



“New cities build by refugees occur around the globe in exiled locations with scarce connections to the existing population for ten, twenty or even forty years. Can we prepare for it? Let’s find out.”



▶ **QR-CODE**
SCAN WITH
YOUR PHONE
TO VIEW
THE PROJECT
ONLINE

VIEW THE COMPLETE RESEARCH ON WWW.REFUGEECITY.COM



RESEARCH PAPER
T W A N A G U L

TU Delft



THE REFUGEE CITY

TWANA GUL

THE REFUGEE CITY

REDEFINITION
OF THE REFUGEE
CAMPS IN
KURDISTAN



LIVE FOR TOMORROW

FIRST EDITION

Printed and bound in *Enschede, The Netherlands*
6 January 2015

Researcher • Twana K. Gul
Person N. • 4156471

Coach • Monique Smit
Technical mentor • Jerzy Latka

Msc Architectural Engineering Graduation Studio



MADE FROM **100%** RECYCLED PAPER



© 2015 REFUGEE CITY
All Rights Reserved
www.refugeecity.com

ABSTRACT	6
INITIATION	9
BACKGROUND	
PROBLEM	
RESEARCH QUESTION	
OBJECTIVE	
RELEVANCE	
SIGN POSTING	
THE ULTIMATE JOURNEY: PYRAMID'S PATH	
FIELD RESEARCH	16
SITE VISIT: ARBAT MAIN, TRANSITIONAL CAMP AND DARA SHAKRAN	
INTERVIEW: MR. PAYADAR, HEAD OF ERBIL'S REFUGEE CAMP ORGANISATION	
INTERVIEW: MR. AKO, MUNICIPALITY OF SULEYMANI, HEAD OF ENGINEERING	
INTERVIEW: REFUGEES IN ARBAT & DARA SHAKRAN CAMP	
DESK RESEARCH	34
PROGRAM PARAMETERS	
LOCAL URBAN ANALYSES	
CLIMATE ANALYSES	
SHELTER AND CAMP TYPOLOGIES	
SUSTAINABLE CITY: ENERGY FLOW AND RECYCLING	
LOCAL MATERIALS	
ECOSYSTEM: THE COMPLEMENTARY EVOLUTION	
DENOUEMENT	62
LITERATURE	64
APPENDIX	65
ARBAT & DARA SHAKRAN CAMP SKETCHES	
REFUGEE CITY PROGRAM BUILDER 1.0 BETA	
QUESTIONNAIRE	
BIO-ENERGY CALCULATION	
* DVD INCLUDES *	
DIGITAL PUBLICATION	
PHOTOGRAPHY	
VIDEO: CAMPS IN KURDISTAN (2014)	

ABSTRACT

THE REFUGEE CITY

The exponential growth and inauguration of refugees around the world transform the connotation of the temporary perception. New cities build by refugees occur around the globe in exiled locations with scarce connections to the existing population for ten, twenty or even forty years. Generations are born, living and working in camps with no external contact. Poor conditions in the camps demoralise refugees to take part in the new beginning.

The camps in Kurdistan (KRG), e.g. the Dara Shakran camp, ascertain in such a condition. With almost no connection with the urban grid, the 10.000 people are forced to stay most of the time inside the camp. Water, electricity and consumptions are imported on the daily basis. Thousands of kilogram of waste is weekly burned on a nearby site. Every six to twelve months new tents are provided, creating more waste and labour work periodically. With the upcoming winter and summer season around the corner, people fear

of the worst, the demolition of their UNHCR (United Nations High Commissioner for Refugees) Family Tents. In addition, adjusting ones shelter according to the family's preferences is a far fetched dream.

This research addresses the refugee camp as an evolving city. A city, which should have been developed with the mindset for the future. The isolated attribute of the city is embraced. Solutions on generating energy, reusing waste, building with local materials are the first steps to the creation of the off-the-grid city.

By involving refugees in the process of the accretion, we can manifest a city with different identities. Using local materials, earth and reed, cuts a huge expense. People will have the flexibility to collect materials on and around the site, adjust their shelter, cultivate their food and provide service using their expertise without the abidance of the higher force. With the focus on a passive solar shelter design, we will be able to balance the ventilation and reasonably cool / heat in different seasons. Accumulation of waste can be disputed by recycling 50% of the total waste into energy, while the other waste will be segregated into different categories for later reuse.

Having the *Steady-State Economics (SSE)* strategy in mind, an ecosystem is developed to take advantage of the site conditions and environment. The knowledge in this research paper will provide guidance and boundaries in transforming a refugee camp into a self-sufficient city with the context of Kurdistan (KRG).

**GENERATIONS ARE BORN,
LIVING AND WORKING IN
CAMPS WITH NO EXTERNAL
CONTACT.**



REFUGEES WORLDWIDE

51.200.000

AS OF SEPTEMBER 2014

THE UN HIGH COMMISSIONER FOR REFUGEES ESTIMATED OVER

3.200.000

DISPLACED PEOPLE IN 2014 DURING THE ONGOING WAR ON TERRORISM IN THE REGIONS OF KURDISTAN, IRAQ AND SYRIA

INITIATION

TODAY AND THE FUTURE

In 2014, ISIS - The Islamic State of Iraq and Syria - has surprised the world with their horrific view on religion and ethnicity. The collapse of both governments in Iraq and Syria has given ISIS - the lethal dispersed virus - to attack many civilians in both countries.

1.1 BACKGROUND

The ones that were able to escape the massacre are ended up in a rapid manifested refugee camp in Kurdistan (KRG), Jordan, Libanon, and Turkey. In total, 3.2 million people has been displaced into these areas with the majority in Kurdistan.

People with different ethnicities and religion - mainly Kurdish Yezidi's and Arabic Christians - are compressed into various camps in the safe areas. In Kurdistan ten permanent are refugee camps established: *Akre, Arbat (+ Transitional), Basirma, Bajid Kandala, Dara Shakran, Domiz, Gawilan, Kawergosk, and Qushtapa*. In some cases, such as the Arbat Transitional Camp, a temporary camp is developed for the newcomers. They stay in poor conditions, living in barely standing (fabric) tents and sharing sanitary up to 8 families of an average of five members, for couple of months until the main camp is ready for new accomodation.

1.1.1 Transformation of Camp to a City

If the war on ISIS takes more time, the issue of supporting the refugees becomes more apparent. Basically, the bare camps are not performing as emergency camps anymore,

but more as cities. When time passes by - for instance, one to two years - people try to pickup their lifes again and try to survive the poor conditions with the use of their occupation. Let's say, one of the refugees was in "his previous life" a barber in the city centre of Singal, after his settlement in the camp he becomes conscious of his stay. He will not return in the coming weeks, but probably after six months, a year or two. Therefor the formal barber would like to establish a barbershop in the camp to enhance the conditions for his family. However, the camp has not been designed to embrace such an idea and if the camp has attempted to define a main street with little shops, this particular individual does not live in that area. Nevertheless, he erects the shop next to his shelter. With more people in the same circumstance, the shops and services are shattered within the transforming camp and reduce the economic rate of the booming city.

1.1.2 The Seasonal Suffering

The summer and winter season in Kurdistan varies between -9 °C to 45 °C. During the low and high tempratures the refugees suffer immensely in the tents - made of several plastic or metal poles covered with fabric sheets - provided by the UNHCR, *United Nations High Commissioner for Refugees*. Most tents will flood during rainy weather, are extremely cold when the snow reaches the site and oppressive and hot in the summer, which requires people to open up their shelter for regular airflow. Resulting into a retrenchment of their private space. Due to these conditions, people tend to determine their own typology and create a shelter made out of local materials around the existing tent.

1.1.3 Observing refugee camps in person

In October and November of 2014, I was able to visit four camps - Arbat Transitional Camp, Arbat Main Camp, Dara Shakran and Basirme - in Kurdistan. All camps had the same objective - supporting refugees - but the application of the organisation was quite different.

For instance, the refugees in the Arbat camp are provided by the local government of Suleymaniyah with 80 m² of free space to own. However the conditions in the camp, in terms of organisational support and camp layout, were poorly manifested. The camp does not have a public square for people to gather, nor a main street for shops or whatsoever. Moreover, the highly utilised facilities were placed in the corners of the camp - such as the hospital and educational institutions, leading to a segregation of living. In addition, every four tent units which are inhabited by a total of 20 people share sanitary services and a kitchen. Lastly, the water supply is distributed by a truck and is not heated. On the other hand, the Dara Shakran Camp is providing a main street for shops, the water supply is laid permanently underground and is heated using a solar boiler for every four tents. The division between the shelters are more consistent and the roads are maintained regularly.

For a detailed observation of the camps, please consult Chapter **Field Research + Appendix**.

1.2 PROBLEM

In general, all camps are developed for permanent use except the Arbat Transitional Camp. On the urban scale, they lack involvement of communal participation to construct the camp - or better said the city - and even though many external institutions provide community gatherings - such as a youth centre - to promote communal identity, all organisations are placed far from the shelters - living. This segregation creates a reversed effect on communal engagement. Additionally, all camps eventually perform as cities located far from the existing cities, sadly this off-the-grid (OTG)*¹ notion is not explored beforehand during a design phase to be prepared for the future.

On the architectural scale, the shelters perform indigent during low and high temperatures. There are no progressive public to private zones. The core shelter - the tent - is not upgradable, nor recyclable or reusable. Sustainable resources - such as the sun, rainwater and local materials - are not explored in the way to support the shelters. Last but

not least, all camps use a Multi-Phased Approach (MPA) *² while an Incremental Process (IP) *³ is more efficient. Unfortunately due to the concept of the emergency establishment, these developments are not taking into account beforehand.

1.3 RESEARCH QUESTION

There are many refugee camps around the world with their own conditions, identity and settlements. All camps have one main objective in common: **providing refugees a place to stay**. For my research I will be exploring and using the camps in Kurdistan as my playground to design and develop a refugee city. By using an actual location, I can test and qualify my design to the constraints of the environment and culture. For this reason the research will be focused on the Kurdish Refugee Camps, which I was able to visit. The goal is to develop a design, which merges sustainability and affordability. With this in mind, my *Overall Design Question* (ODQ) is: *How to redefine Kurdistan's current refugee camps into an off-the-grid (OTG) city using local materials?*

The ODQ will be answered by doing research on several fields, which are defined in the *Thematic Research Question (TRQ)*: *How to apply solar energy, local materials and recycling method(s) to manifest a self-sufficient refugee city?* This paper will mainly focus on the analysis and results of TRQ.

1.4 OBJECTIVE

Develop an off-the-grid refugee city based on local materials and environmental resources. The design should have the ability to be realised on different locations. The shelters should exchange energy, climate and waste.

1.5 RELEVANCE

Thousands of refugees around the world live in a poor climatized shelter for years. Furthermore the involved factions, such as the United Nations, are manifesting non-sustainable and non-reusable shelters which generate a huge amount of waste and inefficiency. My goal is to trigger these sensitive subjects and engender a design which could improve the current circumstances.

THEMATIC RESEARCH QUESTION

**HOW TO APPLY SOLAR ENERGY,
LOCAL MATERIALS AND RECYCLING
METHOD(S) TO MANIFEST A SELF-
SUFFICIENT REFUGEE CITY?**

1.6 SIGN POSTING

The research consists of two main sections: *Field and Desk Research*. The paper is concluded with a final verdict on the gathered information and analyses.

Video material, sketches, pictures of my travel through the camps, and more general information can be found in the appendix.

A crucial part of the research is gaining knowledge on the current conditions of the refugee camps in Kurdistan. It became rapidly clear that a visit to these camps was required before making any architectural or urban decision(s). This part is also known as the *Field Research*.

Hereafter, the collected information has been processed thoroughly on desk, which is discussed in chapter *Desk Research*, with the support of literature and physical models. The result is a variety of analyses on current conditions, a proposal for the urban refugee city composition and a rough sketch of a shelter design. The goal of this experimental phase is to define the boundaries of the prospective design by implementing the gained knowledge.

1.7 THE ULTIMATE JOURNEY: PYRAMID'S PATH

At the beginning of my research, I felt lost in the massive subject known as the refugee city. I questioned myself: "Where do I start with my subject? What do I have to know? What is my goal?", and so on ...

Due to the vague perception of my goal, I started to design my journey as an architect in order to outline my field of work. It seemed axiomatic to start big by gaining knowledge. While moving towards the ultimate goal, the experiments and implementation of my knowledge will cut off superfluous information. I call this method the *pyramid's path*.

*1 Off-the-grid (OTG)

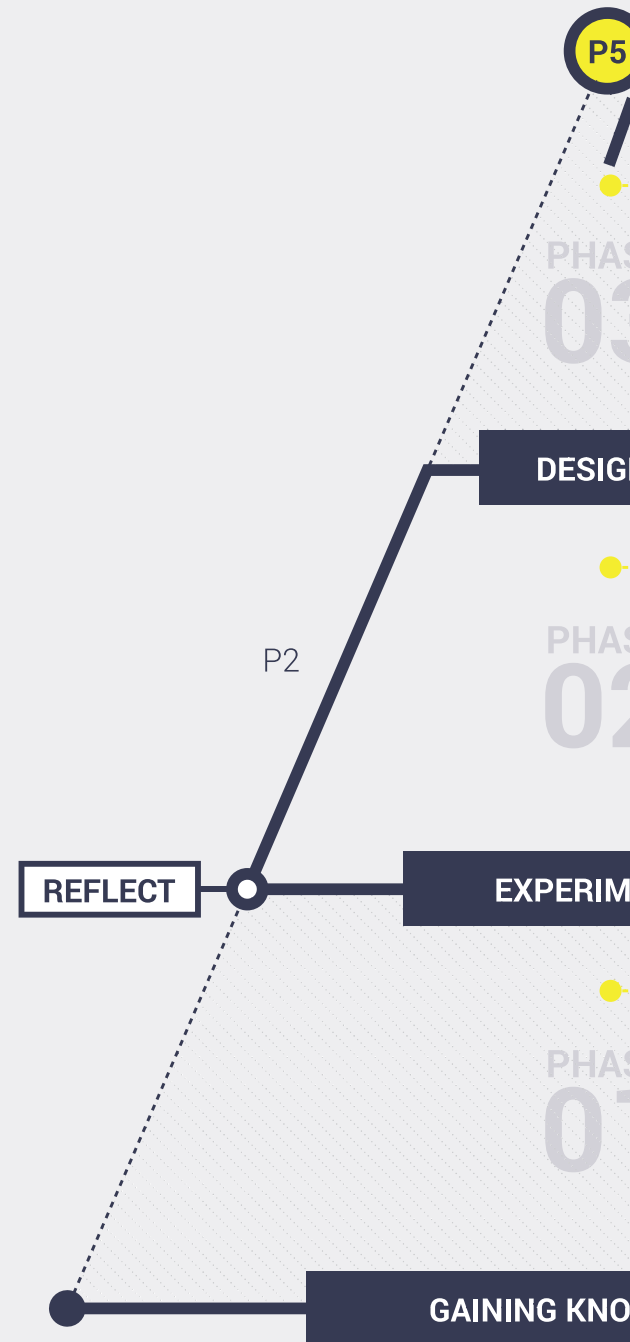
Cities (completely), relying on own resources. For example, generating own electricity, producing own food, collecting and recycling water and so on ...

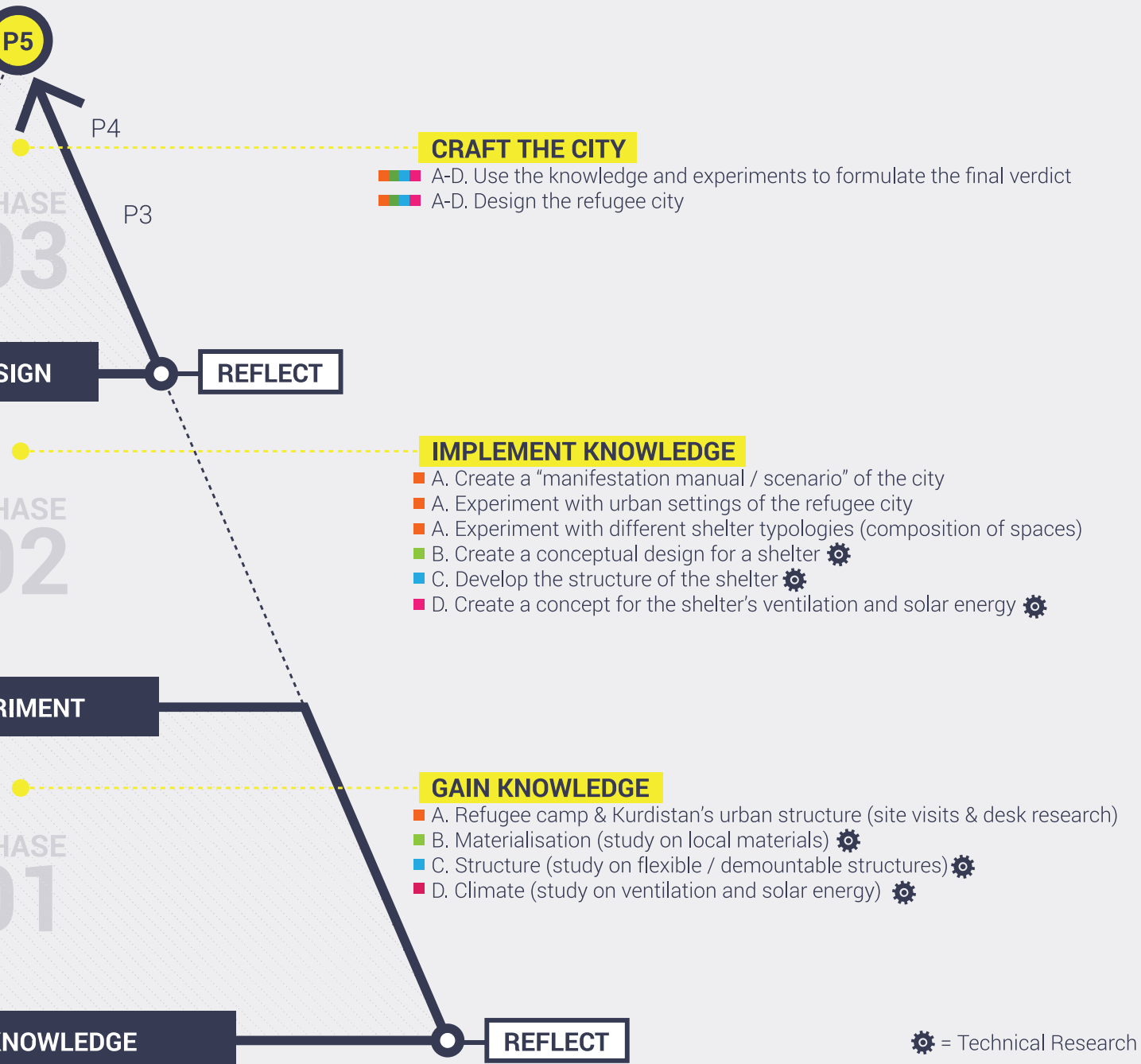
*2 Multi-Phased Approach (MPA)

The construction of the camp starts with a tent, later on - if the disaster / war remains - the tents are removed and replaced with a permanent solution, such as a brick or a container house.

