

An aerial photograph of a city in ruins, likely Mosul, Iraq, at sunset. The sky is a mix of orange, red, and grey, with the sun low on the horizon. The city below is a dense collection of destroyed buildings, many with missing roofs and exposed interiors. Debris is scattered across the ground. A few domes are visible among the rubble. The overall mood is somber and desolate.

BANE ALSABAWI

---

# RISING FROM THE RUBBLE

Affordable Post-War Housing For  
Mosul's Returning Refugees

---

Master Thesis Booklet

Chalmers University of Technology,

Department of Architecture and Civil Engineering

Architecture and Urban Design Masters Program

2018

BANE ALSABAWI

---

# RISING FROM THE RUBBLE

Affordable Post-War Housing For  
Mosuls Returning Refugees

---

Master Thesis, Chalmers University  
of Technology, Department of  
Architecture and Civil Engineering,  
Architecture and Urban Design  
Masters Program 2018

RISING FROM THE RUBBLE  
Affordable Post War Housing For Mosul's Returning Refugees

BANE ALSABAWI  
Master Thesis  
Chalmers School of Architecture  
Master's programme Design for Sustainable Development  
Department of Architecture and Civil Engineering  
Chalmers University of Technology

Gothenburg, Sweden 2018

Cover: (cross checking)© copyright Dana, F.(Associated Press). (2017) Mosul historic Old city[Online Image]. Retrieved from <https://www.apnews.com/727cab6a7e8748d-ba03dee331c179543/Liberation-from-militants-leaves-devastation-in-Mosul>

Examiner and Supervisor: Kia Bengtsson Ekström



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY

## TABLE OF CONTENT

<b>ACKNOWLEDGEMENT</b>	<b>4</b>		
<b>ABSTRACT</b>	<b>5</b>		
<b>SUMMERY</b>	<b>6</b>		
<b>ABOUT THE AUTHOR</b>	<b>7</b>		
<b>1.INTRODUCTION</b>	<b>9</b>		
1.1. Introduction	10		
1.2. Discource	12		
1.3 Thesis Questions	13		
1.4 Projet Delimitations	15		
1.5 Methodology	17		
<b>2. BACKGROUND</b>	<b>18</b>		
2.1 The War	19		
2.2 The Scale Of Destruction	23		
2.3 Debris Quantification	28		
2.4 Refugee Crisis	30		
2.5 Postwar Condition	32		
<b>3. RESEARCH &amp; ANALYSIS</b>	<b>34</b>		
3.1 Iraq	35		
3.2 Mosul	37		
3.3 Old City	42		
3.4 Urban Pattern	44		
3.5 House Typology	46		
3.6 Traditional Architectural Features Of The Old City	48		
3.7 Local Building Material & Technique	49		
3.8 Reference Study	50		
3.9 Interviews Summery	59		
		3.10 Relevant Findings	61
		3.11 Chosen Site	62
		3.12 Urban Strategy	64
		3.13 Building Strategy	65
		3.14 Rubble Recycling Strategy	66
		<b>4. PROPOSAL</b>	<b>69</b>
		4.1 Urban Development Plan	70
		4.2 Development Masterplan	71
		4.3 Site Plan	72
		4.4 Concept And Details	73
		4.5 Material & Construction	75
		4.6 Combination Diagram	76
		4.7 Single Family Units	77
		4.8 Multifamily Housing	88
		4.9 Sustainability Diagram	90
		4.10 Urban Perspectives	92
		4.11 Exterior Perspectives	94
		4.12 Interior Perspectives	102
		4.13 Elevation	106
		<b>5. CONCLUSION</b>	<b>108</b>
		<b>6. BIBLIOGRAPHY</b>	<b>110</b>

## ACKNOWLEDGEMENT

This thesis has been a personal journey for me in rediscovering my roots and in understanding the tragedy that destroyed my family's city. I would, therefore, like to dedicate this thesis to the people of Mosul who have endured intolerable suffering and are continuing to struggle to rebuild their city. I wish that this thesis will give them hope for a better future and shed light on their insufferable situation.

I would especially like to thank my supervisor and tutor Kia Bengtsson Ekström for her invaluable support and guidance throughout this thesis project. She was always helpful and available whenever I ran into an obstacle or had a question about my research and design. She consistently allowed this thesis to be my own work but steered me in the right direction whenever she thought I needed it.

I would also like to thank the participants in my survey from Mosul, who have willingly shared their precious time during the process of interviewing with their experience and knowledge.

Last but not least I wish to thank my mother and sister for their patience and unfailing support and encouragement throughout my years of study and through the process of researching and writing this thesis. I will forever be grateful.



## ABSTRACT

### Objectives

One of the basic human needs after food and security is having a place to call home. The aim of the project is to develop a design proposal and strategies for the resettlement of the displaced people of Mosul and rebuild the city after war from the remains of the old one. By reusing the war debris to lay the foundation for a new city that can meet the modern living standard without jeopardizing the city's unique cultural heritage and identity.

### Background

Mosul is the second largest city in Iraq, and one of the oldest known settlements in the world dating back to 6000 BC (Mallowan 2015). Is now largely destroyed due to a large military offensive described as the longest and largest urban battle since World War II (Shaw, 2017) to retake it from ISIL. Most of the destruction occurred in the more populated western Mosul, where the historical Old City lays. The nine-month offensive displaced one million people. Most of which took refuge in nearby makeshift camps and emergency centers around the city, many of whom are returning but there's nothing left of their homes expect rubbles, corpses, shells, and undetonated weapons. The majority of the destroyed buildings were residential which has created a severe housing crisis of catastrophic scale.

Rehousing the displaced people of Mosul will be a great challenge due to limited financial resources, corruption and the scale of destruction. If not addressed quickly could lead to further instability and conflict in the country. Nonetheless if carried out correctly could be the first step in the reconstruction and rehabilitation process of Mosul and Iraq in general.

### Method

In-depth analysis of the pre and postwar local context which will be re-designed to fit modern living standard and current needs and conditions.

### Results

A design proposal for affordable post-war housing for the returning refugees and internally displaced, that can easily be replicated to other locations in Mosul and the rest of the country to solve the severe housing crisis there after the war. The proposal is a flexible modular system which can be executed through different strategies depending on the available resources.

### Conclusion

Due to the large scale of destruction and humanitarian crisis after the war, a new urban recovery plan similar to the post-WWII "Marshall plan" in the reconstruction of Europe, is needed to enable the rehabilitation of Mosul and help those who wish to return to their hometowns. I believe that the international community should be part of the city's reconstruction in the same way they were part of the war. As architects, we have the ability to influence the process of reconstruction after the war by providing people as well as authorities and NGO's with alternative and sustainable building and design solutions to facilitate their rehabilitation. Using solutions that fit local context and encourages circular economy and self-sufficiency. I hope that this proposal will inspire the local authorities, communities and NGO's on how to design and build affordable post-war housing without jeopardizing the cultural identity of a city.

Key words: Post-War Reconstruction, Affordable Housing, Disaster Relief, Sustainable Development, Human Resettlement, Returning Refugees, IDP Crisis, Urban Planning and Rehabilitation

## SUMMERY

This master thesis is about designing post-war housing for the returning refugees or internally displaced people of Mosul. Through the study of the local context and exploration of different methods to turn war waste into affordable, flexible and sustainable housing solutions which are easy to adapt in other parts of Iraq to solve the severe housing crisis there after the war.

## ABOUT THE AUTHOR

**ACADEMIC BACKGROUND:** I'm a student at the architecture and urban design master program at Chalmers University of Technology. I completed my Bachelor's degree in London, the United Kingdom at the University of Westminster with an upper secondary class honor in Interior Architecture.

**RELEVANT BACKGROUND:** I was born in France to Iraqi parents and lived in Iraq from the age of 5 to 11. After which I moved to Sweden with my family as a refugee after experiencing both war and displacement.

**REASON FOR CHOOSING THIS THESIS TOPIC:** Coming from an Iraqi background and having experienced both war and displacement as a child, allowed me to have a great empathy and understanding for refugees and vulnerable people from Mosul and the rest of the world. I have relatives in Mosul who were directly affected and displaced by this war, this gives me a

drive and insight into the local context, and enables me to conceptualize a design solution according to the local needs and culture.

Designing for social development and marginalised communities has been one of my main focus since I began my bachelor's degree in London in 2012. I always try to relate my academic work to current challenges and events around the world. My undergraduate dissertation was about temporary refugee shelters, and my final undergraduate design project was about designing a youth centre for homeless and "at-risk" youth in the less privileged community of Brixton, South London.

I see this master thesis as a continuation of the same direction and hope that it will have a positive contribution on refugees lives both in Iraq and other places around the world.









# 1. INTRODUCTION

## 1.1. INTRODUCTION

The aim of this thesis is to explore new design solutions and strategies for affordable postwar housing for the returning refugees or internally displaced in Mosul, Iraq. Using the war debris to lay the foundation for a new city that can meet the modern living standards without jeopardising the city's unique cultural heritage and identity.

The scale of the thesis will cover the study, analysis, and design of housing typologies (from a small family unit- to a whole neighborhood) in the most damaged areas of western Mosul. Focusing on affordable, local, flexible and sustainable design solutions to recycle the rubble into affordable and practical building systems for the resettlement of the internally displaced people of Mosul. The design solution will consider some of the most urgent socio-economical and environmental factors in the city such as the great amount of rubble left after the war, the urgent housing crisis, the limited financial resources, and destroyed infrastructure.

Not being able to visit the site, the site analysis was based on research and mapping of the area through photo studies and satellite imagery, as well as data collected from various actors on the ground including The United Nations Human Settlements Programme (UN-Habitat) "Mosul Portal", International and local news agencies and an urban planner from Mosul Urban Planning Directorate.

Mosul is the latest humanitarian crisis in Iraq. The recent offensive to retake the city from the grip of ISIL has reduced the city's built environment into rubble, killing more than 40 000 (Cockburn, 2017) civilians and displacing 1 million in an already war torn country with 3.4 million internally displaced and 8.7 million people in need of humanitarian assistance (UNOCHA 2017). Adding to the already pressing humanitarian crisis in the country and refu-

gee crisis in the world which is the biggest in history estimated to be 65.6 million up to date (UNHCR, 2017).

According to UNOCHA *"The Humanitarian crisis in Iraq remains one of the largest and most volatile in the world"*.

*"The ongoing violence between armed groups and government forces has resulted to over 3 million internally displaced persons across Iraq and left 8.7 million people in need of humanitarian assistance."*

*"People in Mosul and other places in Iraq have lost everything; their homes, livelihoods and loved ones to war"* (UNOCHA 2017).

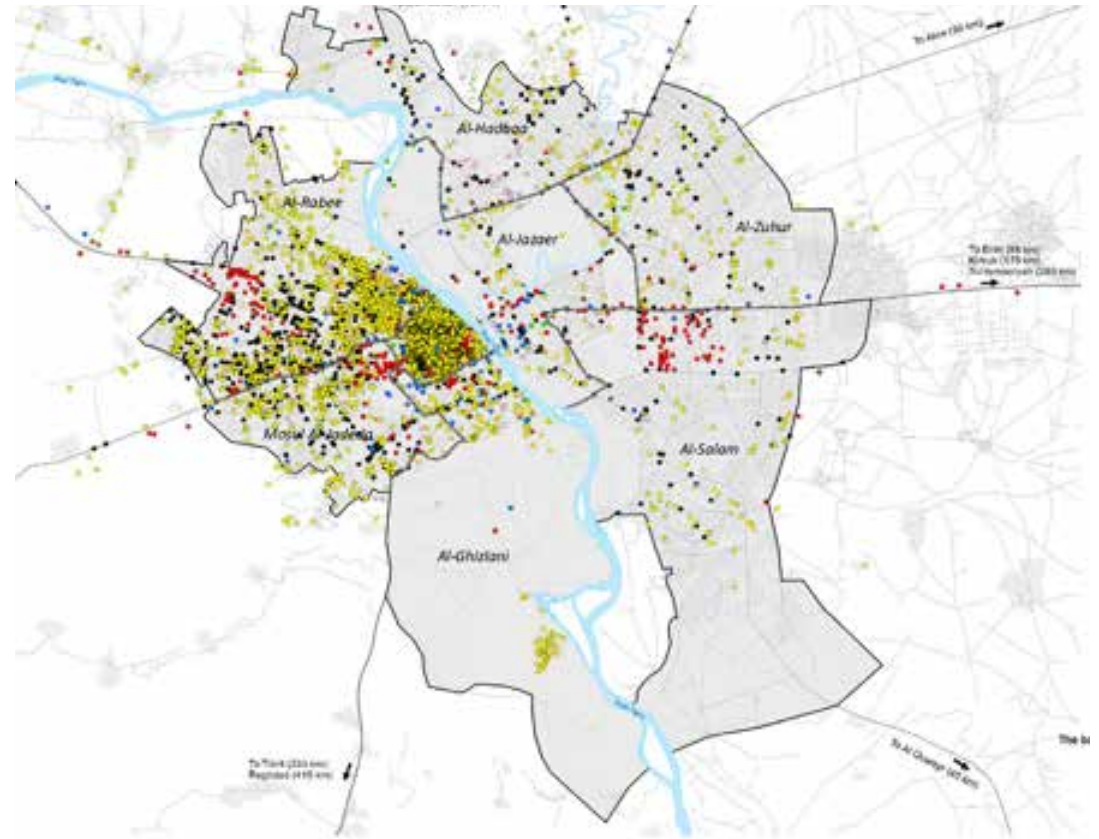
Initial satellite analysis suggests that 85 % of all destroyed buildings were residential which adds to the chronic housing shortage that already existed in the city prior to 2014 (UN-Habitat 2017). All basic infrastructure has been hit (Roads, all bridges, water, sanitation, healthcare, education, and public services) the area is also filled with landmines and rubble. The death toll is still rising as bodies remain under the rubbles one year after the end of the war (Rodgers, Stylianou & Dunford 2017).

The issue of refugees is a pressing issue which is continuing to grow and affect the whole world, people who are fleeing wars and armed conflicts have often lost their homes and have nothing to turn back to in their hometown or countries. The majority of them are internally displaced or living in makeshift camps in neighbouring countries under harsh conditions. Many help organisations only offer temporary sheltering solutions for them, however, long-term solutions are needed for those who wish to return and are unable

to because of a lack of resources in their hometowns.

Therefore providing people who have lost everything and wish to return to their homelands, adequate homes is the first step for bringing them a dignified life and it will be the first step in the rehabilitation and rebuilding process of their disaster/war-torn countries. As architects, we have the ability and responsibility to help in that process by designing practical and inspiring solutions for those who need it the most.

Support for those who wish to return to their homeland will become extremely pressing in the future. In the case of Mosul, limited resources in terms of finance and land and approximately 10 million ton of rubble (UNHABITAT 2017) mean that carefully considered materials and spatial responses are needed.



UNHABITAT Preliminary damage assessment of Mosul. Quantifying the damage per sector, (housing, roads and bridges, commercial & industries, public admin. and facilities, recreation, religious/heritage). UNHABITAT 8 July 2017

Debaga refugee/IDP camp outside of Mosul 2017 Author own picture

## 1.2. DISCOURSE

### WHAT

Design proposal for affordable post-war housing and strategies for post-war reconstruction.

### WHY

Because the war destroyed more than half of the city's built environment including ancient heritage sites and displaced **1 million** people from Mosul, many of whom are returning and are in urgent need of shelter. **54.000 homes** were destroyed(NRC, 2018) and **90 percent** of the infrastructure leading to a severe housing crisis of catastrophic scale. According to UN-HABITAT latest Iraq report, **4.1 million** people need shelter in Iraq most of whom live in Mosul (Reliefweb, 2018).

The war left an enormous amount of rubble. The United Nations estimates that there are **10 million tonnes** of rubble in Mosul, and the Old City's streets are still knee-deep with debris (Reuters, 2018).

### WHERE

The Old City- Western Mosul- Northwestern Iraq. Located on the left bank of the Tigris river opposite the ancient Nineveh ruins.

### HOW

Through analysis of pre and post war urban context, including local typology, urban pattern, local building material, and alternative building material, interviews and precedent studies of affordable housing and postwar reconstruction.





