Technical Research Paper: The Apartment-Garden
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Abstract

The House vs. the Apartment, a Garden vs. an Outdoor space

When we look at the difference between an Apartment and a House there is one distinct difference between the two, an Apartment is a home that isn’t ground-bound, a House is. Because apartments aren’t ground-bound there is no ground and an outdoor space surrounding the apartment if this isn’t build in some form. When looking around at apartment buildings in the build environment the use and quality of these outdoor spaces vary in many ways. Especially in the lower and cheaper segment of apartment buildings a lot of these spaces look neglected and poorly used. Many of these spaces are very small and don’t seem to fulfill any need of the residents, seemingly many of these outside spaces are useless for the residents. People that live in apartments should be able to have a garden quality with their home, this shouldn’t only be a privilege for luxury apartments, when people have the choice to live in a luxury apartment they can also buy a house with a garden. Everyone has the right of a proper private outdoor space, with at least some of the qualities a garden has.
1. Why do apartments need a ‘garden’?

Should the question maybe be turned around: Why shouldn’t an apartment need a garden?

Why should a discussion even exist if people in an apartment need a balcony with the quality that it actually fulfills the same desires like a garden of a house does? With a house we don’t even question this, a house has an outside space: the garden. The answer could be that most apartments have a balcony instead of a garden, the outside space of an apartment. But when we look at the current balconies much of them are just an outside space, they don’t really give an opportunity to fulfill the need of an outside space like a garden does. Gardens give a wide possibility of use, people can use the space in a way they desire and enjoy the outdoor. Apartments won’t have a garden like a house does, but the space for this use should have more potential so people can enjoy it better. The balcony fulfills the need of an outdoor space, but not nearly like a garden. Reason for some improvement.

1.1 Current outdoor spaces

At first there should be an impression of the current situation, what kind of outdoor spaces do apartments currently have and how are they used. Are they more generic in background or custom to a specific project? This will give the basic understanding of balconies and show some strengths and weaknesses.

1 The Mountain, Copenhagen – BIG Architects
The mountain dwelling by BIG architects is a combination of a parking garage and houses. On top of the parking garage BIG made a sloping layer of housing. As seen on the picture each of the houses has their own roof garden. It is clear that this is a custom project and not something that is found really often. The quality of the outdoor spaces are high and give a great opportunity for the inhabitants.

1 Figure: http://www.big.tk/#projects-mtn
2 figure: http://www.archdaily.com/970/vm-houses-plot-big-jds/
The VM houses by BIG architects are two housing blocks built in a V and M shape. As seen on the picture each of the houses has a triangular balcony that is placed for optimal sunlight and communication with the neighbors, increasing the social interaction between the residents and a private outdoor space. This project is a custom project with a high level of individualization. Each of the outdoor spaces has a good quality and should fulfill the needs of the residents.

Roof terrace
In some apartment buildings there are roof terraces to be found. Unless the buildings are built like The Mountain dwelling by BIG architects the only roof terrace to be found are on the top of the building, when looking in the build environment are not common for the most apartment buildings.

Roof terraces aren’t custom outside spaces but also not highly generic. The quality of a roof terrace in most cases is good, there is plenty of light and in most cases there is enough of space and privacy for the residents.

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2 VM Houses, Copenhagen – BIG architects
3 http://iremlandscape.wordpress.com/2012/03/04/vm-house-in-copenhagen/
4 figure: http://www.dakterras.nl/
Closed balconies
With the closed balconies residents get the opportunity to use their balcony with bad weather. Dependent on the type of façade the balcony can also be used in winter times, not all the types are insulated.
Closed balconies have become a generic type, there are several manufactures making systems for this type of balcony. Closing the balconies gives them a wider use, residents get more opportunities for use because the weather isn’t a big influence anymore.

French balconies
French balconies don’t really count as an outdoor space, it isn’t possible to actually go outside. When people have a French balcony they can open (mostly) big doors to the inside creating a space in their home where they can enjoy some fresh air.
French balconies are generic type of outdoor space, just a indoor opening full height window is enough. Residents of an apartment with a French balcony have no freedom in using their outdoor space, they actually don’t really have any.

\[\text{figure: http://koetshuislaan-waalwijk.nl/appartement-te-koop-fotos/balkon/}\]
Loggias

Loggias are a type of balcony that is built into the building instead of sticking out. Depending on the size of loggia they can be useful for the residents. In most cases when the loggias are smaller people don’t use them often.