*3 Incremental Process (IP)

The camp is upgraded in the pace of time using the same base. The provided shelter can be modified using new elements or materials.







FIELD RESEARCH

A VISIT IN KURDISTAN (KRG)

In the first week of October and the end of November of 2014 I have visited four Refugee Camps in Kurdistan (fig.1). While in October the weather was still hot and balanced, in November the cold climate was dominating. The shelters, provided by the UNHCR, were barely resisting the heavy rain and weather-deformed-terrain conditions. For this reason, people tend to adjust their living style - by wearing more clothes, adding a second layer of sheet to their shelter and creating a fireplace - to survive the cold months.

These issues could have been avoided, if the environmental settings were taken into account beforehand. This chapter will discuss three of the visited camps - Arbat Transitional and Main Camp and Dara Shakran - based on population, terrain condition(s), camp layout, building method and unique features. The goal is to comprehend the current conditions in detail in order to form a solid base for the design phase.

2.1 ARBAT TRANSITIONAL CAMP (IDP)



The transitional, *Internal Displaced People**⁴ (IDP), camp is the settlement in which refugees are taken in for the first time (fig.2). They will receive a *UNHCR Family Tent Model**⁵ and are advised to share sanitary services with four to eight tents. Each tent can accommodate up to six people, which is often equal to a family size in the Middle East. The magnitude of sharing is discernible, even though the culture and religion requires differently. The tents are placed on an offset of 1.0 - 1.5 metres. With this setting in mind, privacy is subordinate.

The sanitary service units are made of a steel structure with a thin layer of sandwich panel. The showers and toilet do not have any water supply, the refugee has to collect water at the water supply zone and carry it all the way to their location.

Moreover, there is no specific place marked for cooking. All refugees usually cook inside their Family Tent or in front of the shelter.

The compulsory facilities - which are the hospitals, educational institutions, administration office, security building(s) including the gate, water supply zone and distribution zone - and supplementary facilities - NGO organisation and international care institutions - are mainly positioned in the centre of the camp.

This might be the greatest feature of the camp, hence it makes it easy for everyone to reach the preferred edifice.

KURDISTAN (KRG)

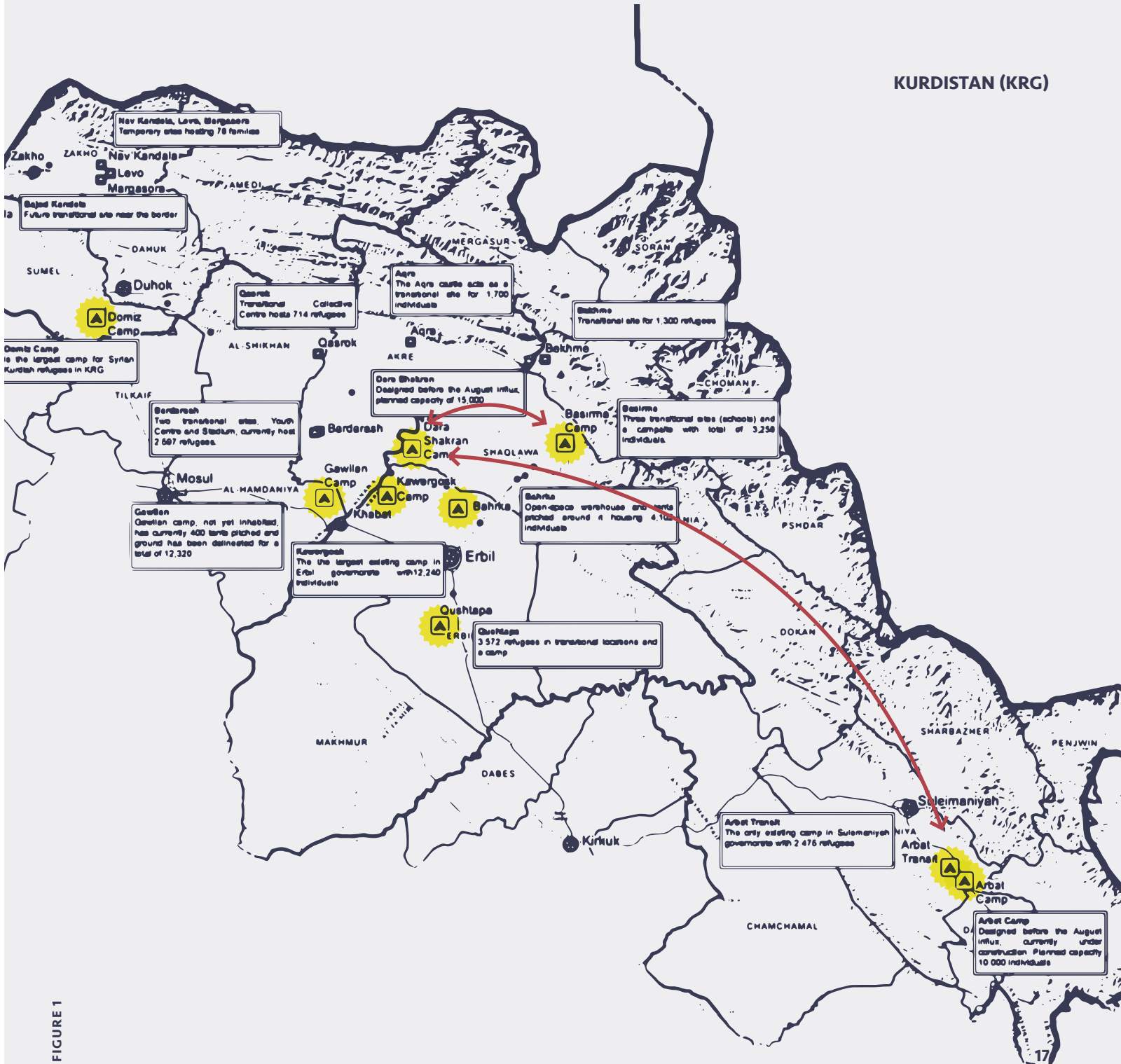


FIGURE 1



ARBAT TRANSITIONAL CAMP LAYOUT

NOVEMBER 2014

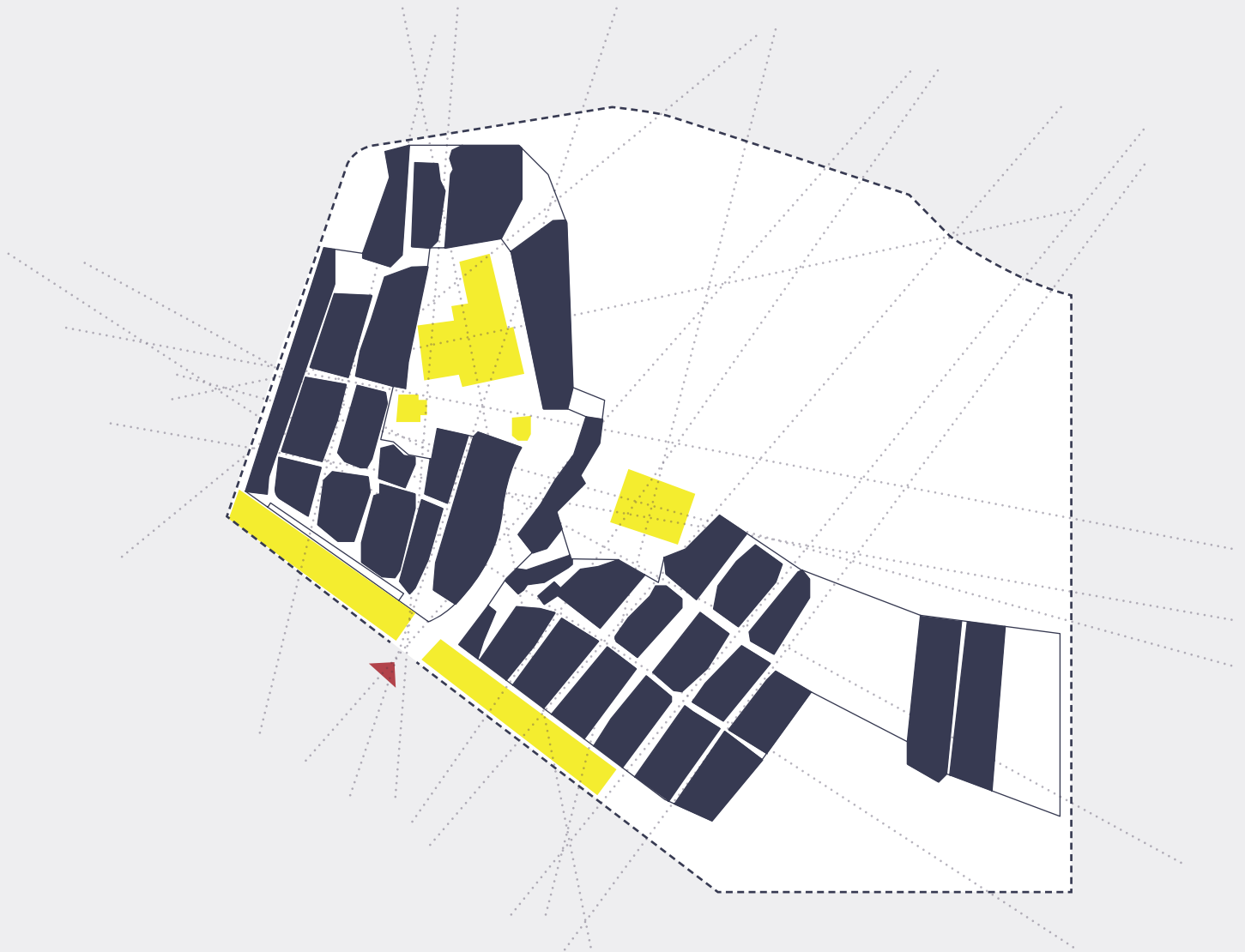


FIGURE 2
● FACILITIES
● SHELTER ZONE
18

180M

ARBAT TRANSITIONAL CAMP
OCTOBER 2014

← **ELECTRICITY DISTRIBUTION CABLES**
PROVIDED BY GOVERNMENT

PORTABLE SANITARY SERVICES

↑ **UNHCR FAMILY TENT*5**

RESULT OF NO SEWERS

2.2 ARBAT MAIN CAMP



PRACTICALLY FLAT TERRAIN

Refugees arrive in the main camp whenever the site is cleared and the shelter is constructed. Normally it takes three to six months for the new refugees to arrive in this camp (fig.3).

The camp obtains electricity from the local grid and water is supplied by trucks on the daily basis.

The first striking feature of the camp is the permanent identity. Every four UNHCR Family Tents are arranged around a kitchen unit made of *cement blocks*, every two tents use one block of sanitary consisting of three toilets / showers. Furthermore, people are allowed to upgrade their shelter, on their own expenses, using *cement blocks*.

On top of that, the local organisation is granting every family - larger than five members - 85 m² space for free. Hence, most of the shelters are transformed into permanent dwellings. Hereby, people are more actively involved in building up the camp. Moreover, the main camp exhibits crumbs of a city life. People work on a daily basis in their own shelter, for instance as carpenters or a dress maker. Due to this distinctive aspect, some of the large streets have transformed into market streets.

The facilities are split into two categories, which also explains the position on the map:

- I. Use once a week
- II. Use everyday (multiple times)

Facilities - such as the administration, security gate and collection zone - has been positioned at the very top of the camp leading towards the exit. On the other hand, the hospital, educational buildings and the internal security squad are located on the centre axis of the camp. In this manner, refugees can be controlled in a more efficient way and the distance to the day-to-day facilities is more balanced on the average scale.

2.3 DARAS SHAKRAN CAMP



PRACTICALLY FLAT TERRAIN

It takes approximately three hours to travel from Suleymaniyah, which is nearby Arbat, to arrive in Erbil, the capital of Kurdistan (KRG). From here a 90 minutes car trip in the daylight is required through the high mountains to get in the exiled Dara Shakran camp (fig.4). The camp is connected to electricity generators - which operates on oil - to serve the shelters and buildings with the necessary power. Water, supplied on a daily basis, is stored in a couple of water tanks. This water is then distributed through the permanent underground ducts to each sanitary service unit.

The most sustainable feature, *the solar boiler*, is only in the Dara Shakran camp present. On every sanitary service unit, one solar boiler is installed to heat up the distributed water.

Additionally, the permanent shelter identity is also noticeable in Dara Shakran. However, the refugees are not allowed to upgrade their building without a permit from the head office of the camp. Once the permit is granted, the refugee can use the area for a period of time based on a monthly rental contract. Refugees can not fully own the area. Once the issue of origin - for instance, the ISIS war - is solved, all refugees will be displaced to their place of origin.

Finally, all facilities and shelters are harshly segregated into two "districts". This political dispersion is manifesting two contradictory perceptions. In one, the refugees are controlling their own city (centre) without any direct surveillance and in the other, the detached world of camp management and education is still required to keep the city operational. In other words, the notion of controlling your own city is presence, however without the presence of the detached facilities the city can not fully operate.



ARBAT MAIN CAMP LAYOUT

OCTOBER 2014

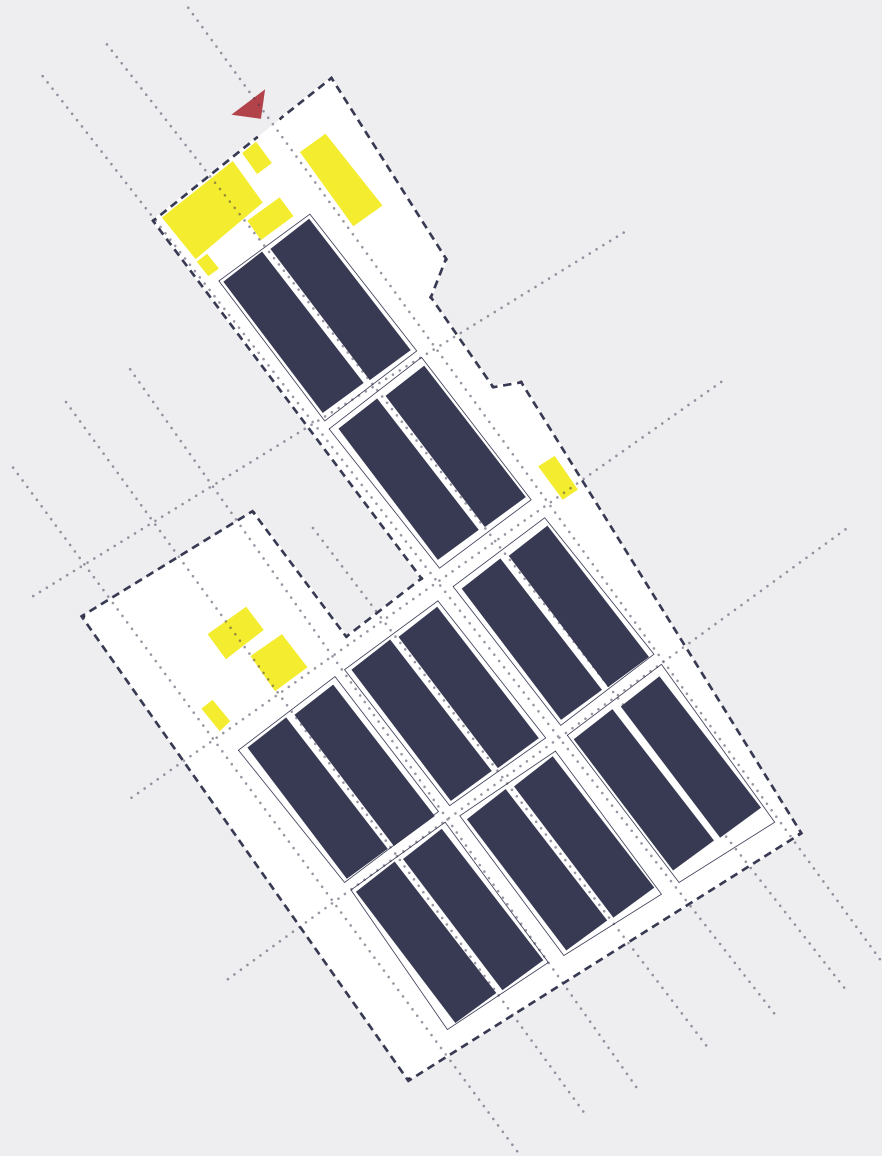
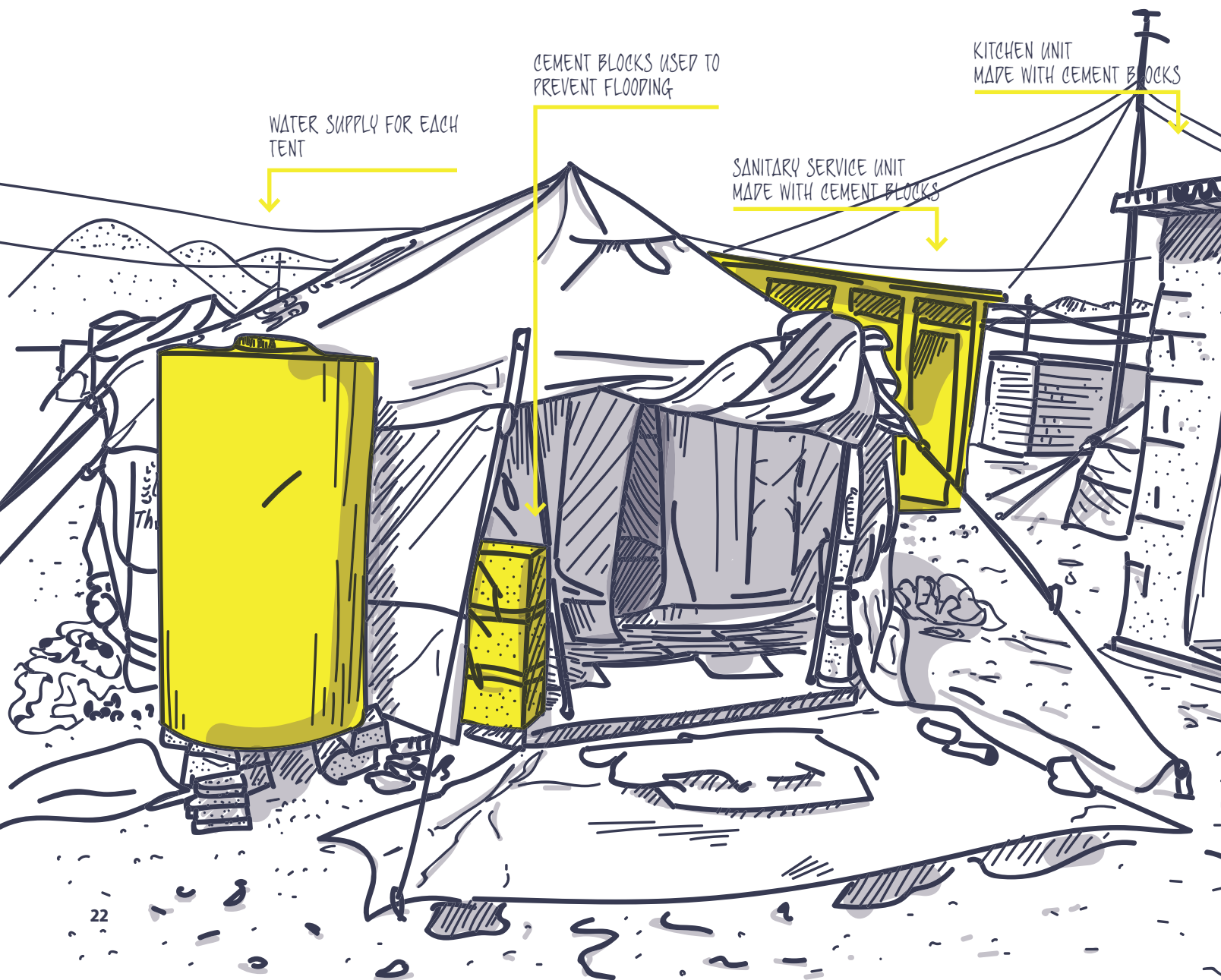


FIGURE 3
● FACILITIES
● SHELTERS

ARBAT MAIN CAMP
OCTOBER 2014

FIND MORE SKETCHES IN THE APPENDIX.



