MASTER

Agri-itecture in a row
urban agriculture for creative row-housing as a way of smart living : the case study of Woensel-West, Eindhoven

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AGRI-TECTURE IN A ROW

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Urban Agriculture for creative row-housing as a way of Smart Living. The Case Study of Woensel-West, Eindhoven.
COLOPHON

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"Agri-itecture in a row. Urban Agriculture for creative row-housing as a way of Smart Living.
The Case Study of Woensel-West, Eindhoven."

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INTRODUCTION 1
1.1. SMART LIVING STUDIO

This graduation project was conducted in the Smart living studio in the Faculty of the Built Environment in TU/e. The studio considered that the development of new concepts with regard to the role of smart technologies in architecture and in architectural design is leading. Its main aim was a concept and design development that would take into consideration the interaction between the occupant and the living environment with the use of smart technologies.

For the time being, the application of smart technologies (smart wall, smart kitchen, smart furniture, etc.) in the building sector is limited mostly to health care and, most commonly, these technologies are added at the end of the design process. However, it seems reasonable that smart technology will significantly affect the spatial design. The core of smart technology is the interaction between users and their environment and, therefore, it is necessary that a smart house should account for the diversity of its occupants. So, as the smart spaces should react to their users, the integration of different technologies into a coherent smart living concept should be an architectural task.

The design assignment of this studio was targeted at housing, as redevelopment projects in particular are facing an immense challenge to convert the traditional living into smart living.

1.2. THE SUBJECT

The Smart living subject may have many different interpretations. My goal in this project affects two main aspects. Firstly, the research and design of a project should be developed on the aspect of smart living and new technologies, and investigate new innovative systems and different ways of living. Secondly, the social dimension of architecture was also a very important aspect. It is my firm belief that the quality of people's life is greatly affected by the environment that surrounds them and that the man should be the reference point of the design of every building. Consequently, my project explores the role of the technology in peoples’ everyday life and, as the studio is targeted at housing, the substantial changes that it can cause in the quality of life in the urban houses.

From a social point of view, it is an undeniable fact that the family institution has undergone major changes in the last decades in the urban context. The technological advances and the modern pace of life have changed the way of living in the urban houses and, nowadays, family and communal alienation is a common phenomenon in the cities. At the same time, nutrition habits have altered, while the role of food is considered to be very important for the social life.

In this project, urban agriculture is suggested as a possible way of advancing the urban quality of life and home farming in the urban houses is proposed as a way of establishing smart living. This idea is implemented in a Dutch middle-class row house in a creative and sustainable way and the design is proposed for the area of Woensel-West in Eindhoven.

1.3. STRUCTURE OF THE BOOK

This book is divided in eight chapters. The first chapter is an introduction to the graduation studio and the specific project. The second one contains the research that was conducted so as to form the social basis of the design project. In the third chapter, a more detailed project description is given while in the fourth the general design concept is presented. The fifth chapter is divided in three parts where the three scales of the design are discussed. The sixth, seventh and eighth chapters include the conclusion, the reflection and the bibliography respectively. At the end of the book, the reader can find the appendix where supplementary information is given.
THEORETICAL POSITION STATEMENT
2.1. INTRODUCTION

In order to provide sound social facts that the design could be firmly based upon, a socially-orientated research was first conducted. The theoretical foundation of the project is the result of a literature study on the importance of the act of eating in the social life of today and the movement of urban agriculture.

2.2. SOCIAL PROBLEM STATEMENT AND ANALYSIS

2.2.1. The quality of life in the urban house of the 21st century.

During the last decades, the increase in the use of digital technologies in all aspects of our daily lives has become obvious. The way of living and working has significantly changed and this phenomenon has many effects in the quality of life, especially in the developed countries. More specifically, the changes in life in urban houses have been substantial. Apart from the basic household technology that was gradually introduced in the beginning of the 20th century, the turning point can be stated as the early 1980s with the introduction of the PC into the home. After this point, the evolution of the technology used in the home was radical and varied from minor gadgets like the VCRs, the microwave ovens, the answering machines, to important electronic innovations like the Internet, the mobile phone and the wireless technologies (Venkatesh, 2008).

However, even though it is easy to say that the quality of life has improved, as many tasks of our daily lives have been much easier to be accomplished due to the offered technology, the truth is that there are some important problems that have arisen. One of them is the alienation and the lack of personal relationships between the family members in today’s home. Latest surveys have shown that 45% of the waking hours of an average adult are spent on using technologies like the PC, the internet, the phone or the television. In addition, 76% of TV, radio and online use is at home, 16% is at work and 8% is on the move (Liz, & Revoir, 2010). Moreover, according to a survey released by the Council for Research Excellence, adults are exposed to screens for about 8.5 hours on any given day (Stelter, 2009). This data implies that family members tend to focus on the screens available and reduce the time spent for interpersonal relationships. Of course technology is not the only one to blame for this phenomenon, but it surely plays an important role to this change.

2.2.2. Food as a means of socialization and improvement of the quality of life. Socializing through eating.

Another important aspect regarding the quality of life in the cities is the changes that have been recorded during the last years in the nutrition habits of their residents. Nutrition plays a very important role in the physical and mental well-being, which is a crucial aspect of the quality of life. A meal has always been considered not only as a vital calorie intake, but also as a social event. Even

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**Table 1:**

<table>
<thead>
<tr>
<th>ATUS activity code</th>
<th>Activity</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>120303</td>
<td>Television and movies (not religious)</td>
<td>16.8</td>
</tr>
<tr>
<td>050101</td>
<td>Work, main job</td>
<td>15.5</td>
</tr>
<tr>
<td>120101</td>
<td>Socializing and communicating with others</td>
<td>5.2</td>
</tr>
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<td>010201</td>
<td>Washing, dressing and grooming oneself</td>
<td>5.0</td>
</tr>
<tr>
<td>020201</td>
<td>Food and drink preparation</td>
<td>4.4</td>
</tr>
<tr>
<td>180501</td>
<td>Travel related to working</td>
<td>3.5</td>
</tr>
<tr>
<td>180782</td>
<td>Travel related to shopping (except grocery shopping)</td>
<td>3.0</td>
</tr>
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<td>Reading for personal interest</td>
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<td>120301</td>
<td>Relaxing, thinking</td>
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<tr>
<td>020101</td>
<td>Household--interior cleaning</td>
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*Figure 1* The top 10 activities that accompanied secondary eating/drinking, 2006-08, age 15+. (Hamrick, Andrews, Guthrie, Hopkins & McClelland, 2011)
though it is impossible to set a general rule for all the developed countries of the world, as there are many variations on the nutritional habits of populations with different geographic, cultural and social settings, a common tendency can be detected.

In the past, families used to gather around the table for lunch and dinner, while at the same time they had the opportunity to express their feelings and share their problems. Meal was made by the mother as a token of love and its ingredients were mostly grown by the family. This assured a respect and a deep knowledge of the identity of each meal. Nowadays, however, the rhythms of everyday life tend to turn this habit into a luxury. The family members tend to have fewer meals together, especially on weekdays, the meals are often pre-cooked and heated to be served, and, most of the times, the origins of its ingredients are unknown to them. A survey conducted by the U.S. Department of Agriculture’s Economic Research Service (ERS), titled “How Much Time Do Americans Spend on Food?” points out that “Americans like to eat quickly, tend to skip breakfast, take shorter lunch breaks, don’t spend much time on preparing and enjoying elaborate meals, make spontaneous food shopping choices, etc” (Hamrick, Andrews, Guthrie, Hopkins & McClelland, 2011).