## 1.3 THESIS QUESTIONS

### **How can we provide affordable post war housing solutions for the returning refugees of Mosul?**

Using local resources that are both affordable and sustainable, as well as finding a solution to reuse the war debris into useful building material. The solution should be fit to the local environment and context, yet flexible enough to be replicated in other areas around Mosul and Iraq to solve the severe housing crises there after the war. Taking into consideration some of the most urgent socio-economical and environmental issues in the city such as; limited financial resources, outdated masterplan, landmines, mountains of rubble, destroyed infrastructure and cultural heritage.

### **Why focus on housing?**

Adequate housing is a universal human right and should be at the centre of the development of any urban policy (UN-Habitat 2016) especially in the context of post-war reconstruction. Because people that have been displaced by war or disasters want to return to their homes and livelihood as soon as possible (UNHCR aug 2017). Providing adequate housing for the returning refugees will be the first step in the rebuilding and rehabilitating process of the country and if conducted well can not only be a solution for a humanitarian crisis but also a powerful tool for local development and prosperity (UN-Habitat 2016).

According to the NRC, 54,000 homes were destroyed in Mosul during the 9-month offensive, which has reduced most of the city's infrastructure into rubble and driven 1 million people to be displaced from Mosul. This has created a severe housing shortage in the city as well as the rest of the country and left 4.1 million people homeless or in need of shelter (Reliefweb, 2018).

### **Why recycle rubble?**

The United Nations estimates the 9-month battle, left the city with 10 million tons of rubble (reliefweb, 2017), equal to the amount of rubble in Haiti's natural disaster in 2010.

There's also a scarcity of financial resources and corruption which calls for an alternative method to rebuild the city.

Rubble is also a pollutant to the environment and can kill people.

Recycling the rubble will not only reduce the cost of reconstruction and the environmental impact of war. It will also create job opportunities for the local community.



*The conditions for returning refugees and internally displaced are extremely challenging. The question of how to support those who wish to return to their homeland will become extremely pressing. Limited resources in terms of finance and land mean that carefully considered material and spatial responses are needed.”*

(Rifat Chadirji, Iraqi architect-Mosul housing competition, 2017)

## 1.4 PROJET DELIMITATIONS

Rebuilding a city after war involves many aspects and parameters such as: economic, political, social and infrastructural (food, water, sewerage and waste systems, roads, transportation systems, electricity, public health, education, and public buildings).

This project will however only focus on the residential part of the city's reconstruction and specifically on exploring a flexible, sustainable, local and affordable design solution to build new housing units for the returning refugees in the most damaged parts of the city, without compromising the architectural heritage of the city.

Issues such as destroyed infrastructure, landmines, corruption, political conflict and land-disputes in Mosul and Nineveh province will be taken into consideration in the research, but will not be covered by my final proposal.

The biggest limitations of this thesis are the lack of sufficient information about the site due to the war and my inability to visit the site to document and analyse it.

### THINGS WHICH WILL NOT BE COVERED BY THIS THESIS:

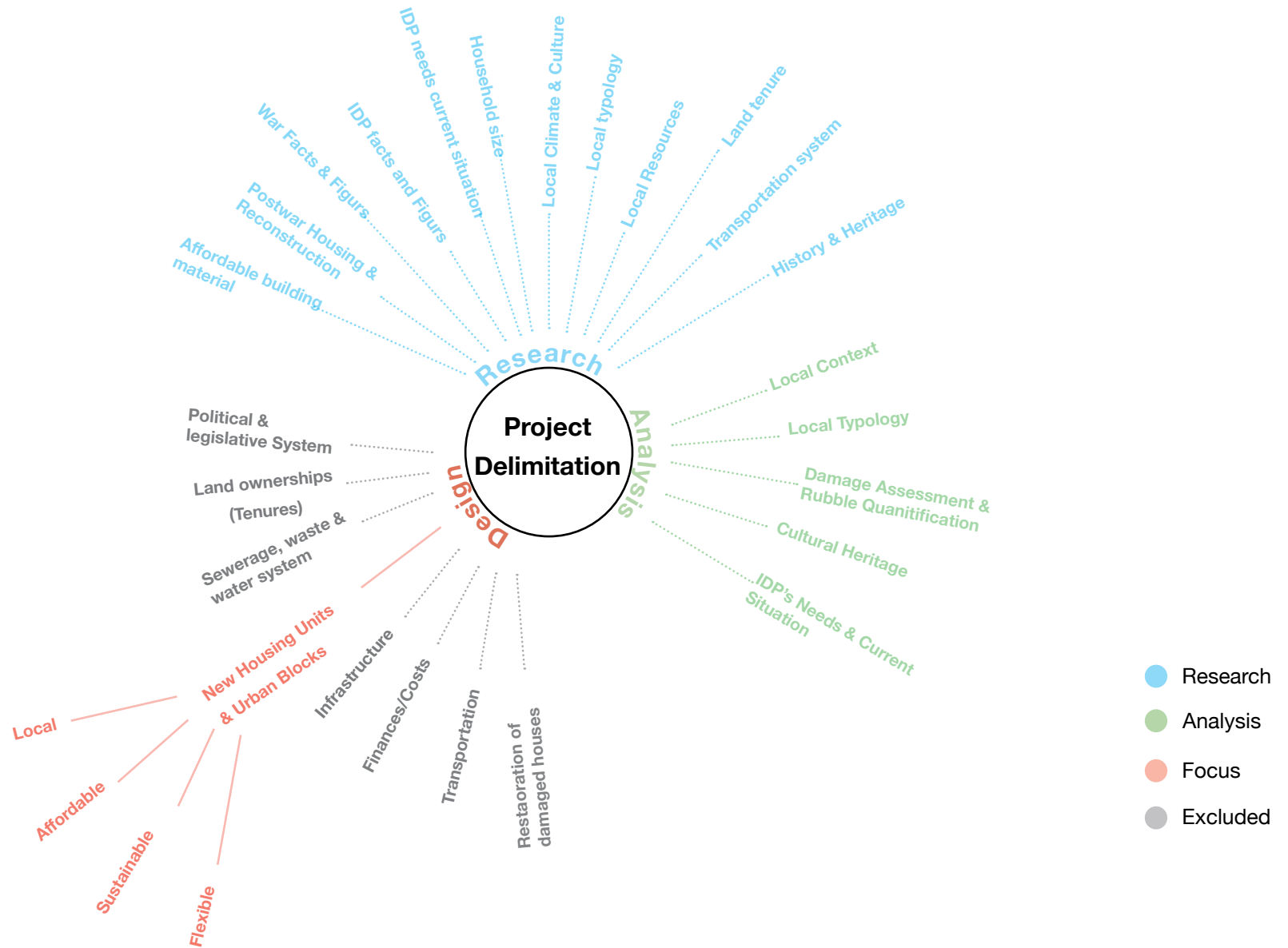
- 
- Infrastructure(sewerage, waste and water system)
- Finances
- Transportation systems
- Land ownership (tenure)
- (Governance) political conflict
- Economical system
- Restoration of existing residential buildings
- Construction details
- Legislation
- Gender

### THINGS WHICH WILL BE COVERED BY THIS THESIS:

- Design new residential units
- Rehabilitation strategy
- Analysis of urban fabric and typology
- Affordable and sustainable building material
- Rubble recycling strategies
- Local needs and living condition
- Flexible layout
- Household size
- Local climate
- Local culture



# DELIMITATION DIAGRAM



## 1.5 METHODOLOGY

It's essential for any design project to have a good understanding of the site context, especially in a context of post-war reconstruction. Not being able to visit the site I relied mainly on satellite imagery and published photographs as well as interview and data collected from various actors on the ground in order to analyse and understand the context and design an appropriate response.

In this thesis, a variety of methods including photo studies, interviews, literature study, and other publications study was used to obtain important information about the site and its pre and postwar context.



Collect, study and analyse facts about the problem: war/conflict background, the scale of destruction, numbers of refugees/internally displaced persons, number of destroyed houses, amount of debris. Collect, study and analyse maps, images, data about pre-and post context, people, architecture, history, and urban structure, using: Photo study, Interviews, UN-Habitat, and UNHCR Iraq and Mosul portals and assessments (UNOCHA), News reports, research, literature study.

Collect, study and analyse facts about local context: climate, economy, environment, local resources, socio-cultural context, household sizes (average, max, min), local house typology, urban fabric, architectural heritage, the spatial organisation inside a Maslawi household and urban context, challenges, and opportunities.

Collect, study and analyse references for similar projects and similar context around the world; Post-disaster/war housing and reconstruction, affordable/social housing in the developing world, Sustainable and affordable building materials, and techniques to recycle the rubble.

After studying and analysing the problem, local context, housing typology, and alternative building techniques—I development a design concept and strategies for the resettlement of the internally displaced back to their Old Town neighbourhood after in-depth analysis of local housing typologies and techniques which are then re-designed to fit modern life requirements and living standards.

An aerial photograph of a city in a state of complete ruin. The sky is a mix of orange and grey, suggesting a sunset or sunrise over a hazy, smoke-filled atmosphere. The ground is covered in a sea of rubble, with the skeletal remains of buildings and several large, damaged domes. A narrow, dirt path winds through the wreckage. The text '2. BACKGROUND' is superimposed in large, white, bold letters across the center of the image.

## 2. BACKGROUND

## 2.1 THE WAR



2003

2014

2016

2017

2018

## AMERICAN INVASION

In April 2003 Iraq was invaded and later occupied by the United States of America and its allies, who dismantled the Iraqi state and installed an interim one. In the decade that followed insurgency against the American occupation and sectarian violence dominated Iraq. As a result, hundreds of thousands of civilians were killed, millions displaced, all institutions, infrastructure, and basic-services collapsed (Hein, 2018). Mosul which used to be the breadbasket of Iraq and an important industrial and commercial center became one of the poorest in the country (Reliefweb, 2016). Shia militias and armed government groups dominated the Sunni majority city and deprived it of a large part of its revenue creating resentment by its population who felt marginalised due to sectarianism and rampant corruption which contributed to the fall of the city in 2014 (Reliefweb, 2017).



An explosion rocks Baghdad during air strikes, March 21, 2003. REUTERS/Goran Tomasevic



US soldier in the streets of Mosul after clashes with Iraqis, 13 June 2003. Gettyimages/Ramzi Haider

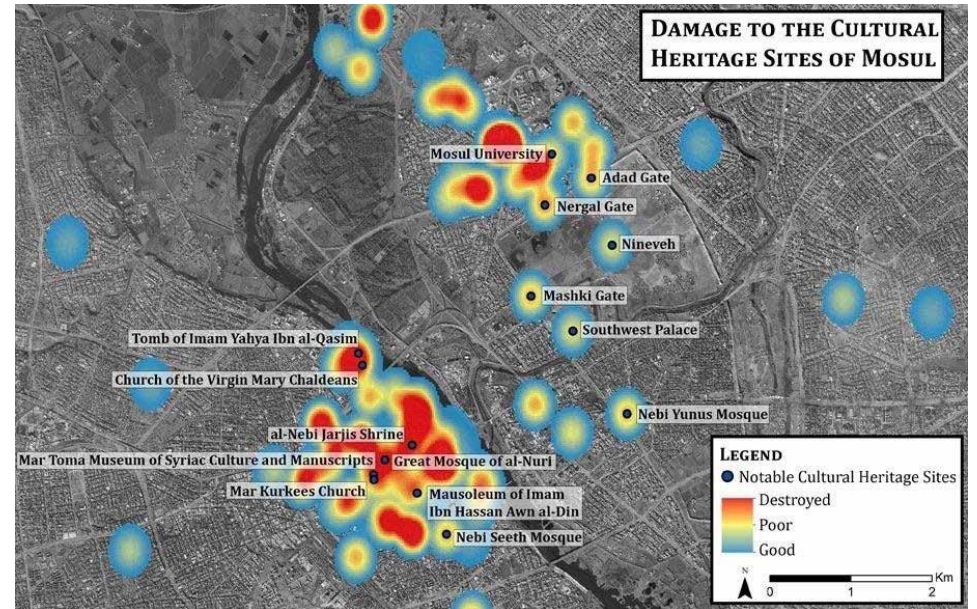
### ISIL OCCUPATION

In June 2014, Mosul fell under the occupation of the so-called ISIL (Islamic State of Iraq and Levant) for three years. During which the living condition deteriorated severely in a city which was already in crisis. The economy almost collapsed, basic services and infrastructure declined, many of its industries were looted and sold to neighboring countries(UN-Habitat, 2016). There was a systematic destruction of its ancient cultural heritage and monuments, including libraries, museums, religious and archeological sites some dating back to 2000 BC(UNESCO, 2018). In October 2015 100,000 books and manuscripts were destroyed during the burning of Mosul University and Central libraries. Many of its inhabitants were forcefully displaced and their properties confiscated, mainly religious minorities who have always been an integral part of the city’s fabric. Most of those who remained in the city lived under harsh conditions and fear with limited access to basic needs and services, including food and water(UN-Habitat, 2016).

“

*The systematic destruction of heritage and the persecution of minorities seeks to wipe out the cultural diversity that is the soul of the Iraqi people.”*

UNESCO Director-General Irina Bokova



Damage to Cultural Heritage Sites in Mosul (Susan Penacho, ASOR CHI)



The destruction of an ancient assyrian relief from 2000 BC by ISIL militias

2018

2017

2016

2014

2003

## THE SIEGE

In October 2016, the Iraqi forces and U.S.-led coalition forces launched a major military offensive to retake Mosul from the ISIL. The offensive lasted for nine months and was described as the largest and deadliest urban battle fought anywhere in the world since World War II (Shaw, 2017). The heavy coalition air strikes and artillery barrage from the Iraqi forces turned large swathes of the city to rubble. Tens of thousands were killed and one million displaced (Carrié, Magid, 2018). Those who remained were trapped under extreme risk throughout, from aerial bombardment, artillery barrage, cross-fire, snipers, and chemical attack. Tens of thousands of civilians were used as human shields by ISIL (Reliefweb, 2018) and those caught trying to flee the old city were executed in plain sight (Carrié, Magid, 2018).

“

*This is the worst devastation I have seen in all my years with UNHCR.”*

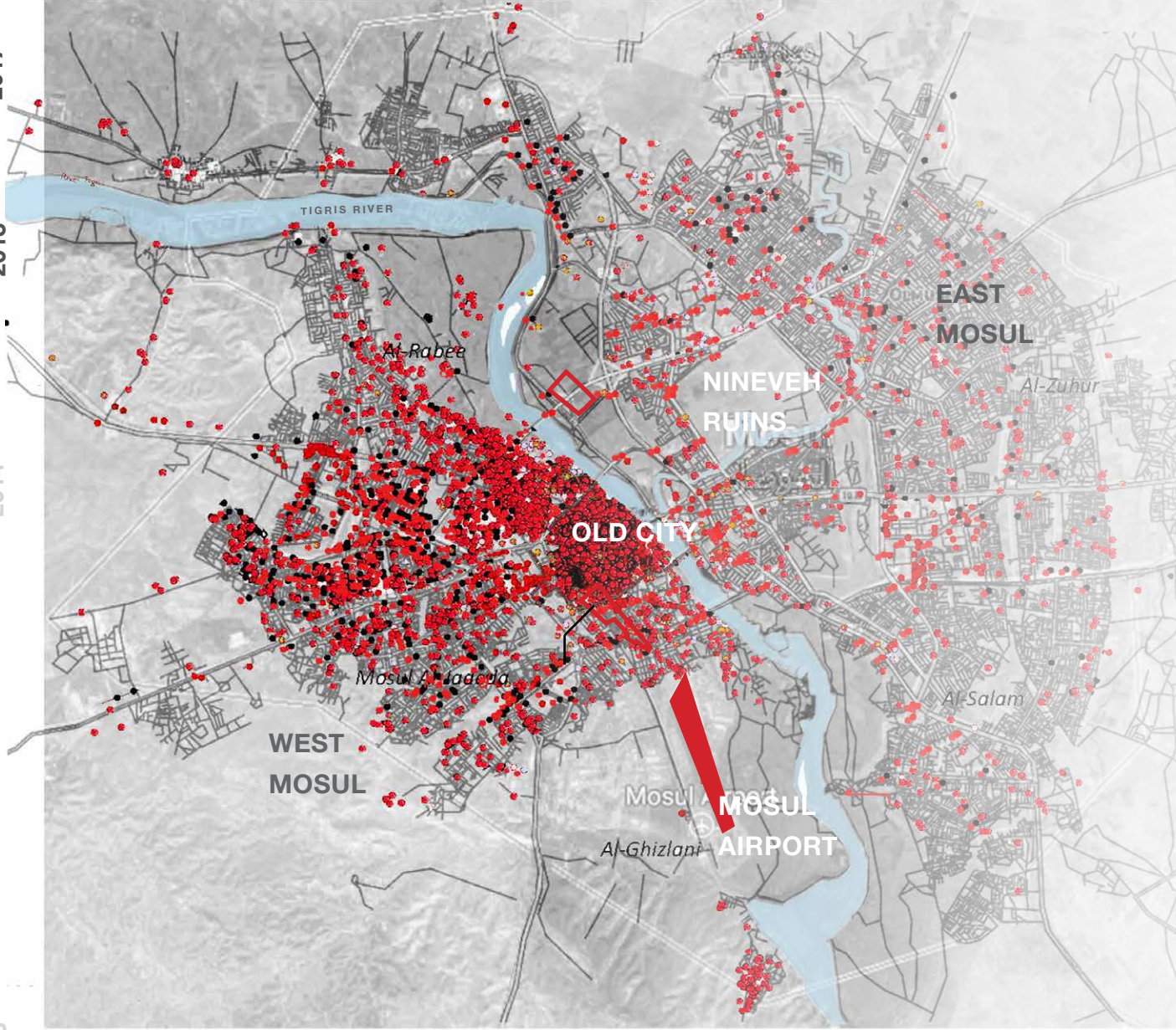
(UNHCR special envoy, Angelina Jolie, June 2018)



An explosion in Mosul during an airstrike in 2017



Civilians fleeing Mosul during the inferno, Mar 4 2017, Reuters/Goran Tomasevic



## 2.2 THE SCALE OF DESTRUCTION

This map shows the scale of destruction in Mosul City during the 9-month offensive, according to analysis of before and after satellite imagery and data collected from UN Habitat Mosul Portal and other international and local news agencies reporting on the ground.

