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PROVIDING HOUSING FOR AN INCREASING INFLUX OF REFUGEES BY DESIGNING
A FLEXIBLE ASYLUM SEEKERS CENTRE USING DIGITAL FABRICATION



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ABSTRACT

At the moment 51 million people are on the run. For some their goal is to get to Europe. The COA (Central Organ Asylum Seekers) who, are responsible for the housing of asylum seekers in the Netherlands have to deal with a record number of refugees. A robust solution is needed which fulfils the different basic needs of the asylum seekers, but also proposes a generic building system which can respond to the fluctuating influx. This building system needs to be adaptable to every new occupant every half-a-year and be customized to the family composition and cultural background of its inhabitants. Digital fabrication might be the right technique fulfilling these requirements.

By researching the vernacular architecture of different cultures on privacy, composition and floorplans the boundaries of the flexibility of the building system in terms of user flexibility can be traced. As well as providing three possible indoor locations that are being evaluated on hard physical aspects such as ventilation and daylight, and more soft architectural elements such as privacy and view. They determine the flexibility the building system needs to perform in terms of urban flexibility.

“LIMINALITY” - *Victor Turner, 1967*

A transitional phase in which a person has been separated from its former context, but not been rooted to its new structure.

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1. INTRODUCTION

The housing of asylum seekers is a controversial issue that requires statements about both political and architectural charged issues. At the moment many countries are in the grip of war and terrorists. As a result 51 million people are on the run at the moment (UNHCR, 2015, pp. 3-5). This is the highest number since the second world war and it's still increasing. Mainly because of the war in Syria. But also conflicts in Eritrea and Nigeria contribute to this rising number. For some their goal is to get to Europe. A hope for an opportunity for a safe and better existence. But how exactly are these refugees welcomed in for example the Netherlands? From a temporary location (up to 4 weeks), which can be in an asylum seekers centre (azc) or in empty halls, the asylum seeker is moved to a more permanent stay (up to 3 years) in an azc somewhere spread over the country mostly abandoned from cities.

Because of the increasing number of refugees worldwide, the COA (Central Organ Asylum Seekers), who are responsible for the housing of asylum seekers in the Netherlands, have to deal with a record number of refugees. Their annual report on the pas year is therefore been aptly titled "Growth." Within this report they state never known to have such a large increase in such a short period of time (COA, 2015, p. 2). In order to cope with this large amount, existing centres had to be expanded. These locations are facing the end of their lifespan according to (COA, 2012, p. 6). But also new centres are being built at a rapid pace that costs tens of millions (Goet, Helder & Siebers, 2014, pp. 19-65). This quick solutions don't contribute to good living conditions admits COA.

But these poor conditions are also caused because of the fact that this locations are always destined for a temporary stay and a rather homogeneous target group, while asylum seekers represent a wide variety of lifestyles and cultures. Besides the family

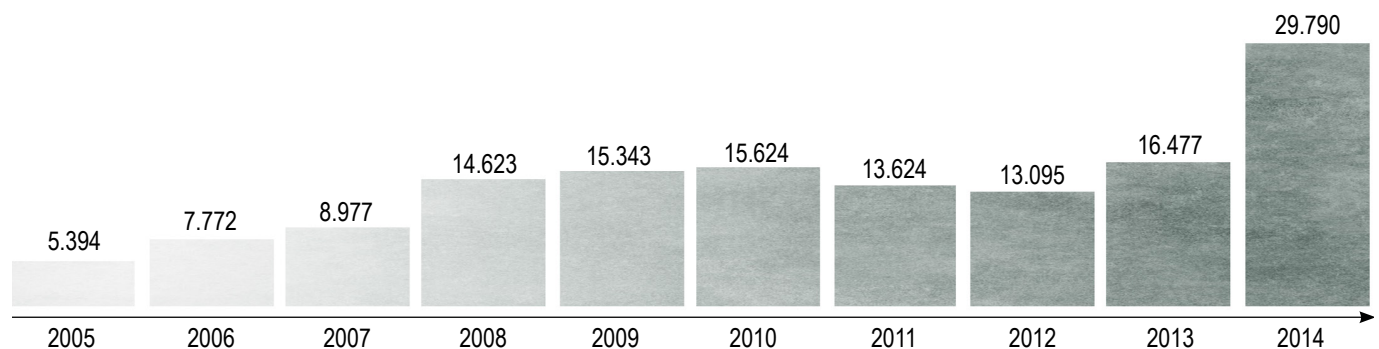


Figure 1. Development influx over the years (COA, 2015, p.51)

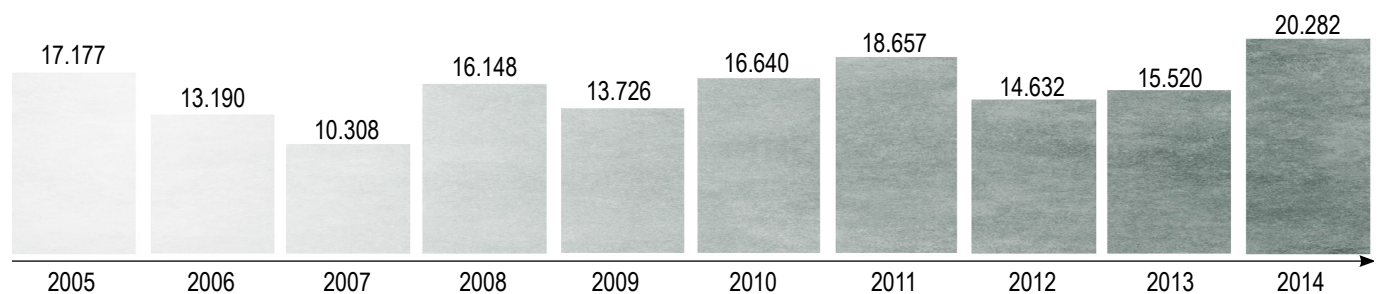


Figure 2. Development outflow over the years (COA, 2015, p.51)

composition and cultural differences lack of privacy is also a big problem. These shortcomings of the AZC results in polarization. The COA receives for example the highest number of complaints from refugees about the way housing is organised (Valk, 2014, pp. 3-5). The integration process after obtaining a residence status is severely hampered.

A robust solution is needed which fulfils the different basic needs of the asylum seekers, but also proposes a generic building system which can respond to the fluctuating influx. This building system needs to be adaptable to every new occupant every half-a-year and be customized to the family composition and cultural background of the asylum seekers. A suited technique is needed that has the potential to build these adaptable, customized and cheap homes. Digital fabrication might be the right technique that can allow mass customization with the benefits of mass production.

Therefore the main research question will be: *How to design flexible homes that can adapt to every new occupant and function as one toolbox that can be implemented within various empty spaces within urban settings using digital fabrication*

This paper starts by describing the methods which are being used to answer the research question. Followed by results on the current situation asylums seekers are housed, how the azc can be flexible to the user, to different generic urban context and how this flexibility can be implemented using digital fabrication. The conclusion is used reflect on the results and provide recommendations which can be used in further research.

2. METHODS

Mapping the current situation is done by literature research, analysing existing azc's, visit them and have interviews with supportive staff and inhabitants. Using all these different methodologies result in a complete view on how asylum seekers are currently being housed. Which is summarized in a list of program requirements.

This list can be supplemented with research done on how to implement flexibility towards the user (A). By choosing three different cultural backgrounds and study their vernacular architecture by literature, on three predefined topics, the degree of adaptability can be further focused. Combined with the flexibility towards family composition the list of program requirements is further supplemented.

Followed by research on how to implement this azc in various urban settings (B). Three indoor locations have been chosen within the ring of Amsterdam: an empty cell block office, the van Gendthallen and the same cell block office but then stripped. Choosing vacant buildings contributes to solving the vacancy problems but it also gives the opportunity to make use of the existing shell which improves the adaptability of the system.

Strategies are given on the basis of studying references, literature and location visits, on hard physical aspects such as ventilation, daylight, water supply, sewerage and electricity but also on more soft architectural aspects such as privacy, view and experience .

Concluding by choosing the best suitable digital fabrication technique which can comply to this urban and user flexibility. This is done by literature research, in which only one source is used that offers a complete overview of all techniques. The different types of connections accompanying this system is also included within this last chapter.

Together this will be the start of a building system which can be used to formulate a design. In the concluding chapter future research is briefly examined. The different degrees in flexibility are illustrated in the following matrixes on the next page and form the core of this paper.