Moreover, apart from the quality of our meals, during the last years there has been a tendency to eat while doing something else. The ERS survey states, “Just focusing on your meals and enjoying them is becoming a thing of the past, especially among the younger generations. On an average day [in 2006 to 2008 – the time period the survey took place], Americans aged 15 and older spent about 2.5 hours daily eating or drinking. Slightly less than half of that time was spent eating and drinking as a primary or main activity, while the remaining time was spent eating and drinking while doing something else such as watching television, driving or working and waiting to eat or traveling to meal destinations.”

Another fact is that, although food has become increasingly separated from the knowledge of where it comes from, how it is produced, processed and made available, the consumer choices highly affect the interconnected system of farmers, supermarkets, shipping companies and others. However, annual growth rates of 16 percent in Europe and 11 percent in the United States on the sales of organic food and drinks may indicate a change towards a healthier behavior with respect to our nutrition (De Borja, Kuijer & Aprile, 2010).

2.3. RESEARCH QUESTION

Having in mind the important facts stated already regarding the family and communal alienation and the significant change in our nutrition habits, a question can be raised. Is it possible to improve the interpersonal relationships in the urban family by recalling the old nutrition habits and how can innovative technologies be used in order to achieve this goal?

To this point urban agriculture can be introduced to offer a feasible solution to this problem.

2.4. URBAN AGRICULTURE (UA)

2.4.1. Food for thought

According to the latest scientific predictions, 90% of all Europeans will be living in cities by the year 2015 (Pederson & Robertson, 2001) while, by the same time, there will be around 564 cities around the world with one million or more residents (Mougeot, 2006, p. 4). As it can be assumed from these predictions, the food needs for the urban population will rise and the matter of nutrition in the cities will be increasingly discussed in the future. This paper focuses on food safety and the social implications of food availability as factors of the quality of life in cities.

Undoubtedly, diet and nutrition have clear health linkages. A diet poor in vegetables and fruits is associated with cardiovascular diseases, certain types of cancer, micronutrient deficiencies, hypertension, anemia, premature delivery, low birth weight, obesity and diabetes (Pederson & Robertson, 2001). However, for the urban residents, access to fresh and healthy fruits and vegetables is not always an easy task. Their high demand in cities around the world requires most of the times greenhouse operations and long distance transport. Consequently, the demand on vegetables and fruits that last longer leads to the deterioration of their quality and nutrients.

A potential solution to this problem has been suggested lately in the form of “Urban Agriculture”, which involves setting the food production closer to or in the cities themselves. This method is likely to provide urban residents with fresh fruits and vegetables of higher nutrition value than the ones that are stored and transferred for a long time.
According to René van Veenhuizen (2006), “Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. Urban agriculture is located within or on the fringe of a city and comprises of a variety of production systems, ranging from subsistence production and processing at household level to fully commercialized agriculture.” However, he continues, what distinguishes urban from rural agriculture is not its location, but the fact that “it is an integral part of the urban economic, social and ecological system: urban agriculture uses urban resources (land, labor, urban organic wastes, water), produces for urban citizens, is strongly influenced by urban conditions (policies, competition for land, urban markets and prices) and impacts the urban system (effects on urban food security and poverty, ecological and health impacts)” (p. 10).

Architectural and planning thoughts on urban agriculture date back to Ebenezer Howard’s Garden Cities of Tomorrow (1902), where the five-sixths of each city were devoted to food production. Two decades later, urban agriculture policies were introduced in Le Corbusier’s “Contemporary City”, as this was described in “The City of Tomorrow and its Planning” (Doran, 2005, p. 54). Finally, in 1958 Frank Lloyd Wright introduced the pre-urban agriculture on a large scale in his book “The Living City”.

Urban Agriculture can occur in almost any unused space within a city’s limits and can...

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GARDENING IS CHEAPER THAN THERAPY AND YOU GET TOMATOES

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[2] Figure[2] Agriculture plots in Thessaloniki, Greece. The Aristotle University of Thessaloniki rents plots of the School of Agriculture to the citizens in order for them to grow their own vegetables in the urban context. (http://cityfarmer.gr/2012/03/06/oikologika-agroktimata-auth/)
appear in different scales. Moreover, there is considerable variation in the purpose, location, size, production techniques, and its end products. According to Mougeot (2006, p.5), crop and animal production can occur on roof gardens, roadsides, beside railroads, in vacant lots of industrial estates, on steep slopes and banks of rivers, and on the grounds of schools, hospitals, prisons, and other institutions. Furthermore, aquaculture is possible in tanks, ponds and pens in rivers.

Individual cases of growing food on windowsills, balconies and backyards are a small-scale type of urban agriculture. However, the strongest examples of urban agriculture are the result of communal cooperation. Roof and other community gardens have gained ground the last years in the cityscape, as they combine the regeneration of the interpersonal relationships between the neighbors and the production of food in order to achieve better quality of life in the urban environment.

Urban agriculture, as all urban phenomenon, has both a positive and a negative impact on environmental, economic, social and health aspects of living in the cities. For the needs of this paper, its benefits and risks will be mentioned, as they are considered to have a significant impact on the quality of life in cities and the social life of their residents.

i. Urban food security and nutrition

The most important asset of urban agriculture is the fact that it covers satisfactorily the nutrition needs of the urban population in both developing and developed countries. As the costs of shipping food around the world from rural to urban environments are getting higher, urban agriculture secures an even supply of healthy food to urban residents. A global estimate is that 15-20% of the world’s food is currently produced within city limits, while in Europe, USA and in Australia, the numbers of citizens that take up gardening or buy directly from nearby farmers are increasingly rising (De Zeeuw, 2004).

ii. Health

As stated before, urban agriculture can secure the supply of the city residents with fresh fruit and vegetables. This is certainly a great benefit for the public health, as growing, buying and eating the right food can reduce the risk for major diseases. Nonetheless, urban agriculture may also present some
Although it may be unrealistic to think that the urban agriculture can thoroughly solve the problem of food supply for the cities, it can offer a major relief in the residents’ concerns towards the food safety and adequacy. It is strongly believed that 30% of the food could be produced within the city borders with significant benefits to its residents and the city environment itself (Whitfield, 2009). On a critical review of the benefits and risks that have already been mentioned, we can claim that each advantage is not strong enough to support the idea of urban agriculture on its own. However, the combination of all its potentials compared to its risks may form a strong argument towards its adoption in the cities of the developing and developed countries.

City residents could benefit the most out of these activities by integrating them into the urban fabric and making them part of the city development. In the case of urban agriculture, the initiative belongs to the communities of the cities around the world. Moreover, taking into consideration that the green policies are of high importance in constructions, developers are expected to invest on this kind of activities.