**96 %**  
of the densely populated historical **Old City** has been reduced to rubble

**84 %**  
of **West Mosul's** infrastructure and built environment has been destroyed.

**45 %**  
of **East Mosul** was destroyed, and is relatively still intact.

(Ipsos-Worldbank, 2018)

Damaged buildings



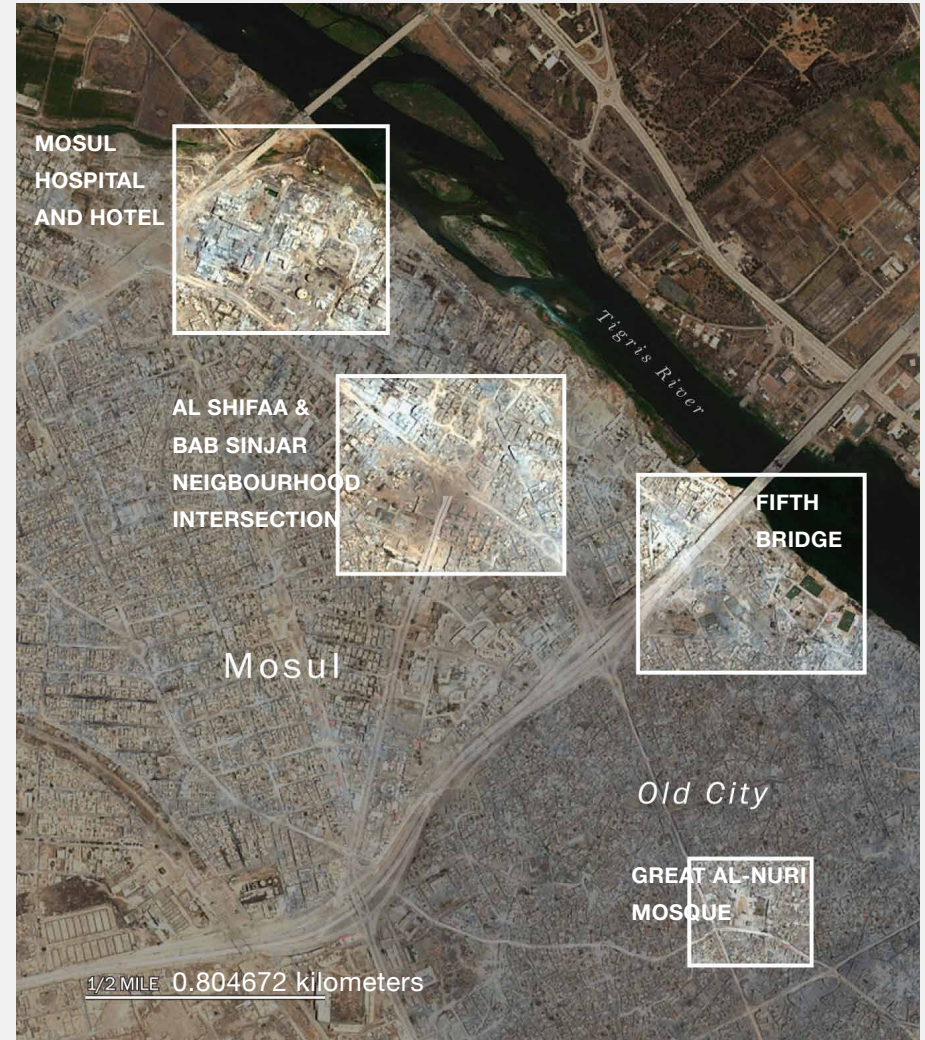
## BEFORE AND AFTER SATELLITE IMAGES

The following images were published in Washington post in the aftermath of the war on July 14, 2017, via WorldView-2 satellite, to show the impact of the war on the the city’s urban fabric and how the conflict has turned a once lively city into rubble.

See page 25, for comparison of before and after images of key locations in western Mosul taken in November 2015 before the offensive and July 8, 2017, after the offensive.

The nine-month offensive on Mosul destroyed half of the city’s built environment, including all vital infrastructure such as roads, bridges, watersupply, powerstations, hospitals, schools and universities. Whole neighbourhoods were flattened to the ground.

The heavy bombardment and artillery rockets destroyed more than 90 percent of the densely populated and ancient “Old City” of Mosul on the Westbank of the river, and more than 84 percent of western Mosul while eastern Mosul on the right bank remained partially intact with only 45 percent damage of it’s built environment (UN-habitat, 2017 & Ipsos-worldbank, June 2018).



Source: July 2017, Washington Post

### FIFTH BRIDGE



November 2015, Washington Post



July 2017, Washington Post

### MOSUL HOSPITAL AND HOTEL



November 2015, Washington Post



July 2017, Washington Post

### GREAT AL-NURI MOSQUE



November 2015, Washington Post



July 2017, Washington Post

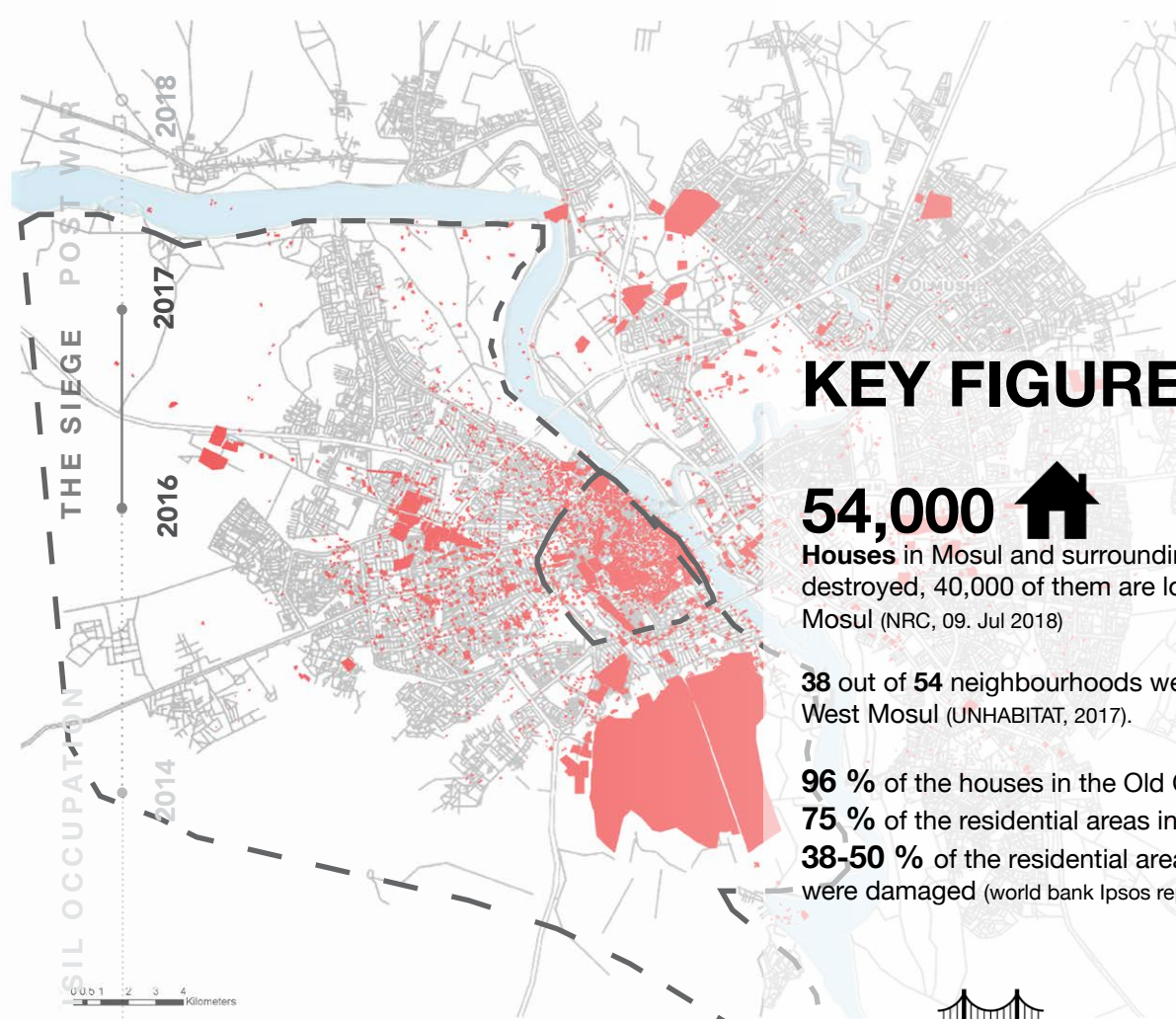
### AL SHIFAA NEIGHBOURHOOD & INTERSECTION



November 2015, Washington Post



July 2017, Washington Post




AMERICAN INVASION

The nine month offensive has destroyed most of the city's infrastructure and built environment According to various reports from United Nations and other organisations:


*"This is the worst devastation I have seen in all my years with UNHCR," (Angelina Jolie-UNHCR, 2018)*


## KEY FIGURES


**54,000**   
**Houses** in Mosul and surrounding areas were destroyed, 40,000 of them are located in West Mosul (NRC, 09. Jul 2018)

**38** out of **54** neighbourhoods were destroyed in West Mosul (UNHABITAT, 2017).

**96 %** of the houses in the Old City are destroyed.  
**75 %** of the residential areas in Western Mosul  
**38-50 %** of the residential areas in Eastern Mosul were damaged (world bank Ipsos report, June 2018)

**735**   
**Roads & bridges** were destroyed, including three-quarters of Mosul's roads, all 6 bridges connecting the city's west to the east across the Tigris, Mosul international airport and 2 major bus stations. Reducing it to 57 % of its previous capacity (Worldbank-ipsos, 2018).

**397**   
**Industrial and commercial sites** were damaged, including the pharmaceutical industrial complex, all grain stores, two large dairies, 212 oil refineries, petrol and fuel stations.


**70 %**   
of the **Healthcare** system was damaged, including 12 out of the 13 hospitals and 76 of the 98 medical centres. (Médecins Sans Frontières- Reliefweb, 9 Jul. 2018)

*"There are still less than 1,000 hospital beds for a population of 1.8 million people, which is half of the internationally recognised minimum standards for health service delivery in a humanitarian context."* (Médecins Sans Frontières- Reliefweb, 9 Jul. 2018)


The returning refugees to Mosul have put a further strain on the city's healthcare capacity as 95 percent of emergency cases were caused by unsafe living conditions, such as people falling from damaged buildings, walls or buildings collapsing, undetonated bombs and weapons. There's a fear from an epidemic due the unrecovered rotten corpses in the Old City (MSF, Doctors Without Borders, 9 July 2018).

90 % 

Of the **Education** system have been bombed (Worldbank, June 2018) including; 476 schools, universities and other education centres (UN-habitat, July 2017), so far 144 schools have been rehabilitated by various organisations (source: UNICEF).

97 % 

of the **Water, Sanitation and Hygiene** network was damaged including; 9 water pumps and treatment plants and stations. Only 3 % are fully functioning today, and 36 % partially functioning (Worldbank, June 2018). **Nearly all of western Mosul lack access to running water one year after.**

98 % 

of the **Electrical** network was damaged, only 2 % is fully functioning today a year after the end of the war, 29% is partially functioning mainly in Eastern Mosul, while 69 % remain destroyed, mainly in WestMosul which has no functioning power stations left (Worldbank, 2018).

253 

**Administration** services & Public building were destroyed including; Mosul Public Library, Mosul Museum and Archives, municipality and governance buildings and all state and private banks ( UN-habitat, 2017).

158 

**Historical and religious landmarks** within the Old City, most noticeably Gr. al-Nuri Mosque(ASOR, 2017)



Mosul university central library, source: ABC news



People are returning to Mosul, Source: NY



Western mosul, source: AP July 2017



One of the demolished streetscape in Mosul, Source: Gaurdian



Mosul general Hospital, bombed by the coalition forces

School children going back to school in Mosul 2017, Gettyimages



## 2.3 DEBRIS QUANTIFICATION

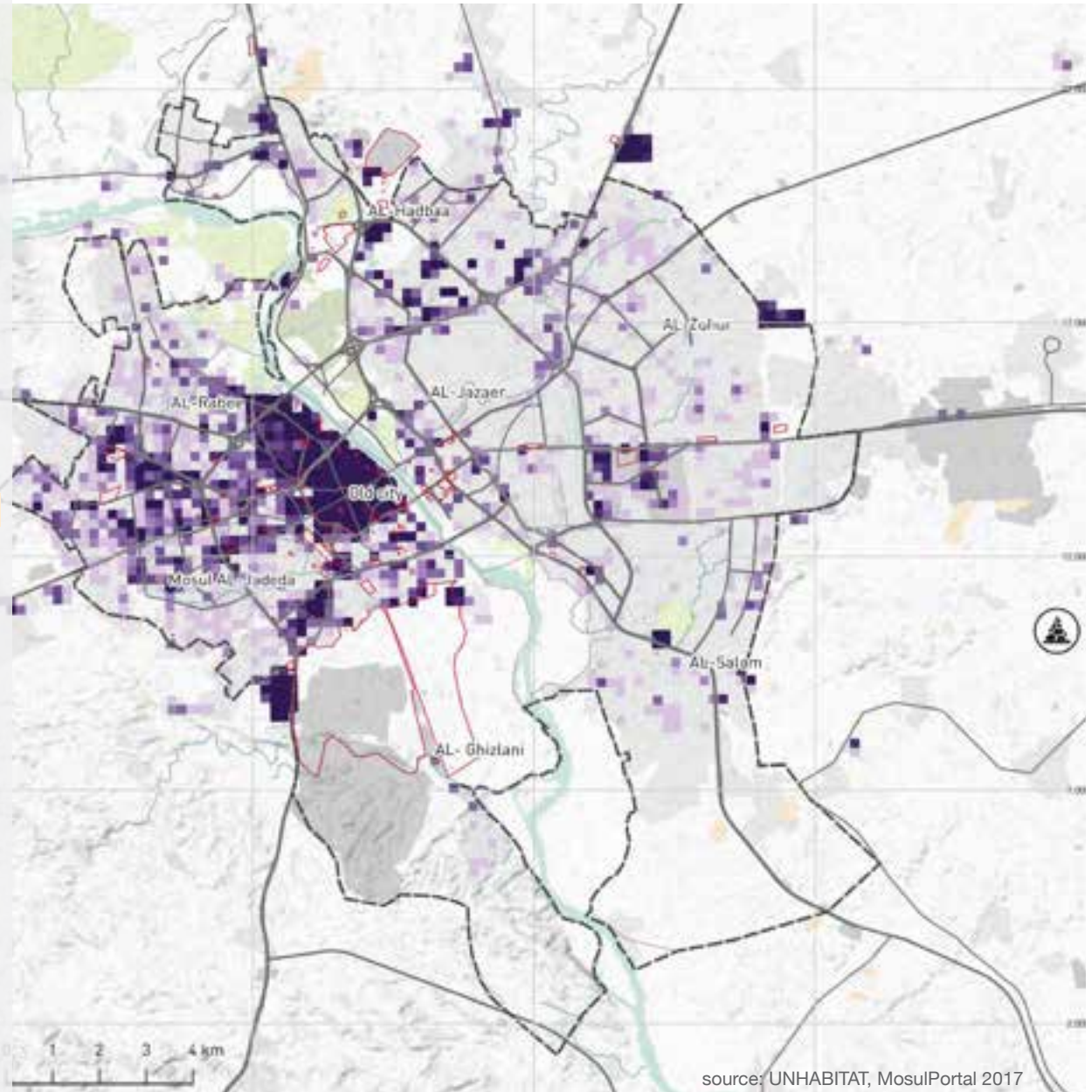
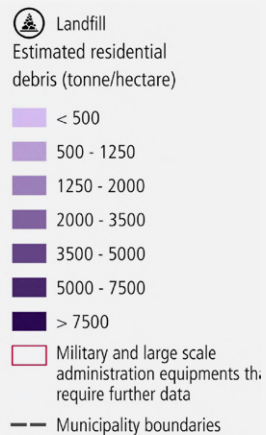
This map shows a rubble quantification assessment which was done by UN-HABITAT in July 2017 upon the end of the 9-month war.