RESEARCH METHODS

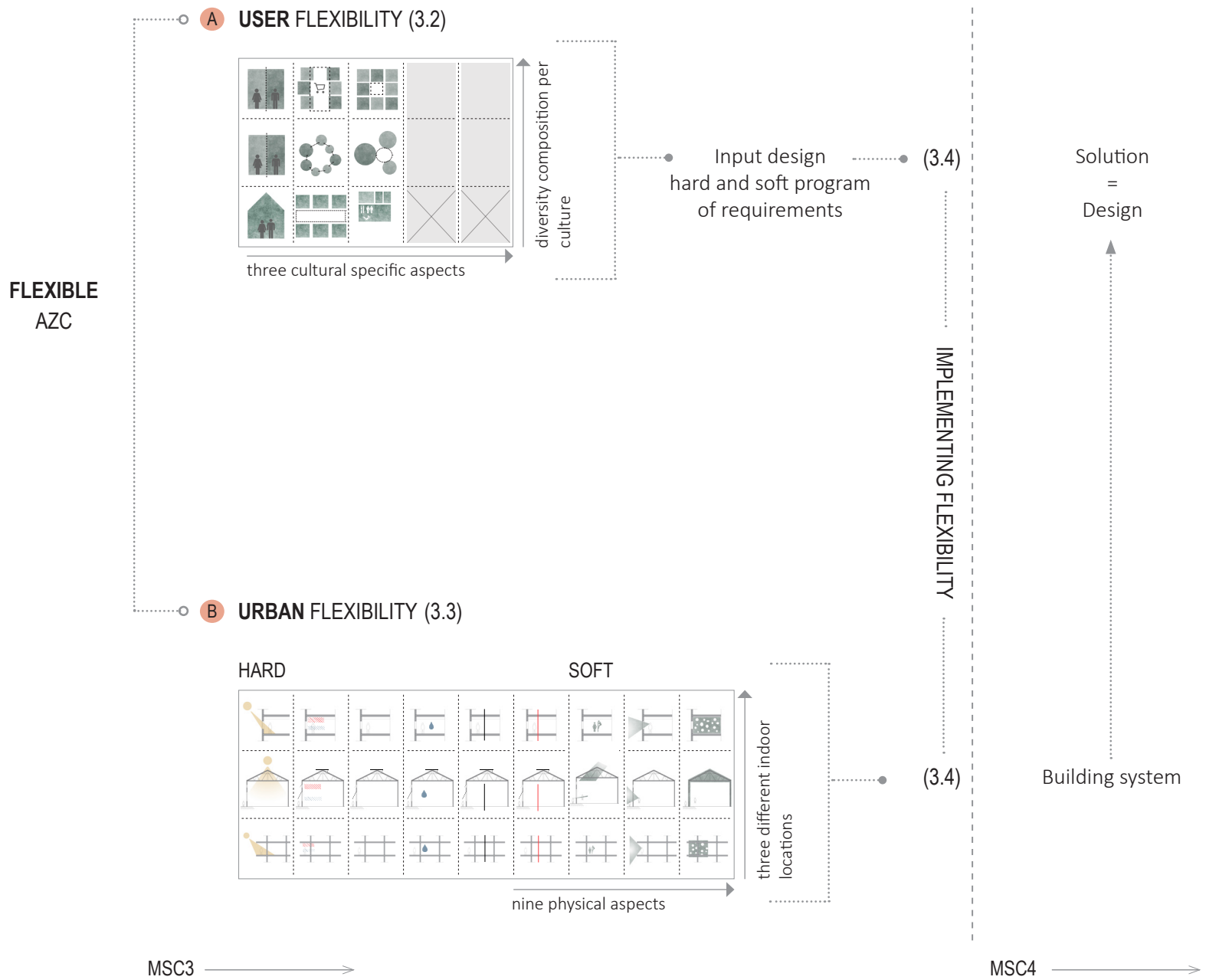


Figure 3. Structure of research paper, own ill.

3. RESULTS

3.1 MAPPING CURRENT SITUATION

BUILDING QUALITIES

BUILDING PROCESS

3.2 USER FLEXIBILITY

FLEXIBILITY TO CULTURAL BACKGROUND

3.3 URBAN FLEXIBILITY

URBAN SITE

PHYSICAL STRATEGIES

3.4 IMPLEMENTING FLEXIBILITY

DIGITAL FABRICATION TECHNIQUE

JOINTS

3.1. MAPPING CURRENT SITUATION

At the moment asylum seekers are facing different problems related to the way of housing. They can be distinguished in building qualities; the quality of housing experienced by the asylum seekers and the building process; the current solutions in response to the unpredictable increasing influx of asylum seekers. Within this chapter each of this topic is being elaborated.

3.1.1 BUILDING QUALITIES

Small housing and lack of privacy

Asylum seekers who live in an azc suffer from a lack of privacy. One of the causes is the tight housing whereby parents and children must live constantly in small or even in one room, or in an apartment that they have to share with another family of unfamiliar people. Single people also have to share their room with multiple unfamiliar people from different ages and cultural backgrounds. (Manesh, 2007). Within the azc people live close together because of the rule each empty bed has to be filled. Every asylum seeker is entitled to 5m² space. There is a rigid amount of people per room resulting in minimum flexibility. This can result in 20m² rooms consisting of max 4 people, a table a chair a closet and a refrigerator and television to share. De boundaries of personal space are being exceeded each time (Manesh, 2007). It became clear from the location visit to the azc in Katwijk and interviewing the support staff that people from different cultures that live close together who don't have any privacy and don't fit well together cause trouble. The fact that most of them are bored, don't have any daytime activities and don't have the opportunity to go to a separate living room enhances this problem.

When analysing the existing azc's it became clear there isn't a clear boundary between shared and private space. People come in unannounced for a chat with the other roommates. For those who don't want to participate within these social activities there is no possibility to elude from this because, there isn't a private space.

Communal spaces such as kitchens and washing areas are dirty, there is noise disturbance, and conflicts can arise due to different habits of residents within these communal spaces. (Bosland, 2007). Children cannot seclude themselves in their own spaces, have a space to do their homework therefore they can get sleep deprivation and emotional problems. The potential for conflict is increased by the lack of privacy (Kalverboer, 2008).

Isolated location of the azc

The isolated location of the azc causes problems such as poor accessibility of shops and other facilities, unsafe roads without a bicycle path, little or no public transport and minimal contact with the outside world. Some of the azc's are located next to unsafe places such as big roads or electricity pylons (Manesh, 2007). Mapping all azc's in the Netherlands results in a table displaying all the distances to the nearest shops (appendix 5.1). The average of all these distances is set at four kilometres. When taking in mind that most of the asylum seekers don't have money for a bus ticket they will often have to walk.

Problematic composition of different cultures

Within the azc people from different cultural backgrounds have to live closely together and sometimes even have to share a room. This can lead to clashes and insecurity in the living conditions of the residents (Jongh, 2004). Female asylum seekers in particular suffer from the large number of single men. They feel intimidated by them. Sexual codes are different within many countries and people don't speak the same language. In many azc's aren't any separated functions for men and women available. These women feel unsafe if they for instance at night have a lonely walk to the bathroom (Brouns et. All, 2003). This also becomes clear in the interviews of both support staff and inhabitants. A clientele nurse from the azc in Heerlen stated: 'There are sometimes clashes and people get physical because of cultural differences. They can ask to be transferred to another room but this isn't always possible.'

Insufficient facilities

Asylum seekers aren't allowed to work for money because they don't have a residence status. They are allowed to do volunteer work, but because most of the azc's are abandoned from cities, native Dutch people don't know of their existence it's almost impossible for them to find volunteer work. The azc provides little cleaning tasks for the residents with a little fee in return. But most of them must search for other activities to fill their days (Geuijen, 2000). But there are too little possibilities to do meaningful activities, get some distraction and relaxation. There are too few possibilities for children to play both inside and outside. There are no good facilities to do homework at the azc. The amount of computers is too little everyone gets a restricted time of the week or day which is insufficient to do homework or apply for volunteer work. When visiting the azc's it became clear there wasn't most of the time any recreational space at all available within the housing block. The only possibility to sit, apart from the chair in the room, were occasionally 2 picnic tables outside. This solution can only be used in summer.

Most of the asylum seekers which have been interviewed feel socially isolated and are ashamed of their situation to live in an azc. They often feel lonely and misunderstood and find it difficult to engage within friendships both within and outside the azc. The fact that the azc's are mostly abandoned from cities or villages only reinforces this phenomenon. This lack of social facilities and contact severely hampers the integration process (Kalverboer, 2009).

Providing a separate school on the azc terrain causes trouble according to experts. A disadvantage will be the language development. It can also have a negative impact on the school's atmosphere because there will be relatively many children with a disturbed behaviour that can have influence on other children. According to the human Rights Committee separate education based on a particular cultural origin provided educational inequality. It prevents integration because it will be harder to take knowledge of the culture of the country where they will stay. It will cause segregation rather than integration (Curtis, 2002).



Lack of privacy



Abandoned from cities



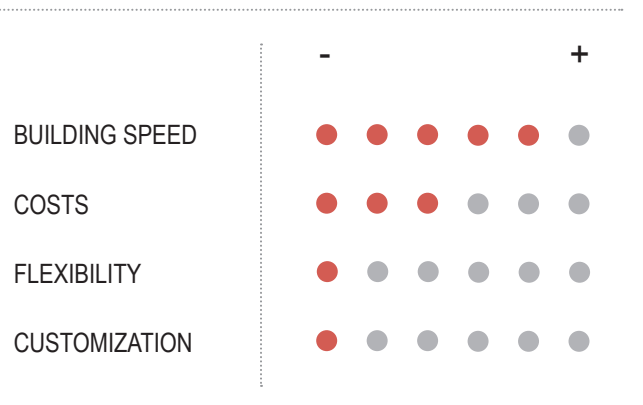
Not adapted to big families



Not adapted to cultural background



Insufficient facilities



According to literature the transformation costs for an office building build between 1970-1989 are €770-815,- /m2 (Lagae, 2010, pp.21-23).

Flexibility

Within the transformation the degree of flexibility is limited through the boundaries of the existing building. The existing grid sizes are used even if they were designed for a totally different target group. The rooms are not adaptable, when having a big family multiple rooms are shared next to each other without a connecting door. When use is made of monumental buildings this effect is only amplified.

Customization

Most of the existing buildings of which use is made consist of an authentic character in presence and location. This can be a big advantage. In case of the azc in Zeist this rather works as a disadvantage. When visiting this location all traces of the former prison function were still clearly visible and tangible. Thereby it's still barely possible to customize the room for the inhabitants. It isn't often allowed to bring your own furniture.