WATER SUPPLY FOR EACH TENT

CEMENT BLOCKS USED TO PREVENT FLOODING

SANITARY SERVICE UNIT MADE WITH CEMENT BLOCKS

KITCHEN UNIT MADE WITH CEMENT BLOCKS

WE NEED A BETTER HOUSE FOR THE WINTER!

WE CAN USE OUR
CARPET TO INSULATE
THE ROOF

HAVE TO HELP MY DAD WITH OUR NEW HOUSE



DARA SHAKRAN CAMP LAYOUT

AS OF OCTOBER 2014

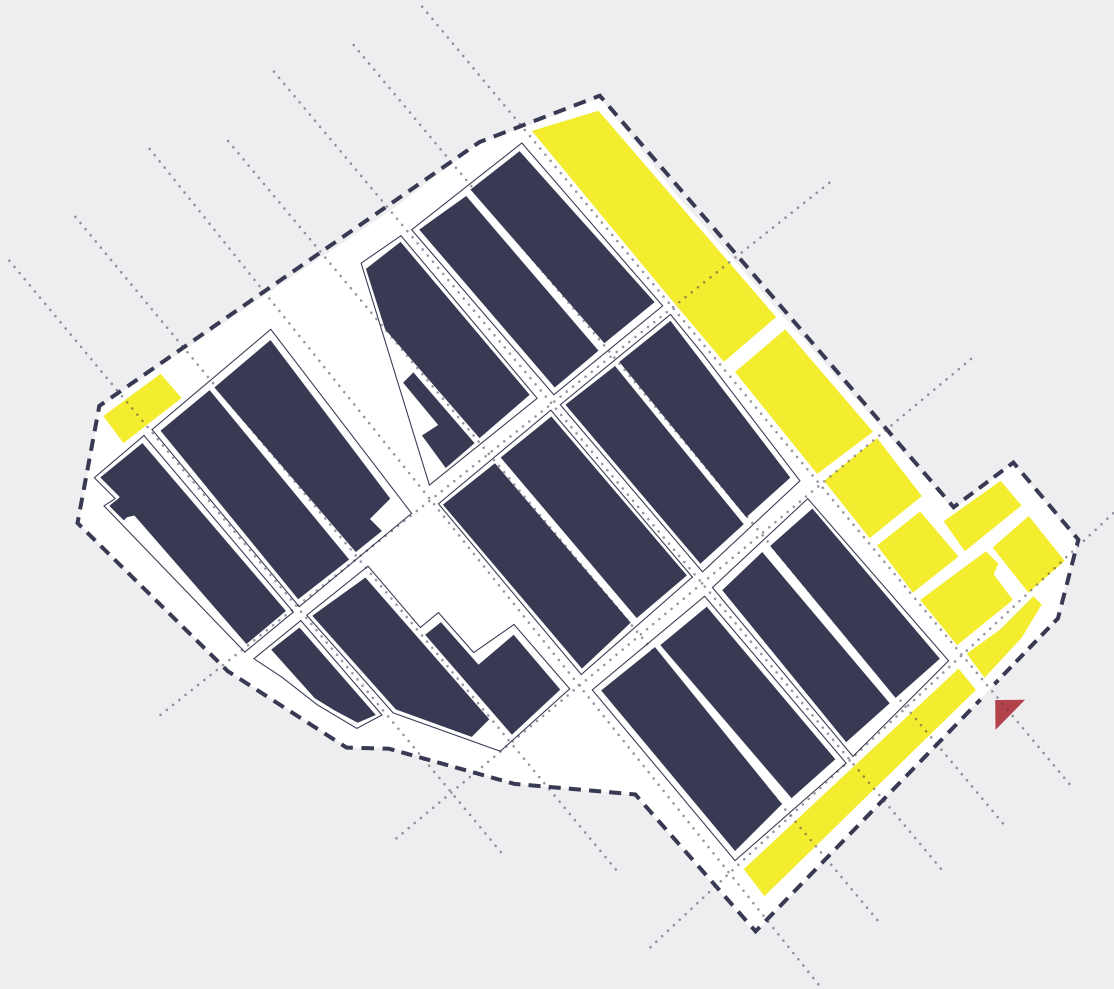


FIGURE 4
● FACILITIES
● SHELTER ZONE
24

400M

PARA SHAKRAN CAMP
OCTOBER 2014

A CARPENTER
WAITING FOR WORK

THE MARKET STREET
OF PARA SHAKRAN

A FULLY FUNCTIONAL
RESTAURANT





SOLAR BOILER

SMALL CULTIVATION GARDEN

PERSONAL VEHICLE

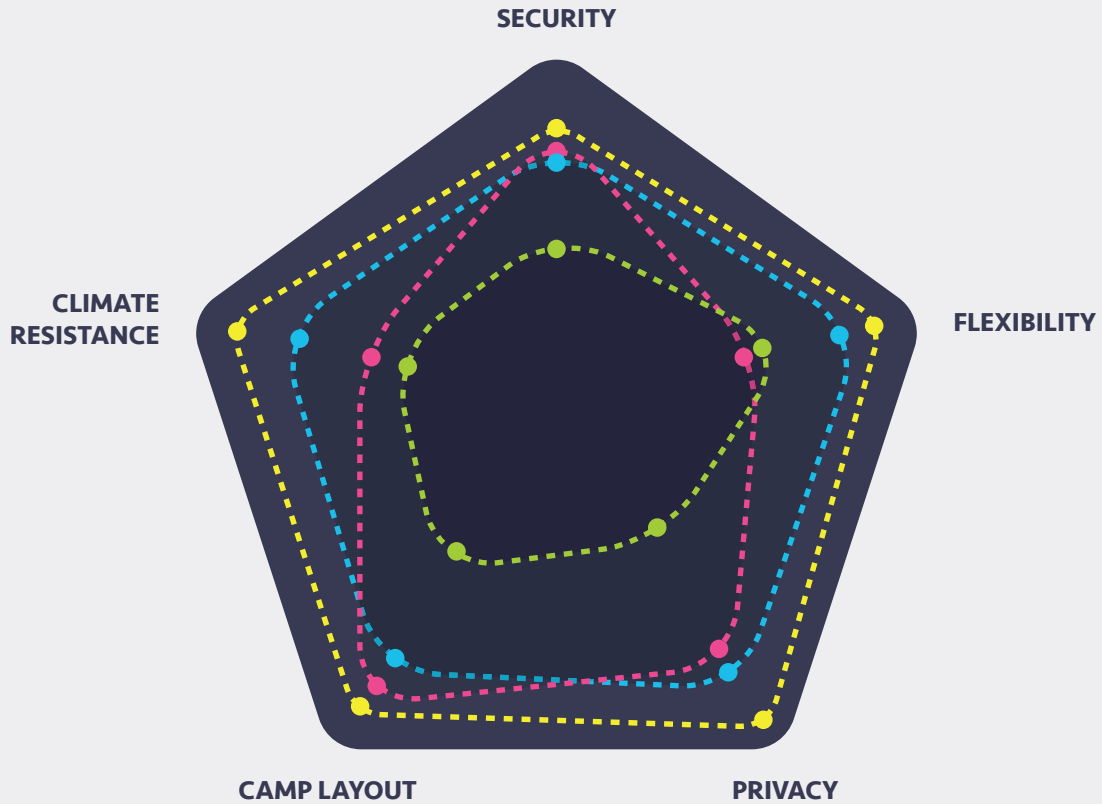
IF I GO TO THE MARKET I HAVE TO WALK ALL THE WAY UP THE HILL

WATER TANKS ON THE ROOF OF SANITARY SERVICE UNIT

FINALLY, I CAN FOLLOW THE WORLD USING MY SATELLITE

MY NEW CEMENT BRICK HOUSE IS MUCH BETTER!

COMPARISON CHART
BASED ON THE THREE CAMPS



- ARBAT TRANSITIONAL CAMP
- ARBAT MAIN CAMP
- DARA SHAKRAN CAMP
- MY GOAL

2.4 COMPARISON

The graph on the left page presents the Arbat Main camp as the best performing settlement on the average scale - in terms of security (due to upgrade), flexibility (upgradable shelters), privacy (due to upgrade), camp layout and climate resistance (due to upgrade).

Essentially, if the camp organisation allows any modification of the *UNHCR Family Tent* it gradually performs superior.

Based on my research on local (building) materials, sustainable analysis and typologies, it is evident that the field of a sustainable transforming camp to city is not fully explored yet. There are many materials that could be used instead of cement blocks, which are clearly free and insulate the indoor climate. For instance, raw reed and compressed earth blocks (C.E.B.).

Additionally, the capability of solar energy can be exploited to generate electricity. A step further to become off-the-grid. Contiguously, the camp generates a huge amount of waste on a daily basis which is not reused. If the waste is separated in different categories, then the materials can be processed and reused as building material or used as an energy source to support the off-the-grid motto.

The goal of the final design - marked as a yellow line in the graph - is to enhance the current conditions, with the main focus on *local materials* and *sustainability (solar energy + recycling)*.

.....
*4 Internal Displaced Persons (IDP)

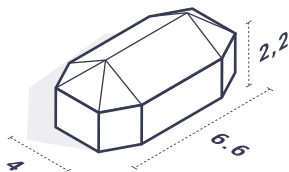
Any person who has left his/her residence by reason of real or imagined danger but has not left the territory of their own country.

- Source: thefreedictionary.com

*5 UNHCR Family Tent Model

The standard model is 4.0 x 6.6 m x 2.2 (WxLxH) with an usable floor area of 16m² and is constructed using:

- 6 side supporting poles
- 3 internal structure poles
- 4 door poles
- One fabric sheet to cover the internal space
- 6-8 robes to vasten the poles to the ground



2.5 INTERVIEWS

The interviews are conducted by using a list of questions composed for the organisation and refugees. The objective was to collect different views, issues and requirements based on the current conditions. The most important questions and answers are shown in this paragraph.

Please consult the **Appendix** to view the full questionnaire.

MR. PAYADAR

Head of Erbil's Refugee Camp Organisation (UNHCR)

T **Is this a Temporary or Permanent Camp? And How are the camps manifested?**

P All camps we have built around Erbil, Such as Dara Shakran and Basirma, are permanent. But for temporary use. When ISIS attacked many cities in Syria and later Kurdistan, we started to build these camps. By selecting the site and rapidly build the array of shelters.

T **How do you determine the size of the camp?**

P This is based on the area we buy or rent from the government or individual.

T **Are there unrelated refugees combined in one shelter?**

P Yes, but they are divided by gender.

T **What kind of facilities are there on this camp?**

P In Dara Shakran we have schools, hospitals, youth centres, sport area / basketball field, registration office, collection zone and a couple of external organisations from France and Japan have their own activity program.

T **How do refugees, in general, arrive at this camp? In what state do they arrive?**

P Most of them are picked up at the border, frontline of the war or arrive by foot. They are mentally devastated, because they have endured a rough time.

T **How do they get food and other everyday life stuff? Is here any production, cultivation or live stock?**

P We do not manage that. But some people cultivate and own chickens.

T **What is the average amount of people living in one shelter?**

P Five - six people.

T **Do they cluster them according to their connections, families, clans etc.?**

P Yes, if they want to live close to each and another yes. We also separate different races.

T **How long does it take to build a shelter?**

P In a couple of hours you can setup the tent.

T **What kinds of shelter do you have here?**

P In the camps around Erbil, most are tents and we build a permanent sanitary unit. Everything is build by our staff.

T **How long is the life span of the shelter?**

P The tent can last approximately 6 months.

T **Are the refugees involved in creating their shelters?**

P No, only if they upgrade their shelter, which is not often allowed here.

T **Are the shelters capable to resist the different seasons?**

P Until now, yes. But we have to see in the winter.

T **If you replace the shelter, how do you manage that?**

P The tents will be replaced by a new one. The old ones will end up in the trash.

T **Is the shelter easy to adjust to the specific needs?**

P No, you can separate one tent into two spaces by using a separation screen inside.

T **How do you manage to secure the camp?**

P We have security squads 24/7.

MR. AKO

Municipality of Suleymani, Head of Engineering

T Is this a Temporary or Permanent Camp? And How are the camps manifested?

A The camps around Suleymaniyah are Permanent, not counting the Arbat Transitional Camp. We started with the transitional camp, because we could not instantly provide the huge amount of refugees a well constructed shelter.

The transitional shelters are easy to setup in a couple of hours and the sanitary is build outside the camp and moved in here. It is quite light and easy to move around.

T Is there any social organisation in the camp, are there some quarters managed by someone, what is the social structure of the camp?

A We have the areas for the external institutions for those activities.

T Do you create any of semi-public space, where they can keep their livestock or belongings?

A We have not thought about that.

T What are the biggest needs of the refugees in the area of housing?

A Privacy and a good "indoor climate".

T Does the shelter provide enough daylight / fresh air / noise insulation?

A There are no windows in the tent, but the fabric is thin, so it lets in some light and air. There is no noise insulation.

T How long is the life span of the shelter?

A We use tents for 6 months, but currently we are working on a new camp in the south that can stay for up to 15-20 years. They are made of steel construction and sandwich panels. You can go and see them by yourself at our contractor.

REFUGEE : HAIDAR M.

Arbat Transitional Camp

T How is your stay in this camp? What do you think about your shelter? Would you like to improve your shelter?

H It is very poor, they told us that we have to wait for a month or two... and now we are here waiting more than six months. We heard that the main camp is much better. Come and see, my shelter. It is almost fallen apart and very cold at night. And look at our sanitary service unit, it is not working. The pipes are stuck and we have to shower down the street. We really like the caravan style shelters, we really would like that. That structure looks more resistable. Give us the material and instructions, we will do it. We will work for it.

T How does your everyday life look like?

H Right now, we are just sitting around, waiting and doing nothing.

T Do you have any profession, what can you produce/ make here in the camp?

H I was an engineer back home. We do not have the materials to do anything here. We buy our food most of the time outside.

REFUGEE : DERYA N.

Dara Shakran Camp

T How is your stay in this camp? What do you think about your shelter? Would you like to improve your shelter?

D It is okay, the people are friendly and the security is great. We hear bad things about the camp in Jordan, but here it is not alike. The tents are not great, I would like to have like those brick buildings. They seem comfortable.

T How does your everyday life look like?

D I am working in the market during the day. When I am back home I am tired. But it is great to be active, otherwise I will be thinking about my days in Syria again.

DESK RESEARCH

SELF-SUFFICIENT REFUGEE CITY

After the illuminating Field Research phase, the Thematic Research Questions (TRQ) is still a field in need of exploration. Nevertheless, the site visits and interviews were, in my perspective, mandatory to comprehend the current conditions and requirements.

This pre-session has helped me to select consciously the information regarding solar energy, local materials and recycling methods.

In this chapter, we will first dig more into the program and site to determine the capacity of a shelter configuration and the efficient path of the sun. Subsequently, possible solar solutions, local materials, and recycling methods will be discussed. For the purpose of the research, a fixed site is required to test these subjects. Among all visited camps, Dara Shakran Camp is the perfect playground for the off-the-grid design, due to the exiled location, large population, and current bad performance in flexibility and climate resistance. The camp is configured in eight districts, within each district there are several blocks and each block contains sixteen shelters units. Each shelter is for five to six refugees.

Note that the Dara Shakran Camp is used as the experimental ground for the design phase (fig.6).

3.1 PROGRAM PARAMETERS

The UNHCR's Manual For Refugees*⁶ has defined the most

essential elements of a refugee camp. Based on their decades of experience and the conducted interviews the urban program for the camp has been matured (appendix II). In Dara Shakran each family can use **33m²** more space on top of the required 16m² (fig.7). This calculation is made using the self-developed *Refugee city Program builder 1.0 beta "software"*.

3.2 LOCAL URBAN ANALYSIS

Apart from the technical aspects of an off-the-grid city, a brief view on **cultural** and **religious values** in the Kurdistan Region has been explored to be aware of current dwelling configuration. Two large cities in Kurdistan - Erbil and Suleymaniyah - are used to incorporate local urban settings and housing typologies. From this analysis, it seems that urban structure of Erbil is developed around **a ring**, while Suleymaniyah consist of a **perpendicular grid**. The different evolution of both cities is related to their historic development. Suleymaniyah has been developed during a western influence, and Erbil is one of the oldest living cities - based on a round castle - in the world (fig.8-9).

Most dwellings evolve from the **private zone** to the **semi-public** and onwards to the **public street** (fig.10-11). This is an important factor, due to the cultural and religious values. Contiguously, the current UNHCR camps are based on the **perpendicular grid** as well.

3.3 CLIMATE ANALYSIS

Kurdistan lays in a climate zone in which the winter can decrease to **-9°C** and the summer inflats to **44°C** (fig.12). Heating and cooling during these seasons are essential. In the whole region the appropriate temperature is often reached using augmented external machines, such as airconditioning and heating stoves. Despite the fact that these seasons are seen as obstacles in the current buildings, the effect could be reversed by reusing heat and cold. A graph, on the next page, is simulating the temperature and windspeed in the Dara Shakran area.