It shows the estimated amount of debris and its location. Landfills are also marked on the map.

The survey is only an initial one and was based on the study of satellite imagery from 8 July 2017. More precise quantification will be produced later using data collected on the field for operational planning purposes.

**Total debris quantity: 10.793.121**

Note this is likely to be an underestimate of the real amount, as the demolition work of largely destroyed buildings will result in a significant amount of rubble (UN-habitat, 2017).



source: UNHABITAT, MosulPortal 2017



## 2.4 REFUGEE CRISIS

### GLOBAL REFUGEE CRISIS

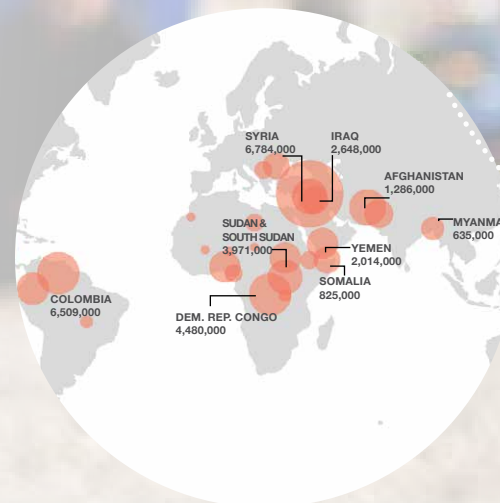
The world is witnessing the biggest refugee crisis ever recorded in history. By the end of 2017, 68.5 million individuals were forcibly displaced worldwide as a result of persecution, conflict, violence or human rights violations. Despite popular belief, the Majority of them are **Internally Displaced Persons (IDP)** and very few of them reach Europe as asylum seekers.

#### Who are the IDP?

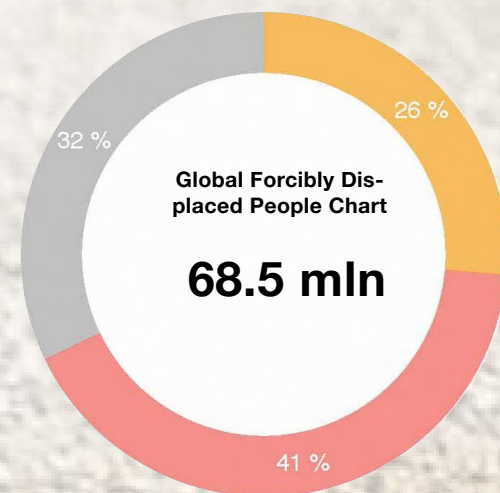
Internally Displaced People (IDPs) have not crossed a border to find safety. Unlike refugees, they are on the run at home, and remain under the protection of its government, even if that government is the reason for their displacement. *“They often move to areas where it is difficult for us to deliver humanitarian assistance and as a result, these people are among the most vulnerable in the world.”* (UNHCR, 2018)

*“The number of new internal displacements associated with conflict and violence almost doubled, from 6.8 million in 2016 to 11.8 million.”*

*Syria, the Democratic Republic of the Congo (DRC) and Iraq accounted for more than half of the figure.”* (UNHCR, 2018)



Countries with the highest amount of IDP (IDMC, 31 December 2017)



## WORLD

Forcibly Displaced People  
Worldwide

**68.5 mln**

Internally Displaced Persons

**40 mln**

Refugees in the world

**25.4 mln**

Asylum Seekers

**3.1 mln**

Sources: UNHCR via ReliefWeb

# IRAQ

People in Need

**8.7 mln**

Returnees

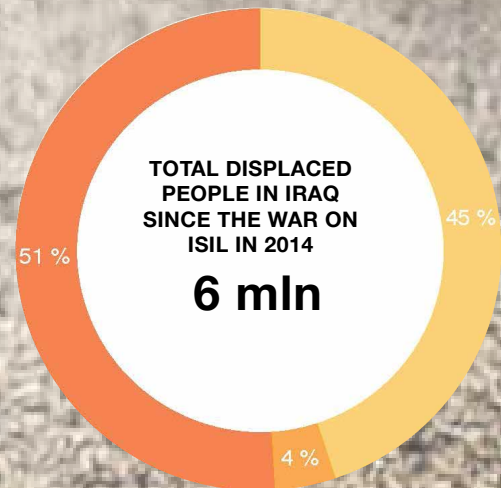
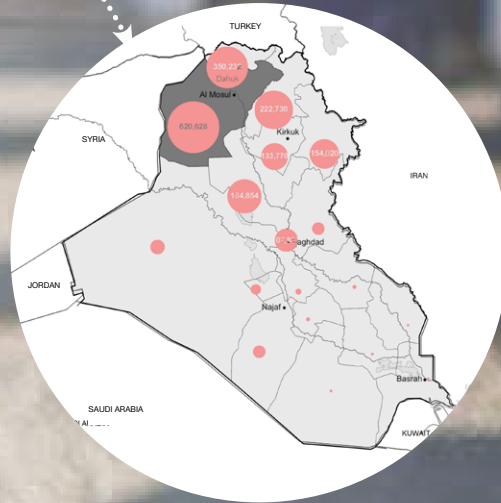
**3.2 mln**

Forcibly Displaced

**2.6 mln**

Internally Displaced

**2 mln**



Sources: IOM via Relief-Web Data - May 31, 2018  
 UNHCR via ReliefWeb Data - Jun 19, 2018

## IRAQ REFUGEE CRISIS

The refugee crisis in Iraq remains one of the biggest crisis in the country and the world. The latest war on ISIL forced around **6 million** to be displaced, **2.6 million** of them remain displaced today (UNHCR, July 2018).

The majority of the forcibly displaced Iraqi people are internally displaced with only **8 %** of them live outside of the country, mainly in neighboring countries such as Jordan, Lebanon, and Turkey (UNHCR, July 2018).

According to the International Organization for Migration (IOM), the nine-month siege on Mosul forced **1,048,044** people to flee.

### Returning refugees

According to UNHCR, many people are returning to their hometown across Iraq, including Mosul, where around **870,000** people returned to the ruins in this past year (Marta Ruedas-UNHCR, 2018). The majority of them are very vulnerable and are in dire need of humanitarian assistance to survive and rebuild their homes (UNHCR, 2018).

Iraqis make up **4.37956204379562 %** of the world entire displaced people and **7.5 %** of all IDP worldwide



## 2.5 POSTWAR CONDITION

A year has passed since the end of the war, and while much of East Mosul has returned to normal, West Mosul still lay in ruins with shell-shocked buildings and streets covered by piles of rubble. The Old City is still in ruins with no running water or electricity. Reeking corpses still cover the ruins and the few shellshocked homes that are still standing are yet to be cleared of unexploded bombs.

Despite that, some refugees have begun to return to the Old City and are clearing the rubble and rebuilding their homes and businesses with their bare hands and volunteering and helping each other as they lack other options or help from the government and outside world (Jolie, UNHCR, 16 June 2018).

While most refugees have returned to East Mosul, only a 5000 out of the 200,000 residents of the Old City in West Mosul have returned according to Iraqi official (Jalabi, Reuters, 21 March 2018). Most of those displaced are still living in refugee camps because there is nothing for them to go back to. Others have relocated into East Mosul, putting additional strain on an already stretched out infrastructure.

The returning families are forced to live in unsafe houses that still contain undetonated bombs or might collapse on their residents. According to Médecins Sans Frontières reports 95 percent of trauma cases received in the emergency room were related to the unsafe living conditions – such as falling rubble, buildings collapsing or people falling

from unstable structures (MSF, Doctors Without Borders, 9 July 2018). Parents are too afraid to let their children play outside as for fear of undetonated bombs among the rubble. There's also a fear from an epidemic due to the unrecovered decaying corpses in the Old City.

Little to no outside help has reached the people of Mosul yet. They are helping each other to rebuild their city. There are many youths and other residents who have organised volunteering groups to clear out the dead bodies, rubble and recovering books from the burned out libraries to help to reopen them. Most vulnerable returning families are surviving on donations from their local community and congregations.

Rebuilding Mosul is an enormous task that will take many years according to the United Nations Development Programme representative for Iraq Lisa Grandé the cost of rebuilding Mosul's basic infrastructure is up to \$1billion and take many years (Kalin, Reuters, 5 July 2017).

An international conference for the reconstruction of Iraq after the war was held in Kuwait on 12-14 Feb 2018, where Iraq pledged for \$88 billion for the funding of 157 urban rehabilitation projects with a focus on housing, that was planned to be executed in a duration of 10 years. The conference ended with a promise of only \$30 billion in credit or investment in different reconstruction projects across the country (M. Chmaytelli, Reuters, 2018).

*“You’d expect that rebuilding a city that was an icon of diversity, peaceful coexistence and cultural heritage would be a top priority. You’d imagine that the streets of West Mosul would be crammed with reconstruction equipment, de-miners, architects, planners, government agencies, NGO’s and world heritage experts providing technical assistance to Iraq on a master plan for the reconstruction of the city. But a year later, West Mosul lies abandoned, ruined and apocalyptic.”*

(Angelina Jolie, UNHCR, 19 June)



Resident rebuilding their shops in the Old City, Jan 2018, Al-mosuliya



Students are recovering books from the burned down University library, May 2017, Mosul Eye



Local residents are clearing up the rubble in East Mosul, April, 2017. REUTERS/ M. Hamed



Local tea seller has reopened his stall to serve tea in the Old City, Jan 2018, Al-mosuliya

A satellite map of Mosul, Iraq, showing the Tigris River flowing through the city. The map includes labels for 'OLMUSH' to the northeast, 'MOSUL' with a red pin in the center, and 'Tigris River' with a purple pin. A yellow road network is visible, with a '1' marker on the left and a '10 M' marker on the right. The text '3. RESEARCH & ANALYSIS' is overlaid in large white font.

# 3. RESEARCH & ANALYSIS

## 3.1 IRAQ



Iraqi map



The Ziggurat of Ur,, source: wikipediaw



tablet of the 1st floor plan of a private home, Ur-Iraq (ca. 2100-2000 BC) Source: UCLA Library ARK

### LOCATION:

Iraq is a country in western Asia that covers an area of 438 thousand square kilometers. It is bordered by 6 countries, Turkey, Iran, Kuwait, Saudi Arabia, Jordan, and Syria and has a population of almost 39 million, one-fifth of which lives in the capital, Baghdad (OPEC, 2018). Iraq is home to a diverse ethnic and religious groups most of which are Muslim Arabs, in recent years many of its minorities left the country however due to ongoing conflicts and instability (citation). The country has a varied landscape, which includes areas of desert, mountains and fertile regions and wetlands around the Euphrates and Tigris rivers that run through the country.

### HISTORY

Iraq means deeply rooted in Arabic, once known as **Mesopotamia** by the Greek meaning “land between the rivers” is often referred to as **the cradle of civilisation**, as it was here that mankind first began to read, write, create laws and live in cities under an organised government-around 6000 years ago (John R. Randall, 2003). It was also here that **the first house floor plan** was drawn in the city of Ur 4000 years ago (ca. 2050 BC)(Schneider, Nikolaus, 1930).

This wealthy region, comprising much of what is called **the Fertile Crescent** gave rise to the world’s earliest civilisations, including **Sumer, Akkad, Babylon, and Assyria**. After the 7th century, Iraq became a central and integral part of the Islamic world(Britannica, 2018). Iraq’s capital, Baghdad, became the cultural capital and an important commercial

centre of the ‘Abbāsid caliphate in the 8th century during the golden age of Islam until it’s fall in the 13th century by the Mongol invasion. The country became destabilised in the following centuries and was repeatedly battled over by the Ottoman Turks and Iran. The Turks eventually won and Iraq was part of the ottoman empire from 1534 - 1918 until the collapse of the ottoman empire during the First World War. The country was later invaded by Britain and remained under British mandate until 1932 when Iraq attained its independence as a Kingdom. In 1958, a military coup d’état ended the monarchy, making Iraq a republic( John R. Randall, 2003).

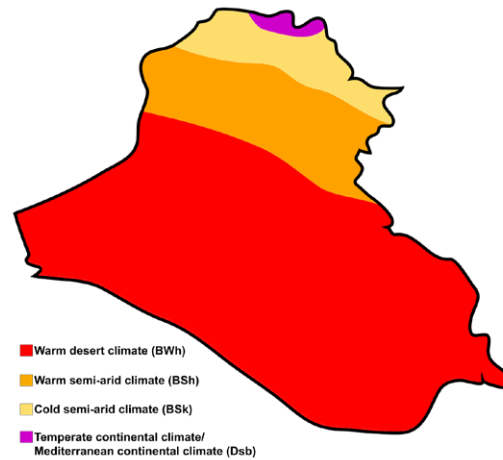
## CLIMATE

Iraq has different climates, ranging from BWh (Hot desert climate) in its south and middle part, to Bsk (cold semi-arid) in its northern part according to Köppen climate classification. Due to its location deep within continental interiors, far from the windward coasts and sources of moist, air humidity and wind speed are low. The average temperatures in Iraq range from higher than 48 degrees C (120 Fahrenheit) in July and August to below freezing in January. A majority of the rainfall occurs from December through April and is more abundant in the northern and mountainous region and may reach 100 centimeters a year in some places. (world security, Sep 7, 2011)

## RESOURCES

Iraq has the 4th largest proven oil reserve in the world (OPEC, 2015) (Apart from petroleum, Iraq's other natural resources include natural gas, phosphates, and sulfur (OPEC, 2018). Up until 1958, Iraq's economy was based almost exclusively on agriculture. After the 1958 revolution economic development was considerable, especially after the nationalisation of the oil in the 1970's, Iraq became the second largest economy in the Arab world after Saudi Arabia, and the third largest in the Middle East and had developed a complex, centrally planned economy dominated by the state. However, Iraq's long years of wars, embargo and later American invasion has affected the country's economy profoundly, as most of its infrastructure was damaged and never fully recovered after.

Iraq map of Köppen climate classification



Baghdad in the 1980's ,source: Encyclopedia Britannica



Oil fiel in Iraq, source: Joe Raedle, Getty Images



Iraqi wheat farmer, Source Blomberg

## 3.2 MOSUL

### LOCATION

Mosul is the provincial capital of Nineveh province located in northwestern Iraq, or Al Jazira region, around the banks of the Tigris river and connected by 5 bridges.