2.4.2. Expressions of UA

As urban agriculture grows in popularity every year, architects, constructors and technology developers are showing an increasing interest in the topic. As far as the already suggested architectural solutions are concerned, hereby is a short analysis of the most important and common used ones.

i. The community gardens

As it has already been mentioned, the easiest and most common way for the urban agriculture activities to take place is the

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*Figure[4] Community garden in Seattle.*

(www.djc.com)
risks for the public health. A problem that comes up regularly is the contamination of the sites that are used, due to their proximity to industrial zones, their former use or the traffic emissions. In these cases, the soil and the water may be polluted with heavy metals, pathogenic organisms or acids and a thorough assessment and clean up of the site is required, so as to avoid the production of contaminated and inappropriate food. Moreover, an insufficient management of the facilities may lead to a spread of certain human diseases by mosquitoes and scavenging animals attracted by agricultural activities, noise and odor nuisances. However, we should not exaggerate about these risks, as they could be eliminated by the sufficient assessment and management of the agricultural activity in the city.

iii. Local economic development

The urban households are the ones that gain the most out of urban agriculture as far as the economy is concerned. According to research, poor people spend 60 to 80 percent of their income on food. So, by growing their own food, the city residents can, on one hand, save on money from buying expensive fruits and vegetables and on the other hand, even earn money by selling their produce in the local markets.

iv. Contributions to urban environmental management

Urban agriculture could significantly contribute to the environmental management and the productive reuse of contaminated or abandoned land within the city limits. Firstly, part of its philosophy is the utilization of the water and the urban waste as a productive resource. Secondly, it contributes to the greening of the cities, the improvement of the urban microclimate and the conservation of soil, water and the cultural landscape. Last but not least, by growing food in the cities, energy consumption on transport, cooling and packaging of food that is transferred from far away is significantly reduced.

v. Social benefits of UA

The social benefits of the urban agriculture are multidimensional, as they have to do with both the communal and the individual life of the city residents. Urban agriculture is considered to be a highly communal driven and managed activity. Its strategies are commonly used for the social integration of newcomers and disadvantaged groups in the urban socio-economic system. Moreover, people of different ethnicity, gender, class and age come together towards a common goal. In this way, stronger urban communities with significant collective identity are built within the city limits. Furthermore, the members of the community through their collective production of food contribute to a better living environment and to the upgrading of their neighborhood. Abandoned plots and dump sites that were used for illegal activities are now being used for growing food activities that make people come closer to each other, interact and communicate. Another aspect that has to be mentioned is the educational value of the urban agriculture. As people come closer to the production, they gain knowledge upon the origins, the cultivation techniques and the proper growing season of what they eat. Last but not least, involvement in growing food has psychological benefits, too. Many people in developed countries admit that they do not undertake this activity for the food production itself, but for the fact that it helps them to relieve their stress, so they consider it as a healthy occupation.
community gardens. In the common areas of a building block or in the abandoned sites of the neighbourhood, the residents come together and grow their own food either for their private consumption or for selling it. The community gardens and the city farms are becoming more and more popular in big cities; in London their owners have their own federation which represents around 120 city and school farms and nearly 1,000 community gardens and attract more than 65,000 people each year (Federation of City Farms & Community Gardens, n.d.), while The Lower East Side community garden in Manhattan is "the place to be" according to the tourist guides.

ii. Green roofs

Cultivating on flat rooftops is not a new trend. Green roofs have been installed on new buildings over the last decades, as they are considered to contribute to reducing energy costs for heating and cooling. In accessible roofs, provided that the load of the soil needed is calculated for the structure, the green roofs could also be used for growing food. In these cases, rainwater is used and the urban biodiversity is enhanced.

iii. Living walls

The living walls are the gardens that are being increasingly used lately on new buildings’ facades all over the world. They can provide shade and physical thermal and acoustic isolation to the construction. Although they are considerably more difficult to be constructed than the green roofs, their existence is impressive and therefore preferred in new buildings. They require a hydroponic system and can be found in many different scales. There is a wide range of plants that can grow on them and the systems that support them vary.
iv. Vertical farms

The concept of vertical farms belongs to Dickson Despommier (The Vertical Farm, n.d.) and was developed in Columbia University in 1999. The main idea is to produce all the food needed for the cities in high-rise buildings built specifically for this purpose. With the use of high-level technologies, such as hydroponics, aeroponics and aquaponics, the production of fish, meat, vegetables and fruit can be achieved. The building could secure a year round production unaffected from the weather.

2.4.3. The technologies of UA

As far as the technological part is concerned, during the last years many new systems have been developed in order to support the urban agricultural activities. Most of them are based on new technologies that aim to make the growing of food possible in other ways than the ordinary ones.

For the growing plants activities, hydroponics, aquaponics and aeroponics are emerging production technologies that do not use soil as a medium. By definition, hydroponics is a method of growing plants using mineral nutrient solutions, in water, without soil (Hydroponics, n.d.). Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, mineral wool, expanded clay or coconut husk. Hydroponics is lately combined with aquaculture, which is the farming of aquatic organisms, into the new method of aquaponics. So, as it is indicated by its name, cultivation practices of fish and plants are integrated in one soilless system that has been widely developed over the last years. This system is based on a biological circle in which the plants provide a natural filter for the water and the fish waste is a natural food source for the plants. As a result, there is a zero environmental impact. With the use of the aquaponics method, safe, organic and fresh fish and vegetables can be produced all year round and, due to the compact nature of its facilities, very close to the end users (Nelson + Pade, n.d.). Another method of growing plants is aeroponics, where air or mist is used instead of soil or a growing medium. The plants’ roots are sprayed in a closed or semi-closed environment with an atomized or sprayed, nutrient-rich water solution. Another specific and interesting method named fungiculture is used for growing mushrooms indoors with the use of straw filled bags.

Apart for growing plants, some methods for growing animals have also been developed. Urban beekeeping, fish farming and heliciculture (snail farming) are activities that are gaining more fans every year in big cities like New York and London.

Figure[6] Unrealised vertical farm project in Chicago designed by Blake Kurasek. (jessesuchoffdesign.com)

Figure[7] Aquaponics System (agduff.tumblr.com)
2.5. UA AS A WAY OF SMART LIVING

The pace of life in modern cities has significantly changed during the last decades. The increasing amount of working hours, the new technological advances and many other factors have played an important role in this change. The people are gradually coming closer and adopt new technologies that promise to raise their quality of life, automate some daily activities and help them accomplish their tasks. However, while people are getting addicted to this way of life, the physical communication between them tends to decline. Nowadays, it is a common phenomenon for the houses of the developed countries to have a wireless high-speed Internet connection, more than one televisions and personal computers for almost every member of the family. Consequently, family members tend to be attracted to their personal screens and the virtual environment of the social media, a behaviour that enhances the family alienation that is also supported by other aspects of the new way of life in cities.

The thesis of this project is that new activities around food could alter this situation between the family and community members. Urban agriculture methods can contribute to the recall of the old healthy habits and bring people together towards a common goal. Through the procedure of growing food, people will interact and the knowledge behind their meals will be regained. Moreover, its results of fresh and healthy food will be rewarding and good for their health.

It is safe to claim that technological advances have contributed to the family alienation; however, technology could be used in order for this problem to be tackled through the urban agriculture activities. As it is already mentioned, technology is highly developed and, with its use, cultivation has become easier, more accessible to city residents and compact enough, so as to be fitted even at home. As such, putting it into practice may only bring about positive results towards the improvement of the city residents’ quality of life.
3.1. DESIGN QUESTION & INTENDED RESULTS

To date, the Urban Agriculture movement focuses primarily on how the cities could become self-sufficient with respect to food supplies and on the solution of the lack of food supplies in developing countries. In a critical review of this goal, I strongly believe that this is a utopian view on the subject as the means required in order to achieve such self-sufficiency are difficult to be obtained and financed. Essentially, this is the reason why these futuristic projects have not yet been implemented. Nonetheless, if we focus on the main idea that this movement proposes, we can take advantage of its high social and nutritional benefits. As aforementioned, urban agriculture, if used in small scale, could definitely contribute to the improvement of the quality of life in urban houses and within the limits of a community. Of course, this is not the only way to achieve an improvement in this aspect. However, it can bring about significant changes in the way of life, if used sensibly.