Figure 4. Transformation azc zeist. source: <https://www.coa.nl/nl/fotos/verbouwing-azc-zeist>

NEW (SEMI) PERMANENT LOCATIONS

A second option when there is a high influx is to place extra new semi-permanent prefab housing on existing plots owned by COA providing housing for about 600-800 people (COA,2015). At the moment 10 from 40 locations are realized as semi-permanent prefab housing. As an example azc Almere is taken which has been used since 2000 which will be reviewed on the following topics:

Building Speed

The construction started in June 1999 after the application was approved by the ministry. In April 2000 the azc was completed, so the construction period took up 11 months (Renout, 2000). The centre is made of prefab elements which only have to be put in place on site.

Costs

The total building costs of the azc were 16.5 million euros converted from guilders. For this amount 800 asylum seekers are being housed, there’s a school and office buildings for the supportive staff (Renout, 2000). This would result in €20.600,- per person, or €2000,- per m². In the period of 2006-2010 the COA rented the buildings to various community organizations, because of vacancy, with the agreement that they could make temporary use of these empty spaces (COA, 2015).

Flexibility

Because it’s a generic building system it can be used for multiple functions which is what happened when the COA rented the azc to other organizations. In this way vacancy can be prevented, and this is therefore the degree of flexibility this construction system contains. Since flexibility between the loadbearing walls, among inner walls, is absent while it’s possible.

Customization

Also with this building system there’s little space to personalize the rooms. But the need to do this is even stronger present. This because the appearance of the buildings are all neutral and monotonous.

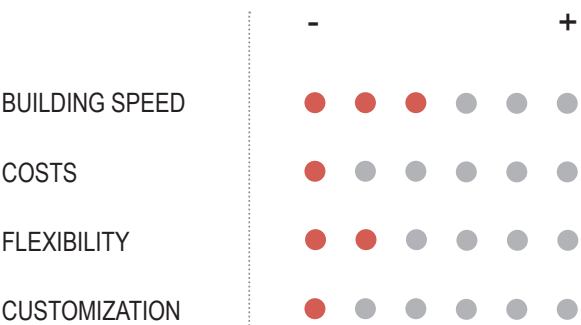


Figure 5. Building semi-permanent housing azc Heerlen
Source: <https://www.coa.nl/nl/opvanglocaties/heerlen>



Figure 6. Prefab housing azc Almere, source: own ill.

EMERGENCY HOUSING

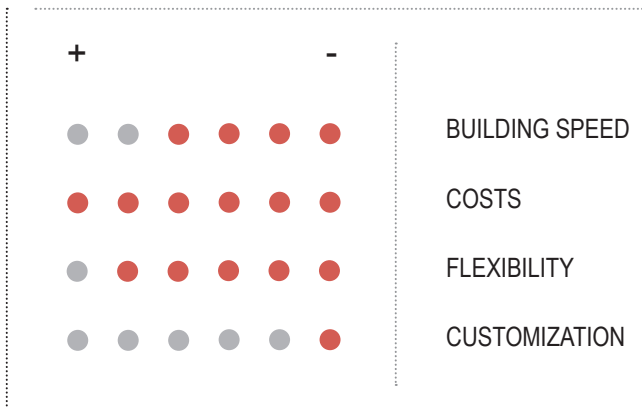


Figure 7. Emergency housing azc Katwijk. Source: own ill.



Figure 8. Emergency housing de Meeuw systems.
Source:<http://www.demeeuw.com/huisvesting-voor-asielzoekers>

When the need for housing is the highest and a solution is needed and dwellings are needed at that moment because of an unforeseen additional influx, use is made of container emergency housing which are located on several azc's within the Netherlands. Similarly in Katwijk which is used as an example to be reviewed on the following topics:

Building Speed

The houses are placed on top of large stone slabs which needed to be laid first. The placing of the container units started in November 2014 and was finished in December 2014 (COA, 2015). When visiting the azc in April the outdoor space still had to be appointed.

Costs

The costs of the azc in Katwijk¹ will be approximately €300.000 for 400 persons and is being rented for upon a year, which results in €750,- per person, per year, or €75,- per m². This isn't a solid investment that gives guarantees in the future. Thereby the quality of these residential buildings is very low. There is for example often no common living room to save costs, while it's obliged in the program requirements set by the (COA, 2012, p. 14).

Flexibility

The entire building configuration is very flexible. The setup can take any desired configuration since there aren't any boundary constrictions. The internal flexibility of this building system is the least compared to the other systems discussed before. This because the fixed size must be taken into account which can be placed on a truck. As a result the free space becomes smaller and smaller. The bathroom is out of proportion in terms of size as a result of the fixed sizes.

Customization

When looking at customization there's little space to personalize the rooms. But also in this case the need to do this is even stronger present. This because the appearance of the buildings are all neutral and monotonous.

¹ Based on a temporary sleeping unit including bathroom and kitchen, according to plan configuration of the azc in Katwijk for a rental period of one year. Source: <http://www.demeeuw.com/verhuur-units-van-de-meeuw/slaapverblijf.htm>.

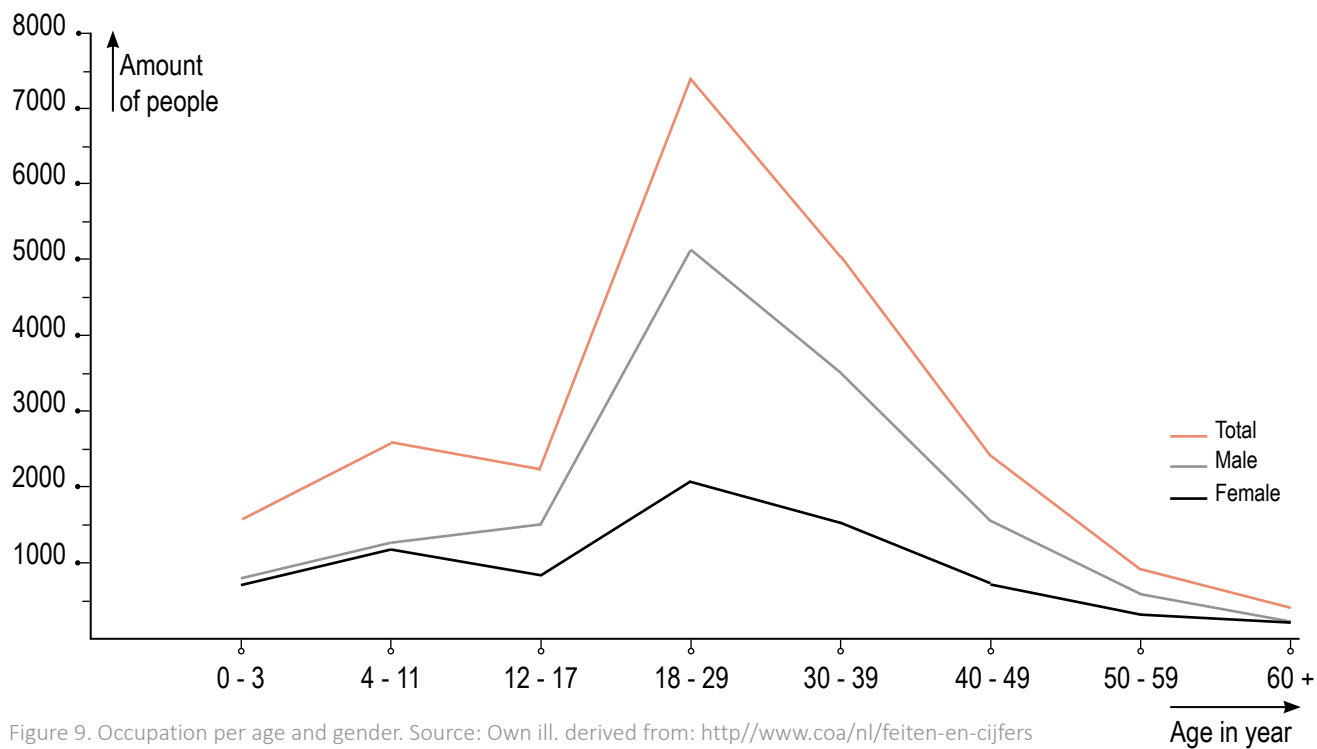


Figure 9. Occupation per age and gender. Source: Own ill. derived from: <http://www.coa.nl/feiten-en-cijfers>

SYRIA

Privacy

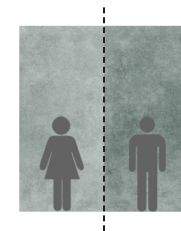
Within traditional Syrian architecture the patio dwelling is the most common type. It provides privacy for the inhabitants as well as a successful treatment for the desert climate. Often these courts were shared by multiple households. Within these traditional dwellings men and women had their own quarter (Oliver, 1997, pp. 1500-1593). Koshiks windows were used to allow light and air to come into the rooms within the court. But because of its perforated appearance it also provides privacy (Oliver, 1997, pp. 1500-1593).

Composition

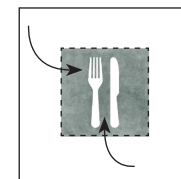
The focal point of each Middle Eastern city is the souk, or bazaar. This determines the organization of the city. It's the social heart of each traditional village and determines the central axis (Oliver, 1997, pp. 1500-1593).

Before entering the home people take off their shoes. This is derived from a religious act in which one take off their shoes when entering the mosque to be pure. Near the entrance of the home a place is being reserved to store these shoes (Vroom, 2009, pp. 311-361).