ANALYSIS OF DARA SHAKRAN CAMP PROGRAM AND URBAN STRUCTURE

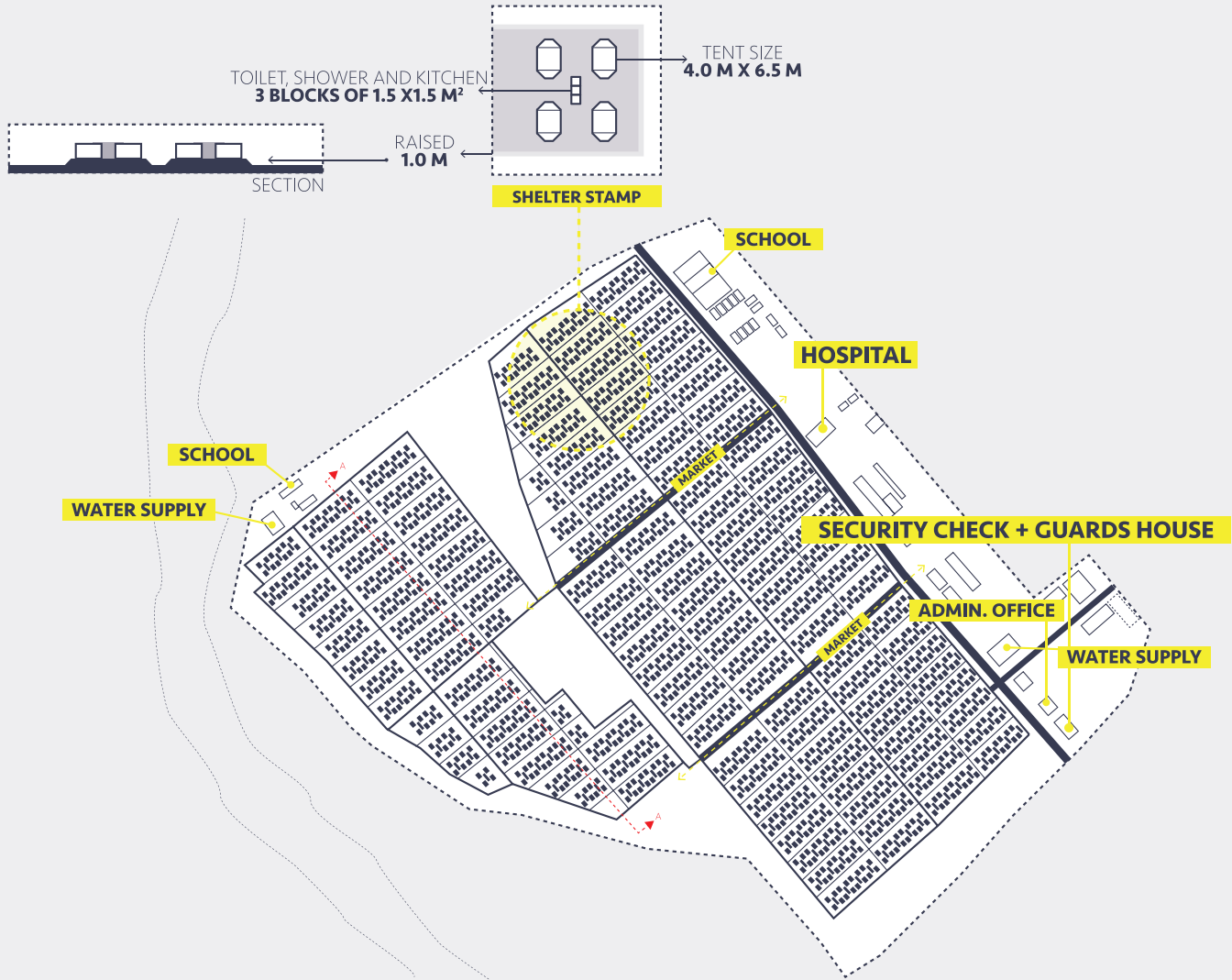


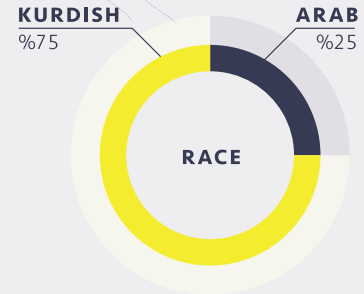
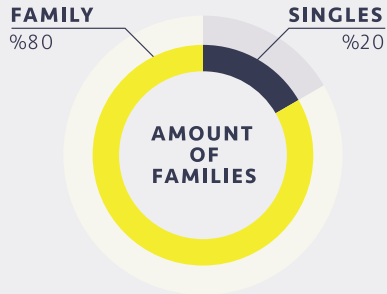
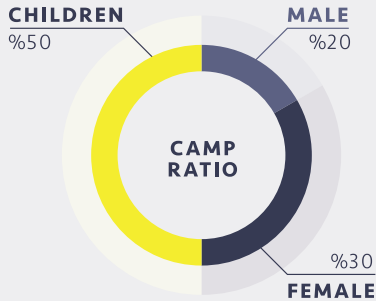
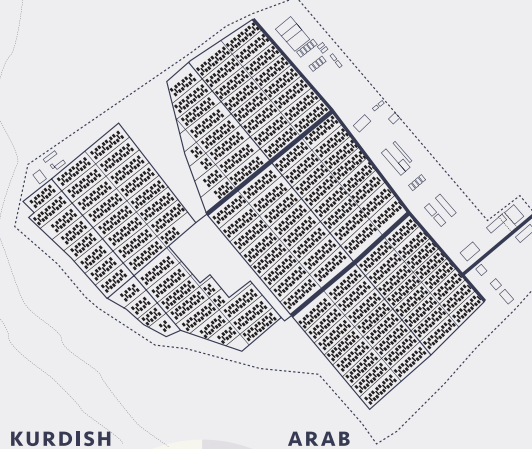
FIGURE 6

200M

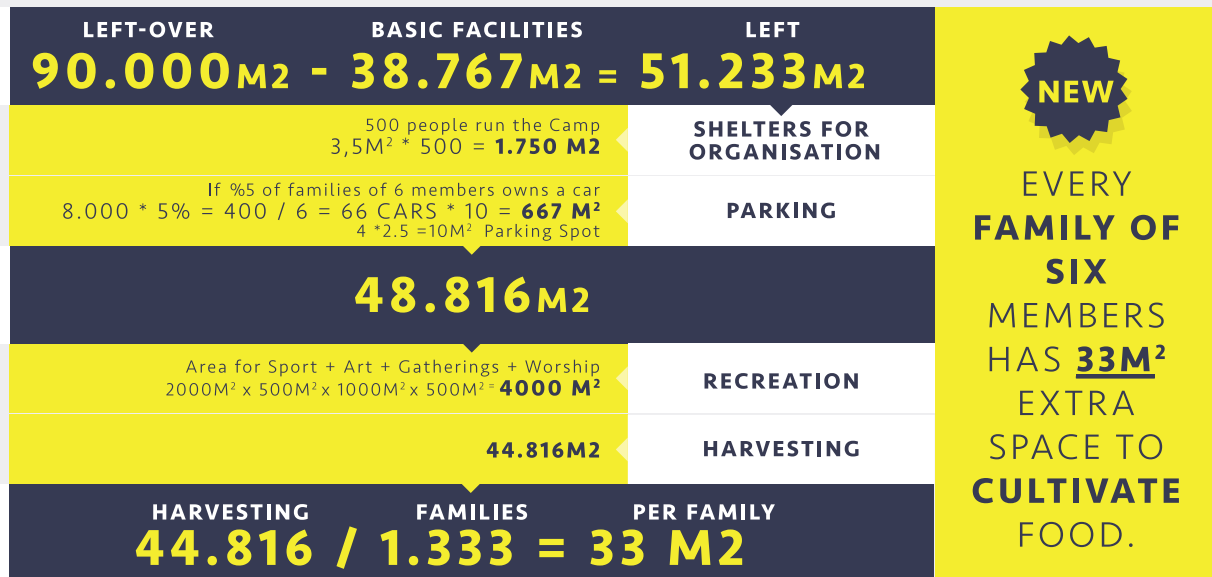
DARA SHAKRAN DATA

TOTAL AREA OF THE SITE
1.150.000M²

MAX. AMOUNT OF REFUGEES
10.000



THE FINAL CALCULATION



ERBIL VS. SULEYMANIYAH

THE RING VS. THE PERPENDICULAR GRID

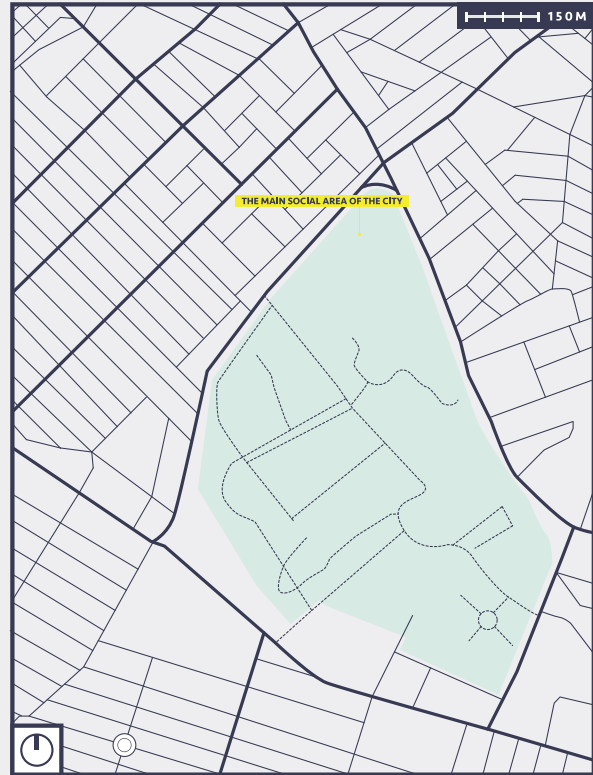
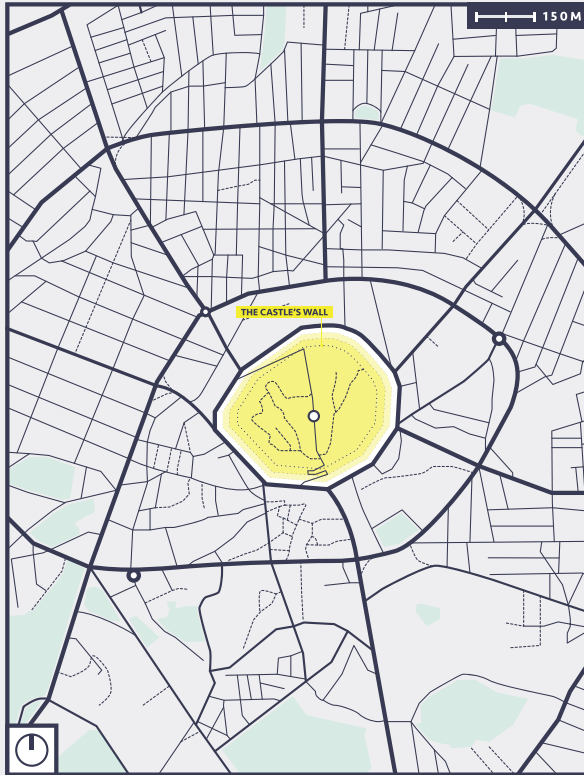


FIGURE 8

ERBIL VS. SULEYMANIYAH URBAN BLOCK TYPOLOGIES



INNER SPACE CONFIGURATION COMMON DWELLING IN THE MIDDLE EAST

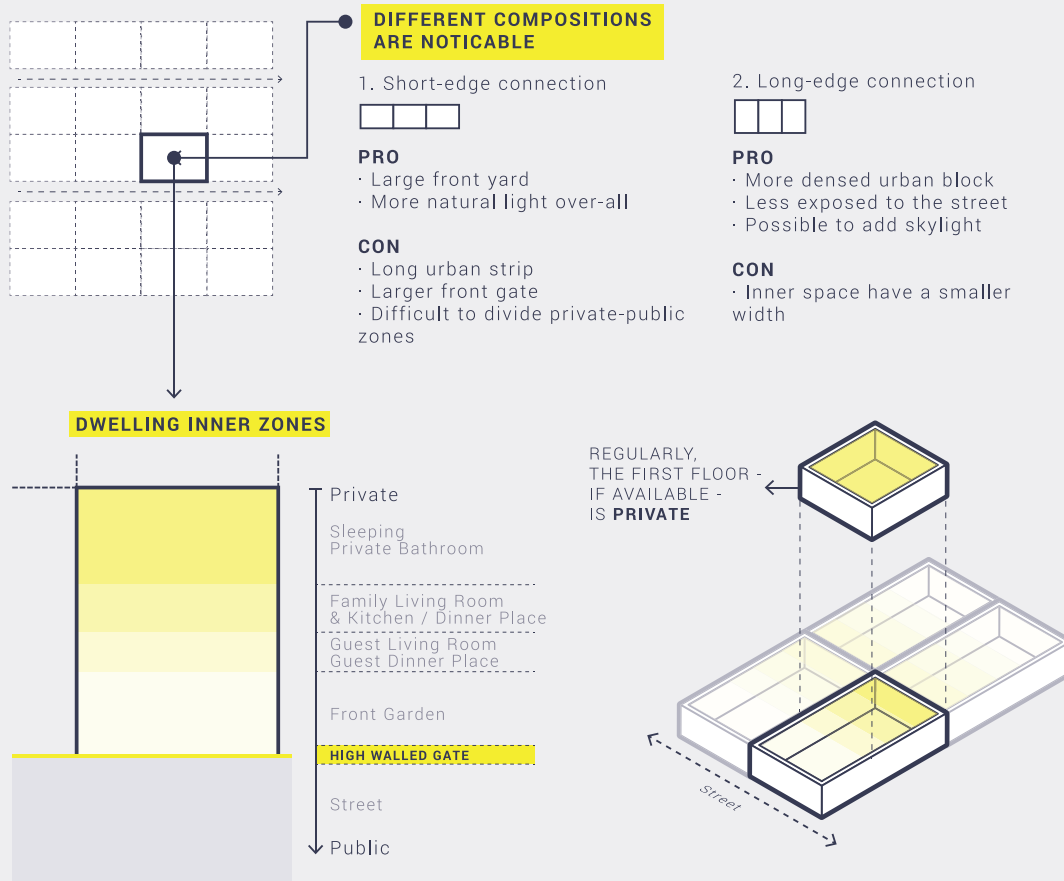
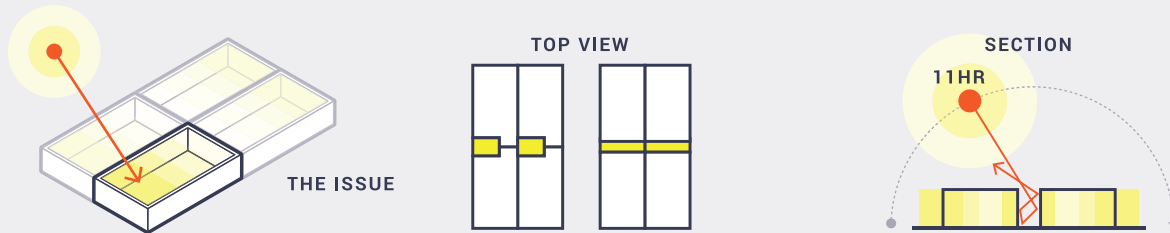


FIGURE 10

NATURAL LIGHTING ISSUE

COMMON DWELLING IN THE MIDDLE EAST



Because of the gradient plan setup the house will always have less light in the back, however in many dwellings a cut have been made in the back to allow natural incidental light in the back zones.

ANNUAL CLIMATE SIMULATION KURDISTAN (KRG)

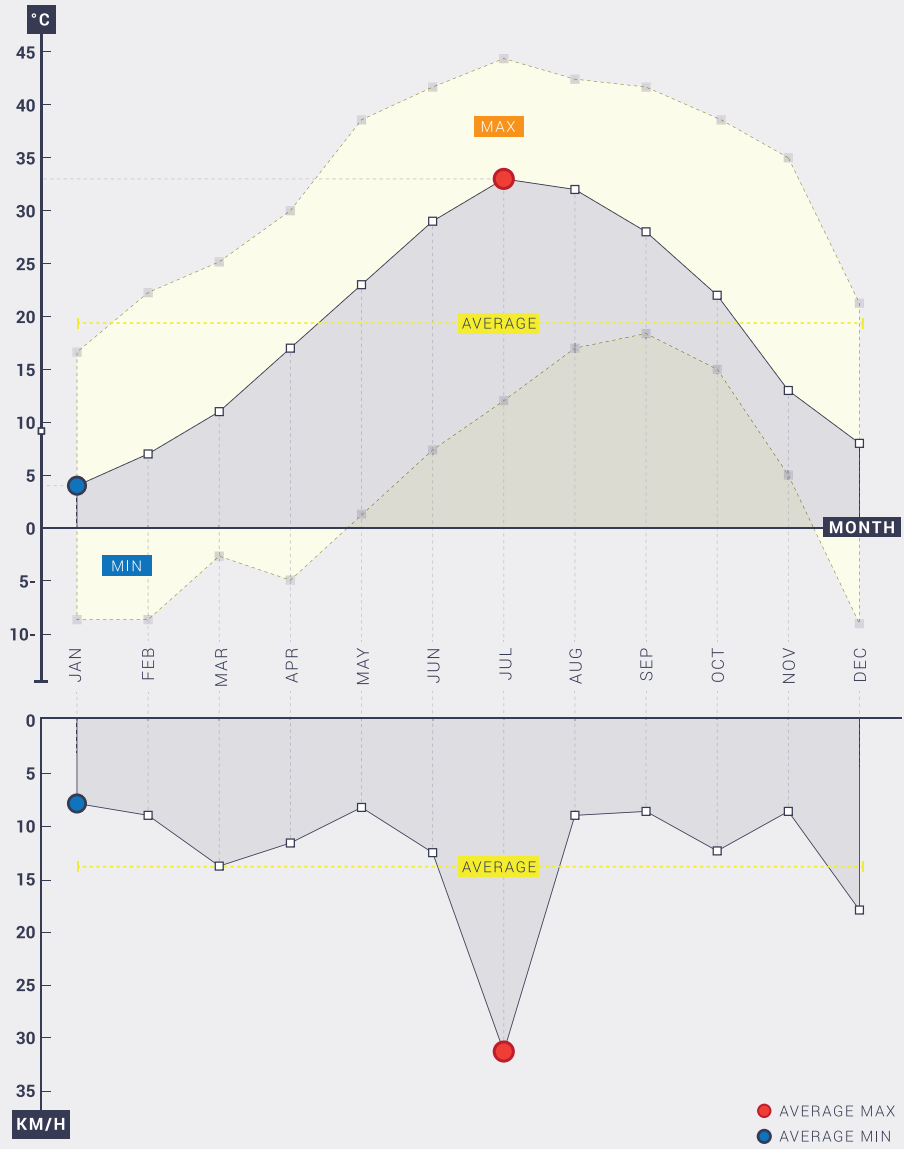


FIGURE 12

3.4 SHELTER AND CAMP TYPOLOGIES

UNHCR is using in the Middle Eastern climate mainly three typologies: Family Tent, Tent Mod.2, and the Caravan Shelter. The cement blocks shelter is an initiative of the refugees, which was discussed before in the section on Arbat Main Camp (§ 2.2). The Family Tent and Tent Mod.2 perform poorly in the hot and winter seasons due to their low-performing building skin: *the fabric sheet*. Note, that these types are mainly for temporary use of six months (fig.13).

In addition, the Caravan Shelter - consisting of a steel structure and insulated panels with a lifespan of 15-20 years - works more efficient in terms of privacy and climate. Unfortunately, due to the high cost, this distinctive type is only used in special case scenario's, e.g. for the staff of the camp organisation. For this reason, people seek a more reliable and affordable solution, such as the cement blocks .

The following section is the conclusion of the booklet **Typologies**. For a profound view into all case studies, please use the booklet.

