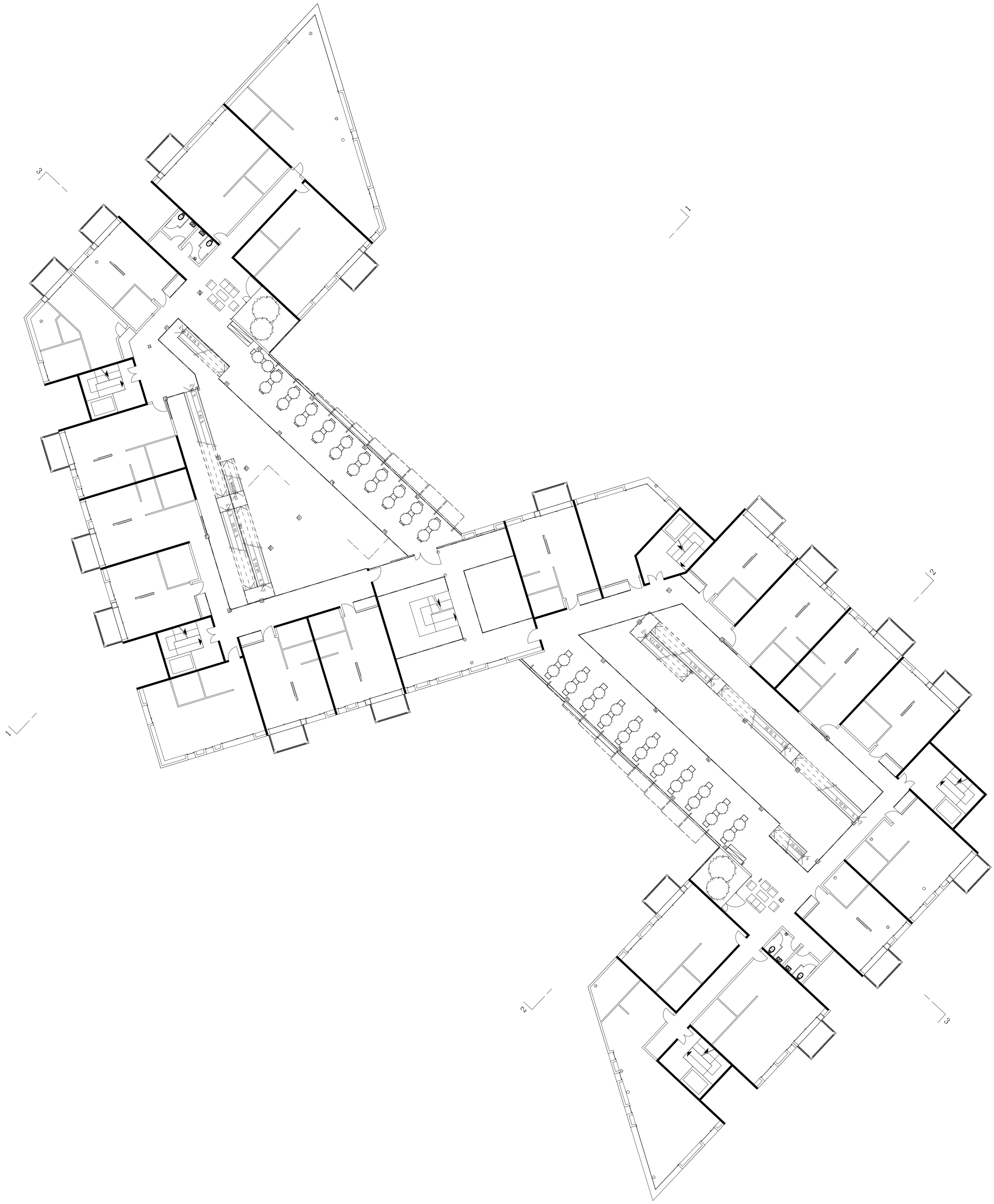
Master plan	**1:500**
Details	**1:20**

1. Childcare facilities
2. Collective space
3. Entrance for public
4. Entrance hall for residents, Coffee bar and mailbox
5. Entrance for residents
6. Library
7. Recreational center
8. Sports center
9. Cafe