Loggias are a generic type of outdoor space for apartments. Residents with a loggia can use their loggia in the same manner as other people would use a balcony.

Continues balconies

Continues balconies are a common used balcony type in big apartment buildings. The balconies are build over they entire length of the apartment connected to the neighbors, divided by a wall. Often the quality of these balconies are low, they are wide but mostly have a small depth. The surface area of these balconies may look big enough but because of the proportion between the width and depth they are less useful.

Continues balconies are a generic and cheap type of balcony, that is why they are applied in large numbers.

7 figure: http://www.pressebox.de/pressecorner/firma/caparol/meldung/boxid/122785/iframe/1
8 figure: http://commons.wikimedia.org/wiki/File:Zwolle_Holtenbroek_Flat.jpg
Small Balconies
Small balconies are the main concern of this research. When looking around in the build environment there are a lot of these balconies and most of them look alike, they are neglected and not used by the residents. Residents of an apartment with this type of balcony don’t get a real opportunity to use these balconies because the size only provides them with enough space to place one or two chairs and a small table. When looking at larger balconies they are used in many different ways, the residents get more opportunities of use. Small balconies are a generic type of balcony that are applied in large numbers of the apartment building.

* figure: http://www.nbd-online.nl/#news_item/175475/Alsan_beschermt_balkons_en_galerijen_tegen_weersinvloeden/html
2. The use of balconies vs. gardens

To find out what the needs of residents are for their balcony there needs to be research and statistics about the current use and needs of residents. Currently it is hard to find definitive research about these topics and some other solution had to be found. To solve this the current use of balconies can be found in the balconies that are current in use, looking at apartment buildings and their balcony use. In the current situations there can be also found what the needs of balconies are, there are cases where the balcony actually functions like a type of garden.

2.1 Garden use

Everyone has one main use for their garden, and that is to sit and relax in the garden and enjoy the (good) weather. This can be put into several categories mainly involving the amount of people. From one person having a drink sitting in the sun and reading a book up to a garden party with many people. People with kids can also use their garden to put in a little playground so their kids can play there.

The biggest advantage of the garden versus the balcony is that it is ground-bound and is made out of soil, all the other uses for a garden need modifications, adding pavement etcetera. The basic use for a garden is gardening, for most people this increases their garden quality. The vegetation in a garden gives the feeling of being outdoor in the nature, the nature they created themselves. Some people go further with this and even make water in their garden. With a garden people are entirely free to do what they want, almost everything is possible.

These are the main basic uses of a garden, there are also people adding more luxurious functions to their garden like a jacuzzi or even a swimming pool. But because the emphasis is on how a garden should at least function in the basic needs these aren’t taken into account.

Garden party

People enjoying the privacy of their garden

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10 figure: http://www.elysianweddingsandevents.co.uk/may-day-garden-party-part-1/garden-party-297/
11 figure: http://www.myhomeideas.com/room-galleries/garden-spot-0041500068298/
2.1.1 Disadvantages of gardens

To ask the question if gardens also have disadvantages is important, it is possible that these disadvantages for gardens could be an advantage for balconies. The weakness of the garden could be a strength of the balcony. One of the main disadvantages of a garden is the requirement of a fence. When all the gardens are adjacent and people still want some privacy they have to place fences to define their own space and keep other people from looking and entering into their garden. Even when people have fences some animals that aren’t welcome in their garden can enter. In many cases these fences create alleys that are unpleasant at night. Most of the alleys have no lighting and can be scary for some people, it is almost impossible to see what is happening there. This also makes it easier for burglars to get into houses when they are in the alley or the garden almost no one can see them.

Most of these disadvantages are resolved with a balcony. The balcony only has to get some more of the qualities a garden has.

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12 figure: http://garden-deco.nl/houten-zandbakken-voor-tuin-durlang-1358.html
13 figure: http://greenlivingmakeover.org/beat-depression-with-gardening/
14 figure: Lex van Lieshout / ANP
2.2 The use of balconies
When researching the balcony the focus is on the more common balcony. In chapter one several kinds of balconies were explained, also types that were of better quality with more possibilities but the focus is on the balconies that lack some of these qualities.
Lots of residents actually don’t really use their balcony, turning it into useless space. When they use it they mostly only use it for private use, they sit there with nice weather and have a drink or read something.
This occurs especially with the smaller types of balconies, some residents put some small furniture on their balcony and/or maybe some plants. It looks like they don’t really like to stay there for a long time.
Some residents actually want to garden and have a mini garden on their balcony, by improvising with different types of pots they manage to grow some plants. When they do this there is almost no more space for furniture. A good balance is hard to find for the combination of the two functions.
When viewing the balconies in the winter time most of them are totally useless the residents only use them for some storage purpose, the balcony is an outdoor space and with the cold weather it doesn’t function.
Almost the same happens with gardens, in wintertime residents don’t use them. The winter situation is an interesting situation for the balconies and could bring some opportunities because a balcony is a built structure.