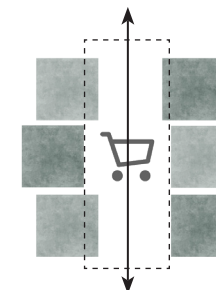
The court of the home is used for cooking and welcoming guests. This is a very important aspect of the Syrian culture. At lunch people eat mezzeh a meal composed of up to twenty or thirty small dishes. A big table is needed to display all these dishes. People sit together on fixed benches around a big low table enjoying their meal but this space is also used



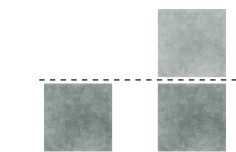
Men and women separated



Houses turn inwards a court



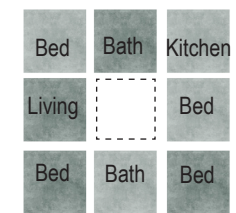
Bazaar is organised element within city



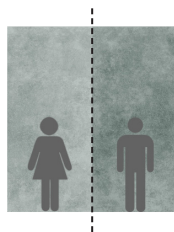
Single max double storey
flat roof



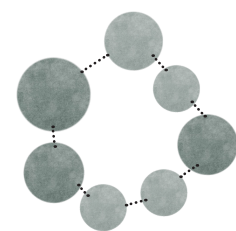
Linear organization



Central court, centre of living



Men and women separated



Urban configuration Igbo culture



Plan configuration Igbo culture

to drink tea at social gatherings. This space can be seen as a mix between a living and dining room and is flexible in use (Vroom, 2009, pp. 311-361). Opposite from the poor ornamented exterior the interior of this room is often richly ornamented which resulted in abstract geometric patterns borrowed from ancient ones in the Koran. Niches in the walls are used as storage space (Oliver, 1997, pp. 1500-1593).

Floorplan

Different plan configurations are possible. The courtyard organization reflected the inward-looking design philosophy. Different rooms were organized around the court in an appropriate manner to cope with social life. The rooms in house were flexible in use, their function being interchangeably for sleeping and living. The dimensions of the rooms rarely exceeded 4 m. As a result the house was built as a modular system. As a result they had a large degree of flexibility in accommodating the changing family size because of the possibility to add or remove rooms (Oliver, 1997, pp. 1500-1593).

But also L-shaped floor plans are commonly used. In section these dwellings showed a variation in ceiling heights and changed floor levels created a feeling of spaciousness in the communal living room (Oliver, 1997, pp. 1500-1593).

NIGERIA

These days 250 ethnic tribes call Nigeria their home. The three largest and most dominant ethnic groups are the Hausa, Yoruba and Igbo. Because of their conquest by Europeans, these ethnic groups had separate and independent histories. Their grouping together into a single country known as Nigeria was done by their British colonizers. These various ethnic groups never considered themselves part of the same culture. They are divided by the Niger and Bendue river overlapping each other in the centre of the country, creating an "Y" that splits Nigeria into three separate sections. The Hausa in the North, the Yoruba in the Southwest and the Igbo in the Southeast (Okoye, 2002, pp 381-396). Research into the vernacular architecture of Nigeria focuses on these three main ethnic groups.

Privacy

Igbo and Yoruba

Within traditional Nigerian architecture the circular cladded dwelling situated in a compound is the most common type. Often these communal inner spaces were shared by multiple households and provide privacy (Oliver, 1997, pp. 1500-1593). When an extended family desires to live all in the same area multiple houses will be connected side by side living together with other families but still providing privacy (Bascom, 1969). But compared to western standards people live in small places meaning constant being in contact with their family and friends, and often literally meters away from their extended families (Vlach, 1976, pp. 48-99).

Hausa

Within Northern Islamic areas the Hausa house takes form. It consists of rooms within

or surrounding a courtyard or forming two or more courtyards. The entryway into the compound is via a large hut built into the wall of the compound. This is the hut of the father or head male figure. The complex is demarcated by a wall giving privacy to the family. Homes are typically geometric, often with Muslim markings and decorations (Oliver, 1997, pp. 1500-1593).

Composition

Igbo, Yoruba and Hausa

The centre of the compound contains the main social and economic unit for the single or extended family. The courts are grouped into families who work in the same field, the share the same food storage space and eat from the same pot. (Oliver, 1997, pp. 1500-1593). Food plays a central role in the rituals of virtually all ethnic groups in Nigeria. Special ceremonies would not be complete without participants sharing in a meal. Normally it is considered rude not to invite guests to share in a meal when they visit (Herrle & Wegerhoff, 2008, p.159). Food in Nigeria is traditionally eaten by hand. However, with the growing influence of Western culture, forks and spoons are becoming more common, even in remote villages. Whether people eat with their hand or a utensil, it is considered dirty and rude to eat using the left hand. People having dinner sitting on the floor, on benches, around a low table or sit at a table on chairs compared to western culture (Okoye, 2002, pp. 381-396).

The majority of Nigerian families are very large compared to Western standards. Many Nigerian men have more than one wife. In some ethnic groups, the more children you have, the greater a man's standing in the eyes of his peers. Family units of ten or more are not uncommon. Men are dominant over women in virtually all areas. Women still have fewer legal rights than men. Within most dwellings men and women had their own domain (Herrle & Wegerhoff, 2008, p.159).

Floorplan

Igbo

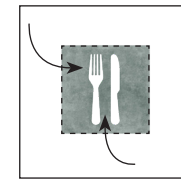
The circular floor plans often consist of three round rooms arranged in a loosely triangular formation. One room is used for sleeping, a second for storage and a third for cooking and socializing. The space between them can be used for gathering. The house is constantly adapted to suit changing family needs (Oliver, 1997, pp. 1500-1593).

Yoruba

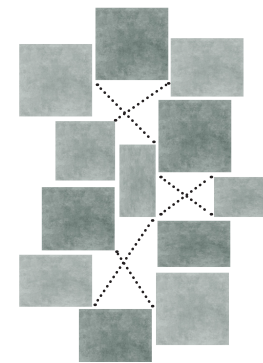
Most of the housing for the Yoruba groups consists of simple buildings with only two rooms (3x3 metres). One of the rooms serves as a kitchen, and one for sleeping. Most of daily life takes place in the court. These simple houses can have different setups. For instance the three legged house. It has multiple 3x3 rooms connected to a long rectangular room that serves as a lobby (Vlach, 1976, pp. 48-99).

Hausa

Different square rooms are connected to each other around a court and protected by a wall. The kitchen is often round and forms the head of the house (Dmochowski, 1990).



Plan configuration Hausa culture



Urban configuration Hausa culture



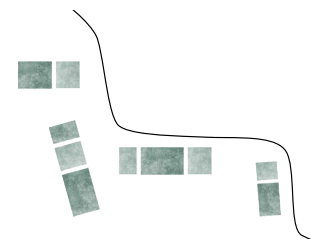
Plan Yoruba culture (3x3m.)



Linear organisation



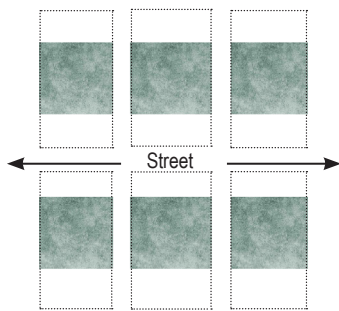
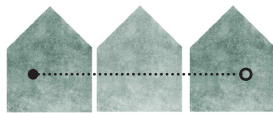
Clustered plan Yoruba culture



Urban configuration Yoruba culture



Men and women together



Rural areas, clustered dwellings parallel facing the street



Dwelling organization rural area, flexible use of living room



Russian urban apartment, flexible use of space

RUSSIA

For many centuries, the question of whether Russian culture is more "eastern" or "western" has been a burning issue. Situated at the crossroads of important cultures and civilizations in every direction, the Slavic groups and other peoples of Russia have profoundly influenced the vernacular architecture (Shvidkovsky, 2007).

Privacy

Multi households are very common in Russia. Families often live together with their grandparents. But they are organised parallel facing the street in order to provide privacy. The organization of the plan is build up in such a way that sleeping functions, viewed from the road, are the most rear warded within the house. Followed by the living room and kitchen. The entrance can be through a porch (Oliver, 1997, pp. 1403-1419).

Composition

In 1851, 92 percent of the population lived in rural villages within clusters of 25-30 households subdivided by family. The Soviet period brought movement to the cities as people tried to escape the harsh conditions on state-run collective farms. More than half of the rural population today is over age 65, because young people continue to migrate to the cities. Although there are still tens of thousands of small villages, many are disappearing as people die or depart. Within these rural areas the exterior of the houses are heavily decorated while the interior remains abstract (Cracraft, 1988).

By 1996, 73 percent of the population was urban, with most people living in high-rise apartment blocks constructed after the 1950s. Families often living in such apartments holding three generations, caused by housing shortage and the high costs. Urban families often have one child. They often live with a widowed parent of one partner, most often the grandmother, who provides child care and food preparation (Cracraft, 2003).

Floorplan

Most of the people live in apartments. Because of limited space, the largest room often serves as living room, bedroom, and dining room for many families. Domestic furnishing is highly consistent, partly because all furniture was purchased from state stores where variation was limited until 1990. Among the characteristics of Russian taste functional furniture is preferred, oriental carpets on the walls, and large wardrobes instead of closets. The bath and toilet are commonly located in small separate rooms side by side. Narrow balconies are used for storage, tools, laundry, and sitting (Oliver, 1997, pp. 1403-1419).