The systems used to support the urban agriculture are mostly developed for achieving mass production. However, as these changes are more likely to occur firstly in the home context, the issue is how these innovative technologies could be implemented in them in a creative and sustainable way.

The project is structured with a view to achieving the two main intended results. Firstly, the implementation of the small and bigger scale activities of urban agriculture in the urban house with the use of new technological advances. Secondly, the provision of a better quality of life to residents of cities in two dimensions; psychologically, by the improvement of the social life of the residents, and physically, by the provision of a healthier nutrition. In that way, the urban houses will provide their residents with fresh food and encourage them to develop better interpersonal relationships in a family and communal scale.

![Diagram](image.png)
3.2. General Concept Development

3.2.1. Analysis of the diagram of UA (Figure 9)

The Urban agriculture movement is used in this project primarily on the grounds of its social values. Under the scope of the food production, common social activities developed both in public and private areas can be expressed in unique and different ways. The act of eating can become a social event, when a collective space is designed for that reason. At the same area, people can come together, meet or share activities connected with agriculture. In the same way, they can have fun through reading and playing. Of course, they can isolate and take advantage of the serenity that the natural environment may offer. Finally, a very important part is the educational activities that can take place in the area. Adults could get informed on the values and the technologies used for urban agriculture, while children could learn through playing.

3.2.2. Building typology

As far as the building typology is concerned, the project proposes a new design for the Dutch urban row house. According to statistics, about 42% of the total of 6.5 million dwellings in the Netherlands corresponds to row houses. Out of these, almost 51 percent were built in the period after the Second World War (1946-1965) and they are definitely outdated and cannot serve the needs of today (Heijneman, Ham, 2004). As the row housing typology is widely preferred in the Netherlands, the proposal of an alternative design based on the urban agriculture philosophy may achieve the sustainability in future buildings by its broad potential application in the future housing system.

Another reason why the Netherlands is ideal for the implementation of this project is its agricultural background. People are familiar to agriculture settlements that stand in the rural environment of the country. Moreover, it is very common phenomenon that allotment gardens that are rented to urban residents are developed outside the cities. This project dares to bring this habit in the urban environment and in the house itself.

Apart for the building typology, the project focuses on the sustainability of the design. For that reason, the urban agriculture activities in the new design are developed to work as a sustainable and independent system. All the activities are interconnected and work complementary to each other in order to achieve a zero energy impact and limited costs for the house’s users. This element is thoroughly outlined in the next chapter.

3.3. Case Study. Woensel-West Analysis

3.3.1. Area selection

In order to thoroughly comprehend the values of the new row house design, it should be implemented in a real urban context. As such, the case study of Woensel-West in Eindhoven was chosen due to its special characteristics.

The basic characteristic of the area is the fact that it is inhabited by 79 different ethnicities. The 62% are Dutch and the 20% of the non-Dutch are Turks. As far as the building environment is concerned, most of the houses are family houses, built before the Second World War. Besides the buildings’ physical problems, Woensel-West also faces social problems. The social welfare position of a group of the inhabitants is not very strong and safety has been an issue for years. According to the list of the Dutch Ministry of Housing, Communities and Integration for the 40 Dutch Krachtwijken (problematic and downgraded
areas) on March 2007, Woensel-West was ranked in the number 14. These residential areas require additional investments in order for their social, physical and economic problems to be solved. For the time being, many residential plans are being conducted for the development of the area. Finally, the Woensel-West is well known for the strong bonds of its community. Events, workshops and communal activities are organized in order for the residents to get to know each other better and spend time together towards reaching a common goal. It is also known in Eindhoven for its inhabitants’ unique habit to gather in sunny days in their front gardens that face the south. They are having BBQs, chatting with their neighbors, enjoying the sun and socializing.

Due to the social conditions, the multicultural context of the area and the existing strong community, Woensel-West could be an ideal case-study for a design that aspires to contribute to the improvement of its inhabitants’ quality of life and create stronger communal bonds between its residents.
3.3.2. Historical Analysis

The area is formed around the main streets of Edisonstraat, Wattstraat, Minckelersstraat and Fraklinstraat and its borders are formed by the Boschdijk Avenue on the east, Marconilaan on the South, the rail tracks on the west and the former Philips Electronic buildings on the North.

The history of Woensel-West starts at the year 400 A.D., when Romans settled in the area. Afterwards, Germans dominated the area and, after their leaving, farmers settled down. In the early Middle Ages the village of Woensel is formed and after 1200 A.D., it assumes an important role in the area. The village of Woensel is much older than the eight hundred year old center of Eindhoven. In 1791, the population of Eindhoven was 1.785 people, while Woensel had 2.276 inhabitants.

In 1891, Frederick and Gerard Philips founded the company "Philips and Co" and they established the light factory in Eindhoven. Since 1900, Philips started growing and the demand for workers increased immensely and so did the inhabitants of Woensel; from about 3000 inhabitants in 1835 to more than 15.000 in 1920. As expected, the housing problem was imperative to be solved.

In the early 20's, the Association of Housing (VVE) started the construction of the first 300 houses in Woensel-West. The A-type houses were built in the Wenckenbach-, Volta-, and Galvanistraat and around the Edisonplein. At the same time, the larger B-type houses started to be built around the Celsiusplein and consisted of 376 houses and 8 shops. The basic characteristic of these types is that they are comparatively small for a whole family to live in. In 1929, the association completed the construction of 270 houses and 4 shops in the

Figure[14, 15] Photos of Watstraat
Figure[16, 17] Photos of Franklinplein
Figure[18,19] Demolition in Edisonstraat
Figure[20] The construction stages in Woensel- West
area between the Boschdijk Avenue and the B-type houses.

At the same period of time, Philips started their own housing association named “Thuis Best”, in order to construct houses for the higher educated workers. In 1929, the construction of 119 bigger “beambtenwoningen” around the Humboldtplein started. In the early 30’s Archimedisstraat, Morsestraat, Amperstraat, Wattstraat, Stevinstraat and Juliusstraat were built, too. The last houses built before the War were the 36 private houses on the Brugmanstraat that finished in 1939.

The bombings on 19 September 1944 destroyed the houses around Edisonstraat. The first signs of new housing in Woensel-West appeared in that place in 1949 in Franklinstraat, Reamurstraat and Pieter Zeemanstraat. The municipality decided to design Woensel-West as a rehabilitation area. Despite the two minor renovations in 1929 and 1959, the quality of the houses remained poor. Although the cost of maintenance after the third renovation was estimated to be quite high, the construction of new houses was not approved by the residents, as they assumed that the rent of the new houses would be twice as high as the old ones. The third renovation started with the A-type houses, continued with the B-type houses around the Celsiusplein and finished in 1984 with the ones around the Humboldtplein. In the early 90’s the first demolitions took place in the houses around Minckelersplein and Kamerling Ohnestraat.

In 2000 the municipality of Eindhoven implemented the renewal urban plan for the area. Until 2010, ten neighborhoods were gradually renewed and the total of the rest of the buildings is expected to be replaced in the coming years.
3.3.3. Program

Until today, most of the buildings in the area are of the typical Dutch row house typology and follow the same patterns as the ones that were firstly built in the same place. The exceptions are particularly located on the corners of more important streets, like the Edisonstraat and the Wattstraat. These corner buildings house multicultural shops, bars, schools and offices. However, due to their small number, the inhabitants are compelled to work, shop and recreate away from the area.