15Gardening on balcony

16figure: http://www.inrichting-huis.com/balkon/balkon-van-daria-dave/
2.3 Possible use for a balcony

To get a better answer about the possible use of balconies the current use is reviewed. Better functioning balconies are used for inspiration. On many balconies the space is minimum, they are just big enough for two or three people. Almost none of the balconies are used for dining and guests, just because the space isn’t available for this. To improve this social aspect of the balcony the size should be increased.

When viewing the difference between gardens and balconies there are far less people using their balcony for plants, people doing this have to improvise. There should be a better solution for this.

In wintertime almost every balcony isn’t used, just because it is an outdoor space and in wintertime the weather isn’t good enough to be outside. Making the balcony useful in wintertime would be a great possibility. If the balcony could be closed in winter times this space would be useful the entire year.

2.4 Improvement requirements

2.4.1 Size

Size is a major issue on many balconies, this limits the use for the residents. With a small space only big enough for only two chairs a balcony hardly has any garden qualities.

If the size of a balcony would simply be increased this could create other problems. Bigger balconies have higher costs and also will block sunlight from entering the apartment.

To improve the balconies the optimal size should be determined.

2.4.2 Sun

To fulfill in the needs of a garden the sun should also be taken into account. When the balconies get bigger this will also block the sunlight. With the placement of the balconies this could be improved, taking into account that the balcony will block sunlight below. When choosing a railing the sun and view should also be an issue, a closed railing will block the sun and the view turning the balcony into a closed box, or a room. In a garden daylight is an important thing.

2.4.3 Air

In some cases balconies have a problem with the air quality, this is the same with gardens. If a garden or balcony is placed in a zone with bad air quality the quality of air will also be bad there. With the balcony this could give an opportunity to increase the quality of air, if the balcony could be closed then the bad air can’t come in. If the balcony is closed its not an outside space anymore, open and closed should be combined. Having an inside space that feels and can change into an outdoor space.

2.4.4. Climate

The climate of the balcony is influenced by the climate of its location, because it’s an outside space the climate can’t be regulated. To improve the balcony this gives an opportunity to actually change the climate by rethinking the concept of a balcony. If the climate on the balcony could be
changed it could be possible to use the balcony over a bigger time, not just relying on the outside weather. Closing of the balcony would give it the opportunity to use it in bad and colder weather, but this has to happen without losing the outdoor space.
3. The apartment-garden

As stated in chapter two apartments in many situations lack the quality of a garden. The outside space provided by the balcony can’t provide the wide range of possibilities like a garden does. With most balconies the use is limited, its hard for people to get some more potential out of it. How can we create a space for an apartment that is less limited and has more of the garden qualities, what is this space? Lets call it the apartment-garden.

3.1 Size
The biggest disadvantage for people is the size of their balcony, they encounter the limitation of the space in their use. What size should the apartment-garden have to be sufficient for the needs of the people, without just making a bigger space then needed? The uses for the apartment-garden are listed to research how big a space each of these applications need.

For each of the common uses estimation of size was determined. From left to right: The first two cases are the minimum space requires for social interaction with quests on a balcony. There should be at least big enough for four people to drink or have a meal. In the first situation there is enough space for a table and four chairs, the minimum space for a meal. In the second situation the space has the same size but there is space for four chairs and a small table, the minimum space for a social drink. In the second case the minimum space for gardening is determined. Enough space for some decent plants, and enough space to enter the balcony for gardening. The last two cases are the absolute minimum cases for just one person. The smallest is just big enough for a chair and maybe a small table. The other is a little bigger that gives the possibility for a more luxurious chair, or lounge.
There is stated that for a better functioning apartment-garden the space should be big enough to at least be able to garden and eat on the balcony, these are also the main applications for a garden: leisure and gardening. With a space big enough for these functions people are free enough to arrange the apartment-garden in the way they like, giving it a wider range of use, just like a garden. This determined that the appropriate space for the apartment garden should be about 3x4m. With the bigger 5x4m the apartment-garden would have a more luxurious size, but the apartment-garden shouldn’t be too big to keep it feasible.
3.2 Requirements