Family members spend much of their time at the kitchen table, eating and drinking tea while talking, reading, watching television, cooking, or working on crafts. When guests come they all sit around one table for the entire gathering, which may continue for hours. Wedding parties usually take place at the home of the family of the bride or groom, and everyone squeezes around an extended table. The threshold to a family's apartment marks a crucial transition zone to private space, which is clean and tidy. Shoes are remain just inside the doorway to keep dirt from the interior of the home (Shvidkovsky, 2007).

3.3 URBAN FLEXIBILITY

3.3.1 CHOICE FOR URBAN SITES

When mapping the problems that occur within current azc's an isolated location is often pointed out to be a big problem. From a table in which all the azc's were documented emerged that the average distance to the nearest facilities are 4 kilometres. Within this paper inner urban locations will be used as a better alternative. Three indoor locations have been chosen within the ring of Amsterdam: an empty cell block office, the van Gendthallen and the same cell block office but then stripped. Choosing vacant buildings contributes to solving the vacancy problems but it also gives the opportunity to make use of the existing shell which improves the adaptability of the system.

In addition, it also has social and economic benefits. This is because xenogamy can occur between the azc and the existing urban fabric (Kloosterboer, 2009). Dual use can be made of schools, day-care and language classes. This not only saves costs, because these facilities should otherwise have to be implemented on the azc terrain, but also provides that asylum seekers get more control over their own life. This will ultimately prevent a feeling of uselessness and enhances the quality of life (Kalverboer, 2008).

The three indoor location urban locations all fulfil these social and economic benefits and are being tested on hard physical aspects such as ventilation, daylight, water supply, sewerage and electricity but also on more soft architectural aspects such as privacy, perception and sight.

¹ (Remoy, 2010)

² (Koorneef, 2012)

³ (Bouwbesluit, 2012, article 4.7)

⁴ (Bouwbesluit, 2012, article 3.78, NEN2057)

⁵ (Bouwbesluit, 2012, article 3.38, NEN8087)

⁶ (Yanovshchinsky et al, 2012, pp. 67-72)

⁷ (Zondervan, 2014, pp. 28-37)

⁸ (Yanovshchinsky et al, 2012, pp. 261-268)

⁹ (Hofkes, 2004, p. 241)

¹⁰ (Yanovshchinsky et al, 2012, pp. 229-244)

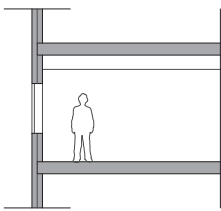
¹¹ (Zeiler, 2007, p. 259)

3.3.2 POSSIBLE IMPLEMENTATIONS

SIZE

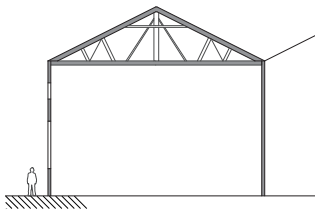
CELL BLOCK OFFICE

- Grid size: Between columns most common size^{1,2,3}
3.5 x 5.4 - 7.2 m. (Koorneef, 2012)
- Floor height: **2.6 - 2.8 m.**



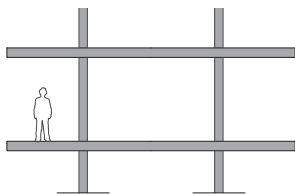
VAN GENDT HALLS

- Size: Hall 5
18.0 x 150.0 m. = 2700 m²
- Height: **10.0 m.**



STRIPPED OFFICE

- Grid size: Between column:
5.4 - 7.2 m. (Koorneef, 2012)
- Floor height: **2.6 - 3.0 m.**
- Floor size: Between column
7.2 x 14.4 m. = 103.8 m²



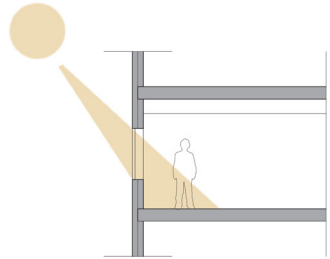
COMPARISON

3.3.3 PHYSICAL STRATEGIES - HARD

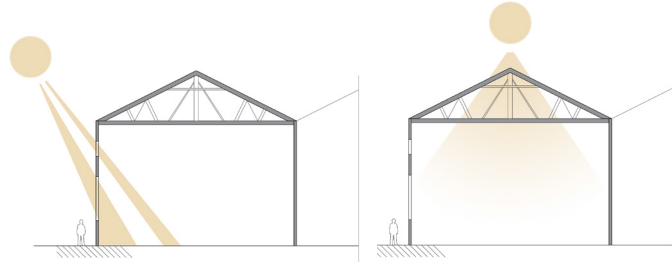
DAYLIGHT

- Regulation: Existing buildings: **0.5 m²** daylight surface required⁴
Offices: at least **5%** of the floor surface as daylight¹
Operable windows and direct light aren't obliged⁴

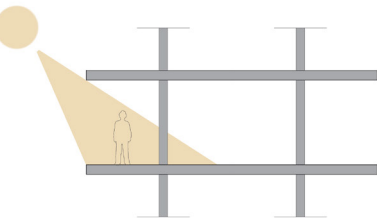
- Calculation: Size one cubical: 18.9 m² (5%) = **0.95 m²**
- Strategy: Sufficient daylight according to temporary building law



- Calculation: Rooflights: 3.0 x 8.8 = **26.4 m²**
Windows : 1.1 x 1.1 + 1.3 x 3.2 = **16.2 m²**
- Strategy: Sufficient daylight according to temporary building law
Floorlevel needs to be raised in order to get direct light



- Strategy: Direct ventilation
Direct sunlight

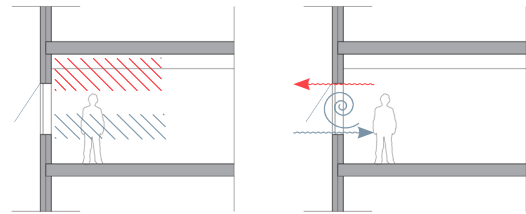


All solutions fulfil the requirements regarding the amount of daylight. Cell block office has the least amount of daylight. Within the van Gendthallen the floor level needs to be raised in order to get direct light.

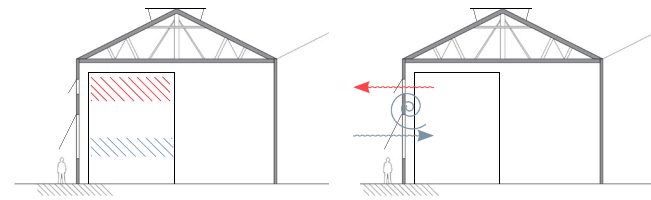
VENTILATION

- Regulation: User area: **0.7 dm³ / s / m²**
Cooking: **21 dm³ / s / m²** (Output direct outside)⁵
Toilet: **7.0 dm³ / s / m²** (Output direct outside)

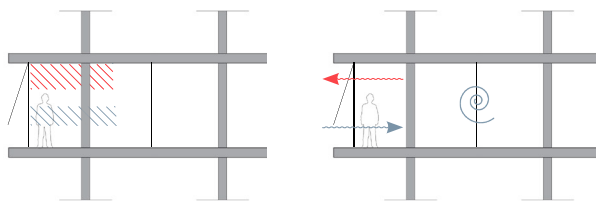
- Strategy: Make use of existing infrastructure. More kitchens and bathrooms are needed: add extra direct output ducts
Operable windows, preventing air pollution.



- Strategy: Operable windows are needed. Ventilation output ducts are needed from dwelling to outside. Hall natural- dwellings mechanical because: Units are individually controllable, natural ventilation in the hall will be naturally adjusted to its airflow. Using fans to extract exhaust air from dwelling. prevent air pollution.



- Strategy: Design dwelling with complete micro climate
Operable windows, Using fans to extract exhaust air from the dwelling, prevent air pollution.

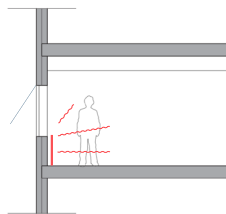


Operable windows and direct output ducts are needed which is in case of the cell block office and the van Gendthallen an adjustment to the building. Within the stripped office this can be integrated within dwelling.

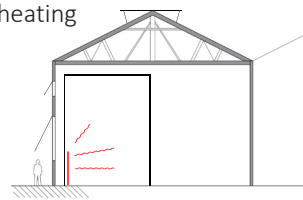
HEATING

- Regulation: Energy consumption 2 p household: **3400 Kwh⁶**
Average energy consumption office: 500 - 10.000 m² : **392 MJ/m²**

- Strategy: Make use of the existing heating infrastructure
Zoning the functions of the dwelling in relation to the heat demand to reduce the energy demand.



- Strategy: Heat the dwellings individually by a electrical heating radiator, or an airco, or electrical stove with oil. Non climatized hall because climate is otherwise not individually controllable and big adjustments need to be done regarding the hall to fill gaps.⁷ Building compact by trying to reduce the facade surface area. Combination ventilaton and heating



- Strategy: Heat the dwellings individually by an electrical heating radiator or an airco, electrical stove with oil, or electrical heating mat. Building compact by trying to reduce the facade surface area. Zoning the functions of the dwelling in relation to the heat demand to reduce the energy demand. Avoid gas.

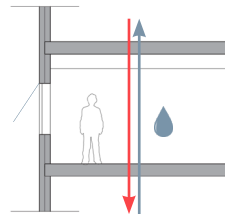


Within the cell block office use can be made of the existing infrastructure. Within the van Gendthallen and the stripped office new heating systems must be placed which can be connected to the electricity network. Avoid gas.