An extensive side-research on small temporary and permanent structures and camp layouts is conducted to obtain a view and inspiration on different building methods, composition and materials. The outcome of the side-research has clarified that most temporary solutions last less than ten years. The objective of my research is to manifest a refugee city, which can actively work for more than 12 years, this is the average amount of stay per refugee. Correspondingly, permanent solutions such as the *Super Adobe* by Nader Khalili and the *Transitional Community* by Elisabeth Babister are considered as inspiration for the design phase due to their lowest-costs, local involvement and identity (fig.14).

Three additional urban case studies - the *Sahrawi Refugee Camp, Kenya's Dadaab, and Mae La Camp in Thailand* - has been explored to learn more about camp layouts in other climates and regions throughout the world. One of the most impressive case study is the *Sahrawi Refugee Camps* in Tindouf of Algeria. Since 1975-76, the camp has been evolved into an organic city crafted by the same refugees. Old tents

were relinquished and replaced by brick buildings made from local materials. Internal community organisations has been formed since their arrival. The *Sahrawi Refugee Camps* are the evident that in some cases refugee camps indeed transform into a permanent semi-autonomous settlement, but unfortunately still outsource the base elements of life, such as electricity (fig.15).

3.5 SUSTAINABLE CITY: ENERGY FLOW AND RECYCLING

Current camps - including the Dara Shakran camp - are connected to the local energy grid, import clean water using trucks and burn the waste on a nearby site. Additionally, the UNHCR Family Tents do not contain climate control systems. Therefore, prosperous refugees append cooling and heating systems, such as an airconditioning. You can imagine that the energy costs in the summer and winter correspondingly increase. In short, the basics of life - *electricity, water, consumption and climate systems* - are imported or neglected (fig.16).

3.5.1 Steady-State Economics (SSE)

The dependent state of the camp can be improved by creating an ecosystem, which consolidates the users of the city and environmental (surrounding) resources with the goal to achieve a state of equilibrium. The difference between the standard economics and the SSE is the integration of the surrounding ecosystem in combination with the reuse of waste (fig.17). The following three core elements are explored to promote the SSE strategy for the refugee city:

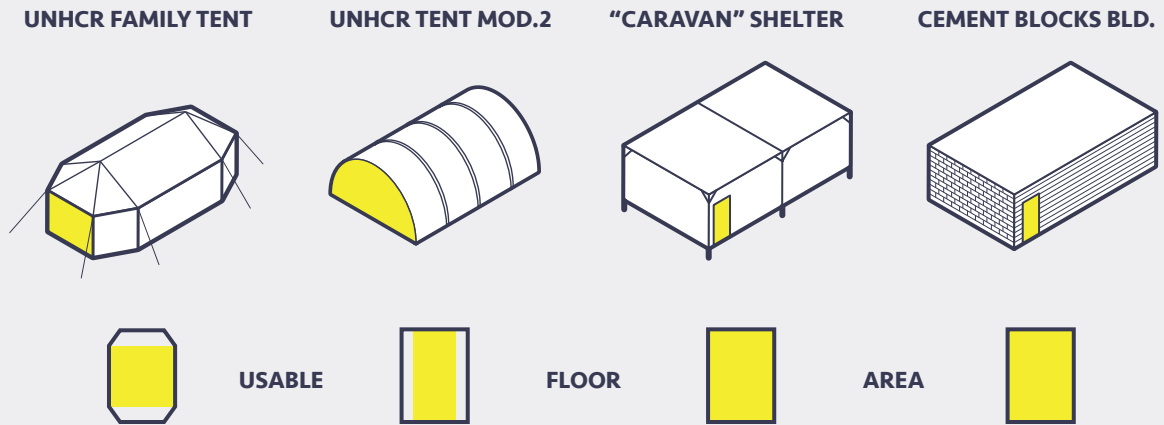
- I. *Active and passive solar approach*
- II. *Partial recycling of waste*
- III. *Aggregate and production of local materials*

While the active solar approach requires supplementary equipment to produce energy, the passive solar approach is focused on the design of the camp and shelter without the use of external machinery. As a matter of fact, architecture is the instrument towards a passive solution.

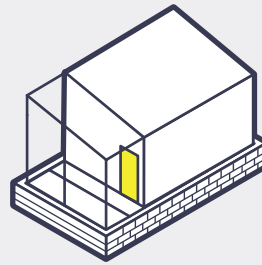
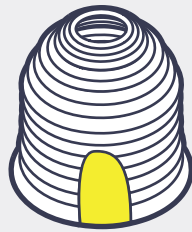
3.5.2 Active solar approach

We can divide the *active approach* into two partially-dependant branches, *production of electricity* and *production*

CURRENT SHELTER TYPOLOGIES
BASED ON MIDDLE EASTERN UNHCR REFUGEE CAMPS



SUPER ADOBE AND TRANSITIONAL COMMUNITY
NADER KHALILI AND ELISABETH BABISTER



**MADE FROM EARTH
SANDBAGS AND
BARBED WIRES**

LASTS OVER 30 YEARS

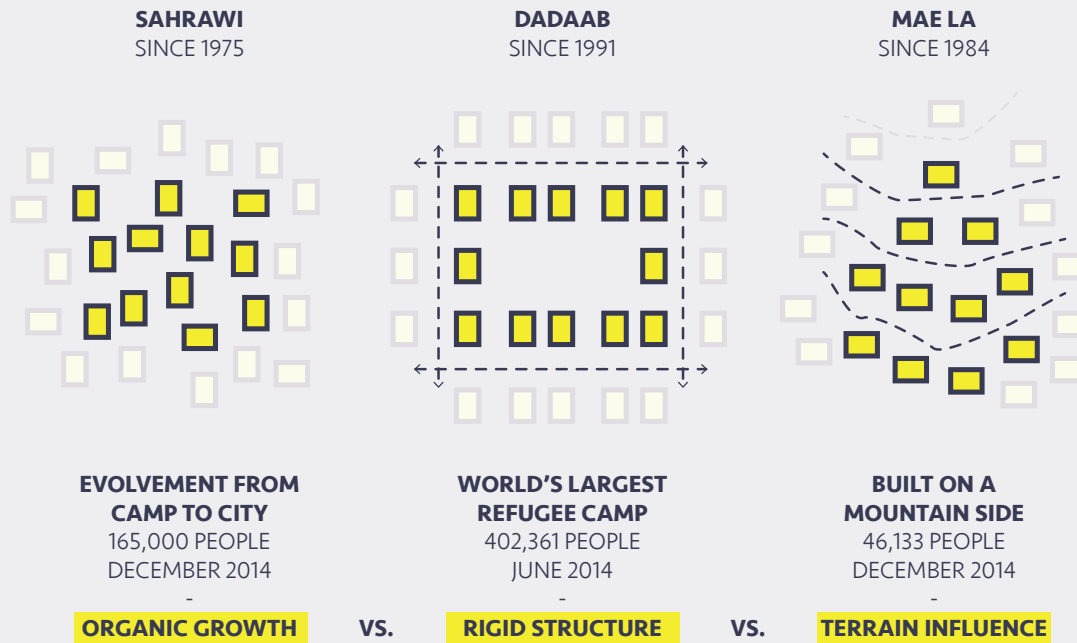


**MADE FROM CEMENT
BLOCKS AND RAW
LOCAL TIMBER**

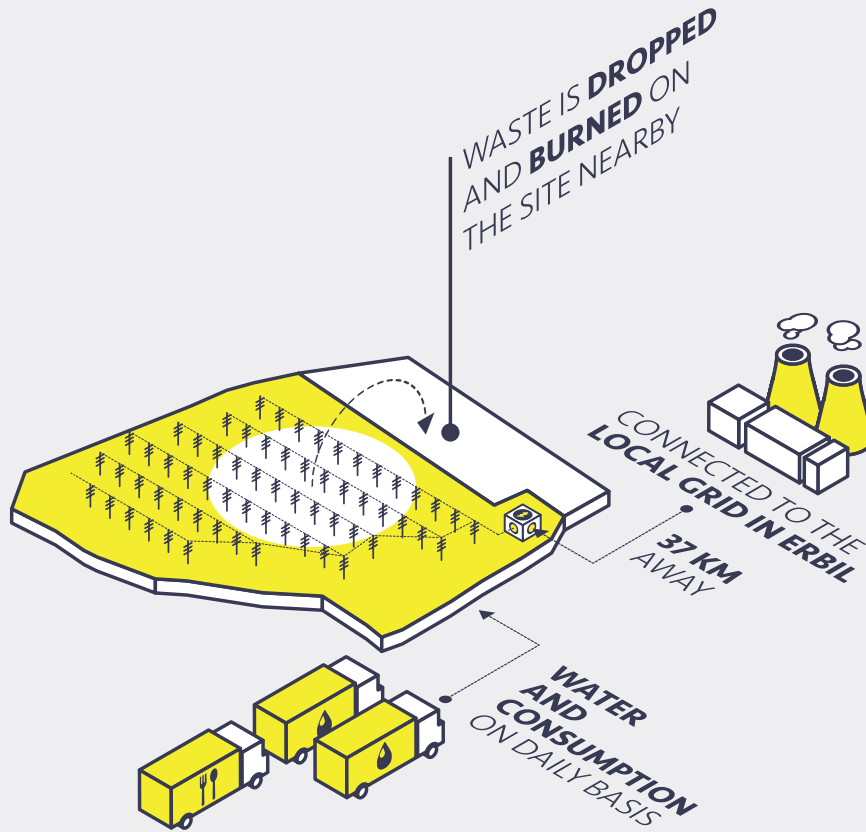
LASTS OVER 30 YEARS

THREE CASE STUDIES

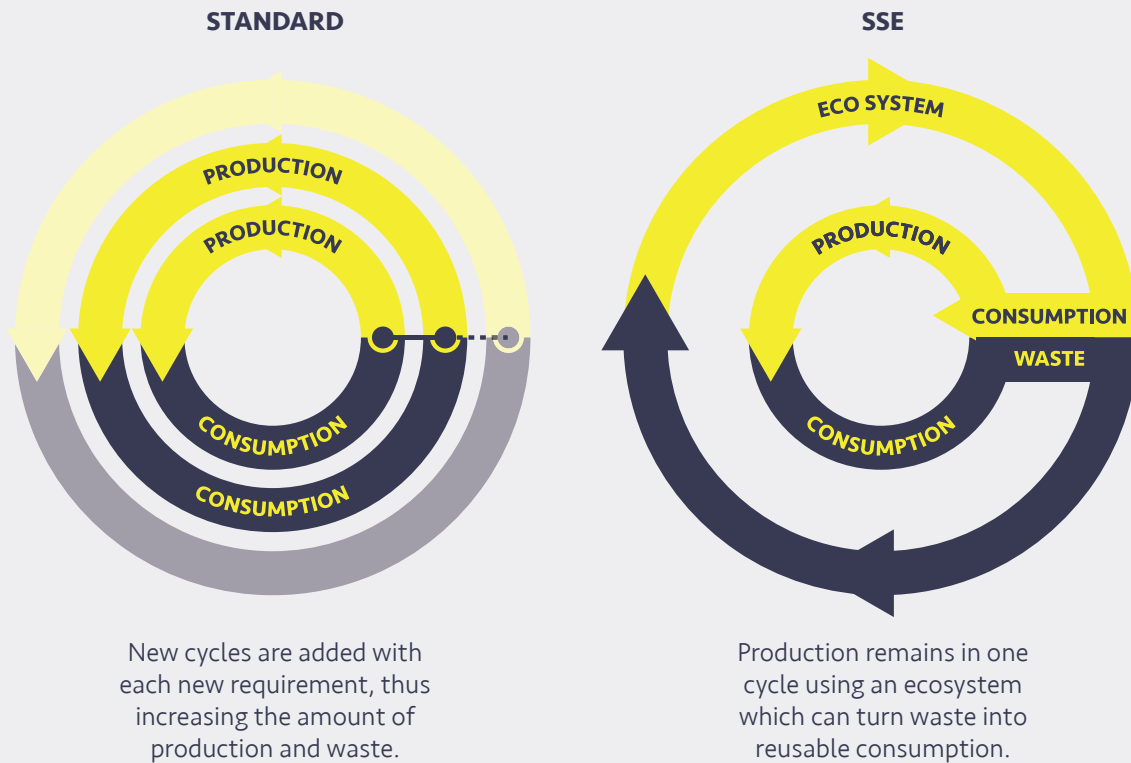
SAHRAWI REFUGEE CAMP, KENYA'S DADAAB, AND MAE LA CAMP IN THAILAND



CURRENT ENERGY, WATER AND WASTE FLOW
DARA SHAKRAN



STANDARD VS STEADY-STATE ECONOMICS (SSE) ECO SYSTEM OBJECTIVE



New cycles are added with each new requirement, thus increasing the amount of production and waste.

Production remains in one cycle using an ecosystem which can turn waste into reusable consumption.

of climate (heat / cooling).

I. Electricity is produced using Photovoltaics (PV) cells, bio-energy, and thermoelectric generators*. The collected current can be stored using a battery on site.

II. Heat is generated by applying a solar boiler. Cooling relies on the conventional method of mechanically driven fans using electricity (fig.18).

PV cells including a battery, bio-energy, thermoelectric generators, and a solar boiler are the most viable solutions for the refugee city. The reduction on (off-shore) materials and external resources allows room to include such active solar systems.

PV Cells

The efficiency of PV cells depend on panel orientation, roof and panel pitch, temperature and shade.

In Dara Shakran all panels should face the southern orientation. During winter it is advised to pitch the roof on a 30° angle, spring/autumn on a 54° angle, and summer on a 78° angle. PV cells perform topnotch in a climate of 25°C. The average temperature in Kurdistan is approximately 20°C with a peak of 44°C. Cooling PV cells - for instance by offsetting the cells from the roof for air flow and using a light color cell - is required to maintain a satisfactory performance (fig.19).

Bio-Energy

Crops, animal and human waste are the fuels to generate energy. An average person produces 1.9 kg of waste per day in Europe. We can assume that refugees do not consume as much, and therefore the rate of waste would be lowered to 0.8 kg per day. With 10.000 people of Dara Shakran, we can conclude that 8000 kg waste per day is generated without any fruitful continuation. Half of the total amount of waste can be estimated as fuel for the bio-energy system. With 4000 kg per day, the city produces roughly 1.46 million of waste yearly, resulting into electricity and heat for 6% of the total city (view Appendix for the calculation).

Materials, such as plastic bottles and packaging, can be isolated from the other half of the waste to revive its purpose. Unlike the self-operating PV cells, production of bio energy is only feasible with participation of the people of the refugee city and a small factory on site to convert the waste.

Thermoelectric generators

Heat can be a problem for the performance of PV cells, but the thermoelectric generators can not function without it. This method is borrowed from the car industry, such as BMW's and Lexus' future electric car program.

The generators use two ceramic substrates with inbetween a grid of conductor pellets tabs to transform heat into current. Heat from the sun or cooking stove can be used to charge a battery that can be used later on.

Solar Boiler

Dara Shakran, Basirma, Domiz and many more camps in and around Kurdistan use solar boilers to heat the water for a shower or for cooking. The system is placed on top of the sanitary service unit, facing the sun, so it will be in close range of the water tanks. Each four shelters use one system. All solar boilers are provided by non-UNHCR organisations from different countries, for example from Qatar and Japan.

3.5.3 Passive solar approach

Architecture is the key for activating environment opportunities: by taking advantage of the sun, wind, earth and user transmission. With design principles - for ventilation, heating and cooling - we can create a passive solar shelter without the use of equipment. The fundamentals of a passive design starts with (fig.20):

I. Thermal mass

II. Orientation

III. Shading / Lighting

IV. Indoor space composition

V. Solar chimney

VI. Underground ventilation

VII. Venturi roof

Note that the passive system should be combined with the active solar approach in order to supply the city with electricity.

One of the most important ingredients of the passive solar approach is the materialisation of the city. Every material has its own thermal mass, which can be explained using the thermal flywheel effect (fig.21). A thorough view on the materials is essential before taking any design decision.