Coordinates: Long. & lat. : 36,33° N, 43,10° E  
Area: 180 km<sup>2</sup>  
Damage: 45 %

### HISTORY

The history of Mosul dates back thousands of years, it was first inhabited around the Nineveh plains around 8000 years ago (UNESCO, 2018) and is referred to as Ninawa or Nineveh locally as it's there that the ancient Assyrian city of Nineveh lays, together with what is believed to be the tomb of the biblical prophet Jonah, on the left bank of the Tigris river or (East Mosul). Assyrians who were north Mesopotamian people were great inventors and mathematicians, they gave us many inventions including the first library, the first 360° division of a circle, the first postal/courier system, etc.

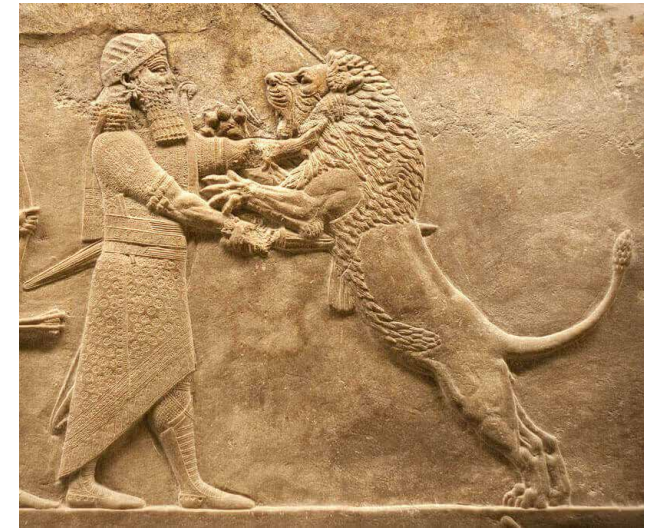
On the right bank of the Tigris (West Mosul) lays the old walled city of Mosul established originally in the 7th century BC as a citadel for the Assyrian Empire, which succeeded the ancient city of Nineveh and became a center of commerce and a link between different civilizations Mesopotamia, Anatolia, the Mediterranean, and Asia. Hence the name Mosul- which means "link" or "meeting point" in Arabic.



Mosul Map

After the fall of the Assyrian empire and Mesopotamia in 225 BC, the city became part of many other empires including Greek, Persian, and Byzantine. Christianity reached Mosul in the 1st century AD, and, by the 6th century, Mosul became the episcopal seat of the Assyrian Church of the East (UNESCO, 2018).

In the 7th century, it became a central part of the first Arabic Islamic empire which gained control of the city without a battle (Dabrowska & Hann, 2008). The city continued to play an important role in the Islamic world as a centre of knowledge, commerce, and industry most notably its fine textiles and "muslin" cotton, as well as masonry and metal craftsmanship which flourished during the Turkish Zangid dynasty in the 12th-13 century and continued throughout centuries (UNESCO, 2018). Crude oil was also used and traded with during that time, before its discovery by the British in the 1920's.



Assyrian wall relief, Ninawa Palace, Mosul 646 BC; © Gunter Hofer

Like the rest of Iraq, Mosul was part of the Turkish Ottoman empire from 1534-1918. In the 1920's, after the discovery of the oilfields by the British, it became a nexus for the movement of oil to both Turkey and Syria, which contributed to the development of the city's urban areas beyond the Old City walls. The city played an important role in the subsequent Iraqi uprising against the British in the 1920's and later in the 1958 revolt against the Iraqi central government.

Despite decades of war and sanctions, Mosul retained its status as one of the most populous urban centers of the region, and, it was known for its places of knowledge and learning, commerce, and exchanges. Its Old City was surrounded by a fortified wall until the 19th century, where it retained the medieval architecture and layout of its historic centre until it was bombed to the ground in 2016-during The war (UNESCO, 2018).

## FIRST SETTLEMENT

First settlement east side of the city (westbank of Tigris)

6000 BC

## MESOPOTAMIA

Nineveh (Mosul) became an important part of the united Mesopotamia (Iraq) under the Akkadian Empire

## NINEVEH

Nineveh (Eastern Mosul) becomes the Capital of the Assyrian Empire

700 BC

## MOSUL

Mosul (Western Mosul) becomes an important trading centre between Asia and the Mediterranean During the Abbasid Dynasty

## OILFIELDS

Discovering of Oil, Mosul becomes a centre for transporting oil to Neighbouring countries

1920's

## FIRST GULF WAR

Gulf War and Sanctions-million people die in Iraq due to malnourishment. Damaged, infrastructure and Economical and industrial decline

## AMERICAN INVASION

American Invasion and occupation of Iraq- Destabilises the country, damage infrastructure, cultural heritage and social fabric- Killed and displaced millions of Iraqis

1990's

2003

## ISIL INVASION

ISIL occupies Mosul, destroys infrastructure, heritage, industries, kills thousands and displaces large number of Mosul's population

## THE SIEGE

Coalition forces offensive- displaces 1 million, kills over 40 thousand, destroys 90 % of the Old town mainly peoples homes

2014

2016-2017

imagecredit: the leaning minaret of al nuri mosque, ©Keystone Feature, Gettyimages

## CLIMATE

Mosul has a hot semi-arid climate, verging on the Mediterranean climate classified as **Csa** by Köppen and Geiger, with hot dry summers and moderately wet, relatively cool winters. Air humidity and wind is low due to its location deep within continental interiors, far from the windward coasts and sources of moist and maritime air. There is significant rainfall throughout the year in Mosul (WMO, 2018). The average annual temperature is 14.4 °C. The average annual rainfall is 622 mm.

## DEMOGRAPHICS

With 2 million inhabitants before 2014. The city was one of the most ethnically and religiously mixed in Iraq. While accurate statistical data on the city's ethnoreligious composition is currently lacking, the city has historically always comprised of an Arab Sunni Muslim majority (over 80 %) followed by Christians (Assyrians, Armenians, Chaldeans), Turkomans, Shabaks, Yazidis and Kurds. However, it is regarded as a sensitive matter in Iraq due to the sectarian violence that followed the American led invasion of the country in 2003. The last official nationwide census was conducted in 1997 during the former Iraqi regime (UN-Habitat, 2016).

Mosul is also the ancient centre of the Christian community in Iraq. Before Islam, most of the Arab tribes who lived in the area of Nineveh were Christian (Dabrowska & Hann, 2008).

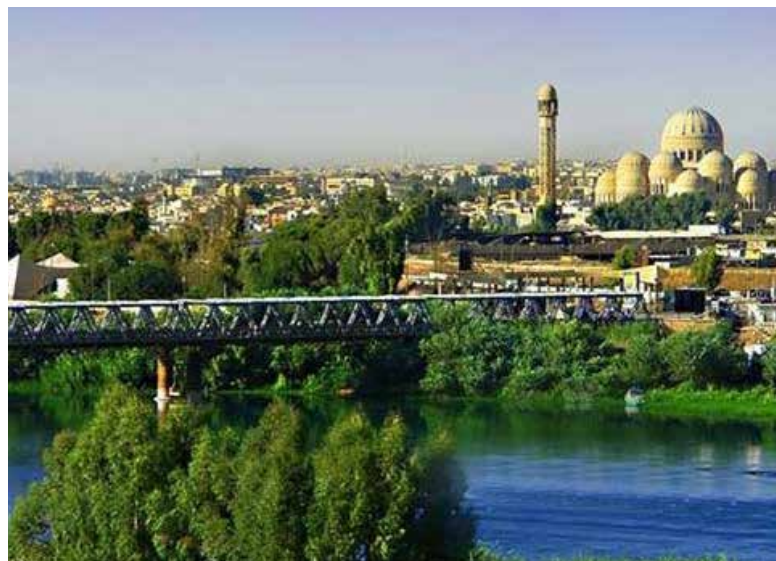
	January	February	March	April	May	June	July	August	Sep- tember	October	No- vember	Decem- ber
Avg. Temperature (°C)	2.6	3.7	7.7	14.2	18.7	23.1	26.5	25.5	21.6	15.1	9.7	4.9
Min. Temperature (°C)	-1	0	3.4	8.7	13.3	17.6	20.9	20	16.3	10.4	5.8	1.2
Max. Temperature (°C)	6.2	7.4	12.1	19.8	24.2	28.6	32.1	31.1	26.9	19.9	13.6	8.7
Precipitation / Rainfall	30	41	48	60	77	84	47	47	47	64	46	31

Weather chart, source: climate-data.org

The predominant average hourly wind direction in Mosul varies throughout the year.

The average wind direction from **3 April- 13 October** is from the **West**, and From **13 October- 3 April** the average wind direction is from the **East** (Weatherspark, 2018).

The average wind speed in is low and varies from **3 mph- 5 mph** (weather2visit, 2018).



View of Mosul from across the Tigris river and Old bridge, prior to the war, © Iraqi Cultural Center, Washington, DC



Maslawi Women sitting in the Park, prior to 2014 East Mosul, Gettyimages/Philippe Desmazes





## RESOURCES



Being part of **the fertile crescent** farming and agriculture has always been a big part of Mosul's economic resources. Once called **the breadbasket** of the country, it used to produce a quarter of the country's wheat.

Because of its strategic location, Mosul became a prominent commercial centre and a trading hub throughout different periods in its history. In more recent times, it acted as an export market for oil, agricultural, since the 1920's. The city's industrial sector, particularly **cement**, textile, clothing, sugar, and food processing industries thrived in the 1970s and 1980s after the nationalisation of the Iraqi oil and building of Mosul's dam. Factories for processing wool and tanning leather also flourished within the city due to its animal wealth. Mosul district is also known for its **pharmaceutical** industries and its **sulphur mining** and processing in the south of the province (UN-Habitat 2007).

Image credits; Mosul dandan area, ©2018 DigitalGlobe,Mapdata, ©2018 Google



Backgroundimage: Mosul Industrial areas, UNHABI-TAT-multisector assessment © October 2016

## Main Industries

The largest ones within the city are the pharmaceutical, medical equipment, sugar, yogurt, clothes and cotton textiles, pre-cast concrete elements, wood and furniture, and flour. Outside the city, the largest factories are cement, brick and mosaic construction materials, pharmaceutical and medical equipment, electricity transformers, plus a number of smaller ones. The city also has a large number of private factories, these include foodstuff, leather products, furniture, drinks and juices, metal furniture and aluminum products, in addition to several others (Ministry of Planning 2013).

2014, ISIL fighters looted and dismantled most factories, and sold their material outside the country. They also destroyed large parts of infrastructural projects (e.g. the German hospital, Ain Al-Iraq project which was in its early stages of construction) and sold their steel, construction materials, salvageable debris inside and outside Iraq (UN-Habitat, 2016).

## The Cement Industry

The cement industry is one of the biggest sectors of the local economy. There are five cement factories in Mosul district (Badoush 1, Badoush, Badush Al-Tawsea'yah, Hammam Al-Alil 1, Hammam Al-Alil 2), and one in Sinjar district (Sinjar Cement Plant) owned by the Northern Cement Company with its headquarters in Mosul city. According to the Ministry of Industry, these factories used to produce more than a million tonnes of high-quality cement per year at a lower cost than the rest of Iraq. In addition to local consumption, Mosul's high-quality cement used to be exported to other countries. In the 1980s, Iraq exported from Mosul more than 300,000 tonnes of cement per year. The peak was the period between 1987 and 1990 when it exported more than 1,100,000 tonnes to Turkey, the Arab Gulf, Yemen, and Singapore. The finest cement from the Hammam Al-Alil plant is used in the injection of the foundations of Mosul's dam (UNHABITAT, 2016).

Today all cement factories have been shut down including Hammam Al-Alil, which is essential to the

functionality of the Mosul Dam functional. ISIL stole the thermal fuses and other materials used in the cement industry labs and smuggled them out of the country (UNHABITAT, 2016).

**Recommendations:** the rehabilitation of those factories, especially the pre-cast concrete one is essential for the reconstruction of Mosul and should be at the top priorities of the rebuilding strategy of the city. As it will speed up the process of reconstruction for a lower cost, as well as improve the local economy by empowering local production.



An Iraqi laborer works at a white cement factory in Bartala in the Nineveh province, Gettyimages/Karim Sahib

## 3.3 OLD CITY

### INTRODUCTION

Founded in the 7th century BC, the Old City is the historical heart of Mosul, Its located in western Mosul or the right bank of the Tigris river (running southward). Until the 19th century, the Old City was surrounded by a wall with 9 gates. It retained the medieval architecture and layout of its historic centre until it was bombed to the ground during the war in 2016.

Damage: 94 %

### DEMOGRAPHICS

The old city was one of most densely populated areas in Mosul with around 200 000 inhabitants of predominantly lower income families from the Sunni Arab and Christian population. Throughout 3000 years, Mosul was the melting pot of diverse cultures and groups, representing Iraq's pluralistic identity and co-existence among its various ethnic, linguistic, and religious groups. The Old City was a physical reflection of this diversity due to its architecture and abundant shrines dedicated to various religious figures – some of whom are revered by the three monotheistic religions(UNHABITAT, 2016).

### HERITAGE

The Great al-Nouri Mosque, built around 1172, with it leaning minaret referred to as the “hunchback” by locals, was one of the most significant buildings in the Old City. Its renowned, 44 meter-high leaning minaret represented an important architectural element of the city and became its icon and the

symbol by which Mosul's population identified. Together with the Clock Tower of the Dominican Church, al-Hadba dominated the skyline of Mosul. Al-Nouri mosque was mostly reconstructed in 1942, while the minaret had remained unrestored until it was largely destroyed in June 2017. Additionally, Mosul still has the remains of the ancient Citadel of Bashtabia from the 11-12 century AD or earlier, which played an important role in defending the City against the various invasions and sieges of Mosul.

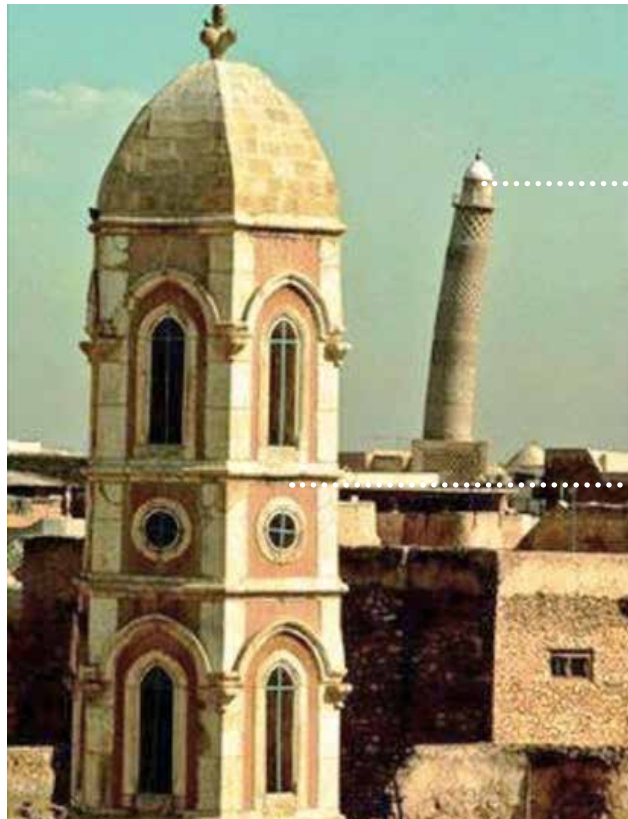
Other outstanding buildings (such as palaces, mausoleums, etc.) belonged to the 12th century. Mosul School synthesized the Islamic Fatimid and local Christian Nestorian architecture and decorative elements, including highly decorated brick facades, marble interiors, and muqarnas vaults. Later on, shrines were built for the prophets al-Khidr, Seth and Daniel. The existence of the graves of five Biblical and Muslim prophets in Mosul gave the town the honorable title of ‘the town of prophets’. Hence, the Old City of Mosul, with its various historical building and sites, may be considered as the result of interchange of values throughout thousands of years and is a testimony to Iraq's rich cultural diversity, which was demonstrated by its numerous monuments representing the different cultural groups, while blending the different elements of Islamic architecture with Christian Nestorian architecture and decorative elements that are characteristic of Mosul.