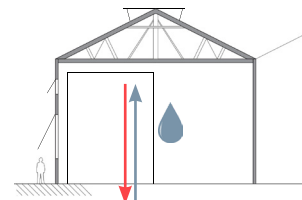
WATER SUPPLY

- Regulation: Water usage per day per person: **120 litres⁸**
The unit should fit anywhere and so should the utilities⁷ be able to connect on any location

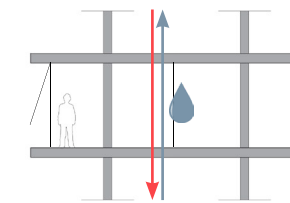
- Strategy: Extra water supply pipes and boilers are needed because of extra toilets and kitchens. Reserve extra space for vertical shafts. Collect and filter rainwater and reuse it.



- Strategy: Extra water supply pipes and boilers are needed, design them within the floor. Make use of extra available floor space by raising the floor height (in order to get direct sunlight) to connect the ducts. Collect and filter rainwater and reuse it.



- Strategy: Extra water supply pipes and boilers are needed. Drill through load bearing structure vertically. Insulate shafts when they will be in an outdoor environment. Collect and filter rainwater and reuse it.

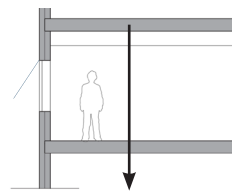


Within all the locations extra water supply pipes and boirls are needed. Within the van Gendthallen this can be the most easily achieved because you don't have to drill through vertical loadbearing structures since its on ground level.

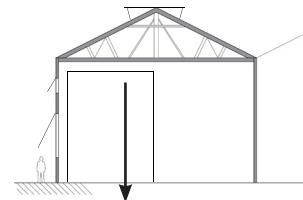
SEWERAGE

- Regulation: When adding new facilities, the collector pipe (which is the horizontal connection between the appliance and the standpipe), always have to be sloped, 5 to 20 mm/m and is required to prevent congestion.⁹

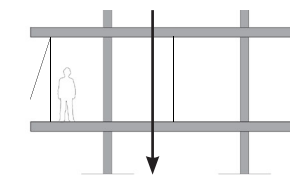
- Strategy: Extra shafts are needed because of the small existing amount of facilities. Possibilities are pipes under the floor, through individual shafts or under raised floors. Raised floors aren't favourable in offices because of limited heights. Therefore the sewer disposer is a good alternative.



- Strategy: No existing sanitary facilities. Extra shafts are needed to connect these to the dwelling. Extra available floor space can be used.



- Strategy: Extra shafts are needed because of the small existing amount of facilities. Possibilities are pipes under the floor, through individual shafts or under raised floors. Raised floors aren't favourable in offices because of limited heights. Therefore the sewer disposer is a good alternative.

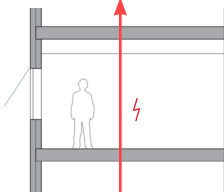


Within all locations extra shafts are needed because of the small existing amount of facilities. Within the van Gendthallen the extra available floor space can be used to put all the ducts.

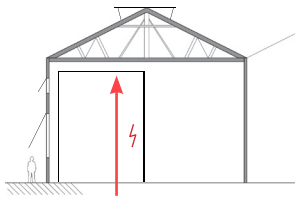
ELECTRICITY

- Regulation: Energy consumption 2 p household: **3400 Kwh¹⁰**
Average energy consumption office: 500 - 10.000 m² : **392 MJ/m²**

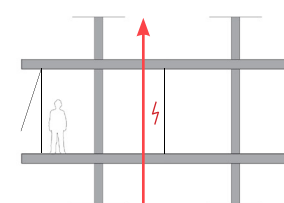
- Strategy: The complete electricity network connected to the central main distribution in the technical space has to be remade.¹¹
Design one connection plug that provides electricity to the entire dwelling.



- Strategy: No existing electricity structure available. Create complete electricity network suitable for dweling. Design one connection plug that provides electricity to the entire dwelling.



- Strategy: When offices are stripped no existing electricity structure left. Create complete electricity network suitable for dwelling. Design one connection plug that provides electricity to the entire dwelling.



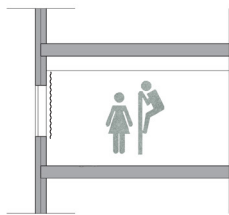
Within all locations the complete electricity network connected to the central main distribution must be remade.

3.3.4 PHYSICAL STRATEGIES - SOFT

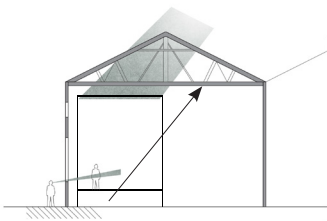
PRIVACY

Studying the vernacular architecture of the different cultures have shown that they all attach great importance to privacy.

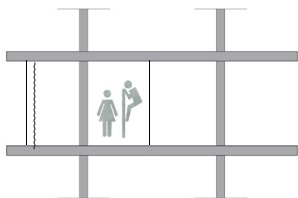
- Strategy: Prevent viewing inside from outside by zoning living functions on higher levels and facilities on lower levels.



- Strategy: Create private and semi private layers on dwelling scale. Make use of rooflights van gendthallen, design rooflights within the dwelling, more privacy.



- Strategy: Prevent viewing inside from outside by zoning living functions on higher levels and facilities on lower levels.



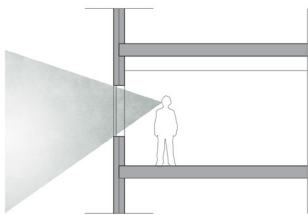
The van Gendthallen needs the least adjustments to the building providing privacy. When raising the floor level it becomes unable to look inside from outside. The skylights make it possible to design less windows.

VIEW

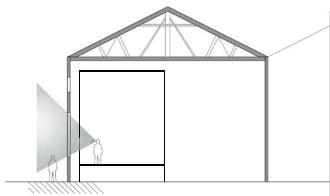
A good view implies that one has a view of:¹¹

- Green or movement at street level
- The dome
- The horizon or objects that are far away

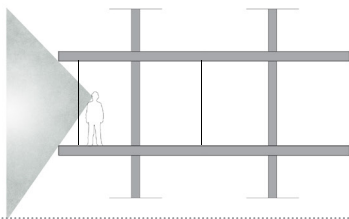
- Strategy: Zoning of functions that require daylight horizontally and vertically. Select offices in vibrant settings



Strategy: Zoning functions that require daylight horizontally. Selecting spots within the halls which fulfill the law on the amount of daylight



- Strategy: Zoning functions that require daylight horizontally and vertically. Living functions on higher floor levels, office functions on lower levels.

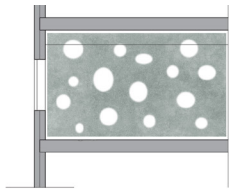


When zoning the living functions in the right order in relation to the office functions, each location will have the potential to fulfill the requirements of a good view, without adjusting the building.

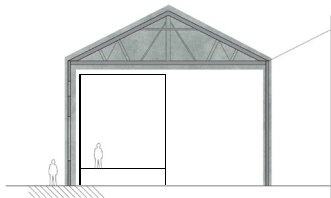
EXPERIENCE

The need to personalize the dwelling became very important as a result of the research. An authentic setting helps to fulfill this need.

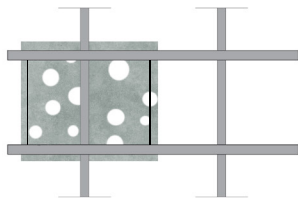
- Strategy: Often monotonous office blocks. The authentic experience will take place within the interior design caused by designing tailor made housing



- Strategy: Keeping the old structure untouched as much as possible. Design personalized dwellings within this authentic framework.



- Strategy: Framework functions just as a carrier. Personalized designed dwellings stacked on top and next to each other will give an authentic experience.



To ensure that the building has a residential appearance, the often monotonous facade of the cell block office should be adjusted.

CONSTRUCTION SIZE

The dwellings need to be transportable. It needs to be modular, demountable and lightweighted.

Variable loads housing:¹² **1.75 kN/m²**

CELL BLOCK OFFICE

- Element size: Dependent on size elevator:¹³
Door: **0.85 x 2.1 m.**
Floor: **1.05 x 1.35 m.**
- Strength: Variable load offices:¹⁴
5.0 - 10 kN/m²

VAN GENDT HALLS

- Element size: Ground floor, entrance big
Restriction in size determined by weight panel:
Manual allowed: **25 kg**
- Strength: Ground floor, sandy soil
Building is adjusted to let trains entering.¹⁵

STRIPPED OFFICE

- Element size: When there is still an elevator:
Dependent on size elevator:
Door: **0.85 x 2.1 m.**
Floor: **1.05 x 1.35 m.**
- Height: **2.6 - 2.8 m.**
- Strength: Variable load offices:¹⁴
5.0 - 10 kN/m²

The van Gendthallen has the biggest freedom in determine the construction size followed by the stripped office.

3.4 IMPLEMENTING FLEXIBILITY

3.4.1 DIGITAL FABRICATION TECHNIQUE

There are endless possibilities to construct adaptable homes for asylum seekers. As previously has been shown in this paper, a generic building system is needed which can respond to the fluctuating influx. In this chapter will be investigated if digital fabrication is the right technique that can build these adaptable, customized and cheap homes.

By compiling eight criteria on which the homes must meet and validate them against various digital fabrication techniques, the most suitable technique can be chosen. The book 'Digital Processes' by Hauschild, Karzel & Sternhell (2011) gives a complete overview of all additive and subtractive techniques. They will be tested on demount ability, easy design and production of joints, light weighted, the possibility of personalization, sustainability in terms of material use, how time consuming of the process and the degree of material variation.