3.2.1 Sun
For a proper functioning apartment-garden, there should be at least enough sun. Especially for some of the applications sun is a big requirement: sunbathing and gardening. Second to take in account is that the apartment-garden shouldn’t block too much sun to the inside, the living room is behind the apartment-garden. If they would be made to big or wrongly places, the apartment-garden on the level above could block a lot of sun for the living room in the apartment below.

3.2.2 Air
For a useful apartment-garden the air quality should be in good condition. On some locations the air is of such a quality that this is clearly noticed when sitting outside. When the apartment-garden would be an outside space like a balcony this problem wouldn’t be solved. To maintain a good air quality in the apartment-garden closing of is an option. The apartment-garden then should be a closed room with the qualities a garden has.

3.2.3 Climate
To get the apartment-garden more useful during the whole year the climate should be regulated. To regulate the climate in the apartment-garden it has to be shut of from the outside climate. Closing it will change it into a room, but the goal is a garden and a garden is outside. The apartment-garden has to be closed in such a way that the people inside don’t feel like it is shut of, it also should be able to open it when the weather is better and people want to sit outside. To achieve this the façade should have two main qualities; It has to be open and closed in such a way that it transforms into a balcony, when it is closed the people inside should still have the feeling that they are not in a typical room. The façade should have a high transparency.

Lumon Balcony glazing, open vs. closes

17 http://lumon.com/balcony-glazing
3.4 Could apartment-gardens influence the public environment?

When looking at some current situations the buildings are situated with their backs to the street, this creates a semi closed of public space between the buildings were people can go. These spaces are almost completely closed off and non visual from the road, only from the houses. In the current situation lots of people don’t use their balcony what means that there is no one who sees what is happening in these spaces, making it easy for criminals.

When people use their balcony more the social control in these places will increase what also will increase the safety in these areas because there is a higher change for people to get caught. This could be a positive social side effect for better balconies / apartment-gardens.

Enclosed areas at Hoograven Utrecht
4. Building types for the apartment-garden

The apartment-garden isn’t for a particular type of building. It’s a proposal on how it would be possible to give a apartment a ‘garden’. This means that the apartment-garden should be able to apply on almost every type of apartment building we can find. Each of these buildings give their own restrictions for the apartment-garden, resulting in a list of requirements it should apply to.

4.1 New apartment buildings
When looking at new buildings and the apartment-garden the list of restrictions is very low determined by the technique of the building. The construction technique used for the building gives a guideline for the apartment-garden, but mostly it’s totally free how it can be made. Because there isn’t anything existing the building can be adjusted before it will be build, you don’t have to rely on an existing structure, material or strength.

4.2 Existing apartment buildings
Some of the older apartment buildings are in bad shape and need to be renovated. Many of these buildings could also use an upgrade for their balconies. The apartment-garden is a great solution for this problem. These buildings were the actual motivation for this research. To keep these buildings useful and profitable for more years many of them need a major upgrade and renovation.

4.3 Transformation
When empty buildings like offices are empty for a long time or the urban fabric of the location is changing it could be interesting to change these buildings into apartment buildings. When transforming these building into apartment buildings they will have to add outdoor spaces. In these cases the Apartment garden could also be a good solution, they have to be made in such a way that they are easy to build and use.
5. Technical fascination

The technical fascination for this paper isn’t entirely about the technique, but about the way of thinking this technique brings along.

5.1 Greenhouse construction systems

The interesting thing of greenhouse systems is they are highly developed and standardized. Because of this engineered system and standardization of the greenhouse systems its rather easy to place one. When you don’t have to think out everything each time you make it this saves a lot of time in design and construction, also saving money. For balconies this is also an important issue in the lower price segment of apartments. If there would be a good proven system it would be more attractive for developers to implement this in their buildings, instead of only doing this in a higher price range. The lightweight structure of the greenhouse systems also makes it possible for a lot of daylight to enter the building, what for the greenhouses is very important. This was also one of the things that is pointed out for an apartment-garden, there should be enough daylight on the balcony to give the outside feeling.