Apart from the houses for the workers, Woensel-West became the area of the prostitutes shortly after the War. At first, they were trying to get customers openly on the Edisonplein. And later in 1977, when this way was prohibited, “windows” could be found anywhere in the area. After the year 2000, the prostitutes were limited to the Baeckelandplein, where they stand until today.

As far as the green areas are concerned, their absence is obvious not only in the public green spaces, but also in the semi-private ones. There is no designed green public area and the ones that currently exist basically host the playgrounds. The linear green public space adjacent to Woensel-West cannot be categorized as a public space, because it is located exactly next to the train line and, therefore, it is not a place to rest or relax but a linear transit space. The semi-public spaces which contain greenery are commonly not well designed and cared for and are only visible in areas close to Edisonstraat and Wattstraat.

3.4. Expectations

As already mentioned above, the area of Woensel-West was particularly chosen due to its unique social characteristics in Eindhoven. The new way of living that is introduced by this project can be embodied in the lives of the residents and enhance the already existing tendency of communal living and sharing. It can also set the basis for a new orientation towards a more developed, safer and friendlier neighborhood as well as contribute to the development of a green core that is missing from the area. In a personal level, it can introduce the residents to a different way of living closer to the natural environment, provide them with fresh and healthy food and give them the satisfaction of creation. Moreover, the new design for the typology of the row house that is proposed in the project can perfectly fit in the existing housing stock of the area that consists mostly of row houses, too.
4.1. INTRODUCTION

The site of the project is in the heart of Woensel-West and its borders are defined by the streets Celsiusstraat, Brugmanstraat, Fahrenheitstraat, and the Celsiusplein. Its position in the area is important, as it stands at the end of Edisonstraat, one of the most important streets in the area. Although Celsiusplein is in fact one of the limited few squares in the area, it is used as a playground and its position is crucial, it is nevertheless quite abandoned. For this reason, the project includes the redesign of the square, too.

Having analyzed the social background of the project, the design is developed with a view to fulfilling its cause. The primary and secondary concepts and gestures that infused the design are discussed thereof.

4.2. PROGRAM

The project is based on the concept of Urban Agriculture (UA) and is outlined in three scales of design; the block, the housing unit, and the technological systems used. The block scale describes the complete design of a block in the heart of Woensel-West and its main objective is to create a communal and a public core that mutually contribute to its development. The housing unit is designed upon the principles of the row-housing typology and can be built in every city in the Netherlands and abroad. Finally, the technological systems scale aims at the creative implementation of the existing Urban Agriculture systems in the design. Urban agriculture activities appear in all the designed scales. The users are taking advantage of growing and eating their own fruit and vegetables, coming together, and developing a community under the scope of agriculture.

Figure[22] Panorama of Celsiusplein
4.2.1. “The Battery”

In order to make the idea of living in an agricultural environment even more appealing, the activities around agriculture do not burden the users financially, as all scales are designed in such a way that they can provide their users with a self-sufficient and sustainable production. For that reason, the idea of the energy circles is introduced.

All scales are equipped with a system of areas that is called “the battery”. This is because its design is in fact based upon the working principles of a real battery; it produces and saves all the energy needed for the UA systems to work and delivers it in the way and at the time required. The mechanical systems that support the agriculture activities in all scales are placed in these areas, from now on referred to as “batteries”, which are interconnected in order to achieve optimal energy provision for the project. The design of the “batteries” will be thoroughly presented in the following chapters that describe the three scales of the project.

In order to achieve self-sufficiency, this project employs the following systems; aquaponics, hydroponics, aeroponics, rainwater harvesting, wastewater treatment, waste composting and solar panels. The analysis of these methods will be done extensively in the technological systems scale chapter.
5.1 **THE BLOCK SCALE**

5.1.1. **Concept**

At the time being, the block is developed in the typical enclosed Dutch way and has 34 houses with gardens. The new design proposes a block where the public, the collective, and the private sectors function under the scope of urban agriculture. The block aims to work as a model for the further development of the neighborhood. The public sector refers to one thousand people or more, pedestrians or residents of other neighboring blocks. The collective sector refers to about one hundred people, adults and children, living in the 25 houses of the block. The private sector refers to two to five people that live in the two typologies of the housing units. These sectors are coming together, but are also separate in order to serve the users' needs best. Living or passing by the block will be a new experience in the urban fabric.

The basic concept of the block scale is the creation of a pedestrian road that crosses the block as an extension of the Edisonstraat with all functions developing on and around it. The public and collective batteries are designed across this street, while the houses are placed on the two long sides facing northeast and the southwest. The difference in the levels of the sectors is the way that the borders between them are formed. The house units are designed in a strict way, so as to be able to use the same design in other blocks too, while the public sector is freer and site specific.

5.1.2. **Design**

Taking the orientation and the natural light into consideration, the design consists of 25 houses, public and collective buildings and areas. The house concept and design is analyzed in the next chapter of the house unit scale.
5.1.2.1. The Public Sector

The public road is forming a route through the block that brings the visitors closer to the movement of urban agriculture. Its shape is based on the orientation of the greenhouses that lie alongside it and follows a crooked pattern, with a view to offering different views for the visitors that walk on top of them. The design of an open block was chosen as social awareness is accomplished due to the route through it. This was the main challenge of the research question.

The starting point is the educational center and the garden that is placed in the beginning of Fahrenheitstraat, on level +0.00. In there, the visitors can be informed on the possible ways of urban agriculture, the technological systems used and the advantages of this way of living. They can get a first glimpse on what is happening in the block and the way things work. The exterior part - in the place where Celsiusplein used to stand - is transformed into small public allotment gardens that are taken care of by the workers of the center, but can also be used by the children of the school that stands nearby as part of their environmental education process.

The route continues with a stepped ramp that leads to the first elevated observation point in +2.10 meters. At that point the visitors can have a first overview of the collective gardens of different cultivations that lay down at -1.00m. The visitors continue their walk on the roof of the collective greenhouses which is made of triple glazed glass and steel plates. The first greenhouse’s tilted roof serves as a ramp that leads to the main public square that is elevated to +3.50 and stands in the middle of the block. This is where the third activity of the route takes place. The square hosts the flea
market of the block, where the inhabitants and also other producers can sell their products to the public once per week. This event enhances the social character of the block. People can buy the fresh products while being already in the place of the production; on the two big collective greenhouses and surrounded by the open air collective and private gardens. During the rest of the week, people can rest on the benches enjoying the natural environment and the quietness that it offers.