### URBAN ANALYSIS

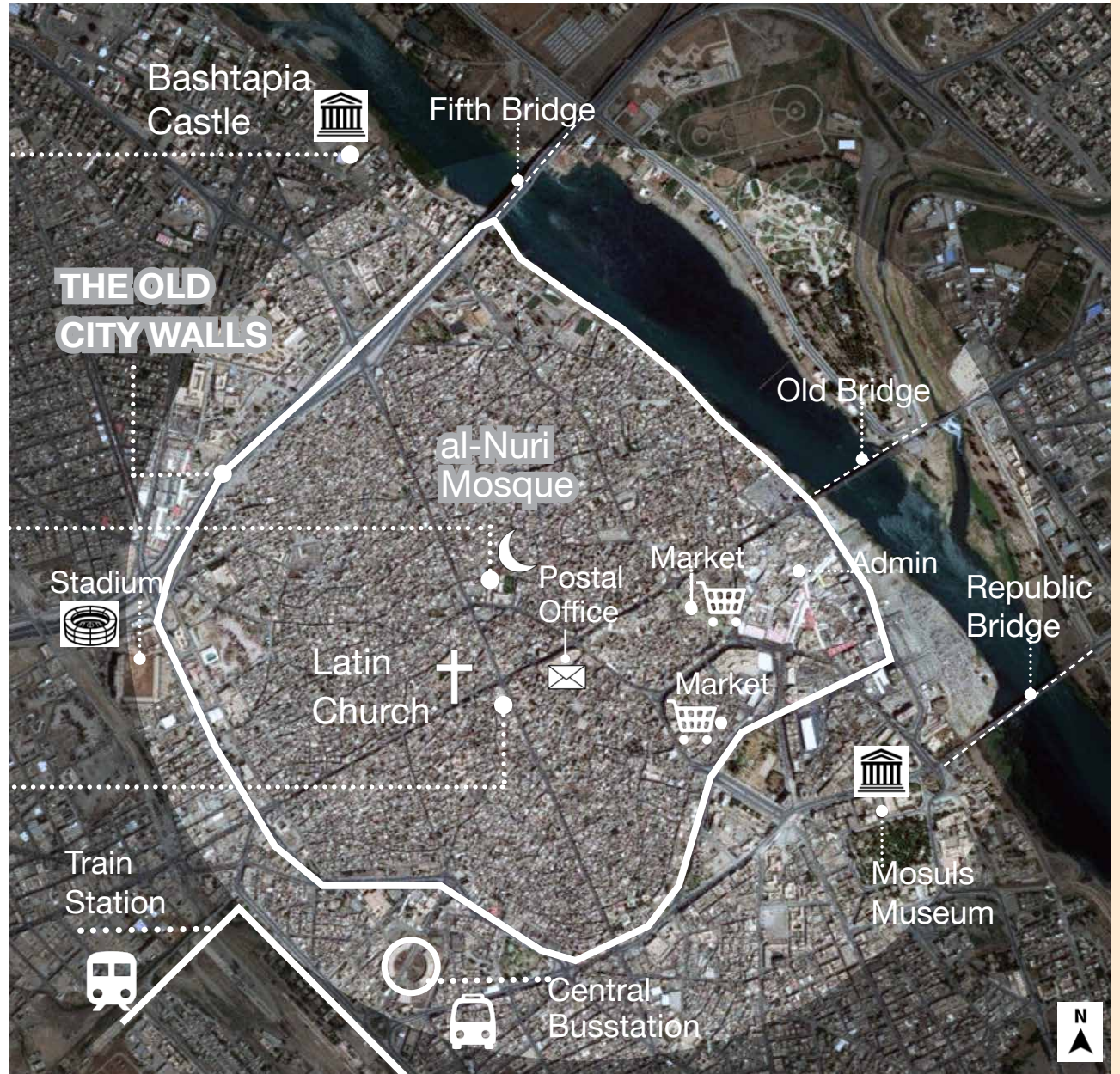
The Old City of Mosul represents a complete ensemble of an evolved traditional town through centuries, mainly covering the Ottoman period. With its labyrinth of intricate alleyways, it comprises dwellings, schools, diverse religious buildings, and markets. It had 38 living quarters called (mahala), each self-contained with its own market, bath(s-pa), church, mosque, cemetery. Originally all the living quarters were within the parameters of the wall, with 13 gates that surrounded the old city. In medieval times visitors and caravans could enter and leave the city only during daylight hours, as all 13 gates were shut at sunset. (Dabrowska & Hann, 2008). The remnants of the city wall and some of the gates were destroyed by ISIL 2014-2015 (UNHABITAT, 2016). The once busy, bustling heart of the city, filled with markets and prospering businesses is now more than 90 % destroyed.



Bashtapia citadel 2014, source: Abu al-Iz



Latin Church Clocktower and al-Nuri Mosque Leaning Minaret, side-by-side, The Old City, Mosul, 2002, googleimages



Old city, Mosul 2016, source: ArchGis-Esri satellite imagery, DigitalGlobe.

## 3.4 URBAN PATTERN

### TRADITIONAL URBAN PATTERN

The Old City of Mosul, with its intricate labyrinth of small streets, used to be a very well-preserved Heritage environment. In contrast to other towns in Iraq, it had been little affected by modernisation and retained much of its traditional ethnic and religious heterogeneity. The network of streets, alleyways, and cul-de-sacs represented one of the best examples of the spontaneously-grown pattern of Cities in the Arab World. All of the buildings, together with the domestic architecture and medieval urban plan, gave Mosul a distinctive cityscape (UNESCO, 2018). The cityscape was dominated by a low-rise private residential building which doesn't exceed 2-3 levels.

### MODERN URBAN PATTERN

The rest of the urban areas in Mosul, like the rest of Iraq, are organised according to the modern grid urban pattern, with straight or linear wide streets and alleys with vehicle access and sidewalks. The residential areas are divided into different blocks, which in turn are divided into plots that are often rectangular in shape with a private front yard and car garage. Most residential buildings remain low in height, according to the Iraqi traditional urban layout, with a maximum height of 2-3 levels. The urban expansion in Iraq is dominated by horizontal growth with private low rise townhouses. Very few Iraqis reside in apartment buildings as it is considered undesirable.



Traditional organic "Cul-du-Sac" Pattern of the Old City



Modern Grid Pattern in rest of Mosul



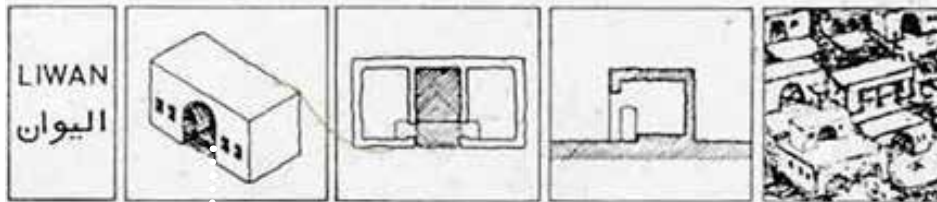
Winding narrow alleys with courtyard houses and passageways, Aga Khan Documentation Center at MIT



Wide streets with modern frontyard townhouses, google images

## MORPHOLOGICAL ANALYSIS

Morphological analysis of the residential buildings in the Old City shows that most of the traditional houses found in the Old City of Mosul consisted of the Courtyard and Liwan types of houses, according to the categorisation of the vernacular Arabic houses.



Drawing credits: Vernacular Housing types Syria. MIT

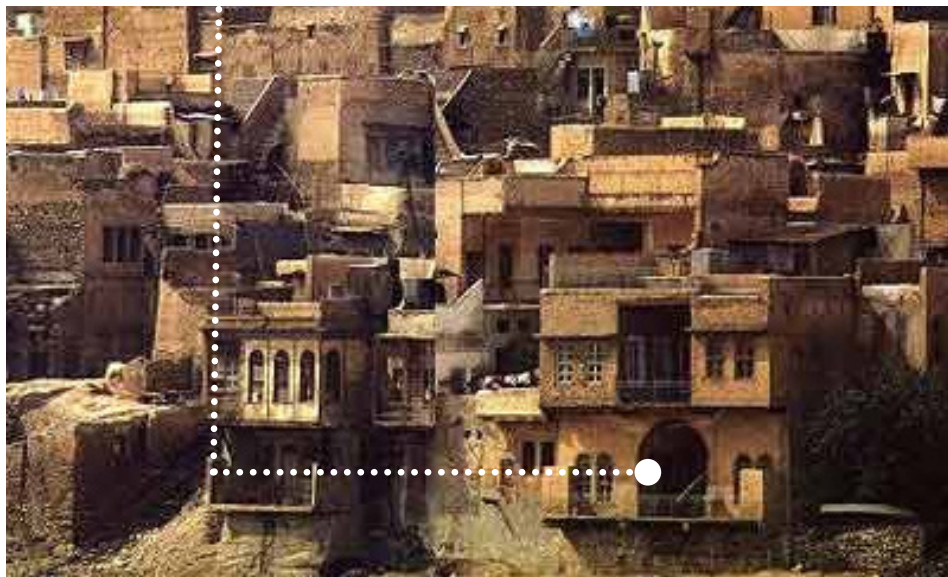
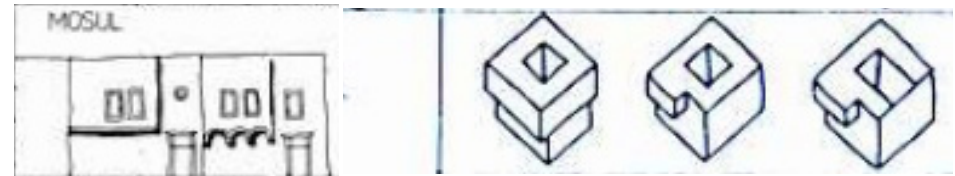
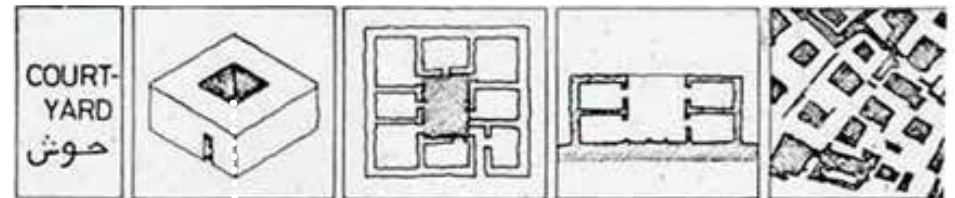


Image sources: Mosul old city waterfront, google images



Drawing credits: Iraq-Mosul vernacular house typology. (Haraty, 2015)



Drawing credits: Vernacular Housing types Syria. MIT



Image sources: Mosul old city, archgis, esri satellite imagery.

## 3.5 HOUSE TYPOLOGY

### TRADITIONAL HOUSE TYPOLOGY

Most of the houses or domestic architecture in the old city is of the traditional courtyard and Liwan types of houses. The courtyard house can be traced back to the early cities of Mesopotamia (Iraq), Ur, 2100 BC (Schneider, Nikolaus, 1930). It is well adapted to the climate and culture of the region, which empathises on three key parameters; PRIVACY, MODESTY & HOSPITALITY. Its characterised by its inner yard at the centre, and introverted layout (see image), to ensure protection from the elements and a degree of privacy or segregation from visitors/guest whilst ensuring efficient thermal comfort, movement, and accessibility for the whole household.

### MODERN HOUSE TYPOLOGY

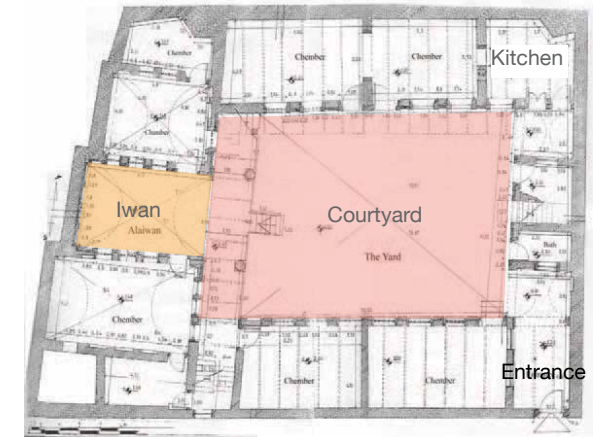
This type of house is the most common in Iraq and the region since the 1940's. Due to modernisation of building material, way of living, scarcity of land and rapid urbanisation. Though some elements are still preserved such as the roof terrace, they're completely different from the traditional houses, as contrary to the courtyard house they have an extroverted layout with yards on the outside, usually in front of the house (see image). They often lack "the local identity" or local features and are more adapted to the car and less adapted to the climate and culture of the region. They are faster and cheaper to build than the traditional stone courtyard houses of the old city but are dependent on the availability of electricity for ventilation and thermal comfort. Something that is lacking in most Iraqi cities since 2003 (UNHABITAT, 2016).



Traditional introverted housetypology with inner courtyard, source: archnet



Modern Extroverted housetypology with yard on the outside, source: google image 2013



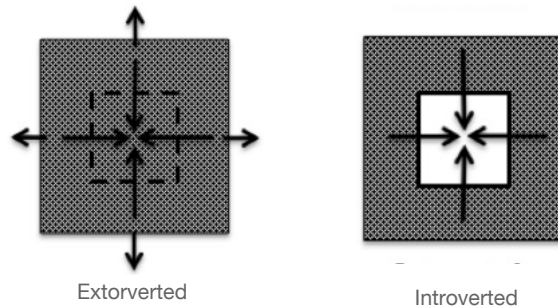
Typical plan of traditional house in Mosul city, THANOON Ahmad Abdul Wahid



Typical plan of modern house in Mosul, University of Mosul Dept. of Architecture, Ali H. Al-Jameel 2012

## ANALYSIS OF THE TRADITIONAL COURTYARD HOUSE OF MOSUL

The definition of the Mosulian courtyard house is characterized with openness towards inside by the existence of the inner courtyard and the distribution of rooms around it, and its isolation from outside.



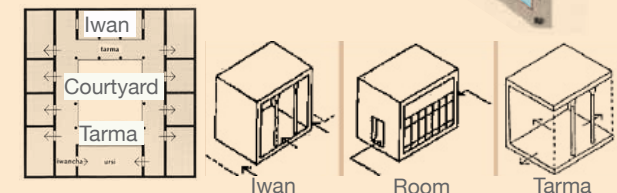
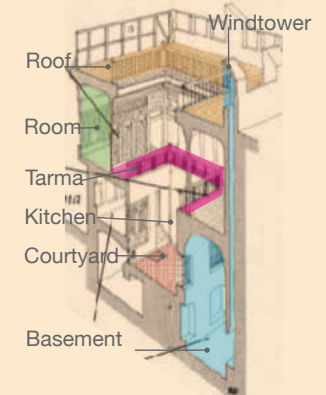
Residential buildings are the most dominating fabric of the Old City. They are characterised by the use of masonry that is often carved with decorative motives and inscriptions, adorning doors, windows, and arcades. This alabaster stone that is locally found (often dubbed as Mosul marble) renders the City its characteristic appearance reflecting architectural sophistication that gives Mosul its distinctive character.