ACTIVE SOLAR APPROACH
PRODUCE ELECTRICITY AND HEAT

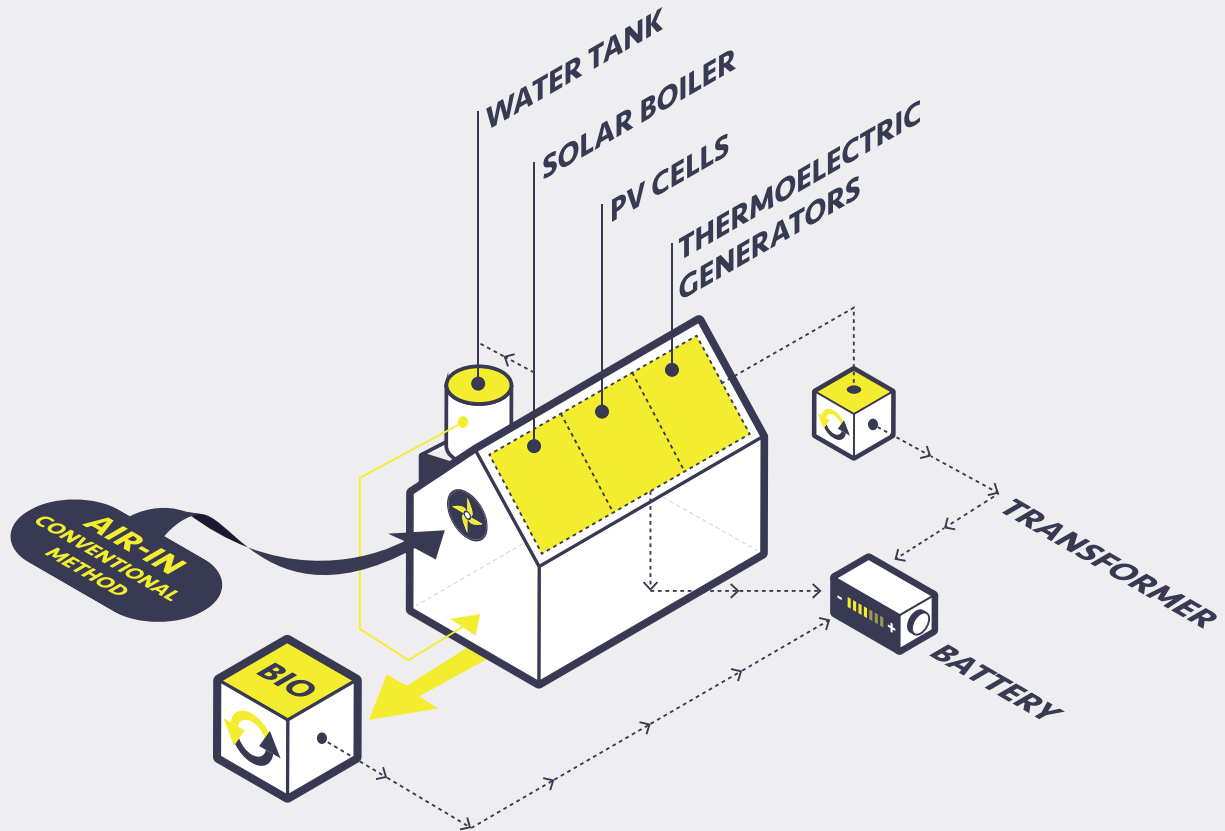
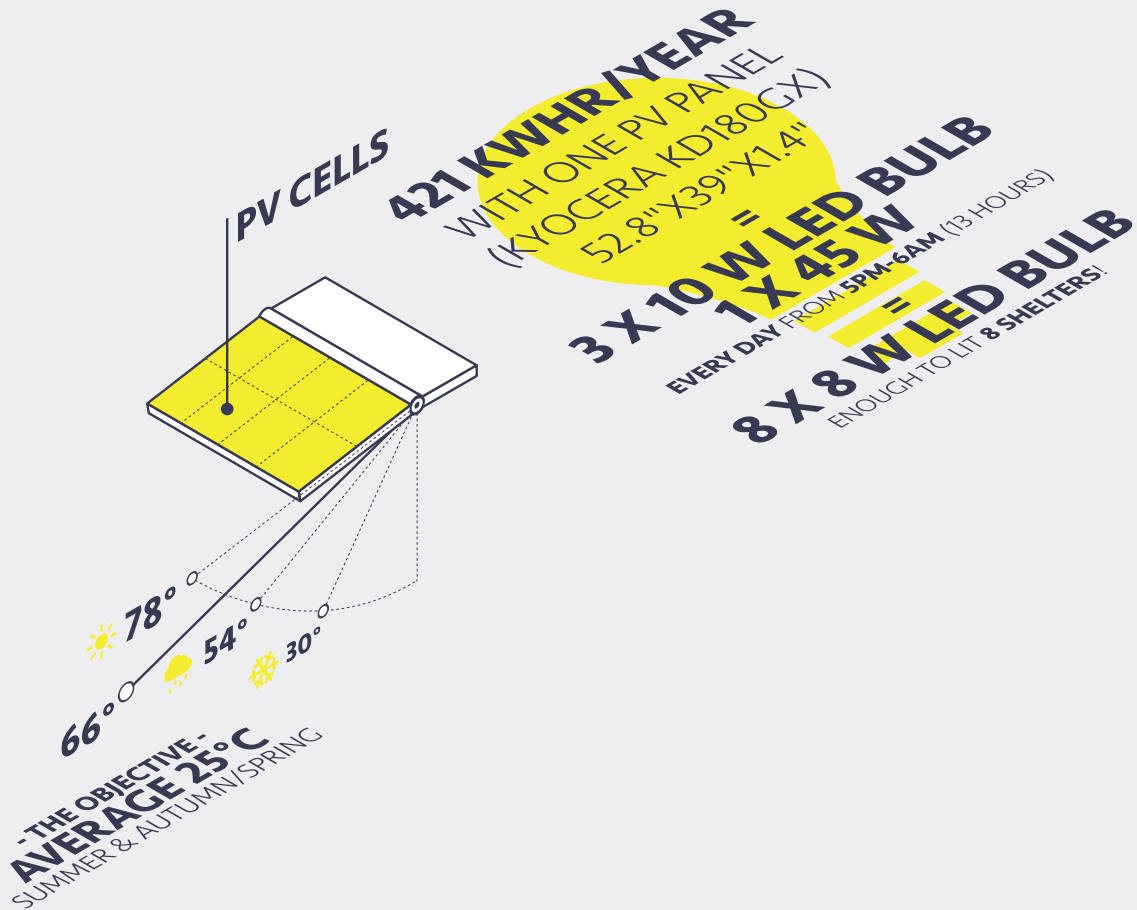


FIGURE 18

SOLAR ANGLE IN KURDISTAN

CALCULATION MADE WITH SOLAR ANGLE CALCULATOR BY GREENSTREAM PUBLISHING LIMITED



10.000 refugees live in **2.000** shelters, every **8** shelters use one panel, **250** panels is required for the whole city.
One panel costs **\$200** on average scale, **\$50.000** investment required to lit the whole city.

PASSIVE SOLAR APPROACH DESIGN PRINCIPLES

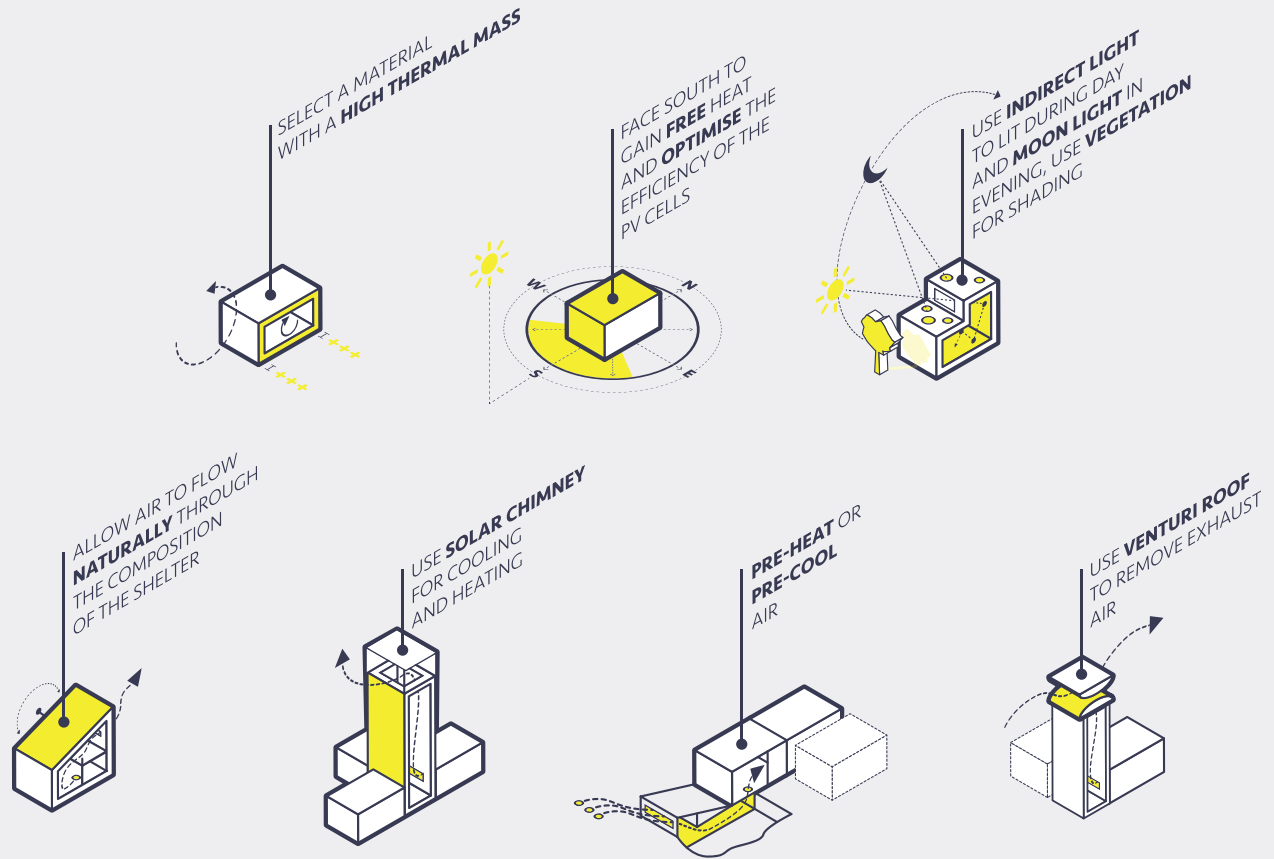
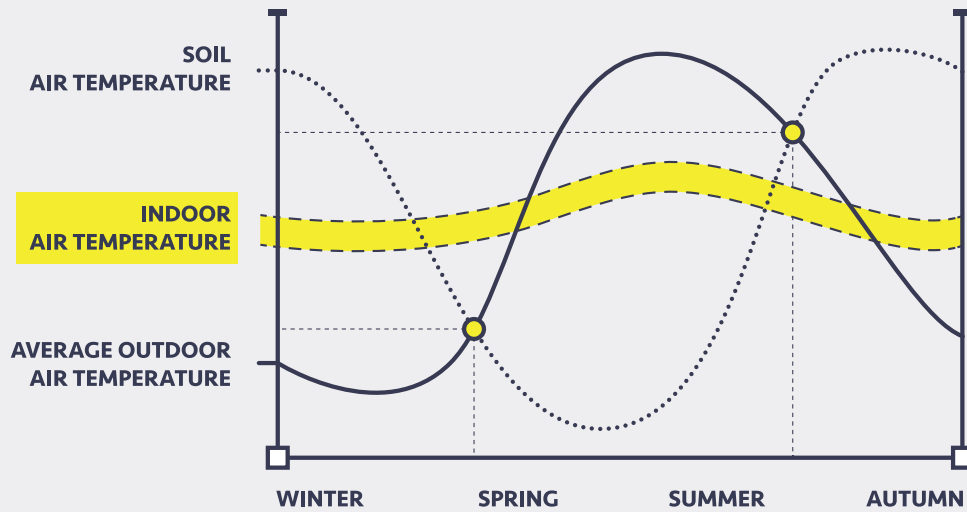
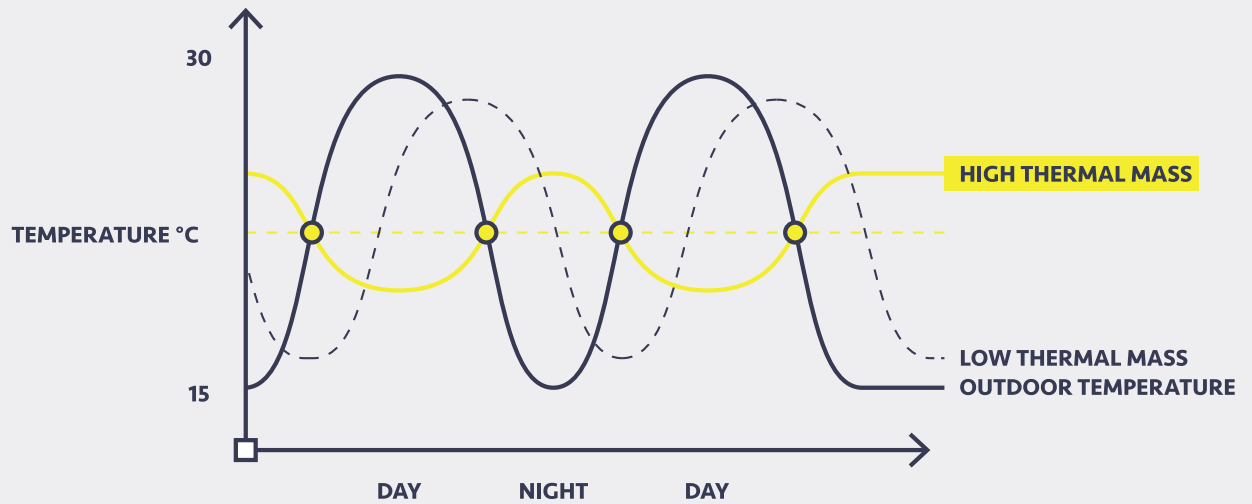


FIGURE 20

THERMAL FLYWHEEL EFFECT THE THERMAL MASS



Materials with a high thermal mass have a delay in temperature change. The higher the thermal mass the slower its effects on temperature change. The thermal flywheel effect above demonstrates the condition of soil (earth) during the whole year.



The following section is the conclusion of the booklet **Materials**. For a comprehensive view into all materials, please use the booklet.

3.6 LOCAL MATERIALS

In the Kurdistan Region are various local materials available - such as clay, reed, fabric and natural stone - that are not or rarely used as a building material. The community has been comfortable with concrete and cement blocks for years, due to its robust character and mundane reliability. However, the other range of materials has been neglected due to unfamiliarity. It is time to permeate this notion and settle a new scope.

The material comparison table shows that among all local materials, *reed* and *earth* are the first-rate option for a refugee city, which depends highly on affordability and rapid development. Dara Shakran is fortunately in a close range of these materials as shown on the location map (fig.22-23).

3.6.1 Earth

Using *Earth* as building material has several pros and cons. The main advantage is a reduction of energy costs related to transportation and production, because it can be produced on site. Secondly, a huge reduction of material costs can be reached due to its availability on site. Lastly, earth is an environmental friendly substance with a high thermal mass, which is preferable to reduce heat and cool loss.

The down side, earth requires - depending on building technique - periodical maintenance, 4 - 7 days dry / baking time and the labour can be time-consuming. But this should not be a reason to disregard the great features it offers. There are three major techniques to transform raw earth into a operational building material (fig.24):

I. Rammed Earth

II. Mud Bricks

III. Compressed Earth Blocks (C.E.B)

Each technique has its own instructions to prepare the material. The most labour-intensive and time-consuming method is the rammed earth. On the contrary, the C.E.B. can be rapidly produced thanks to the use of apparatus.

3.6.2 Reed

Reed can be used in four different ways by virtue of its all-round performance, it can be used as:

I. Insulation material

II. Roof / facade finishing (*Breathing Facade*)

III. Lightweight structure

IV. Water treatment

The Mae La Camp in Thailand depends fully on the use of reed. Due to its flexibility, insulation property and brisk wild growth, this material is an efficient asset to use in the refugee city. Especially if a huge amount of material is required for low-cost and in different seasons. The easiest way to use the material as a building component is by collecting a range of reed and binding them together. Subsequently, the bundle has to be cut to be aligned. Hereafter, the material is ready to be used as a column (fig.25).

3.6.3 Incremental building with Earth and Reed

A crucial aspect of the refugee city is the rapid settlement of new refugees and the need of adjustable shelters. New shelters should be developed instantly in all seasons. With this mindset, an incremental design approach is a sensible solution. The city will first be developed using reed, as this is a lightweight and all-season material. While time passes by, compressed earth blocks - due to the rapid production - will be integrated into the existing reed structure, this will enhance the thermal mass and extend the lifespan of the shelter (fig.26).

3.8 ECOSYSTEM: THE COMPLEMENTARY EVOLUTION

The off-the-grid mentality comprises of three integral systems. First, the city should predominantly use the passive solar approach to support the *Steady-State Economics (SSE)* strategy. Second, the active solar approach is essential in generating electricity and keeping the city functional during day and night. Finally, recycled bottles and packaging evolve into building material in the pace of time, resulting into a reduction of the amount of waste.

This dynamic sequence works parallel with the evolving refugee city. The more people arrive and settle, the more energy and reuse of waste is processed (fig.27).

MATERIAL COMPARISON TABLE
KURDISTAN'S LOCAL MATERIALS

MATERIAL NAME	AVAILABILTY	COSTS (\$)	SPEC. SCORE	OVERALL
Cane / Reed	★ ★ ★ ★ ☆	+ + + + +	2.3	1 ST
Clay	★ ★ ★ ★ ☆	+ + + + +	3.6	3 TH
Concrete / Cement (blocks)	★ ★ ★ ★ ☆	+ + + + +	3.3	
Earth	★ ★ ★ ★ ★	+ + + + +	3.6	2 ND
Fabric / Nylon	★ ★ ☆ ☆ ☆	+ + + + +	3.0	
Fertilizer	★ ★ ★ ☆ ☆	+ + + + +	4.3	
Natural Stone	★ ★ ★ ★ ☆	+ + + + +	3.6	
Timber	★ ★ ★ ★ ☆	+ + + + +	2.6	
Water	★ ★ ☆ ☆ ☆	+ + + + +	4.3	

LOWER IS BETTER!

THE FORMULA

$$\frac{\text{LABOUR} + \text{MAINTENANCE} + \text{WEIGHT}}{3}$$

DARA SHAKRAN AND THE SURROUNDINGS

WHICH MATERIALS ARE IN THE NEIGHBORHOOD?

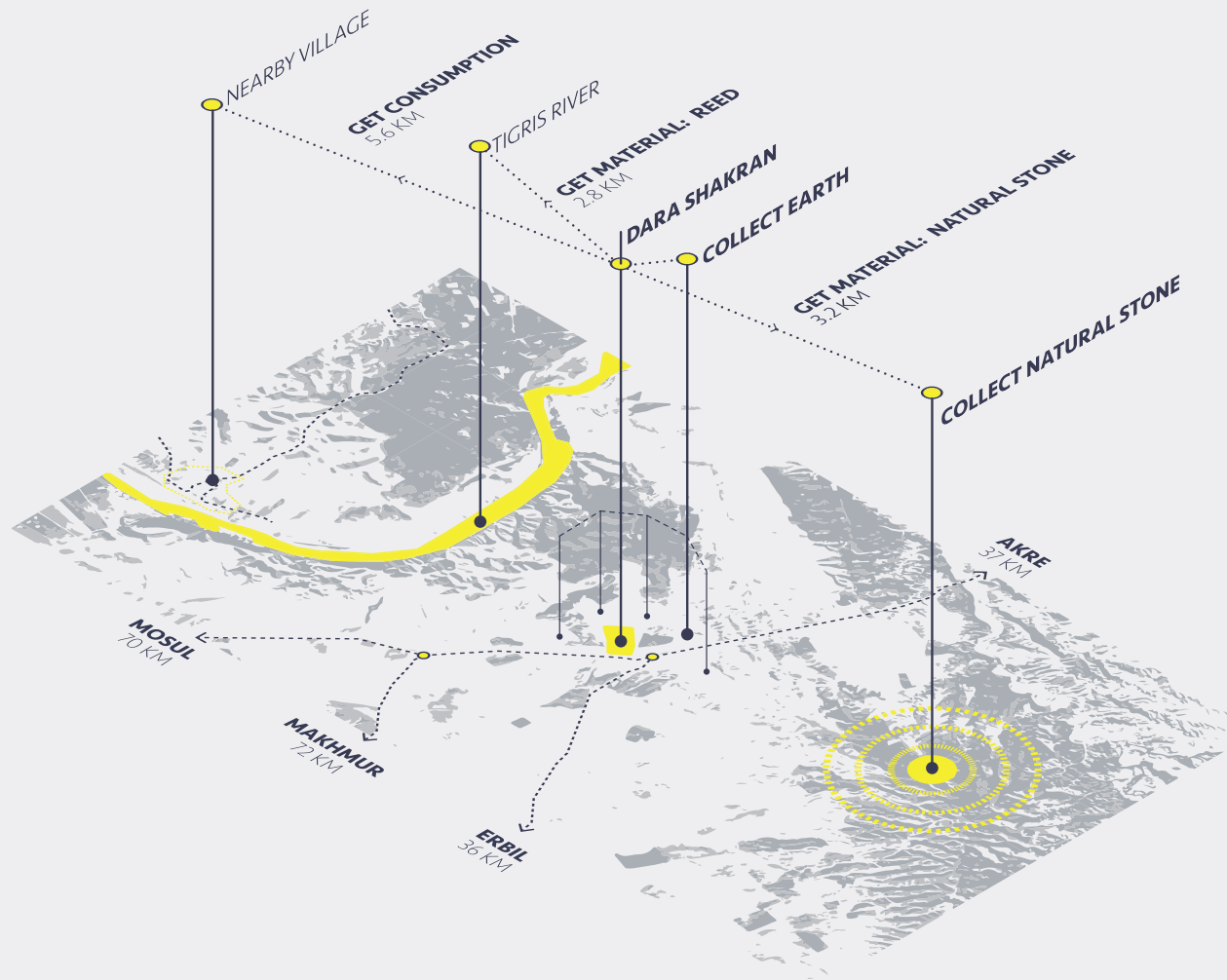


FIGURE 23

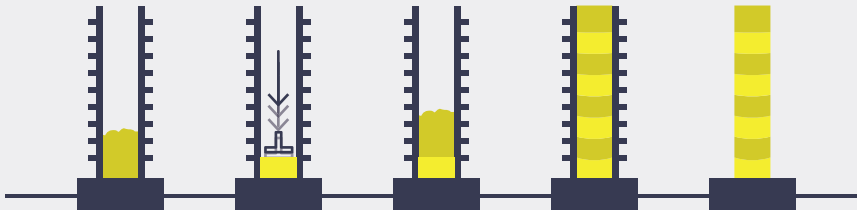
EARTH BUILDING METHODS

THE INSTRUCTIONS

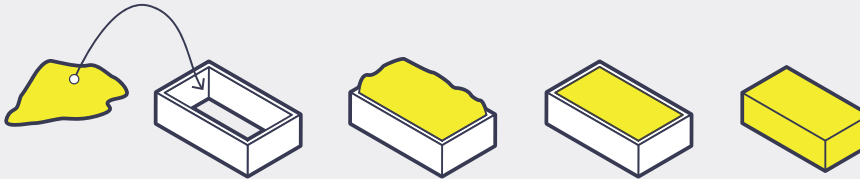
SCAN QR CODE TO VIEW A VIDEO OF EACH BUILDING METHOD ON



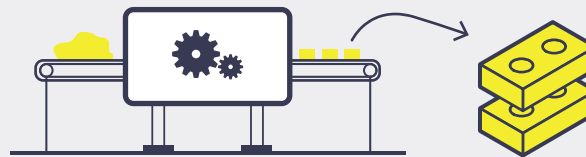
RAMMED EARTH



MUD BRICKS



COMPRESSED EARTH BLOCK



C.E.B. WITH **THE BLOCKMASTER 300**



NOTE: THE VIDEO'S ARE ONLY FOR EDUCATIONAL PURPOSE AND THE RIGHTS REMAIN TO THEIR RIGHTFUL OWNER(S).