18 figure: http://en.wikipedia.org/wiki/Wageningen_University_and_Research_Centre

18 The Lumen Building – Wageningen University
6. Technologie of the apartment-garden

The apartment-garden is a structure composed out of several components, each type of these components need to be determined.

6.1 Technologies

For each component of the apartment-garden there are several types of materials and systems to build with. What are these materials, and what are the properties? This will help to choose what type of material there should be used in a specific situation.

6.1.1 Structural technologies

When we look at types of construction for balcony’s there are two major categories that can be taken into account. The first is a connected construction that gets its structural strength from the structure of the (existing) apartment building; the apartment-gardens are hung on to and attached to the building. The second system is a structural stand alone system, that could be stable on its own, or partly connected for stability from the (existing) building.

Each of these types has their own subtypes that have been researched for possibilities.

6.1.1.1 Hanging, Cantilevered

With the cantilevered technique, the floor of the apartment is extended out of the building bearing all the loads. The connection between the building and the floor of the apartment-garden has to be a fixed moment connection.

Strengths; It gives a wide freedom for the façades of the apartment-garden, the floor bears all the loads without any visual structural element added. The construction is totally invisible.

Weaknesses; It strongly relies on the existing structure of the apartment building that should be able to withstand all the structural forces, a strong fixed moment connection is required. Making this a harder technique to apply on existing structures.

Opportunities; When making a new building this construction technique gives lots of freedom for the façades and transparency because there are no visual structural elements

Threats; When building a new building the structural design is still completely open, but even in this case the fixed moment connection needed for the cantilever could become that high that is desired to chose a different system. With an existing building it has to be sure that the existing structure can handle the forces, making it dependent on the knowledge of the existing structure and its integrity. With existing buildings this is a complex and less reliable system.

Application; The cantilevered connection gives a great freedom in the design of the façades because there are no construction elements visual.
This system is most likely to be applied on new building, giving freedom in design of the façade.

6.1.1.2 Hanging, supported from top or bottom

With the supported connections there are extra supports connected towards the end of the floor, making the use of fixed moment connections between the floor and the building unnecessary. This makes this connection less critical in application.

Strengths; It gives a possibility to make a connected hanging construction, without having to create fixed moment connections.

Weaknesses; It needs extra supports, more structural elements are in visual view. These extra elements creates a less clean view in the apartment-garden.

Opportunities; When existing buildings are strong enough to bear the load of the apartment-gardens but a connection with torsion isn’t possible or desired the supported system could be an solution.

Threats; When making a new building the structure isn’t defined yet, if there is total freedom in structure and design the use of extra construction elements can be avoided.

With an existing building you rely on the existing structure, this structure has to be researched if it is strong enough to support this system.

Application; The supported connection gives an opportunity to make connected apartment-gardens without the fixed moment connection on existing buildings, this makes it interesting for existing buildings where the space below the apartment-gardens has to be free.

This system is most likely to be used in situations (new and existing) where a fixed moment connection isn’t desired, but the structure can handle the stresses.

6.1.1.3 Self-supporting with own stability

With the self-supporting structure with its own stability the apartment-gardens will be made of a totally free structure on its own, it has its own stability and doesn’t even need to stand next to a building to be stable.

Strengths; It is totally self-supporting and can be placed next to weaker buildings that lack the possibility of any structural connection.

Weaknesses; It’s a much more complex structure because it needs its own elements for stabilization.

With higher buildings this could become a heavy complex structure blocking view and compromising the openness and transparency an apartment-garden needs to have.
Opportunities; When there is a lower and older building this construction could be placed without damaging and relying on the existing structure. Retaining the integrity of the existing building.

Threats; When the construction is totally stable on itself this results in a bigger and heavier construction, with the apartment garden there is preferred to have a lightweight and slim construction to maintain the openness and transparency in the apartment-garden.

Application; The free standing construction with its own stability gives a great freedom of appliance, because it doesn’t depend on any structural property of the existing building. These properties make it unnecessary to have any structural connections, loadbearing or for stability. In some cases this could be useful, the existing structure could lack the possibility to make a connection for stability. When feared that the façade would be damaged in the construction this is prevented.

This construction type is most likely to be applied with an existing building where a structural connection isn’t desired because of fear for damage.

6.1.1.4 Self-supporting with stability from existing building

With the self supporting structure that gets its stability from the existing building the apartment-gardens will be made of a structure that is loadbearing but not stabilized on its own. The structure needs to be connected to the building to be stabilized.