When chosen the most suitable technique there will be investigated which connection method will be most suitable to construct the homes and adjust them over and over again. This part of research will be done by means of case studies.

¹¹(Yanovshtchinsky et al, 2012, pp. 190-196)

¹²(Boveldt, 2004, p. 86)

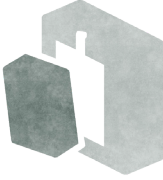
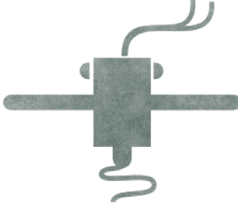
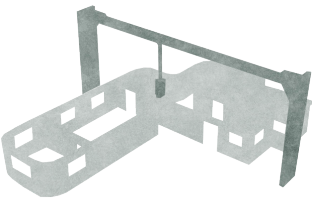
¹³(Bouwbesluit, 2003, article 4.7)

¹⁴(Koornneef, 2012, p.62)

¹⁵(Evers, 2004)

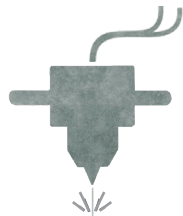
OVERVIEW DIGITAL FABRICATION TECHNIQUES

ADDITIVE

	CNC PRECAST CONCRETE	3D PRINTING LARGE SCALE	CONTOUR CRAFTING CC
			
Description	Advantages <ul style="list-style-type: none">- Procedure is limited to 2 dimensions- Parametric structures possible- Possible to link additional functionalities such as insulation layers	Advantages <ul style="list-style-type: none">- Free form construction without molds- Structure is very light, easy to transport- Lot of materials possible	Advantages <ul style="list-style-type: none">- Extrusion procedure- A casting is created
	Disadvantages <ul style="list-style-type: none">- Heavy elements- Moulds are needed for every element	Disadvantages <ul style="list-style-type: none">- Sculptures no walls- No connections possible- Fragile	Disadvantages <ul style="list-style-type: none">- Sculptures no elements- No joints possible- Dependent on chemical bending agents- Expensive
Materials	<ul style="list-style-type: none">- Polymers- Thermoplastics- Wax	<ul style="list-style-type: none">- Ceramics- Aluminum- Plastics- Cement / Concrete	<ul style="list-style-type: none">- Artificial sandstone
Thickness	<ul style="list-style-type: none">- Dependent on mold	<ul style="list-style-type: none">- 6 x 6 mtr. (print size)	<ul style="list-style-type: none">- Dependent on size printer
Energy use	<ul style="list-style-type: none">- Variable to machinery and mat.	<ul style="list-style-type: none">- Variable to machinery and mat.	<ul style="list-style-type: none">- Variable to size machinery
Demountable	<div>NO<div><div></div><div></div><div></div><div></div><div></div><div></div></div>YES</div>	<div>NO<div><div></div><div></div><div></div><div></div><div></div><div></div></div>YES</div>	<div>NO<div><div></div><div></div><div></div><div></div><div></div><div></div></div>YES</div>
Joints	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Lightweight	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Personalize	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Cheap	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Sustainable	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Time	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
Material var.	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div>
	3D	3D	3D

SUBTRACTIVE

CNC LASER CUTTING



Advantages

- Joints are possible
- Flexible, demountable
- Customization
- Engraving for ornamentation is possible

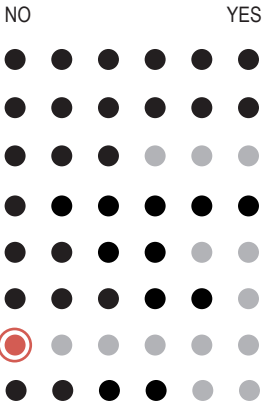
Disadvantages

- Size for components is limited to size of the machine
- Time consuming

- Wood
- Metal
- Aluminum

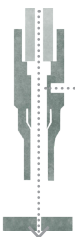
- 400 mm

- 100 kW



2D

CNC JET CUTTING



Advantages

- Possibility to cut very thick materials
- Used for solid materials
- Flexible, demountable
- Customization

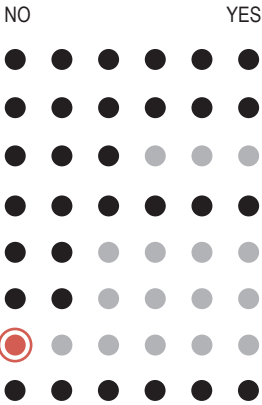
Disadvantages

- Uses water, pressure pump
- Time consuming
- Rapid wear and tear

- Plastic
- Plywood
- Foam
- Paper

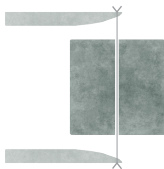
- 350 mm

- 37 kW depending on pump



2D

CNC HOT WIRE CUTTING



Advantages

- Possibility of efficiently producing large volume geometries
- Customization

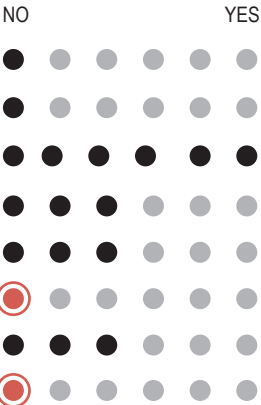
Disadvantages

- Foam material
- Not flexible demountable
- Used for temporary constructions and prototypes

- Polystyrene
- Styrodur

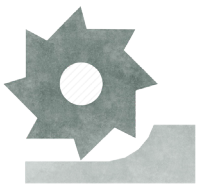
- Depending on thickness wire

- Variable to machinery and mat.



2D / 3D

CNC MILLING



Advantages

- 2D objects can be milled from sheets
- All software
- Joints are possible
- Flexible, demountable
- Customization, Engraving

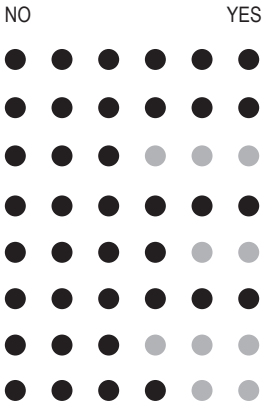
Disadvantages

- Size for components is limited to size of the machine
- Time consuming

- C- Wood
- Metal
- Aluminum

- 250 mm (with 100 mm drill)

- 18 kW



3D

ADDITIVE

CNC precast concrete

Traditional precast concrete elements are moulded by hand, and so can special shapes, openings and inserts only be made with a large degree of manual effort. This process is carried out by a CNC controlled moulding robot. Framing elements are positioned on horizontal moulding benches and fixed with magnets. The robot inserts the prefabricated concrete reinforcement and fills predefined areas with concrete. Since you have to build a separate mould for every customized solution this technique isn't suitable to design adaptable customized homes for asylum seekers.

3D printing large scale

Large 3D printers enable the production of construction elements up to 6000 x 6000 x 6000 mm. The production process functions comparable to the printing process of a classic inkjet printer. Each layer is able to support the following one. With this technique it is not possible to design demountable structures, therefore it is not suitable to build adaptable homes.

Contour crafting (CC)

The contour crafter uses digital geometry which, as with the large 3D printers, is divided up into horizontal layers. The CC needs a constant influx of semi-fluid construction materials such as plastic, cement or concrete, which cure quickly so that it can cope with the pressure of its own weight from up following layers. Also with this technique it isn't possible to design demountable structures, therefore it is not suitable to build adaptable homes.

SUBTRACTIVE

CNC laser cutting

No cutting edge is used for separating material parts within this technique but a jet. When laser cutting this is done by bundled energy. This technique is well suited to architectural model building. 2D drawings are used for producing model construction elements out of two-dimensional materials. Disadvantage is that laser can only cut or engrave the material and is limited

as a 2D technique. Thereby cutting in steel is fast but cutting in wood is a slowly process. It is not possible to make notches which can make joint design very easy. It's therefore not the best suitable technique to design adaptable homes that need to be adjusted to every new occupant.

CNC water jet cutting

Water can be also used for separating material parts. Jet cutting techniques consist of a high degree of flexibility in relation to the materials to be cut and cutting conditions. In this way it is possible to process hard materials such as stainless steel, copper, titanium, glass, stone and ceramics. The low material loss on the edges make this method suitable for friction lock connections. Disadvantages are the rapid wear and tear of the machine, the time consuming process and 2D limitation. As a result of these disadvantages this technique isn't suitable for rapidly building adaptable customized homes.

CNC hot wire cutting

An electrical current is sent through a metal wire heating it and can be used to cut large blocks of foam. The technique can be used for the construction of light, voluminous construction parts. When the hot wire is mounted on a multi-axes-robot all sorts of three-dimensional shapes can be created. Since this technique can only make use of foam as a building material, it is not suitable for building adaptable customized homes.

CNC milling

When using the milling machine for wood, a motor head is rotated and moved over the material, scraping off the material when passing. There are 3-, 5- and even 7- axial machines available that can mill material from almost every angle. As a result it becomes possible to create highly complex geometries. As a disadvantage, the slow processing procedure and the restriction to milling-head-specific radiate internal corners, can be pointed out. But within the requirements that are imposed on the technique this one serves the best (Hauschild & Karzel, 2011, pp. 45-60).