REED BUILDING METHOD
INSTRUCTIONS

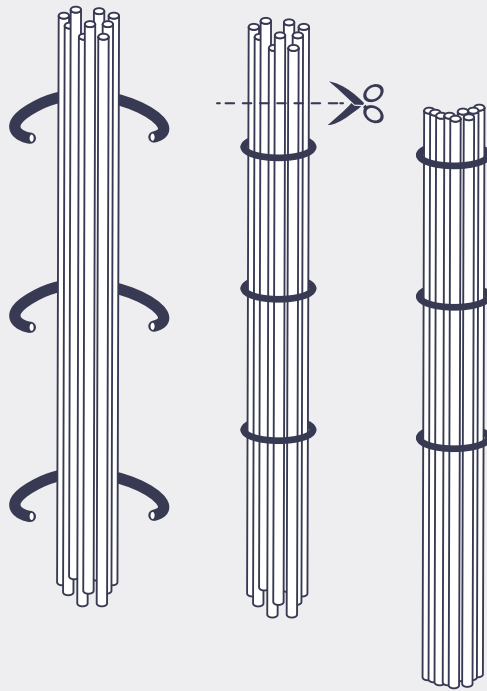
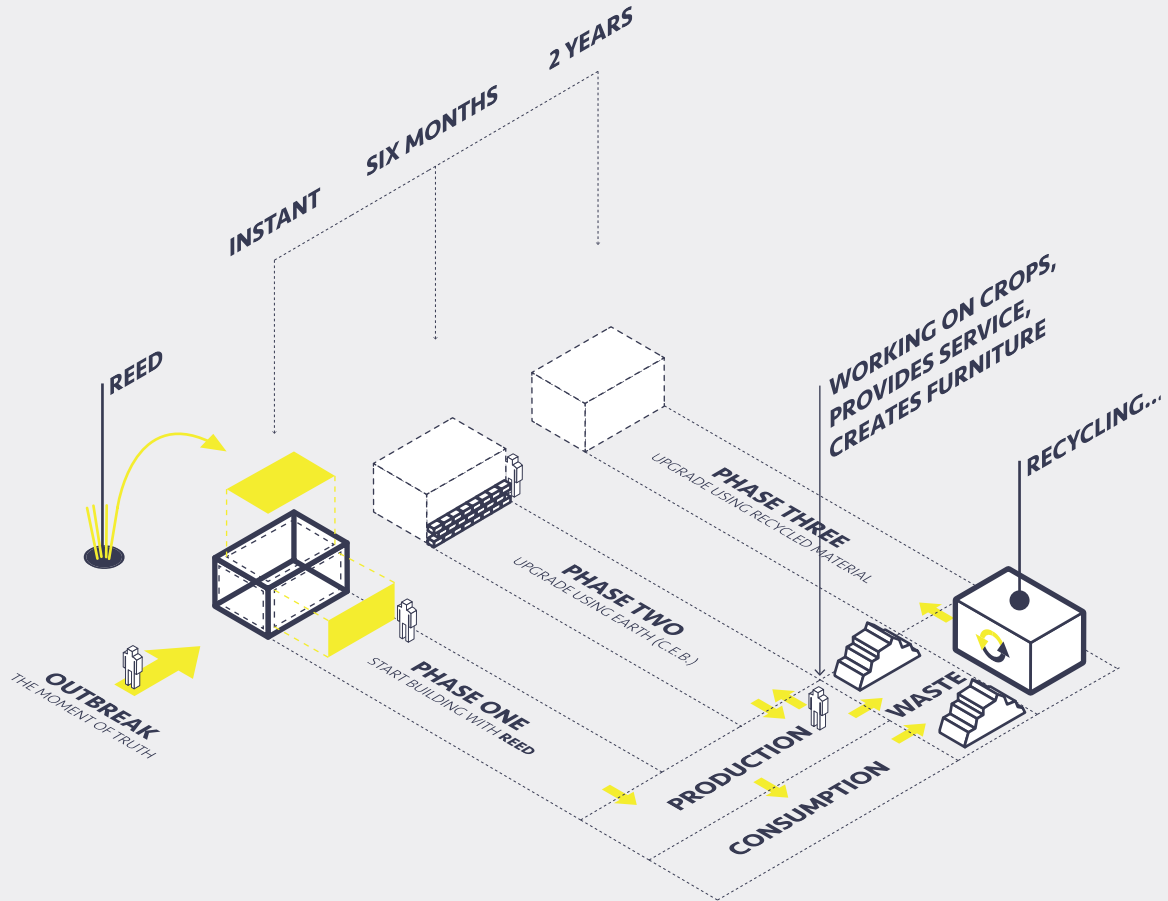


FIGURE 25

INCREMENTAL BUILDING PROCESS WORKING WITH EARTH AND REED



THE COMPLEMENTARY EVOLUTION ECOSYSTEM OF THE REFUGEE CITY

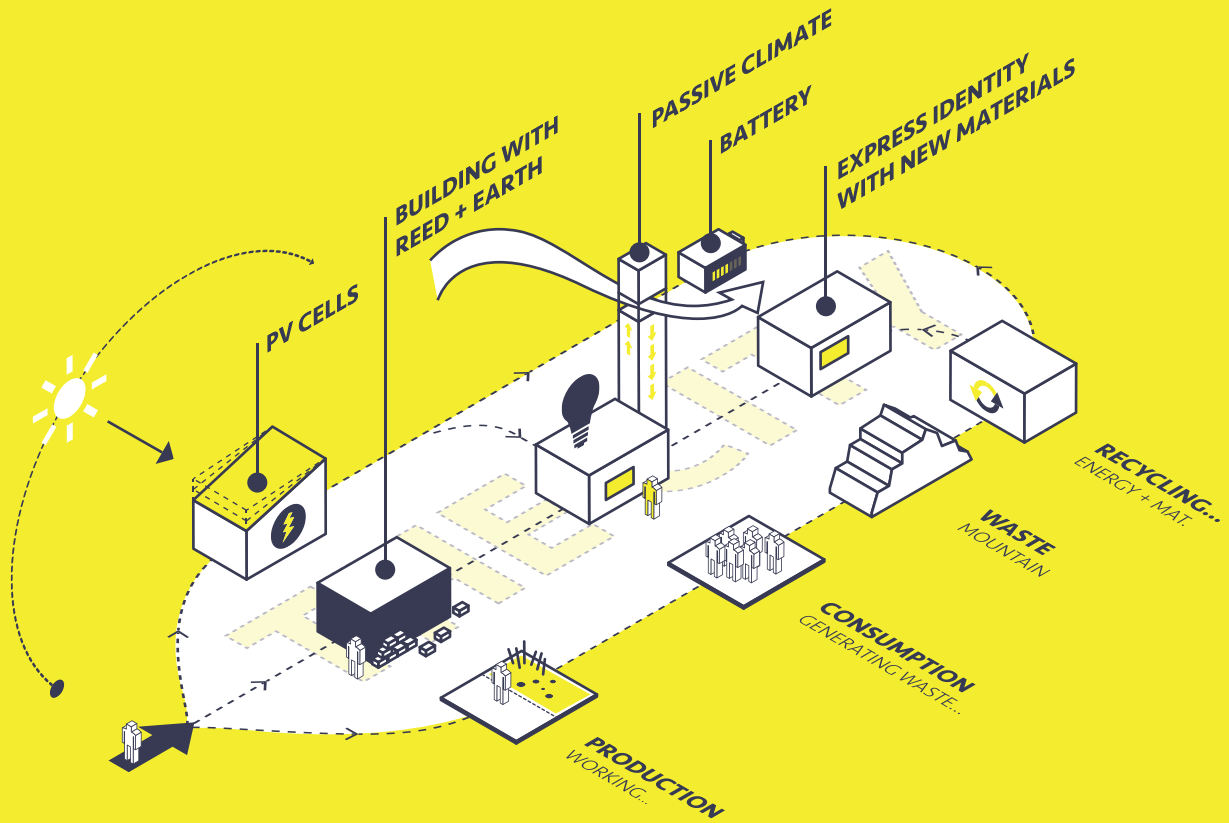


FIGURE 27



DENOUEMENT

& THE FUTURE THEMATIC DEVELOPMENT

Creating an off-the-grid refugee city obligates a mutual combination of settings to fulfill the objective. The efficiency of the self-sufficient mentality depends on the involvement of the citizens, the configuration of the urban structure, the balance between passive and active solar approach and finally the nimble reusage of waste.

The first important department of the strategy is engaging the refugees with the transformation of the camp from a dependent camp to an autonomous city. Segregating waste (conception: *add strategically placed waste collection marks*), converting waste into usable material (conception: *including a recycling fabric on site*), and providing work opportunities (conception: *create public spaces in which people can gather and trade*) using architectural interventions are some of the strategies for the final composition.

Secondly, the configuration of the urban structure is acutely in sync with the arrangement of the ecosystem. The position of the shelters towards the sun, the provision of energy, and the cycle of the waste will influence the design of the urban structure. This perception triggers an awareness to design on different scales, from urban to architectural and the very detail. Moreover, we have discovered that the current settlement of urban structure create an environment of

separation and insecurity with a low amount of privacy. Based on the conducted interviews and analysis these assumptions have become facts. In addition, although the current camps, e.g. Dara Shakran, are recognized as a temporary establishment, in reality they have transformed into *incomplete identityless cities*. Kevin Lynch's theory in *The Image of the City*,

"The contents of the city images so far studied, which are referable to physical forms, can conveniently be classified into five types of elements: paths, edges, districts, nodes, and landmarks..."

reveals the absent elements - the nodes and landmarks - of most camps in Kurdistan, including Dara Shakran. These particular two elements are the stimulators for the community to unify, gather and trade. At the design phase the five elements of Lynch should convoy the process.

The last two settings of the self-sufficient mentality, passive vs. active solar approach and recycling, are immensely focused on the technical department of the design phase.

Reduction on material cost, offshore production and transportation is reached by using local earth and reed. Active solar approach increases the total budget expeditiously. Therefore, the focus should be laid on the passive method using architectural interventions. The passive design principles are developed to retain within the boundaries of the budget. Ventilation, heating and cooling should be manifested using architectural fundamentals. The urgency of PV cells, bio-energy, batteries, solar boiler and thermoelectric generators should be minimized as much as possible.

Using the guideline in this research we can conclude that the Thematic Research Question (TRQ) - *How to apply solar energy, local materials and recycling method(s) to manifest a self-sufficient refugee city?* - is answered and the foundation of knowledge for the refugee city has been laid. More

constrains and possibilities are yet to be explored during the design phase. The next step is creating the environment that vitalises the refugees to *Live for Tomorrow*.

FUTURE THEMATIC DEVELOPMENT

Another subject in need of exploration is the usage of wind(mills) in Kurdistan and in the refugee camps in general. Some questions that come to mind are:

- I. What are the benefits of wind?
- II. How could it be applied in these regions?
- III. How much does the application of wind energy production methods cost?

Furthermore, the industrial process of waste reuse can be elaborated more profoundly in the current context. The vision of the off-the-grid city will be reinforced by exploring all green solutions.



LITERATURE

THE RESEARCHER'S LIBRARY

Architecture for Humanity (2006) *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*. London: Thames & Hudson

Architecture for Humanity (2012) *Design Like You Give a Damn 2: Building Change from the Ground Up*. London: Thames & Hudson

Aquilino, M.J. (ed.) (2011) *Beyond Shelter: Architecture for Crisis*. London: Thames & Hudson

Bergman, D. (2013) *Sustainable Design: A Critical Guide for Architects and Interior, Lighting, and Environmental Designers*. New York: Princeton Architectural Press

Bergman, D. (2013) *Sustainable Design: A Critical Guide for Architects and Interior, Lighting, and Environmental Designers*. New York: Princeton Architectural Press

Eltrop, L. and Telsnig, and T. Fahl, U. (2013) *Energy and Sun: Sustainable Energy Solutions for Future Megacities*. Berlin: JOVIS Verlag

Hailey, C. (2009) *Camps: A Guide to 21st-Century Space*. Cambridge: MIT Press

Hegger, M. and Fuchs, M. and Stark, T. and Zeumer, M. (2008) *Energy Manual: Sustainable Architecture*. Basel: Birkhauser Verlag AG

Herz, H. (ed.) (2012) *From Camp to City: Refugee Camps of the Western Sahara*. Baden: Lars Müller

Howard, E. (1965) *Garden Cities of To-Morrow*, Cambridge: MIT Press

Lynch, K. (1960) *The Image of the City*. Cambridge: MIT Press

Meinhold, B. (2013) *Urgent Architecture: 40 Sustainable Housing Solutions for a Changing World*. New York: W. W. Norton & Co.

Minke, G. (2000) *Earth Construction Handbook*. Southampton: WIT Press

Rael, R. (2010) *Earth Architecture*. New York: Princeton Architectural Press

Shaoqiang, W. (2014) *New Portable Architecture: Designing Mobile & Temporary Structures*. Barcelona: Promopress

Siegle, L. (2010) *Recycle: The Essential Guide*. London: Black Dog Publishing London UK

Yeang, K. and Woo, L. (2010) *Dictionary of Ecodesign: An Illustrated Reference*. London: Routledge

UNHCR (2007) *Handbook for Emergencies*. Geneva: UNHCR

INTERNET

The Weather Channel, LLC. (2014). *Solar Calculator*. Available: <http://www.wunderground.com/calculators/solar.html>. Last accessed 28th Dec 2014.

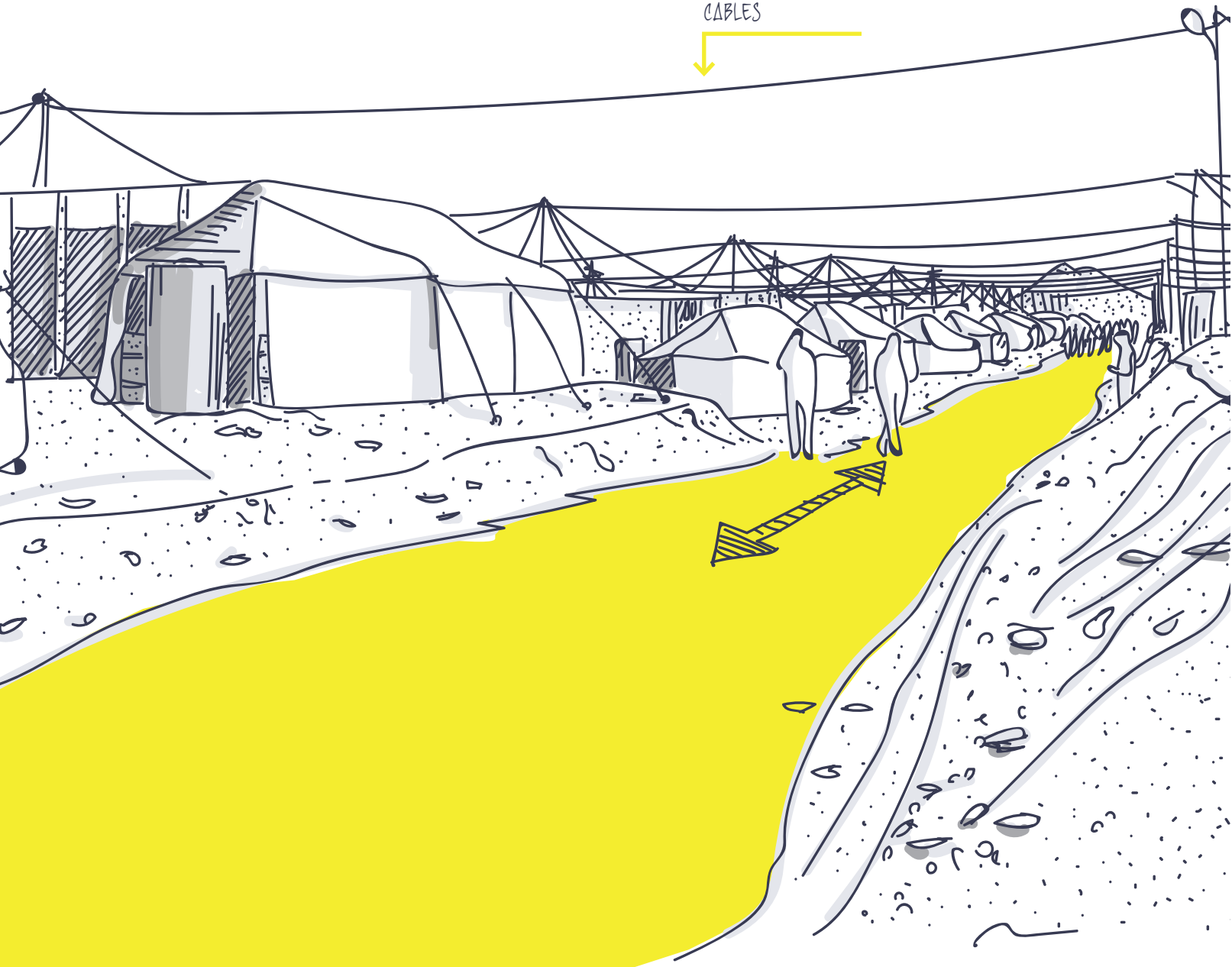
Greenstream Publishing Limited. (2009). *Solar Angle Calculator*. Available: <http://solarelectricityhandbook.com/solar-angle-calculator.html>. Last accessed 30th Dec 2014.