Strengths; It is totally self supporting and can be placed next to weaker buildings that can’t hold the bearing loads. It doesn’t need any own structural elements for stability, decreasing the structural dimensions.

Weaknesses; It’s a structure that is self-supporting but not stabilized, it needs stability from the existing building. There needs to be a way of connecting the existing structure to the structure of the apartment-gardens. With a higher building the self-supporting structure could become big and compromising the use of the apartment-garden.

Opportunities; When there is an existing older building this construction could be placed without relying on the loadbearing properties of the existing structure. The stabilizing forces are much lower as the loadbearing, using the strength of the existing building this strength is there almost every time.

Threats; When the construction relies on the stability of the existing building it has to be possible to make these connections, and they have to be strong enough. With a new building the extra loadbearing structure in the apartment-gardens could be seen as unnecessary.

Application; The self-supporting structure that is stabilized by the building gives great opportunities in the renovation of existing buildings. It can be used in almost every case, relying on its own loadbearing structure and stabilized by the building. Relying as less as possible on the existing structure and itself is a simple structure without extra elements for stability.

This construction type is most likely to be applied on existing buildings.
6.1.2 Structural materials

To make the choice in structural materials there are several criteria why a material is sufficient for the apartment-gardens. The materials should make the construction of the apartment-gardens easy and systematic. It has to be a material that can be easily applied with different types of buildings, regardless of what the building is made of. The material should be in line with the use and feeling of the apartment-garden. The apartment-garden should increase the feeling of a garden, in gardens some materials are not that common used. Its not only a structure of a building, but a “garden” of a building.

6.1.2.1 Stone materials

The most common used material in 19 housing for the Netherlands are stone materials, especial concrete, limestone and masonry. When these types of materials would be applied for the structure of the apartment-gardens it would most likely become a rather massive structure. For the apartment-gardens it is desirable to have a lightweight and a subtle structure, this is hard to achieve with stone materials. The stone materials also don’t have the desired texture and feeling for the apartment-gardens, it is desired to have a feeling of a natural garden like situation.

6.1.2.2 Metal materials

For a higher structure metal materials 20 are a great choice, they are efficient and can be made as a lightweight structure. When this type of material would be applied for the structure of the apartment-gardens they would give the desired subtle structure. Especially in prefabrication metal is a strong choice. For these reasons metal is the main type of construction used in greenhouses, the structure is very slim and doesn’t block many sunlight that the plants need; the professional gardens.

However, metal materials don’t have the appropriate texture and feeling that is desired, they have a rather cold and industrial image. For the

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19 figure: http://blog.davies-smith.com/latest-news-from-ironstone/
20 http://frankdejol.blogspot.nl/2011/05/indifference-of-metal-structure.html
apartment-gardens it is desired to have a more natural image that will increase the garden experience.

6.1.2.3 Wood materials

When choosing a material for a garden wood materials are the main choice. When people construct something in their garden they mostly chose to use wood, it’s a natural product that fits in the garden. Wood is also a highly durable and natural material; unlike other materials wood is the only product that reproduces itself. If the forests are managed in a durable way, the supply is endless. Other materials like metal and concrete use energy (CO2) in the production process, in the production process of wood (natural tree growth) carbon is stored in the trees and actually creates a carbon reservoir. If wood is applied in construction this also serves in the carbon reservoir, preventing the carbon from releasing into the atmosphere again when the tree dies and rots. When applying wood instead of other materials carbon is stored, in the production processes of other materials like concrete and steel carbon is emitted into the atmosphere.

For high-rise structures wood doesn’t come in as a first choice for many architects and constructors. Wood has an image that it is less reliable (weaker) and more expensive than metal and stone materials. Architect Michael Green wants to change this because wood is a great product, and can be also used as a structural material due to the mass timber technique. In his report “tall wood” he researches the question of making a 30 story high building with wood. Mass timber exists of laminated lumber that in the process eliminates the natural weakness of trees, creating a product that is almost equivalent to reinforced concrete.

For the apartment-gardens wood would be the most desired material, the material gives the natural feeling that is desired. The structure would become less lightweight as with steel but the material itself doesn’t interfere in the ‘garden’.

Metal and wood are the two materials that are most suitable for the apartment-gardens structure, each of them have different strengths. Metal creates a lightweight construction and wood has the natural feeling that is desired for a garden.