### The Main components of traditional Mosulian house are:

- **The courtyard:** is an open space at the centre of the house- surrounded by the other parts of the building. Usually with a tree or a water pond the middle. It was imposed because of climatic and social condition, it allows fresh air flow in the house without compromising the privacy of the household.
- **Al-Iwan:** Livingroom facing the courtyard, closed from three side. Along its sides lies the rooms of the house.
- **The rooms:** Has only one entrance, with one or more windows overlooking the courtyard. The rooms contain a set of wall cupboards.
- **Tarma:** Corridor/galleries surrounding the courtyard, they usually are cantilevered to provide shading from the sun, and are formed by row of pillars that are joined together by pointed or semi circular arcs.
- **Talar:** upperfloor Iwan/livingroom
- **The Basement** either be fully under the ground floor or its ceiling higher than the level of courtyard ground and under the building structure called "Alrahrh". Its often accompanied by a wind-tower for natural ventilation and air cooling.
- **Roof Terrace:** (used as extra sleeping area during the hot summer nights)

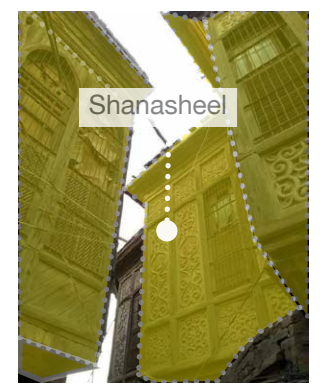
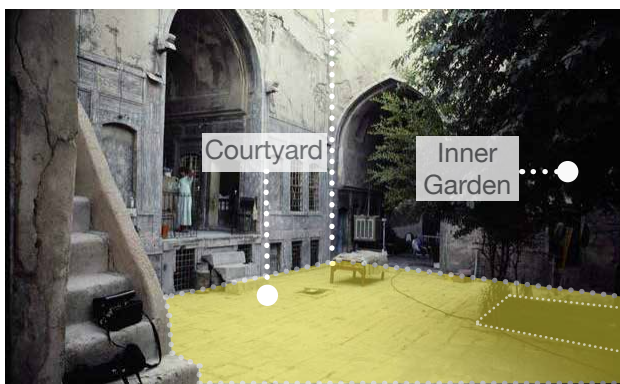
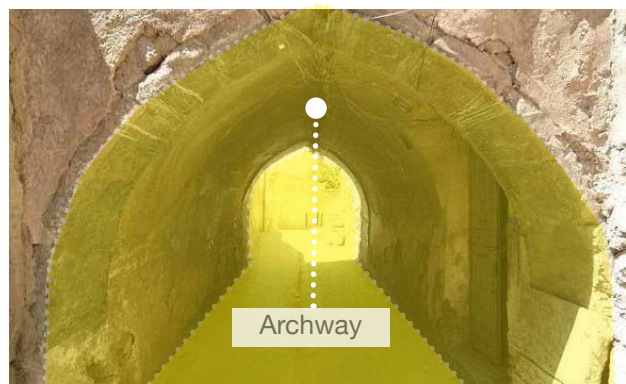
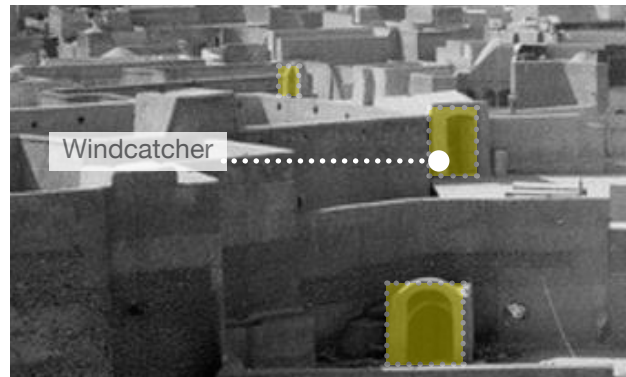
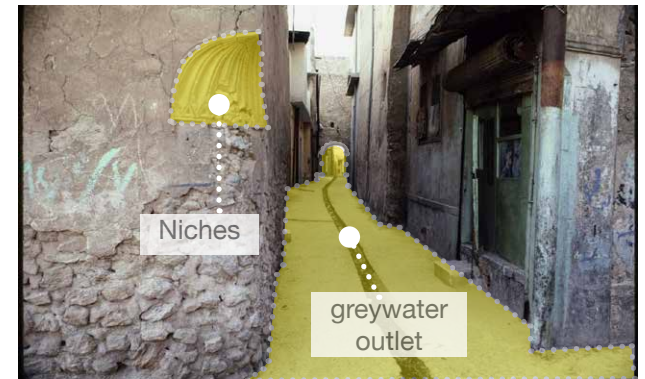
- **Shanasheel/Mashrabiya:** Is a bay window with perforated wood screens that controls the passage of direct lights and reduces the air temperature. It shades the alleys underneath and provides an extra outdoor/indoor space without compromising the privacy of the household.
- **The entrance:** Usually consists of two pillars, covered by an alabaster arch that is decorated with ornaments. The door is usually made of hardwood for its sustainability and aesthetic appeal. The entrance often leads to an aperture or a second door which leads to the courtyard, to avoid facing the outside directly and keeping the privacy of the household.
- **Secondary components:** They come after establishing the basic components of the house

1. Kitchen
2. Storage
3. Stairs
4. Roof terrace
5. al-shkhim
6. Archway (carries the room over the road. (picture)
7. Shanasheel
8. The well





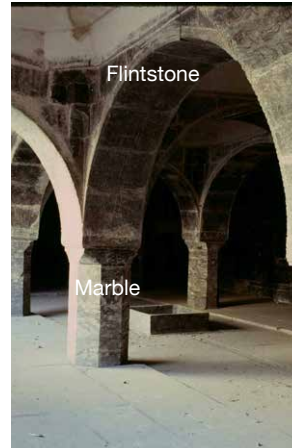
### 3.6 TRADITIONAL ARCHITECTURAL FEATURES OF THE OLD CITY



## 3.7 LOCAL BUILDING MATERIAL & TECHNIQUE

### TRADITIONAL BUILDING MATERIAL AND TECHNIQUE

The structural system used in Mosul's traditional house building is a load bearing wall system in addition to structural columns system in the basements. The roof is made out of diverse forms of domes (Cradle dome, Bakdasheya dome, Tisht dome). The main construction materials used in the traditional house construction in Mosul, is flint stone, plaster, Alabaster (Mosul marble) and limestone. The walls are built with flint stone and plaster, where the bases are built with the same materials in addition to hydraulic lime. The domes are built by fresh gypsum, plaster and Al khirshan (lightweight local plaster). Mosul marble (Alabaster stone) is often used for decorative frames and other decorative needs of the house such as doors, windows, cupboards, etc.



Basement structural columns & Cradle dome with flintstone masonry. Aga Khan Documentation Center at MIT.



Mosul marble (Alabaster) used in entrance frame decoration.



Stone and marble destroyed traditional house structure, 2018

### MODERN BUILDING MATERIAL AND TECHNIQUE

Although prefabricated concrete factories exist in Mosul and Iraq, the most common construction system used in Mosul and Iraq is Reinforced Concrete Frame Structure, which is built on site. Where reinforced bar cages are placed and tied with rebars and then put into a formwork of plywood where concrete is poured in and left to settle. The walls are then filled in with any material, usually either concrete block or bricks, which is then cladded with stucco plaster. The beams, foundation, and slabs are built with reinforced concrete formwork. Interior floor is usually cladded with terrazzo or marble tiles.



Reinforced concrete frame structure, google image



Concrete frame structure with brick wall filling, google image



Concrete block wall structure Mosul, UNHABITAT

## 3.8 REFERENCE STUDY

In addition to studying local context, architecture, building tradition and technique, I had to study similar case studies of postwar reconstruction and affordable housing before developing my design proposal and guidelines for the reconstruction of Mosul. While it was difficult to find literature on postwar reconstruction, I managed to find a few articles about post World War 2 reconstruction in Germany and postwar World War 2 housing policies in Italy and France, as well as a pamphlet about postwar architecture in sarajevo (War and Architecture).

I also found a few examples of affordable housing (Elemental), building material and techniques (Sandbag, compressed earth brick) which can be used in the reconstruction of Mosul, as well as how to recycle rubble in the case of Haiti.

A summary of the study is presented in the following pages with own reflections.

“

While there is a massive literature on the history of modern cities attacked in the Second World War However, there is a very few literature on the rebuilding of these damaged cities—many of which were severely damaged—and even less about the actual concepts that guided their reconstruction” (Woods, 2011).

### DESIGN- AFFORDABLE HOUSING



"Half-finished houses", Elemental, Monterrey -Mexico



Sandbag house, MMA, South Africa

### THEORY- POSTWAR HOUSING IN EUROPE



Post-war Roobin Hood garden estate, Smithsons, Sheffield



Post war Italian housing Ina-Casa plan (1949-63)

### BUILDING TECHNIQUE- RUBBLE & EARTH



Sandbag structural wall, MMA South Africa



CSEB (compressed soil, sand and cement blocks)



Rubble gabion wall



G-Brixx. Recycled rubble to LEGO brick (The mobile factory)

## POSTWAR HOUSING LITTERATURE STUDY

### 1. Sarajevo-War and Architecture

This is a continuation of the pamphlet which the author wrote upon the attack on Sarajevo in 1993. Here he revisits those ideas in a critical way in the hopes that it would be useful in today's conflicts where new ways of thinking of architecture and urban redevelopments have to be considered in rebuilding strategies after war and catastrophes.

*"I am revisiting the work I did some fifteen years ago for an unhappy reason. Originally intended to address the destruction of buildings in Sarajevo, Bosnia—which I and many others hoped would prove to be an isolated catastrophe—it has instead turned out to be only the beginning of a new trend resulting from globalization, a proliferation of regional, often insurgent-driven wars that have resulted in the piece-by-piece destruction of cities and the killing of their inhabitants that characterized the torturous three-year attack on Sarajevo"* (Woods, 2011).

His radical proposals upon the war were criticized for "aestheticizing violence" and "exploitative of a tragic human condition" as he failed to put them in **a broader human perspective** which is needed in understanding proposals for architecture serving rational and needed purposes. He argues that the principles he developed in War and Architecture upon the Bosnian war can be applied to the growing number of cities that have suffered the same

fate since the 1990's such as, Bagdad, Kabul, and Tripoli. However, I don't think that they could be applied to the case of Mosul, where the destruction has been much more profound leaving whole neighborhoods such as the old city flattened to the ground. But some of the principles can be applied in moderation according to the need of the city or neighborhood.

*"My "war and architecture" work was not aimed at proposing the reconstruction of particular buildings—that should be the work of local architects—but at deriving guiding principles"* (Woods, 2011).

*"I strongly believe that reconstructions should be designed by local architects, who understand the local conditions far, far better than I ever could"* (Woods, 2011).

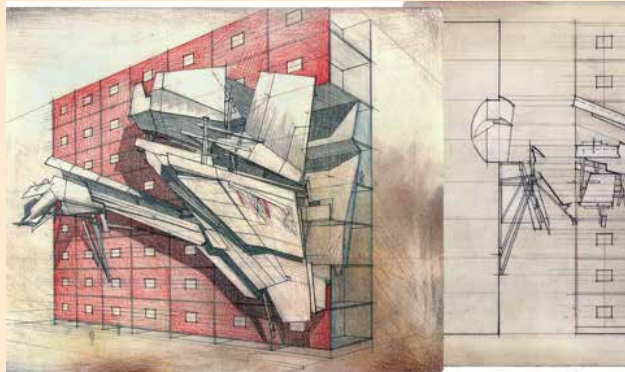
**The First Principle:** Restore what has been lost to its pre-war condition. The idea is to restore 'normalcy,' where the normal is the way of living lost as a result of the war. The idea considers the war as only an interruption of an ongoing flow of the normal.

**The Second Principle:** Demolish the damaged and destroyed buildings and build something entirely new. This 'new' could be something radically different from what existed before, or only an updated version of the lost pre-war normal.

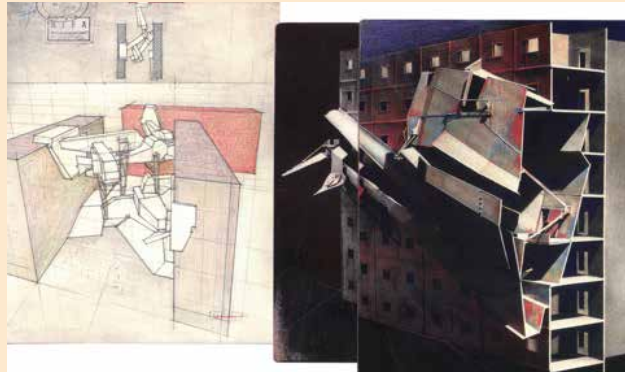
**Third Principle:** The post-war city must create the new from the damaged old. He argues that

*"Many of the buildings in the war-damaged city are relatively salvageable, and because the finances of individuals and remaining institutions have been depleted by war and its privations, that salvageable building stock must be used to build the 'new' city. And because the new ways of living will not be the same as the old, the reconstruction of old buildings must enable new ways and ideas of living. It is worth mentioning that the most needed buildings are the so-called ordinary ones—apartments and office buildings, primarily. Symbolic structures, such as churches, synagogues, mosques and those buildings of historical significance that are key to the cultural memory of the city and its people, must also be salvaged and repaired. With these latter buildings, the First Principle—restoration to the pre-war state—is almost always justified, whatever the cost"* (Woods, 2011).

This is not applicable in the case of Mosul where the amount of damage opposed to the city's residential stock is unprecedented and only equal to a natural catastrophe such as Haiti's. Such solutions can only be applicable to office buildings, hospitals, museums, and universities were some of the buildings are salvageable. Hence my proposal will not address the reconstruction of the damaged residential ones but propose a new, inspired by the old using recycled rubble produced by the war. However, I also propose that historical and religious building of cultural heritage value should be restored to their previous state whatever the cost, to preserve the local heritage of the city.

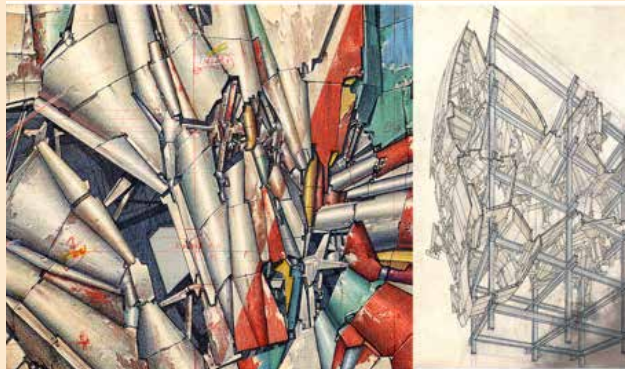


Woods proposal for the reconstruction of a damaged residential block in sarajevo, using his 3rd principle



Woods proposal for the New Bosnian Parliament.

“the scavenged construction materials are carefully reshaped and reconfigured, then fitted together with a high level of craft—a technique appropriate to the New Parliament’s methods and goals”.  
(Woods, 2011)



Source: War and Architecture, Woods, 2011

## 2. Germany, Post War Housing

Much like Mosul in Iraq, during World War II, carpet-bombing by Allied forces leveled up to 80 percent of the historic buildings in Germany's main cities. 8 million German homes had either been destroyed or damaged and millions of Germans had been made homeless; whole city centres were in ruins; almost half of Germany infrastructure – gas and electricity supplies, roads and railways – had been destroyed. An enormous amount of rubble was produced, in West Germany alone, some 400 million cubic meters of rubble was piled up after the war (Liebelt, 2010).

### How did Germany rebuild their cities after the war? What did they handle the enormous amount of rubble?

Germany rebuilt its towns and cities rapidly and extensively which transformed the urban landscape of the country and its historical town centers radically. It was at the height of the modernistic era, and Modernistic worldview and city planning were adapted to replace the old historical city which was discarded as outdated and regressive by many planners and designer of that time. The priority then was to clear all the rubble and rehouse all the rendered homeless due to the war. Within 15 years 5.3 million apartments were built in western Germany alone. The enormous amount of rubble was turned into hills which are found today all over Germany and are part of its landscape.

It was only financially possible because the western

countries needed West Germany to be a bulwark against the Soviet Union. Money poured into the country via the Marshall Plan and other conduits (Liebelt, 2010). The outcome, however, was mass produced buildings that compare poorly to the prewar buildings which they replaced. These cities were later criticised for being “inhospitable” as the German social psychologist Alexander Mitscherlich described them in 1965. The new cities were designed according to modernistic ideals of “**functional city**”, “**Light and air for all!**” They were to provide “**clarity**” rather than the “**confusion**” of the historical city with all its “**bothersome neighbors.**” Unfortunately, the clean new suburbs and satellite towns didn't result in a better quality of life, they resulted in sterile environments and soulless ghettos instead (Liebelt, 2010). This sparked a new wave of retro architecture and a desire to return to the historical city. But it also solved the catastrophic housing crisis that the country suffered from after the war and made Germany recover in a record time and become one of the strongest economies in the world today with a high quality of living for its inhabitants that have lasted until this day. **I wonder what would have happened if Germany chose a different path to stick to its past and rebuild all its destroyed buildings instead of building new ones? Would it have been as stable and as economically and socially prosperous as it is today? Was it necessary to adapt to new technology and a new way of thinking?**

Moving forward and adaptation to new technology and lifestyle is inevitable when rebuilding a city after



Cologne after World War II, 1945, source: spiegel.de

a war or disaster, but one cannot simply dismiss the past, because it's necessary to look at the past in order to avoid repeating its mistakes. A balanced approach to rebuilding and rehabilitation of cities after a war or disaster is needed. The new planning and architecture solutions should act as a continuation of the old inherited knowledge and characteristics of the vernacular that has been acquired through generations.