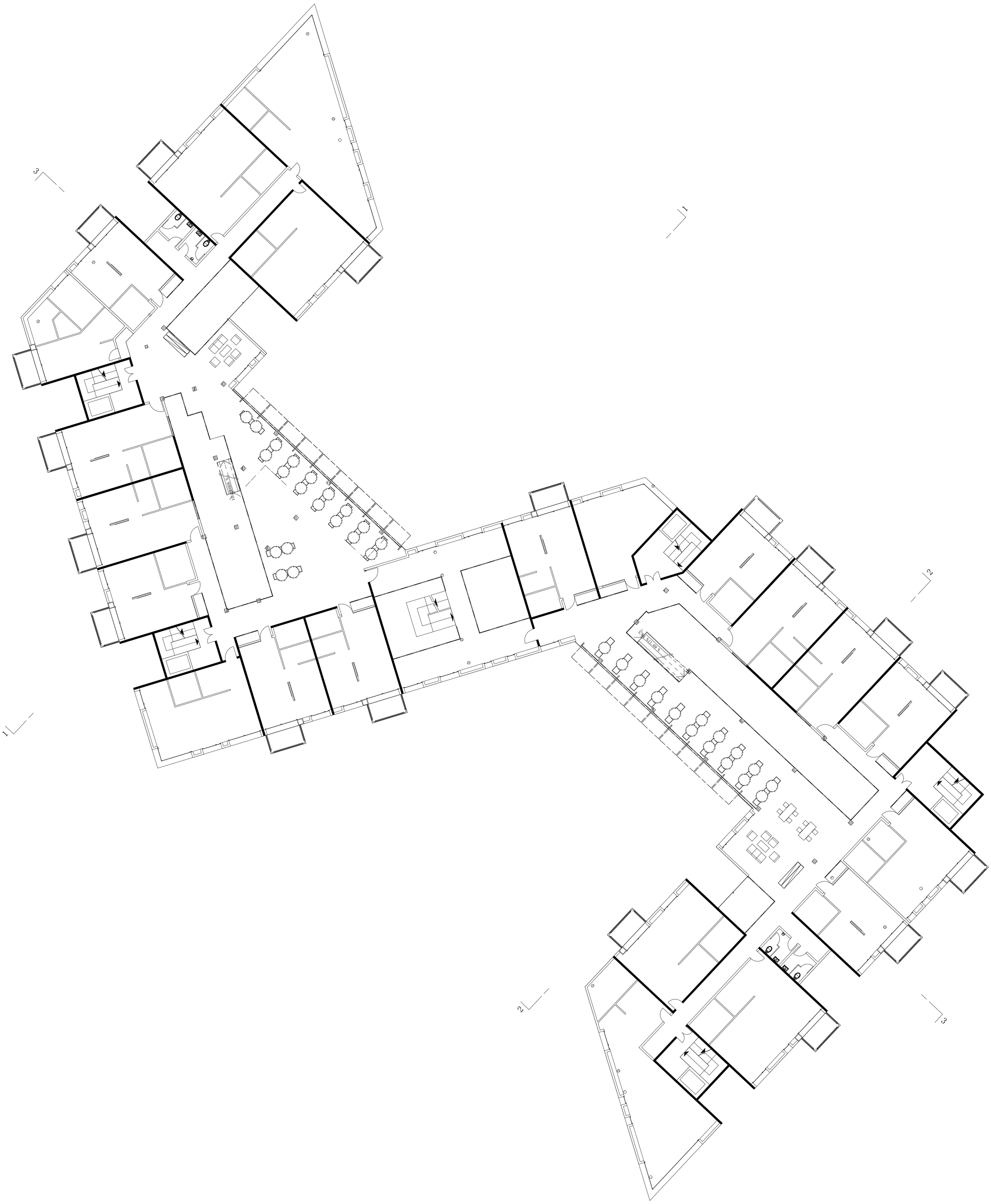
Ground Floor 1:200



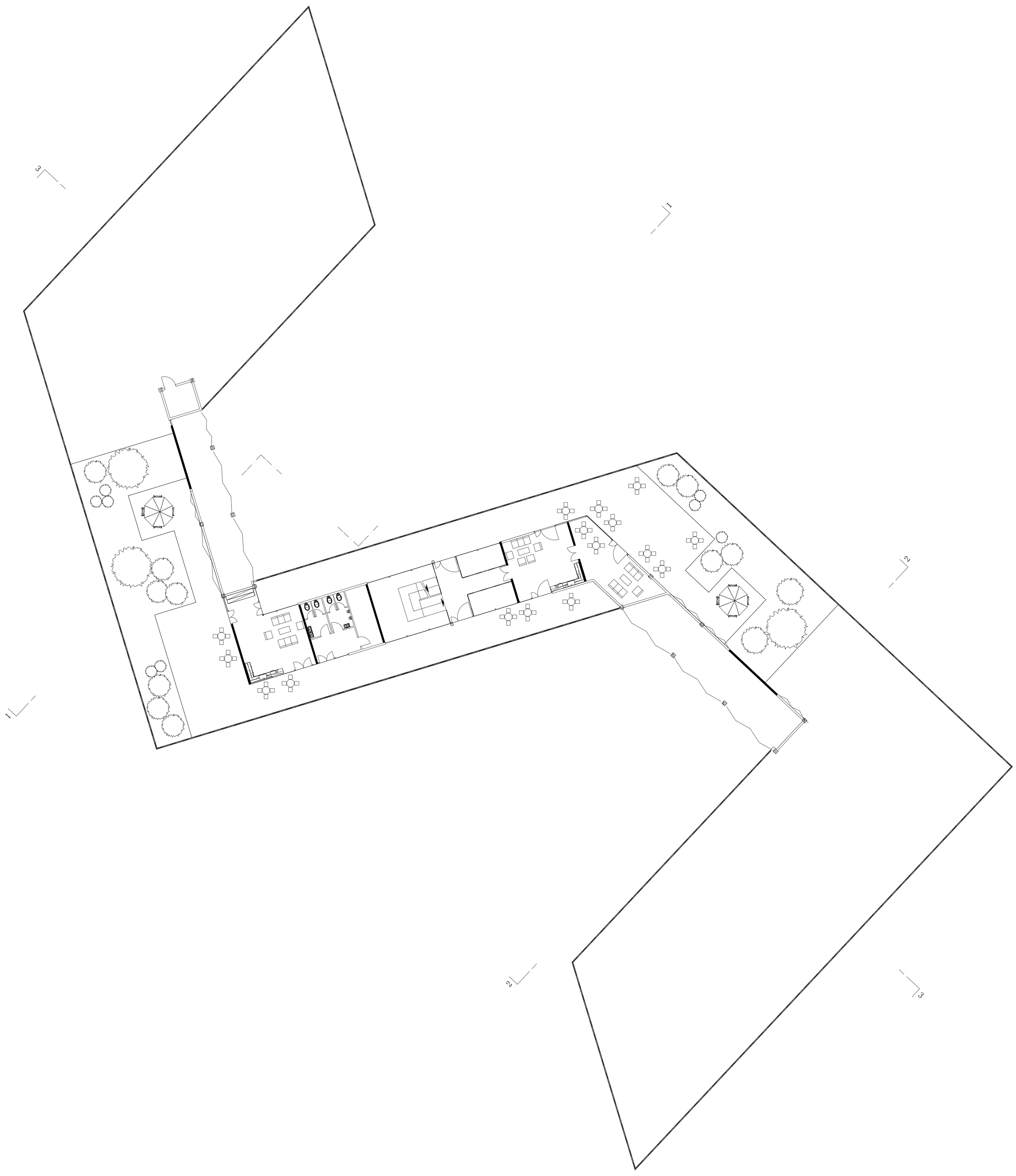
First Floor 1:200