For the structure of the apartment-gardens wood would be the best choice, the natural material corresponds with the need.

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21 M.C. Green(2012) TALL WOOD
22 figure: http://deosaver.info/wood-balcony-design.html
6.1.3 Floors
For the floor of the balcony there are some choices there can be made about material of construction and finishing. When the balcony would be indeed an extra room for the apartment and closed in winter and bad weather this could also have an effect on the floor finishing, making it possible to put materials on the floor that normally can’t survive the influences of weather.
An idea could also be to really (make it possible) to complete the garden concept in such a way that it has the texture of a garden, could there be grass on the balcony?
For the apartment-garden and the complete garden experience the floors should be made in such a way that people are free in their own choice. When people get a garden they are also free to do with it what they want.
The floor should be adjustable to the needs of the people, just like a garden, where people have the freedom to arrange it in a way they want. To accomplish this the base constructed floor of the balcony should be lower then the interior floor. Over this layer the people are free to put their own material on top of this, leveling the apartment-garden floor to the inside floor. This means that the apartment-garden isn’t ‘finished’ when the people occupy the apartment for the first time, with a garden this is exactly the same.
6.1.4 Roofs

The roof of the apartment-garden can be made in some different ways, some simple and ‘standard’ and some more complex and developed. When choosing a roof there also should be taken into account where the roof is placed. The placing and amount of roofs can effect the choice, when you also have roofs on the lower levels the finishing becomes more important, because people can see them from the top. This doesn’t happen when you stack the apartment-gardens in a tower and there is only one roof on the top level.

For the apartment-garden there is not a specific type of roof that is preferred, especially when there is only one roof on top of the structure. When the apartment-gardens are not (only) places on top of each other but there are also roofs on lower levels that people can see from above it would be preferred to use a more natural material like green roofs.
6.1.5 Windows closing the apartment-garden
When closing the apartment-garden with windows we can separate these windows in several categories. Each of these categories has its own way of opening and closing with their own advantages and disadvantages.

6.1.5.1 Turning windows; opening to the in- or the outside
Turning windows are hinged on one of the sides of the windows, making it possible to open them to the inside or the outside, depending on the type. When the windows are completely open, the windows are still in the same place they were when they were closed. The apartment-garden is a mix between a balcony and a room. These windows are used in the most cases with normal rooms so they will be associated with a normal room. These windows aren’t desired for the apartment garden, they don’t have the opportunity to give the people a feeling like they are outside like a balcony because they will always stay in place. When the windows open to the inside they even prevent some of the space in the apartment-garden from use.

6.1.5.2 Sliding windows
Sliding windows slide open to one or two sides of the apartment-garden. When opened, these windows are completely removed from their place and give a clear view to the outside. Because the windows are moved, this results in the total façade being open up to a certain amount. For the apartment-garden there is the desire to completely open the façade, transforming the room into a balcony. For the apartment-garden the sliding windows aren’t useful.
6.1.5.3 Accordion Windows

With the accordion windows the windows are connected to each other and can be opened in the middle or at the end of the façade, when you open the windows you can slide them together like a harmonica that opens the whole façade. For the apartment-garden the harmonica windows are a useful option, giving the option to completely open the façade and transform the room into a balcony. A big benefit it that the accordion windows are also available as insulated windows, completely upgrading the apartment-garden.

![Accordion Windows Diagram]

6.1.5.4 Stackable windows

Stackable windows are a variation on the turning windows opening to the inside. With the stackable windows it is possible to move the windows to the side of the façade when they are opened, completely opening the façade. It is also possible to open the windows individual when the users desire this. For the apartment-garden the stackable windows are an excellent option, the users are free to open a window when they want and it is also possible to completely open the façade, transforming the room into a balcony.

For the windows of the apartment-garden there are two options that fit the needs. The first option are the accordion windows and the second option are the stackable windows. Each of the two options gives an almost similar result in use and application. The stackable windows are the most interesting for the apartment-garden because with this system it is possible to open each window separate, giving more freedom in use.
6.1.6 Door between the apartment-garden and the apartment.
Because the apartment-garden is an extension of the living space inside the apartment but also an outside space there is a wall separating these two rooms. What type of door is the most appropriate to use for the apartment-building?

6.1.6.1 (Normal) Turning door(s)
This would be the most common door to place in the wall. This is also the most common with current balconies, but the apartment-garden isn’t a balcony. For the apartment-garden doors have the disadvantage that they always will separate the apartment-garden from the living space inside. It would be nicer to dissolve this barrier and make it possible to combine the two into one bigger space, like a conservatory.