The route continues over the fourth collective greenhouse, whose tilted roof leads to the second observation point in +2.10. At this point stands the elevator and the stairs that connect the collective storage room and the public path, too. There starts the stepped ramp that ends at +0.00 between the entrance of the public restaurant and the green space in Brugmanstraat. Based on the multicultural character of the area, the restaurant has the potentials of becoming the place where eating could become a social event. The green space is a multifunctional open space that can be used as a relaxing area, a playground or an outdoor space used in public events with the support of the restaurant. In the corner of Brugmanstraat and Fahrenheitstraat, a public bike shedding is placed. Finally, as far as the privacy of the housing units that stand on the borders of the block is concerned, the closest that the public route gets to them is 9 meters. In short, the public route is designed with a view to allowing for people to get informed on UA activities, observe, shop, eat, relax, recreate, socialize and have fun through urban agriculture.
5.1.2.2. The Collective Sector

In parallel with the public sector, the collective one is also developed in the interior of the block. Set in -1.00m., the collective area consists of greenhouses, storage rooms, gathering points, gardens and water tanks. As it has been said before, the biggest part of the public sector lies above the collective one. The buildings under the public stepped ramps and the glass-metal structure that runs through the block and hosts a major part of the collective sector consist the so-called "collective battery". This is because the mechanical systems that support the production and the plant rooms are placed in it. Under the eastern stepped ramp stands the plant room of the systems used in the area and a storage place. The two small collective greenhouses with the tilted roofs host the low vegetation, while the two central ones can host mid-sized trees that cannot survive outside and the collective aquaponics system. The western stepped ramp hosts in practice the crops', vegetables' and fruit's storage room and it has a direct connection to the flea market that stands on top. In the same area a small room hosts the collective fungiculture. All these covered areas have small gathering hubs where the people living in the block can meet, eat and spend their leisure time.

With respect to the open air part of the collective sector, gardens, paths and water tanks are designed. The gardens follow the design of the greenhouses, albeit in a more orthogonal way. Every garden is cultivated with a specific type of vegetation depending on the period of the year and it is taken care of by the inhabitants of the block. The trees that are grown in these gardens also work as a privacy filter for the housing units. However, apart from the vegetables, a small plot is dedicated to the activity of urban beekeeping. The paths in the collective sector are designed in order for all houses to have access in every part of the open space. Last but not least, the water tanks installed in between the gardens are part of the rainwater harvesting system that is set in the plant room. They have a linear design and they are one meter deep, so as to avoid high levels of evaporation. They are placed in partly shadowed areas that crops and vegetables would be difficult to grow and next to the greenhouse, so that they can get the water from the roofs, too.

5.1.3. Special Characteristics

The Block's Circles and Systems

In order to achieve self-sufficiency in the block production, the public and the communal batteries are supplementary and interconnected. Solar panels are installed on the roofs of the educational center and the restaurant, in order to provide the energy needed for the urban agriculture systems. As already mentioned, the rainwater that is collected in the water tanks of the collective area is transferred in the plant room and is used for irrigation in the collective and public sectors. In the same way, the wastewater from both areas is also cleaned and used for the same purpose. Finally, the organic waste produced in all activities is composted and used as fertilizer in the open air gardens and in the systems that depend on soil.

Concerning the way that food grows in the block scale, the greenhouses host aquaponic systems, still regular growing techniques are also used. The ventilation is ensured by natural means through the openings on the top of the glass walls, but also mechanically by means of the installed ventilation system. Moreover, under the steel plates of the roof hangs the lighting system that is needed for the days with limited sunlight. For the open air gardens, temporary semi-transparent structures are designed in order to protect the cultivations from unfavorable weather conditions. The complete list of the vegetation that can grow in every part of the block is shown in the Appendix.

5.1.4. Conclusion

The main characteristic of the block strategy is the interaction of the residents and the visitors. The level difference is crucial to achieve two simultaneous circulations in two directions that can support not only visual, but also physical connection when this is desired.
THE MAIN CHARACTERISTIC OF THE BLOCK STRATEGY IS THE INTERACTION OF THE RESIDENTS AND THE VISITORS
Agri-itecture in a row
5.2. THE HOUSING UNIT SCALE

5.2.1. Concept

The project proposes an alternative design for the row-house typology that can be potentially implemented in every city that this typology is applied. The basic idea pervading the design is the satisfaction of the family members’ need to come together, express themselves while eating and get fulfillment by growing their own food.

As the project revolves around the urban agriculture activities, the house orientation and light permeation plays a very important role to their design. For that reason, it was necessary to develop two different designs that would share the same principles and still correspond to the orientation demands in the best possible way. Moreover, the two house units have different target groups. The ones in Celciusstraat are designed for couples or families with maximum one child, while the ones in Fahrenheitstraat are for families with 2 children or more. In this way, diversity is achieved both in the image of the block and in the types of people that use the collective areas. The units are mirrored and placed in pairs one next to the other in the block borders.

5.2.2. Design

The design is based on the typical way that Dutch row-houses are developed. However, as this is not a typical house, the functions are rearranged in order to serve the new needs, while the “battery” element is added. Both types adhere to the same design principles and include the same elements. These elements and their connections are first explained individually and then their applications and differences in each type are being analyzed.
5.2.2.1. The Unit Areas

The two types are developed by the synthesis of the eating, leisure, relaxing/working, sleeping areas and the “battery”. Each of them has different expectations with regards to urban agriculture and contributes to it in a different way.

The eating area is the core of the house design, as it provides the main access to fresh food and contributes to the family bonding. In order to enhance this value, the eating area is equipped with a special structure that hosts the growing part of the aquaponic system which serves the “cut and eat” principle in the house. This construction will be discussed in the next chapter. The leisure area lodges the entertainment and educational functions. It is the place where the fish tank of the aquaponics system is installed as part of the battery and a smart wall that is connected with the agricultural system data and the cable television stands. In this way, the family members can always be updated with the status of their farming, get informed for the seasonal vegetables and, at the same time, enjoy their free time in a modern way. These two areas form the social core of the unit and, for this reason, they are placed next to the greenhouse and are immersed to -1.00m, the level of the collective garden. The relaxation area is separated from the social core of the unit, with a view to achieving the required peace and quiet and is split in the ground floor (+0.00m) and the terrace where a roof garden is designed (+6.00m). The sleeping areas are also isolated and shadowed and are placed on the first floor (+3.00m). In their balconies, an exterior version of the “cut&eat” structure is installed to ensure the preservation of their own privacy and their shading.

Figure[28] The transformation of the row house typology

Figure[29] The Unit Areas distribution in Type A house. The same concept is used for the Type B, too.
The “battery” hosts the plant rooms, the systems’ pipes, the sanitary areas, the atrium and the unit’s small private greenhouse. The basic core of the battery is the plant rooms that are hosting the mechanical parts of all the systems which are installed in the house and are analyzed in the next paragraph. The sanitary areas are split into the two levels of the house. A small W.C. is placed next to the entrance, while the family bathroom is located on the first floor. The greenhouse and the atrium are two linked elements of the battery. The atrium allows for the circulation within the house premises, as the stairs are part of it. It is covered with U-channel glass that filters the solar radiation and preserves the users’ privacy. The greenhouse is placed in the level of the social core (-1.00m) and has three functions. Firstly, it provides the house with a protected area for the growing of the private cultivations. With a height of four meters and covered with transparent glass, it can host medium trees and other vegetables that are impossible to grow in the small-scale interior systems. Secondly, as it is south orientated, it forms a transitional space between the outdoor, often cold, environment and the house interior. As the temperature in a greenhouse with a south façade can build up to 10 °C while the outside temperature is 0 °C, openings are designed in the glass walls in order to transfer the warm air to the interior. Of course, for ventilation needs, the greenhouse has also openings to the open air and a mechanical system is also installed. Finally, as it is placed next to the gardens, it can also be used as a covered relaxation area for the inhabitants. Towards achieving diversity in the block elevations and adding identity to each house, part of the battery is exposed to the street in both types. This means that as the design is identical between the houses of the same street, the difference in the facades can be made by the vegetation growing in the batteries of each house.
5.2.2.2. Type A- North

The first house unit type is developed for houses that their entrance maintains a north orientation. In the present case study, this type is facing northeast and is placed in Fahrenheitstraat.