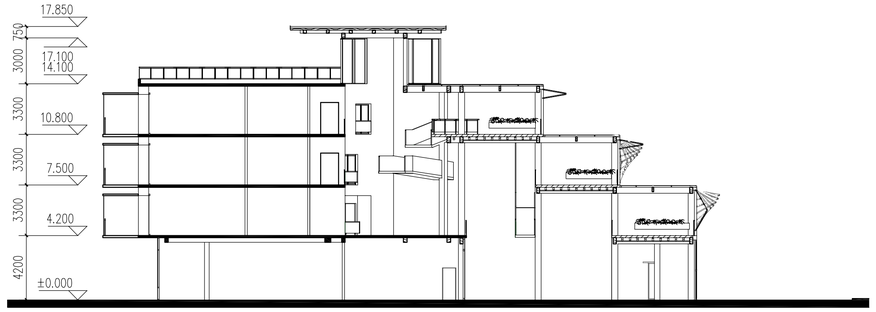
Second Floor 1:200



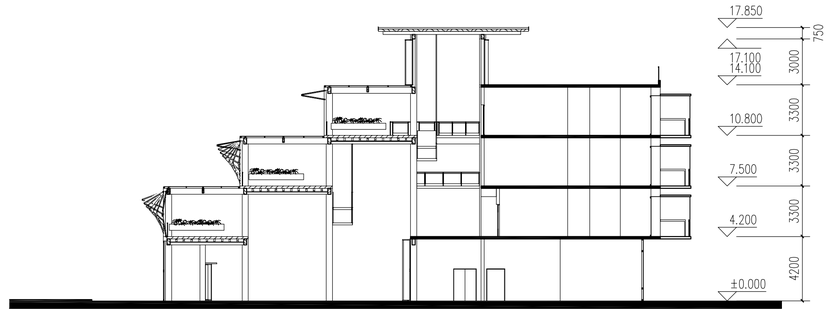
Third Floor 1:200



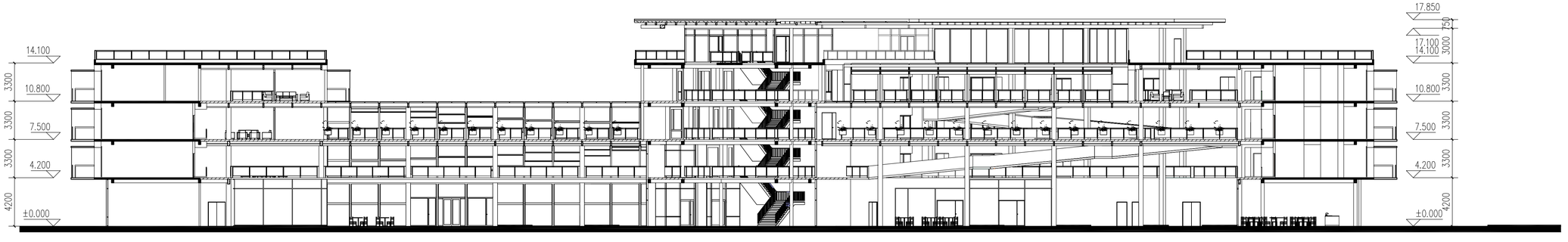