3.4.2 CONNECTIONS

Based on the criteria to design customized and adaptable housing for asylum seekers CNC milling proved to be the most suitable technique. Which corresponding connection method will be most suitable to construct the homes, adjust them over and over again and store them in case when the influx decreases and the homes become vacant. Therefore they must fulfil the following criteria: processed with cnc, reconfiguration within three upto six months, one type of understandable joining, manually adaption in combination with an installation tool, cheap and stackable in case when the homes have to be stored temporary. A small selection of connections have been reviewed on the basis of friction fit and the use of external joints in order to define which joints meet the requirements imposed on the building system in order to build adaptable housing for asylum seekers.

LAMELLO CONNECTION

Demountability

This type of joint makes use of two rounded parts which can be placed in a milled hole within a wood sheet. When one looks at the cross-section, a T-shaped milled slot becomes visible. Because of the protruding T-shape of the connection piece it remains firmly in place. These two rounded parts can be connected to each other and tightened with an Allen wrench. This process can also be performed vice versa without causing wear (Lamello, 2015).

At the moment this system is mainly used for interior features such as bookshelves. In order to make dwelling components such as bathrooms and kitchens further research has to be done on sealing the connections in order to provide a water proof connection. This can be done for example by the addition of rubber strips.

Type of joining

Since the system is not only suited for horizontal, but also for perpendicular connections, all possible structural housing components such as floors, walls and columns can be designed and connected using this system hypothetically (Lamello, 2012). But looking at the load path this type of connection is particularly suitable for columns, because there is only a normal force present. All force passes through the boards. In case of a beam shear due to bending occurs whereby the connections will be loaded. Therefore higher demands will be made on the connection used as a beam. This could result in placing extra connections making the system inefficient.

Storage

Because it's a flat connection stacking is very easily performed when the system is demounted. This is a great advantage of this type of joining.



2 component connection system, (Lamello, 2015)



Placing component in milled sheet (Lamello, 2015)



Tighten the connection (Lamello, 2015)



Slot connection
(DeArchitect, 2013)



Slot connection
(DeArchitect, 2013)

SLOT CONNECTION

Demountability

In a slot connection a protruding part of one segment slides in or over a notch in an adjacent segment (DeArchitect, 2013). This is not a pressurizing connection but still segments can be pushed against each other and then bolted together with a slot connection, which will be loaded then. This type of connection is demountable but even with a pressured connection the joints still have to be made watertight in areas such as the bathroom and kitchen. This can be achieved with for example rubber strips.

Type of joining

The connection whereby segments are pushed against each other and then bolted together with a slot connection are suitable for columns, because there's only a normal force present and the connection won't be under load. In case of a beam a friction fit connection such as figure 20 are more favourable since shear to bending occurs. With this type of connection shear to bending can be easily incorporated.

Storage

Depending on the slot connection easy storage is possible. Some consist of a protruding connection parts which makes it more difficult to stack together with a slot connection are suitable for columns, because there's only a normal force present and the connection won't be under load. In case of a beam a friction fit connection such as figure 20 are more favourable since shear to bending occurs. With this type of connection shear to bending can be easily incorporated.

Storage

Depending on the slot connection easy storage is possible. Some consist of a protruding connection parts which makes it more difficult to stack.



Mia wall system (MiaWall, 2015)



Mia wall system (MiaWall, 2015)

GALL CONNECTION

Demountability

This type of connection is currently being applied to wall systems for stand constructions. It makes use of a slot connection with a protruding pin in which the next wall can be placed and locked (MiaWall, 2015). Because this connection is bolted with a screw this system is demountable

Application

The system is ideally suited for the connection of modular walls. Connecting other building components such as beams and columns will result in adjusting the connection system since it's not designed to include shear to bending forces at the moment.

Storage

The storage of this system is hampered by the protruding connection parts. Because they are in the plane of the sheet stacking becomes easier.

PACKAGED HOUSE CONNECTION

Demountability

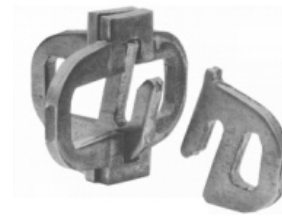
The connection designed for the packaged house by Konrad Wachsmann and Walter Gropius was originally an standard Y-shape connector that, because of its three dimensionality, proved difficult to be manufactured and was easy to damage. Therefore they designed an X-shaped wedge connector that linked each panel vis-à-vis of metal plates housed in the panel edge (Lowry, 2008, pp. 80-87).

Type of joining

A pilot version of the packaged house has been built and was assembled by means of only one modular connector, making the assembly process very easy. In theory every individual could set up the home (Lowry, 2008, pp. 80-87).

Storage

The connection is essentially flat which makes stacking very easy when the home has to be stored temporary.



X-wedge connection
(Lowry, 2008, pp. 80-87)



X-wedge connection
(Lowry, 2008, pp. 80-87)

4. CONCLUSION

USER FLEXIBILITY

URBAN FLEXIBILITY

IMPLEMENTING FLEXIBILITY

LIMITS

RECOMMENDATIONS



5. APPENDIX

5.1 MAPPING AZC'S

MAPPING THE NETHERLANDS

ANALYZING AZC'S

5.2 USER FLEXIBILITY

5.3 URBAN FLEXIBILITY

PROGRAM OF REQUIREMENTS

OVERVIEW OF ALL THE AZC'S WITHIN THE NETHERLANDS

	PLACE INSTITUTION	NUMBER OF PEOPLE	FORMER FUNCTION	TYPE OF BUILDING	DISTANCE TO CENTRE
-	Alkmaar	400 people		Permanent	3.0 km.
-	Almere	800 people		Prefab Semi permanent	4.5 km.
-	Arnhem	100 people		Permanent	4.5 km.
-	Azelo	375 people	Barracks	Permanent	2.0 km.
-	Baexem	425 people	Monastery	Permanent	2.0 km.
-	Bergen aan Zee	95 people	Hotel	Permanent	1.0 km.
-	Breda	400 people	Prison	Permanent	1.5 km.
-	Budel Cranendonck	1500 people	Barracks	Permanent	3.5 km.
-	Budel Dorplen	239 people		Permanent	0.5 km.
-	Delfzijl	430 people		Semi permanent Caravans	2.5 km.
-	Dronten	1000 people	Finish holiday bungalows	Permanent	11.0 km.
-	Echt	425 people		Permanent	3.5 km.
-	Eindhoven	700 people	Dwellings	Permanent	7.0 km.
-	Gilze en Rijen	850 people	Air force ground	Permanent	5.0 km.
-	Grave	600 people	Barracks	Permanent	2.0 km.
-	Gulpen Wittem	250 people	Bungalowpark	Permanent	4.5 km.
-	Heerlen	412 people	Monastery	Permanent Semi Permanent	5.5 km.
-	Katwijk	570 people	Offices	Permanent	3.5 km.
-	Leersum	500 people	Rehabilitation	Permanent	4.0 km.
-	Luttelgeest	1000 people	Bungalowpark	Permanent	9.0 km.

Source: adapted from: <http://www.coa.nl/opvanglocaties>

	PLACE INSTITUTION	NUMBER OF PEOPLE	FORMER FUNCTION	TYPE OF BUILDING	DISTANCE TO CENTRE	
-	Maastricht	600 people	Prison	Permanent	3.0 km.	
-	Musselkanaal	450 people	Elderly home	Permanent	2.5 km.	
-	Nijmegen	325 people	Barracks	Permanent	2.5 km.	
-	Oisterwijk	450 people		Semi permanent	3.5 km.	
-	Ommen	370 people	Bungalowpark	Semi permanent	3.5 km.	
-	Onnen	480 people	Bungalowpark	Semi permanent	4.0 km.	
-	Oude Pekela	328 people		Semi permanent Caravans	1.0 km.	
-	Overberg	200 people	Prison	Permanent	5.0 km.	
-	Overloon	800 people	Prison	Permanent	3.0 km.	
-	Schalkaar	550 people	Barracks	Permanent	1.0 km.	
-	Sint Annaparochie	400 people		Offices Caravans	1.0 km.	
-	Sweikhuizen	242 people	Monastery	Permanent	4.0 km.	
-	Ter Apel	1850 people	Warehouse	Semi permanent Caravans	3.0 km.	
-	Utrecht	450 people	Hospital	Permanent	1.5 km.	
-	Veenhuizen	400 people	Penitentiary	Permanent	4.0 km.	
-	Venlo	480 people		Semi permanent	4.0 km.	
-	Winterswijk	500 people		Permanent adaptable	2.0 km.	
-	Zeist	367 people	Penitentiary	Permanent	4.5 km.	
-	Zweeloo	450 people		Semi permanent	5.0 km.	
		20.772 people	+		4.0 km.	average

5.2 USER FLEXIBILITY

OCCUPATION PER AGE, GENDER AND NATIONALITY

AGE			MALE	FEMALE	TOTAL
-	0 - 3	years	896	821	1.717
-	4 - 11	years	1.507	1.323	2.830
-	12 - 17	years	1.540	807	2.347
-	18 - 29	years	5.548	2.247	7.795
-	30 - 39	years	3.796	1.582	5.378
-	40 - 49	years	1.861	789	2.650
-	50 - 59	years	619	355	974
-	60 +	years	280	258	538
Total			16.047	8.182	24.229

Source: Retrieved 23-03-2015 from: <http://www.coa.nl/over-coa/cijfers>

NATIONALITY		AMOUNT
-	Afghanistan	535
-	Armenië	160
-	China	145
-	Eritrea	3.950
-	Georgië	355
-	Iraq	775
-	Iran	595
-	Libië	115
-	Mongolia	500
-	Nigeria	250
-	Pakistan	215
-	Russia	200
-	Servië	215
-	Sudan	205
-	Somalia	895
-	Syrië	9.775
-	Unknown	3.305
		24.229

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