This type has a linear garden that forms the transitional space between the house and the pavement. When entering the house, the users first pass by the relaxation area, which is separated from the entrance by a bookshelf and from the eating area by the vertical “cut & eat” structure. Afterwards, visitors may either take the stairs that lead to the sleeping areas of the first floor or go downstairs to the eating and leisure areas. Due to orientation issues, in this type the greenhouse and the open air garden are placed towards the collective garden. On the first floor, the master bedroom and the two other bedrooms are found. The master bedroom has its own balcony and the separation between the neighboring one is done by the exterior “cut & eat” structure. On the second level stands the terrace, where the roof garden is present. Moreover, on the north part a rainwater tank is designed, while the solar panels are installed on top of the atrium and the battery core.
North Elevation

+10.10
+8.40
+7.00
+5.30
+3.90
+3.00
+2.30
+0.90
+0.00
5.2.2.3. Type B- South

The second house unit type is developed for houses that their entrance maintains a south orientation. In the present case study this type is facing southwest and is placed in Celciusstraat.

As this type is facing the south and in order to keep the areas' tradition of social gatherings in front of the houses, an open air garden is added on this side. The basic circulation follows the same principles as the one in type A. However, in this case, the relaxing area is placed next to the garden and the “cut & eat” structure of the eating area is installed next to the greenhouse. On the second floor stand a small bedroom and the master bedroom with its own balcony equipped with the exterior “cut & eat” structure towards the south for shading purposes. On the second level, the roof garden is to be found. Part of the terrace is covered with solar panels, while the water tank is placed on top of the battery core.
North Elevation


5.2.3. Special Characteristics

5.2.3.1. The Housing Unit Circles and Systems

The systems work in the housing unit scale in the same way as in the block scale. Everything is connected to the “battery” either visually or not and performs in energy circles. The aquaponics systems are being controlled from the smart wall in the leisure’s area and the systems installed in the “battery” core. Moreover, all the organic waste is disposed in the composting system attached to the battery next to the eating area. The fertilizer produced is used in the greenhouse and in the open-air gardens. The rainwater that is collected in the roof tank, as well as the wastewater produced in the sanitary and eating areas, is cleaned in the “battery” and used for irrigation. Finally, the solar panels installed on the roof are producing sufficient energy for the systems to operate. The complete analysis of the systems performance is done in the chapter “The Systems Scale”.

Figure [31] The energy circles in the house units
Figure [32] The systems’ location in the battery of Type A house. The principles are the same for the Type B, too.
Photovoltaics

Photovoltaics plant room

Rainwater tank

Waste water tank

Clean water tank

Composting area

“Cut & Eat“ structure

Rainwater collector
5.2.3.2. Materials

As far as the materials used in the house unit design are concerned, their choice was based on the character of the neighborhood and the Dutch environment in general. The basic material that covers the whole structure is the typical Dutch brick. The only difference is made in the design of the “battery”, which is a steel structure attached to the main brick volume. The main core of the battery is covered with plywood in the interior, the atrium is covered with U-channel glass and the greenhouse is covered with double transparent glazing.

5.2.4. Conclusions

The housing units are designed with a view to achieving the intended results, as stated in the third chapter. They implement the UA activities in the daily life by employing the latest technological advances, bring their inhabitants closer to the natural environment, provide them with a healthier nutrition and - by design - tackle the problem of family alienation in the house.
5.3. THE SYSTEMS SCALE

Crucial is the role of the systems that support the urban agriculture activities in the block and housing units, as well as the ones that support the energy circles conservation. Bearing the hectic everyday life rhythms in the urban context in mind, the inhabitants’ free time is limited, in general. Towards addressing this issue, the technology is being used as a tool to help the users in their UA activities. As all the systems are automated and operated mechanically, the time users are getting engaged into the production process is limited in comparison with the traditional cultivation methods. For each user, approximately one hour per week is deemed sufficient for the maintenance and the inspection of the production in all scales.

In this project, home acts as a machine which filters, processes, recycles and produces. The systems used in the design are as follows:

5.3.1. Sustainable Energy Methods

5.3.1.1. Rainwater Harvesting

As the project is established in the Netherlands, it would have been a true omission not to implement the rainwater harvesting system, so as to take advantage of the increased rainfall that is prevalent in the area. The two housing types are equipped with water tanks of 4 m³ each, while the collective water tanks have a capacity of 400 m³ of water in total. The mechanical parts of this system are installed in the “batteries”. The water is cleaned by the use of filters and used for irrigation purposes, but also for the fresh water supply in the fish tanks.

5.3.1.2. Waste Water Treatment

In combination with the rainwater harvesting method, the waste water treatment method is also used for the same purposes. Moreover, the two methods can share the same mechanical system. The wastewater treatment system cleans the grey water produced from the sanitary and eating areas by the use of filters.

5.3.1.3. Composting

There are many ways to achieve waste disposal. In this project, in-vessel composting units are being installed in the “batteries”. Compost is really one of the most useful resources upon which agriculture can truly benefit. Moreover, it is suitable for use as a soil fertilizer without any further treatment.

Apart from the fertilizer produced, the composting of organic waste generates methane, which is in turn burned to generate heat & CO2. The amount of CO2 that is captured is beneficial for the plants in the aquaponic systems. (Lennartsson, 2005)

5.3.1.4. Photovoltaics

In order to obtain the energy needed for the operation of the aforementioned systems, photovoltaics are installed on or next to the “batteries”. PV systems can generate electrical energy by converting solar radiation into DC current using semiconductors that exhibit the photovoltaic effect. Photovoltaic energy generation employs solar panels composed of a number of solar cells containing a photovoltaic material (Photovoltaics, n.d.).

In this project monocrystalline photovoltaic panels are used like, for example, Daqo 250Watt Mono Grid Connect Solar Panel. A very important parameter is the orientation of the solar panels. For the Netherlands the best option is facing to the south and the optimum performance can be achieved at a tilt from the horizontal plane equal to Woensel- West’s latitude which is 51° 27’ 0” N. For design purposes, the panels are installed in the angle of 30°.

In the case of the house units, the panels are mounted at a frame on top of the roof, and in the case of the public buildings, they are integrated in the roofing. Each house of the type A can take 9 panels that can produce 1890 kWh/year in total while the type B house can take 4 that can produce 85 kWh/year. According to studies, an average Dutch household consumes 3.400kWh/year. As the solar collectors are installed in order to make the vegetables production sufficient, their performance is enough to satisfy this need. As far as the collective energy needs are concerned, there are 28 panels on the educational center and 34 on the restaurant.
Plants

Photovoltaics

Rainwater collectors

Aquaponics

Composting areas

Fungiculture

Urban beekeeping
that can produce 13.020 kWh/year in total. This energy production is also regarded as sufficient for the mechanical systems’ needs.

5.3.2. UA Methods and Activities

The UA methods and activities implemented in the design are the aquaponics, hydroponics, fungiculture and urban beekeeping. A first introduction on their working performance was made in the end of Chapter 2.

5.3.2.1. Aquaponics

Aquaponics is the main way of growing food in the interior of the buildings of the project. It is an autonomous system that consists of a fish tank and growing beds on top. The fish fertilize the plants, the plants release oxygen, which feeds the fish, and the excess oxygen is released into the atmosphere. Aquaponics is used in the eating areas, the balconies and in the eastern collective greenhouse as a supplementary way of growing food.