Roof Floor 1:200



Section 1-1 1:200



Section 2-2 1:200



Section 3-3 1:200

North elevation 1:200

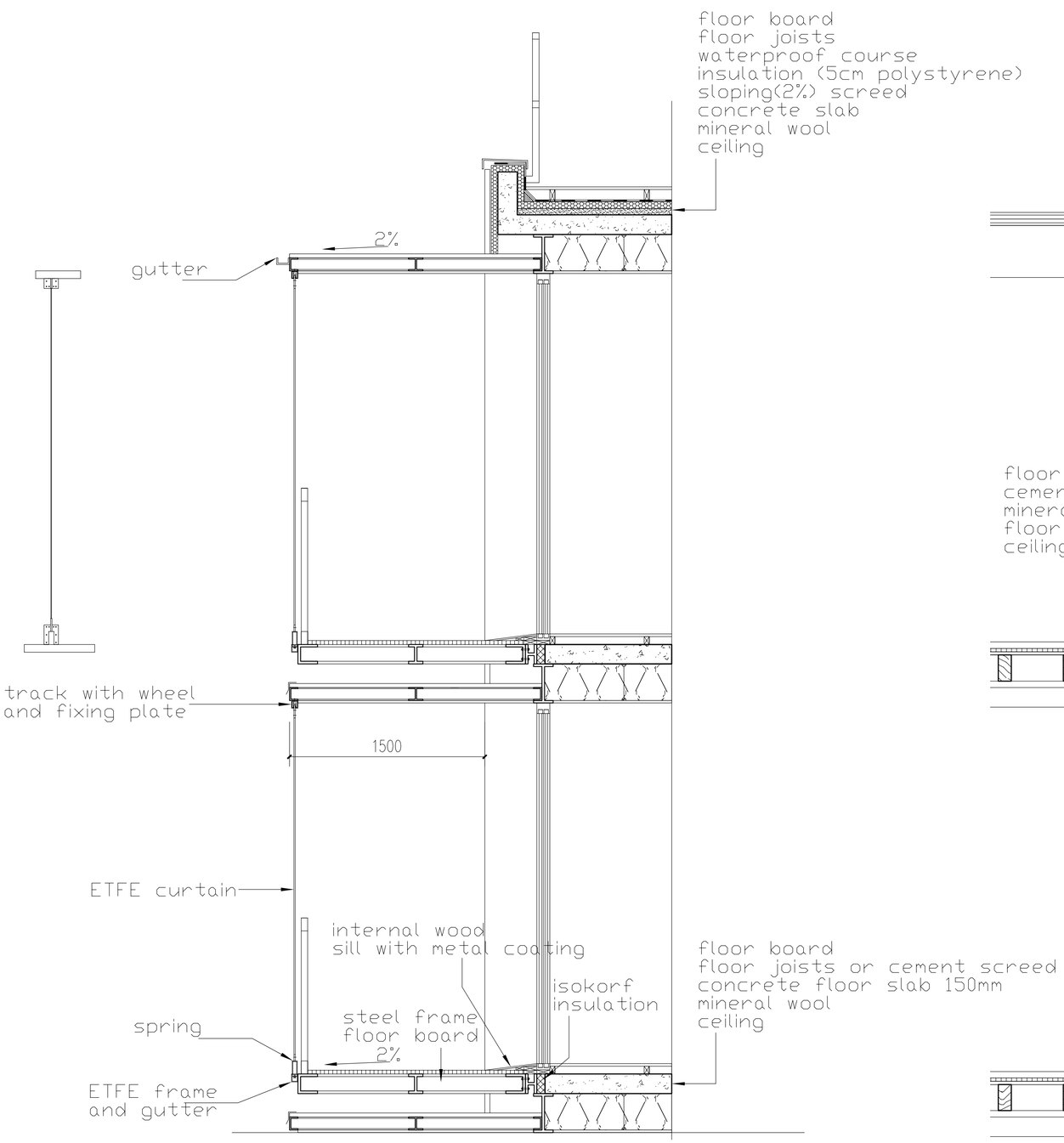