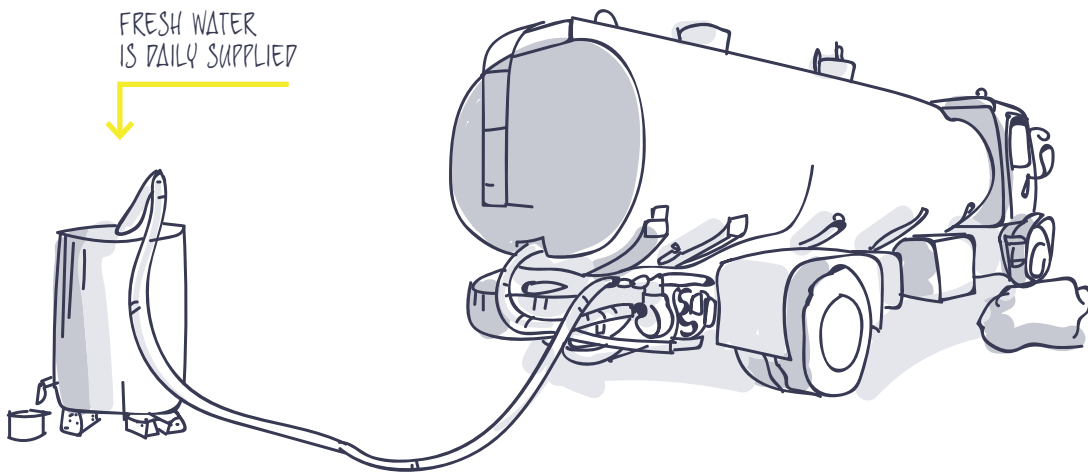
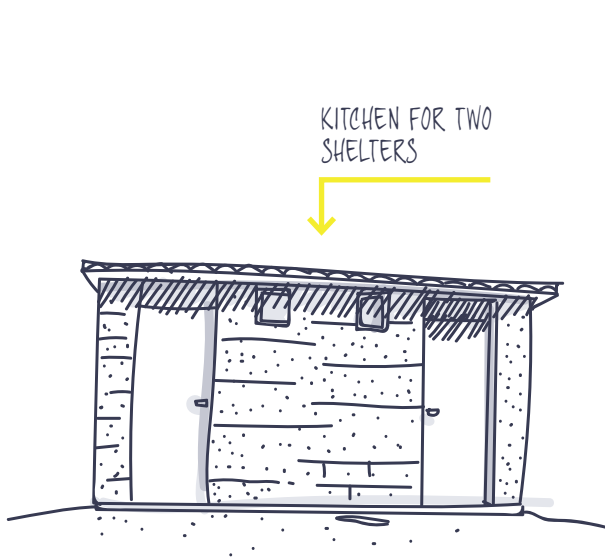


I. ARBAT & DARA SHAKRAN CAMP SKETCHES

THE JOURNEY

ENDLESS ELECTRICITY
CABLES







► **QR-CODE**
SCAN TO MAKE
YOUR OWN
CALCULATION
ONLINE

The UNHCR has developed a set of rules that should be considered and followed while designing a refugee camp. These guidelines are developed through years of experience and show the lowest amount of necessity for a human being to survive an emergency situation. After visiting the camps in Kurdistan - Arbat, Dara Shakran and Basirme - and having several interviews with the refugees, it became clear some rules were not helping the refugees, but rather present an obstacle in their daily life.

CORRECTION REQUIRED =

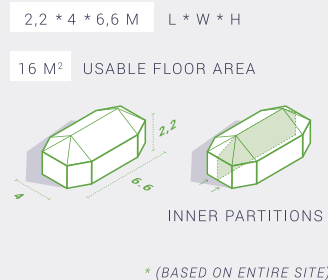
FACILITIES

1	LATRINE + KITCHEN	=		10 - 6 P. (3 * 3 M)	
1	WATER TAP	=		100 - 80 P.	80 - 60 P.
1	HEALTH CENTRE	=		1 CAMP ≈ 20.000 P.	10.000 P.
1	HOSPITAL	=		UP TO 200.000	50.000
1	SCHOOL	=		1 SECTOR ≈ 5.000 P.	2.500 P.
1	MARKET	=		1 CAMP ≈ 20.000 P.	10.000 P.
2	REFUSE DRUMS	=		1 COMMUNITY 100 - 80 P.	
1	COLLECTION CENTRE	=		1 CAMP ≈ 20.000 P.	
1	ADMINISTRATION	=		1 CAMP ≈ 20.000 P.	
1	SECURITY GATE	=		1 CAMP ≈ 20.000 P.	

AREAS

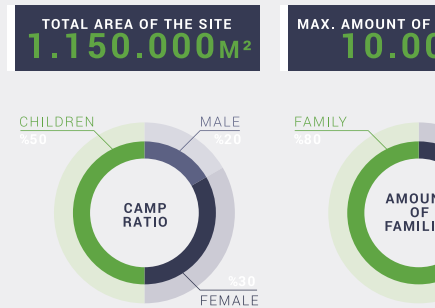
45-30 M ²		P.P OF WHOLE CAMP
3,5 M ²		P.P SHELTER
1,5 M		SPACE BETWEEN SHELTERS
%25-20*		ROADS & WALKWAYS
%25-20*		OPEN SPACE & PUBLIC FACILITIES
6,0 M		MAX. HEIGHT ON SITE

MEASUREMENTS OF A TENT

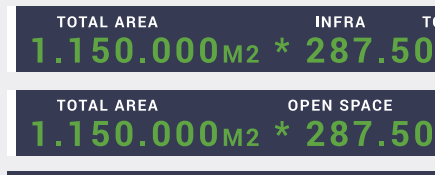


For the purpose of the research the site of Dara Sh... Camp will be utilised to construct the Refugee City... Shakra... in the **northern part** of the Kurdistan... (KRG), Khabat. The area of the camp is approximat... **minutes** from the capital Erbil (Hewler) and is... approachable by car.

DARA SHAKRAN DATA



CALCULATIONS USING THE CITY CAME RULES



485.000
 FOR REFUGEE

II. REFUGEE CITY PROGRAM BUILDER 1.0 BETA

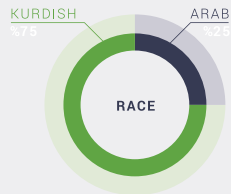
CALCULATION OF THE PROGRAM

Dara Shakran
Refugee City, Dara
Ez-Zor Region
Approximately 60
families and is only

AMOUNT OF REFUGEES
1000



DARA SHAKRAN CAMP
KHABAT, ERBIL



TOTAL INFRASTRUCTURE
500 = 25 M²

TOTAL OPEN SPACE
500 = 25 M²

575.000M²
SPACE LEFT OVER

AREA REFUGEES
0.000M²

AREA SHELTERS
5.000M²

5.000M²
R REFUGEES

90.000M²
LEFT FOR FACILITIES

AMOUNT OF FACILITIES ON GROUND

1000	LATRINE + KITCHEN	=	9,0M ² * 1000	=	9.000M ²
166	WATER TAPS	=	1,0M ² * 166	=	166M ²
1	HEALTH CENTRE	=	500M ² * 1	=	500M ²
1	HOSPITAL	=	1000M ² * 1	=	1.000M ²
4	SCHOOLS	=	3,5M ² * 5000 CHILDREN	=	17.500M ²
1	MARKET	=	8,0M ² (HALF OF A TENT SIZE) * 1000	=	8.000M ²
200	REFUSE DRUMS	=	1,0M ² * 200	=	200M ²
1	COLLECTION CENTRE	=	2000M ² * 1	=	2.000M ²
1	ADMINISTRATION	=	20,0M * 10,0M	=	200M ²
1	SECURITY GATE	=	20,0M * 10,0M	=	200M ²

38.767M²

USED FOR BASIC FACILITIES

THE FINAL CALCULATION

LEFT-OVER	BASIC FACILITIES	LEFT	
90.000M ²	- 38.767M ²	= 51.233M ²	
	500 people run the Camp 3,5M ² * 500 = 1.750 M ²		SHELTERS FOR ORGANISATION
	If %5 of families of 6 members owns a car 6 / 400 = %5 * 8.000 = 66 CARS * 10 = 667 M ² 10 = 2,5 * 4M ² Parking Spot		PARKING
		48.816M ²	
	Area for Sport + Art + Gatherings + Worship 2000M ² + 500M ² + 1000M ² + 500M ² = 4000 M ²		RECREATION
		44.816M ²	HARVESTING
HARVESTING	FAMILIES	PER FAMILY	
33	= 1.333	/ 44.816 M ²	

NEW

EVERY FAMILY OF SIX MEMBERS HAS **33M²** EXTRA SPACE TO CULTIVATE FOOD.

III. QUESTIONNAIRE

QUESTIONS USED TO LEAD THE INTERVIEW

GENERAL

1. Is this a temporary or permanent camp?
2. How is the camp manifested? Beforehand or Instantly when the disaster / ambush takes place?
3. How is the set up of the camp? (In terms of layout, grid)
4. Is there a rule to configure the camp in this way?
5. How do you determine the size of the camp? Do you expand the camp? If so, what are the rules to do so?
6. How many people do you accommodate here? Is there a limit to the amount of people here?
7. What is the balance of the people here? Percentage of families, singles and so on ...
8. Are there unrelated refugees combined in one shelter?
9. How are the sanitarian services?
10. Where and when are the refugees eating?
11. What kind of facilities are there on this camp? For example, school, gathering spot and so on ...
12. How do refugees, in general, arrive at this camp? (walking or vehicle) In what state do they arrive? For example, hurt or aggressive ...

ABOUT THE SHELTER

13. What kinds of shelter do you have here? (tents, bricks)
14. How much does a single shelter cost?
15. How long is the life span of the shelter?
16. Are the refugees involved in creating their shelters?
17. Are the shelters capable to resist the different seasons? (snow and rainy weather)
18. If you replace the shelter, how do you manage that?
19. Is the shelter easy to adjust to specific needs?
20. Does the shelter provide enough privacy for the different inhabitants?
21. Does the shelter provide enough daylight / fresh air / noise insulation?
22. How do you appreciate the materials of your shelter?
23. What happens to the camp if the disaster or war is over?

QUESTIONS FOR REFUGEES

24. How is your stay in this camp?
25. What do you think about your shelter?
26. Would you like to improve your shelter? If YES, what would you like to improve?

QUESTIONS REGARDING THE ORGANISATION

27. Who is in charge in this camp?
28. How do you manage to secure the camp?
29. How many staff are working here?

----- FROM HERE ON -----

QUESTIONS BY MR. JERZY LATKA

GENERAL

30. How long is it here, how long is it going to stay, do you have any information, was there any announcement for how long you are planning to stay here?
31. Is there any social organisation in the camp, are there some quarters managed by someone, what is the social structure of the camp?
32. Is there any "order" in the campus organisation? Was there some order or procedure or rather who came first got first place?
33. Is this place dangerous, is there any "police" or patrols?
34. Do you have any common areas? If not, are there any places where people gather? How is the everyday life in the campus? What can the people do here?
35. How they get food and other everyday life supplies? Is there any production, cultivation or live stock?
36. Do you have some special units here as a day care center, hospital, kitchen, hygiene unit, school, shops, etc?
37. What about the kitchen, sanitary units and so on?
38. Do you prepare food together or individually or is there someone who is taking care of that?

ABOUT SHELTER

39. What is the average amount of people living in one shelter?
40. Do they cluster them according to their connections, families, clans etc.?
41. Do they create any of semi-public space, where they can keep their livestock or belongings?
42. What are the biggest needs of the refugees in the area of housing?
43. How long does it take before the shelter is being build / rebuild or taken into use?
44. How does the building organisation of the shelter look like? Do you get a package with it so you can build it by yourself, in groups or under supervision of someone who brought it here?
45. Can you describe a minimum need for existence, a medium need and the comfortable mode (for a refugee camp)?
 - a. Minimum is an immediate shelter
 - b. Medium is after some time
(please describe the time span, e.g. 2-6 months)
 - c. Comfortable is for a longer period of time, after several months till the next 2-5 years.

FOR REFUGEES

46. How does your everyday life look like?
47. How does your previous house looked like, what are your habits?
48. Do you have any profession, what can you produce/ make here in the camp?

IV. BIO-ENERGY CALCULATION

HOW MUCH ENERGY CAN WE PRODUCE?

400,000 tons of garbage each year is enough heat and electricity for about 150,000 households (Based on Den Mark)

400.000 tons / 150.000 = 2.66 ton per western household

-

2.66 tons = 2.413 kg

-

1.460.000 kg / 2.413 kg = **605 Households**

6% of the refugee city gains electricity and heat from the bio-energy system.

Note that the demand of a household in the refugee city is much lower than a western household!

Source

<http://www.dwell.com/green/article/european-plants-generate-energy-and-pride--waste>

**6% OF THE REFUGEE CITY
GAINS ELECTRICITY AND
HEAT FROM THE BIO-
ENERGY SYSTEM.**

INDEX

FIND THE SUBJECT

- Active Solar Approach **42, 46, 49, 53, 62**
- Arbat Main Camp **9, 10, 16, 22-23, 28, 29, 31, 42**
- Arbat Transitional Camp **9, 10, 16, 18, 19, 28, 31**
-
- Basirme Camp **9**
- Battery **46, 62**
- Bio Energy **46, 62**
-
- Camp Layout **10, 16, 18, 21, 24, 28, 29, 42**
- Climate Analysis **34**
- Compressed Earth Blocks (C.E.B.) **29, 53, 56**
-
- Dadaab Refugee Camp **42, 45**
- Dara Shakran Camp **6, 9, 10, 16, 20, 24, 25, 27, 28, 30, 31, 34, 35, 42, 62**
-
- Ecosystem **6, 42, 48, 53, 59, 62**
- Erbil Urban Structure **34, 37, 38**
- Earth **6, 29, 44, 46, 52-54, 56, 58, 62**
-
- Interviews **30, 31, 33, 62**
-
- Mae La Refugee Camp **42, 45, 53**
- Materialisation **46**
- Material(s) **6, 9-12, 29, 31, 34, 42, 46, 52-55, 62**
- Mud Bricks **52, 56**
-
- Overall Design Question (ODQ) **10**
-
- Passive Solar Approach **42, 46, 51, 53, 62**
- Program **30, 34, 35**
- PV Cells **46, 62**
- Pyramid's Path **12**
-
- Rammed Earth **53, 56**
- Recycling **6, 10-12, 29, 34, 42, 62**
- Reed **6, 29, 53, 54, 57, 58, 62**
- Research Approach **12, 13**
- Research Question **10, 11, 34, 62**
-
- Sahrawi Refugee Camp **42, 45**
- Solar Angle **46, 50, 64**
- Solar Boiler **10, 20, 26, 46, 62**
- Steady-State Economics (SSE) **6, 42, 48, 53**
- Suleymaniyah Urban Structure **35, 37, 38**
- Super Adobe **42, 44**
-
- Thematic Research Question (TRQ) **10, 11, 34, 62**
- Thermal Flywheel Effect **46, 52**
- Thermal Mass **46, 52, 53**
- Thermoelectric Generators **46, 62**
- Transitional Community **42, 44**
-
- UNHCR Family Tent **6, 16, 19, 20, 29, 42, 43**





تور فروش راپهرین
0778122042

CREDITS

THE HELPING HAND

All photographs are made by the researcher, *Twana K. Gul*, on the site's controlled by UNHCR (United Nations High Commissioner for Refugees) in Kurdistan (KRG). All photo's are **only** for **educational purpose**.

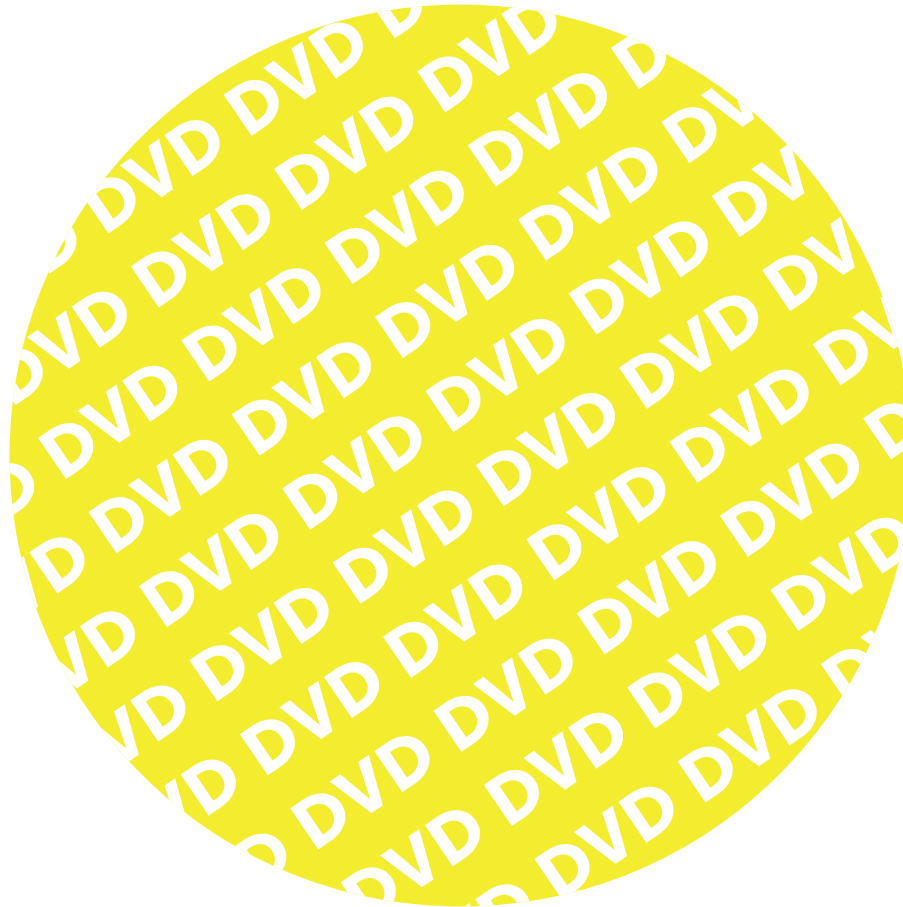
Thanks to the tutors *Monique Smit* - Architectural Engineering Tutor at the TU Delft University - and *Jerzy Latka* - PHD Candidate of TU Delft University - the development of this research has been interactive, thank you!

A gratitude to Mr. Payadar, M. Ako, Haidar M., Derya N., and all *the people in the refugee camps* of Arbat, Dara Shakran and Basirme for sharing their stories and input.



© 2015 REFUGEE CITY
All Rights Reserved
www.refugeecity.com

CHECK IT OUT NOW!



CONTENT

DIGITAL PUBLICATION

PHOTOGRAPHY

VIDEO: CAMPS IN KURDISTAN (2014)