In the case of the greenhouses, the system is implemented according to industry standards. However, in the case of the housing unit, the fish tank is separated from the growing beds. The first is placed in the “battery” next to the leisure area, while the second is placed in the “cut & eat” structure in the eating area and on the master bedroom’s balcony. A medium production involves six fish, which can in fact provide the house with a reasonable amount of vegetables (100gr of fish could support 1m² of food production). The connection between the two systems is made possible by means of pipes on the ceiling of the house.

The “Cut & Eat” Structure

For the growing beds of this project, an original design based on the main aquaponics principles is proposed. It consists of a metal structure, growing beds, irrigation pipes and the mechanical system. The metal structure consists of a metal frame that contains the pipes and small beams where the growing beds are placed. The growing beds are made of plastic, filled with gravel and soil, contain the typical irrigation system of aquaponics and are covered with the same wood used for the covering of the “battery” core, so as to achieve coherence in the final design. The growing beds are of different lengths and their placement can be chosen by the user. However, their attachment to at least one side of the metal frame is obligatory for irrigation purposes. The first wooden box on top contains the water tank and the irrigation mechanism. The water tank is filled by the pipe that runs on the ceiling and comes from the fish tank. A pipe distributes the water to secondary pipes which are placed under the wooden boxes so fresh water is sprayed on the vegetables. The water that is taken out of the growing beds is transferred immediately back to the fish tank in order for the aquaponics circle to close.

As far as the lighting is concerned, according to the Plant Lab, plants mainly need blue and red light for photosynthesis and far-red, a color not even visible to the human eye but visible to the plant. Having their prototype as a reference, the structures in the eating area are equipped with special LED lights which are installed under each box with a view to enhancing the natural light and accelerating the growing process. In contrary to the sun, traditional assimilation lighting and TL lighting, LED only omits one color of light.
which means that the exact colors needed for the photosynthesis are provided (Revolution in plant growing, n.d).

5.3.2.2. Fungiculture

Fungiculture takes place in the area under the western stepped ramp. A dark and humid room is necessary in order for the mushrooms to thrive. The straw bag technique is used and the inhabitants of the block can take advantage of their production.

5.3.2.3. Urban Beekeeping

The urban beekeeping activity grows in popularity in the UK and New York. Philips Design has already proposed a system that can be implemented for interior use. In this project, the traditional beekeeping technique is being used in a plot at the north side of the eastern greenhouse.

5.3.3. Conclusion

The systems that are used in the project are carefully chosen in order to meet its needs. They are installed in a way that can only help and not hinder the users’ everyday life. Based on the energy circles, the systems of each unit are developed and interconnected with the others ensuring that the produced energy may not be wasted. The exceeding energy is being stored in the “batteries” and is used when needed. There are many “Do it yourself” examples that try to connect multiple systems. Such an attempt is being made in this project, too.

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Figure[36] The “Cut & Eat” Structure.

Figure[37] The “Cut & Eat” structure detail. The implementation of the aquaponics system and the water distribution.
Urban agriculture is widely recognized as a way of achieving urban regeneration and its values on the inhabitants’ nutrition and quality of life are indisputable. As stated in the book “Continuous productive urban Landscapes: Designing urban agriculture for Sustainable cities”, “food growing projects can act as a focus for the community to come together, generate a sense of ‘can-do’ and also help create a sense of local distinctiveness – a sense that each particular place, however ordinary, is unique and has value.” (Viljoen, Bohn, Howe, 2005, p. 57). In the same book, UA is suggested as a way of tackling crime and reducing discrimination.

The case study of the problematic and multicultural area of Woensel-West was chosen for that specific reason; in order to support and promote the rehabilitation plans that are currently being developed by the Municipality of Eindhoven during the last years. A design of a new row house typology was conducted, but the project also proposed a complete plan of the rehabilitation of the most central block in the area that can be the starting point for a whole new way of living.

The inhabitants and the visitors of this block are given the chance to meet, talk and socialize, while taking part in all UA activities, from the educational procedure, to the act of farming and eating, in both family and community contexts. At the same time, innovative technological systems are being designed and employed in a creative way with a view to playing an assistant role in the production and contributing to a better, user-friendly design. For these reasons, this project aspired to promptly answer the research and design questions that have been stated in the beginning of this book.

However, this was only a first attempt to create a neighborhood that is based on UA in so many ways. This project can serve as the starting point for further discussion and genuine proposals that could work even in a bigger scale than this single block. Firstly, as far as the social part of the project is concerned, an intense social study on a particular neighborhood can be made. As far as the technology is concerned, another design that can implement more types of urban agriculture can be proposed. Of course, the systems and connections used in the present project can also be altered or developed. Finally, as this is a graduation project, finances were not taken into consideration. For a potential real implementation, a SWAT analysis and a complete business plan should be conducted.
In the Smart Living Studio we were asked to reflect upon the traditional way of living and propose a design that could enhance it by means of technology. My first approach was from a social point of view. The matter of alienation in the modern family arose while research into the role of modern technology in the house of today was being conducted. Apart from that, people’s unhealthy nutrition habits nowadays were also discussed. A proposal for a different way of living that could improve these matters with the use of new technological systems was regarded as a feasible option for this studio.

The architectural community has been preoccupied with the Urban Agriculture movement for the last few years. After the research into the aforementioned matters was completed, Urban Agriculture was determined as the link connecting the three main topics; family alienation, nutrition & technology. Indeed, the theoretical discussion proved that this idea is based on true facts.

The design development started after the formation of this social basis. The main goal was to propose a non site-specific design so that it could be implemented anywhere. However, for design purposes, a plot in Woensel- West was chosen as an example of how the developed house unit could be incorporated in the urban context. As far as the block design is concerned, it was developed by taking into consideration the specific site characteristics and needs. However, for any other block, the same design principles can be used in a different composition. As for the two house units, their shape makes it possible for them to be placed in many different sites in the Netherlands but also abroad in a neighborhood with similar design characteristics.

Undoubtedly, the residents of the specific houses should be ready to adopt the proposed lifestyle. However, a sensible use of urban agriculture is suggested in order for the project to be feasible and attractive as well. The residents enjoy the advantages of urban agriculture in their houses without dedicating a lot of time to its activities since they are mechanically supported.

As far as the systems are concerned, a creative combination of well known techniques is proposed. The goal is to implement them in the original design and not add them afterwards so as to achieve a complete result. Extended mechanical analysis of the way these systems are combined does not concern this project as it is a purely architectural one. However, this part can be developed in detail in future projects.

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Eindhoven, 28 August 2013


Vegetation List

As in this project different possible positions are offered for growing plants, 6 different lists of indicative species of trees, herbs and vegetables are conducted.

List 1. Trees

Open air collective gardens: Chestnut, Cherry, Quince, Kiwi, Pear, Apple, Apricot, Plum, Grapes

Greenhouses: Orange, Lemon, Mandarin, Peach, Nectarine

List 2. Fruit & Vegetables

Open air gardens: Broccoli, Cabbage, Carrot, Chives, Lettuce, Peas, Radish, Swiss Chard, Spinach, Cauliflower, Asparagus, Strawberries, Blueberries, Mulberries, Onions, Potatoes

Greenhouses and in the “eat & cut” structure: Zucchini, Cucumber, Tomatoes, Paprika, Eggplant

List 3. Herbs

Open air gardens: Oregano, Mint, Lavender, Rosemary, Sage

Greenhouses and in the “eat & cut” structure: Basil, Parsley, Peppermint, Celery