South elevation 1:200

West elevation 1:200

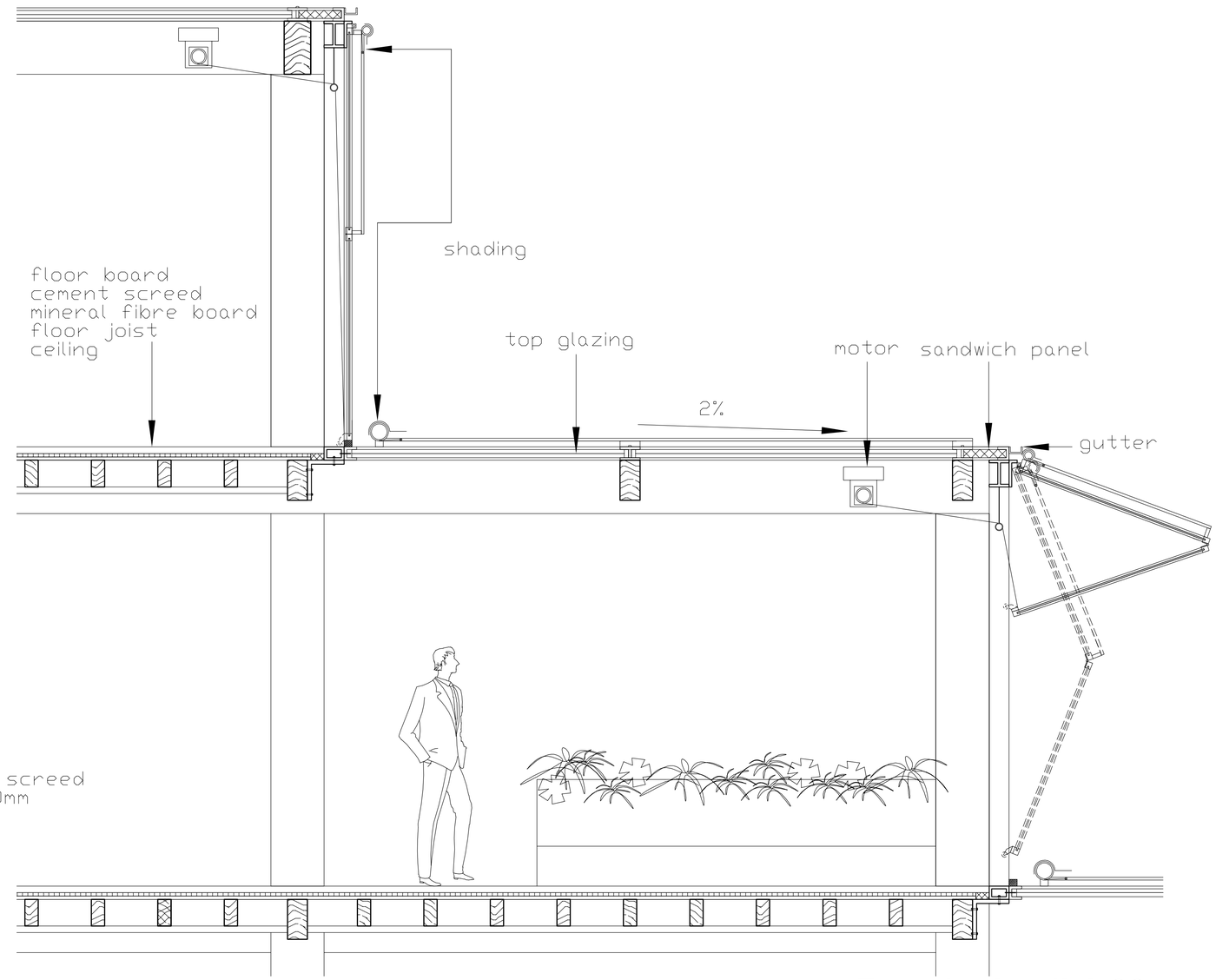
East elevation 1:200

Masterplan 1:500

1. Playground for children
2. Outdoor sports filed
3. Residential entrance
4. Public entrance
5. Imkerspark



Balcony detail 1:20



Facade detail 1:20