6.1.6.2 Sliding doors
With the sliding doors it is possible to almost open the whole wall between the two rooms. When the doors slides to one or more sides of the wall it creates a connection between the two spaces. For the apartment-garden the sliding door is a nice option, it doesn’t completely open the wall but creates an big connection between the two spaces. It is nice that is combines the two spaces almost as one, only a slight separation still shows that it are two different spaces. The sliding façade doesn’t consume any space in any of the two spaces, it isn’t necessary to move furniture around when the door is opened.
6.1.6.3 Accordion doors

With the accordion doors it is possible to completely open the wall between the two spaces. When it is opened the doors segments fold up to the side. For the apartment-garden this is nice because the wall is completely opened, but the disadvantage is that when the segments fold up there has to be space for them. For the apartment-garden the accordion doors isn’t a good option, it prevents people from using their whole space.

6.1.6.4 Stackable doors

With the stackable doors the door segments open like turning doors and slide to the side to completely open the wall between the two spaces. For the apartment-garden this is nice because the wall can be completely opened, but the disadvantage is that when the segments are opened and slide to the sides there needs to be space for them. For the apartment-garden the stackable doors aren’t a good option, it prevents people from using their whole space.

For the façade between the apartment-garden and the apartment the best option is the sliding doors. These doors make it possible to almost completely open the wall, but don’t use any space when they are opened.
6.1.7 Railing filling of the apartment-garden
When looking at the requirements for the apartment-garden the experience and view off the outside is important. When looking at types of railings for the apartment-garden this would result in a railing with a high transparency. With a transparent railing this increases the sunlight on the apartment-garden and the view to the outside. This results that the apartment-garden gives a less closed of experience.

6.1.7.1 Steel filling
With a steel filling and the need to close the apartment-garden this would result in a completely non-transparent filling. If the filling is closed the view to the outside is blocked at the bottom part, what isn’t desired for the apartment-garden. For the apartment-garden the steel filling isn’t a good option, it would block the view, also does the material not correspond with the choice of the wood structure.

6.1.7.2 Wood filling
With a wood filling the railing would correspond with the rest of the structure of the apartment-garden, wood. But because it has to be closed the wood would completely block the view of bottom part of the façade, compromising the desired openness. For the apartment-garden a wood railing isn’t a good option, it would block the view.

6.1.7.3 Mesh or columns filling
With a mesh or column filling the bottom part of the railing would have an open view to the outside. If only this would be applied the bottom part of the façade would be also open, not only for the view but also to the outside air. For the apartment-garden only a mesh or columns wouldn’t be an option, it doesn’t close the space from the outside air.

6.1.7.4 Glass filling
With a glass railing the apartment-garden is transparent and closed of from the outside air. For the apartment-garden a glass railing would be the best choice, it has the desired transparency. People standing in the apartment-garden with a glass railing would have the idea that they could almost just walk out of the space.

For the railing filling of the apartment-garden a combination between two techniques would be interesting. With the glass façade the space is closed from the outside but still open for view. Adding wood columns on the inside would complete the garden apartment with the wood structure, masking the more industrial feel of the glass.
7. Building the apartment-garden

In this research there is stated that apartments need an outdoor space that has a better quality, similar to a garden. The current outdoor spaces where analyzed and the idea for the apartment-garden is created. An outdoor space of an apartment that tries to fulfills the need like a garden does. The main issue is the size of the apartment-garden, the dimensions of the apartment garden are chosen in a way that the it becomes a multifunctional space. Residents get a wider possibility of use for their space. The apartment-garden should be a balcony that can be closed in bad weather and. This transforms it into a more usable space, not being dependent on good weather. To retain the outside experience in the apartment-garden this façade should be highly transparent.

To construct the apartment-gardens the structure is an independent self supporting structure, only depending on the existing building for its stabilization. This makes the apartment-garden easy to apply in many cases. To keep the identity of a garden the material for the apartment garden mainly will be wood, combined with glass for its transparency. Accordion windows will enclose it, making it possible to completely open the façade.

Because the apartment-garden is an extension of the indoor space these are divided by sliding doors, when these are opened the barrier between the spaces fades. The apartment-garden is a new space for residents, giving them an opportunity for wide use during the whole year.
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