Germany's first high-rise apartment complex, Hamburg's Grindelberg, built in 1957. source: spiegel.de

## AFFORDABLE HOUSING CASE STUDY

### 1. “Half-finished houses”, Elemental, Quinta Monroy, Chile

Is one of the open source affordable social housing project by the Chilean architect Alejandro Aravena’s elemental group, who have been designing and releasing a number of residential design projects as an open-source resource to help tackle the global affordable housing crisis.

Aravena’s firm, Elemental, has posted drawings for four of its low-cost “incremental” housing projects on its website for free download.

The aim is to provide the material to government agencies and developers who might think it’s “too expensive” to invest in well-designed social housing.

Aravena has championed an approach in which governments fund construction of “half a good house,” with residents completing the other portion as resources allow.

The projects he is releasing information for are three Chilean developments – Quinta Monroy, Lo Barnechea and Villa Verde, completed in 2013 and 2014 – and Monterrey in Mexico City, completed in 2010.

The architect said *government agencies and*

*developers are hesitant to spend money on forward-thinking designs, as they perceive them as high risk.*

The need for social housing is becoming more pressing, with three billion people now living in cities and a third of them living below the poverty line, according to Aravena(dezeen, 2016).

*“We hope will be able to rule out one more excuse for why markets and governments don’t move in this direction to tackle the challenge of massive rapid urbanisation,” said Elemental.*

*“[The designs] are knowledge that we have tested, that have proved to be beneficial to communities and that have been implemented accepting very pressing budget and policy constraints.”*

The firm added that the designs might need to be modified to comply with local regulations and building codes, as well as “local realities” and availability of materials.

The architecture group aims to alleviate poverty and eliminate slums using a participatory approach that engages local communities in early stages of the design process (dezeen, 2016).

Elemental, of which Aravena is executive director, first attracted international attention in 2004 for the Quinta Monroy development in Iquique, Chile. The scheme was designed to make the most of a tiny budget by building the frame and the essential

spaces for each house, leaving the remainder for residents to complete themselves over time.

The group also played a focal role in the rebuilding of Constitución, one of the towns that was almost destroyed by the 2010 Chilean earthquake and subsequent tsunami.

Elemental solutions are even more essential today in the context of rebuilding many war and disaster-stricken countries with limited budget and land resources. They have been inspirational in my design proposal and strategy for the post-war housing in Mosul.



Quinta Monroy Housing in Chile in 2004, Source: Dezeen.com





## 2. Sandbag house, MMA, South Africa

Was built as part of a pilot project for affordable housing for slum dwellers in the outskirts of Cape Town, South Africa, initiated as a design competition by design Indaba who asked 10 S.A teams and 10 international teams to produce designs 'low cost houses within the S.A Govt subsidy budget of R50.000'. The winning entry by S.A design firm MMA led by the architect Luyanda Mpahlwa was chosen to be implemented first, due to its innovative, sustainable and low tech solution to use sand bags as a building material. The sandbags provide adequate insulation through thermal lag, and is a material that is readily available on site thus it has low embodied energy and reduces the carbon footprint during construction. It is also cheaper and easier to maintain due to the availability of the material on site. Nylon bags which are otherwise considered to be pollutants to the environment have been chosen to contain the sand. The project also used existing technology; Eco beams, a product of a South Africa based company to frame the house. The vertical beams are made of timber connected with a galvanized metal element. The bags are then stacked within the Eco-beam frame which is then covered by chicken-wire mesh which is then plastered to achieve a smooth wall finish. With this structured walling mechanism, there is no need for foundations as the sandbags act as anchoring elements to further reduce construction costs. The houses cost only \$6000 and were built with the help of its future residents, and women labour who were able to gain a sense of ownership through the building process.



Sandbag house, MMA, South Africa, 2008, Source: Dezeen.com & Inhabitat.com

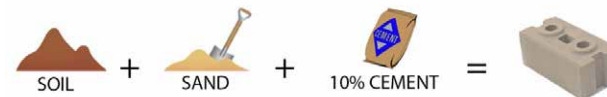


## OTHER AFFORDABLE AND RECYCLED BUILDING MATERIAL

### 1. ICEB (Interlocking compressed earth bricks)

Interlocking compressed earth block (ICEB) masonry is a cost-effective and sustainable construction material. ICEB construction has the potential to bring durable and affordable homes to developing countries around the world. Today, ICEB construction is becoming increasingly popular in developing countries. Compressed earth blocks are energy efficient; they require anywhere from 1/5 to 1/15 of the energy to make when compared to fired bricks and concrete masonry units (Maini, 2010). Since indigenous soil is the main ingredient in ICEBs construction, there is a large reduction in purchased materials (Maini 2010). Traditional masonry relies heavily on skilled labor and expensive materials. The interlocking nature of ICEBs allows for dry stacked, mortar-less construction, which reduces the need for skilled labor and shortens construction time. These reductions lower the cost of labor by as much as 80% (Anand and Ramamurthy 2005). These advantages make ICEBs a practical and preferred construction form.

While this might not be the best alternative for building material in Mosul. It can be used as an alternative semi-permanent for wall filling material, for its thermal quality and affordability, but not as a loadbearing system. Since presently, there's not enough understanding of its behaviour(strength and performance) as a load bearing wall material.



### 2. Gabion (caged rubble walls) House-Haiti

The earthquake that hit Haiti's port de prince in 2010, produced the same amount of rubble as the 9-month attack did in Iraq's Mosul, around 10 million tonnes (Oxfam, 2010). And the Haitians were faced with the same difficult challenge of how to clear and dispose of the enormous amount of rubble in order to rebuild the city. One of the suggestions then was to reuse the crushed rubble in gabion cages to produce affordable housing for Haiti's displaced people. The result was a gabion housing prototype for the cost of \$6500.

**What is Gabion?** A gabion is a wire cage that can be stacked vertically in a wall and then packed with various materials. Normally they are used as retaining walls, but in the case of the Gabion House, their design has been modified to allow them to be stacked to form a load-bearing, masonry wall.

I think combined with a structural concrete frame will make the gabion or rubble cages very interesting building material that can be used for house walls as well as other uses such as trench walls, public seatings etc. Though relatively low tech, trained labor is needed as well as new building regulation codes for using gabion as a structural material, could be a challenge for the Iraqi authorities who have not yet proven effective in taking quick and reliable measures to rebuild the country.



Gabion cages being filled with rubble and plastered to form a wall



Finished gabion house prototype, haiti; Source: oxfam, 2011

### 3. Q-Brixx-the mobile rubble brick factory-Haiti

The Mobile factory is a Dutch engineering group invention developed after the earthquake that hit Haiti in 2010 to help victims of war and disaster to rebuild their homes by turning rubble into “Lego” stackable building blocks. Their method is published in a step by step manual on their website where they describe the process of production and implementation. It’s funded through crowd funding.

*“No building lasts forever. Demolition, war and natural disasters will eventually turn every man-made structure into rubble. In case you didn’t know, rubble is a real killer. It’s the world’s largest polluter in volume, it destroys the environment and it’s a health hazard for the people who are forced to live among it. But we think we’ve come up with a sustainable solution to give new function to all this rubble. The Mobile Factory fits into two shipping containers and can be sent anywhere in the world. Rubble goes in at one end, is processed into liquid concrete, and eventually comes out the other side as brand new building blocks. These are designed so that you simply stack them, just like Lego. The new blocks allow victims of war or natural disasters to construct their own earthquake proof homes. In short, the Mobile Factory helps them rebuild the communities they lost.”* (themobilefactory.org)

I think its a groundbreaking idea which can help many people in war and disaster-stricken places. I hope it can be tested in Mosul as one of the methods to recycle rubble into new building blocks or be an inspiration for similar solutions. It will be a main source of inspiration in my proposal for recycling the rubble but modified to fit the local context in Mosul where the existing concrete industry can be included in the process, to strengthen the local economy and utilizes the existing resources.



Q-brixx manual, source: themobilefactory.org



The mobile factory illustration, source: themobilefactory.org



Finished product, source: themobilefactory.org

## 3.9 INTERVIEWS SUMMERY

### ALIYA HAMAD ALSABAAWI, CIVIL ENGINEER AT MOSUL URBAN PLANNING DIRECTORATE

21/11/2017

In the interview with the local civil engineer at Mosul urban planing directorate in 2017, it was apparent that the main obstacle facing the reconstruction plan of the old city was the limited or non existing reconstruction budget, lack of coordination between the authorities and corruption.

The war had just ended and people had just started to go back to their normal lives in the east side of the city. No plans could've been made before the annual national budget was announced in 2018.

The engineer thought that most old houses in the old town could not be rebuilt as were too damaged, and that the remaining structures were too hazardous for its resident to live in as they might risk falling on their heads because unlike their concrete counterpart they were very old and hadn't been repaired before the bombing. They were also the most targeted by the coalition bombings.

She therefor suggested that new homes would be built for the returning families and that those new would resemble the old traditional one because the resident of the old town were very attached to them.

*"The best thing is to house the displaced families in new buildings that bear the same character of their*

*old traditional homes, because they love them"*

All public houses and infrastructure were destroyed in western Mosul including the municipality building.

Up to that date only few streets were cleared of the rubble and opened.

*"There still bodies to recover and rubble everywhere. The houses in the old town all had basement that are now filled with bodies."*

The people were desperate for help to rebuild their town and lives, but had not received any help from the outside.

*"Most people in that area are poor, very poor people".*

It seemed that they were left alone to build their houses. But there were promises of a compensation fund where residents can seek money to rebuild their homes from the government after making a full damage assessment of their house.

When asked if the people preferred to rebuild their homes on their own, she replied

*"The people have lost everything, they're displaced and are forced to live on the streets, they would love to receive any help. In-fact everyone was queuing when they heard about the compensation fund, they Need Help."*

The urban planing directorate was also open to cooperate with any for outside organisations who's interested in rebuilding the city or conduct researches. They had already experience of coordinating the medical help organisation who came before.

When asked about ownership or tenure issues that might occur if a new development was to be built on the old house premises, she provided many solutions.

In case the new building will house more than one family on the same plot?

A: *"In that case the one who moves in have to pay a compensation to the land owner, that is usually done through the municipality"*

In case of complete change to a private residential block, *"Then the best or easiest solution is for the municipality to buy the whole block or neighbourhood and build new developments."*

When asked about building material.

*"We use concrete blocks for walls, and cement and metal rods all are locally manufactured. There are many local concrete block manufacturer operating."*

*" We get all the cement locally from the local factories in Hamam Al-Alil and Badosh."*

She also emphasized on the reopening the Prefab concrete factory, as it would be a crucial thing in speeding up the reconstruction process.

**HASHEM ALSABAAWI-LOCAL  
RESIDENT FROM THE OLD CITY  
OF MOSUL  
23/11/2017**

Hashem was a young dad from Mosul that I interviewed via the phone. His extended family lived in an old traditional courtyard house from the turn of the century in western Mosul, just outside of the old city walls. Until it was bombed in an American airstrike by three missiles, all while the family members were inside, women, children, and elderly people were injured but all survived. They later fled to their relatives in a village outside of Mosul in Nineveh.

They were now planning to go back once their house was rebuilt. I asked about how they were going to rebuild it, if it is going to be restored or not. I also asked about if they expect to receive any help from the government or other help organisations. And if he knows about what other people from the Old City are doing after the end of the war?

His answers are presented below:

**Q: How will they rebuild their house, will they rebuild the old house?**

*A: No, they will build a new "modern house" "western style"*

**Q: Why not build the old way?**

*A: Because it's easier and cheaper to build, "no one build in the old style today" it's too complicated and outdated.*

*Q: what about other people from the old town?*

*A: "Most have returned and renting in east Mosul, but the rents there are too high and many have become homeless as a result as they can't afford rent- Some locals are helping by letting them stay in their houses.*

*Q: do you know if or how they're planing to rebuild their homes in the old city?*

*A: No-one is allowed there yet-but I have heard that some have started selling their plots.*

*Q: To whom?*

*A: I don't know maybe private investors!*



### 3.10 RELEVANT FINDINGS

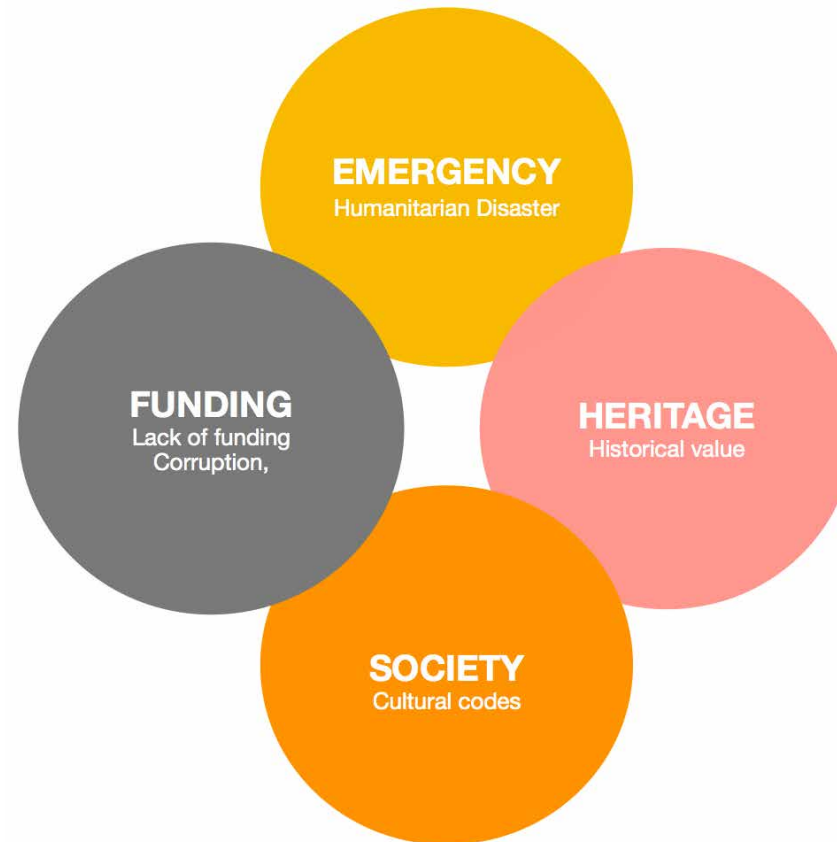
The final proposal is based on four parameters (issues) shown in the figure to the right, which defines the scope of the project and its limitations.

After an in-depth analysis of local context and interviews with both local authorities and residents of Mosul, I came to the conclusion that a new housing development in Mosul is necessary to solve the severe housing crisis after the war and accommodate all the returning refugees who have lost their homes. The unprecedented destruction of Mosul especially West Mosul and the Old City, together with the scarcity of funding and the enormous amount of rubble and corruption require carefully considered material and spatial responses. It is also important that the new housing solution take into consideration the architectural tradition of the city in order to preserve its ancient cultural heritage and avoid the mistakes of the post- WWII housing in Europe.

I, therefore, propose a modular system which is flexible enough to fit different locations in Mosul that are either completely destroyed, such as the Old City, or undeveloped in the city's outskirts, both in the West and East Mosul. The system should fit well into its local context both in proportion and function, as well as incorporate some of the traditional architectural features and modify them according to current needs and living standards.

The project can be executed through different strategies presented in the following pages.

It is also crucial to find a sustainable way to recycle the enormous amount of rubble to lower the reconstruction costs and reduce the environmental impact of war.



The final proposal is based on these four parameters (issues) which define the scope of the project and its limitations.

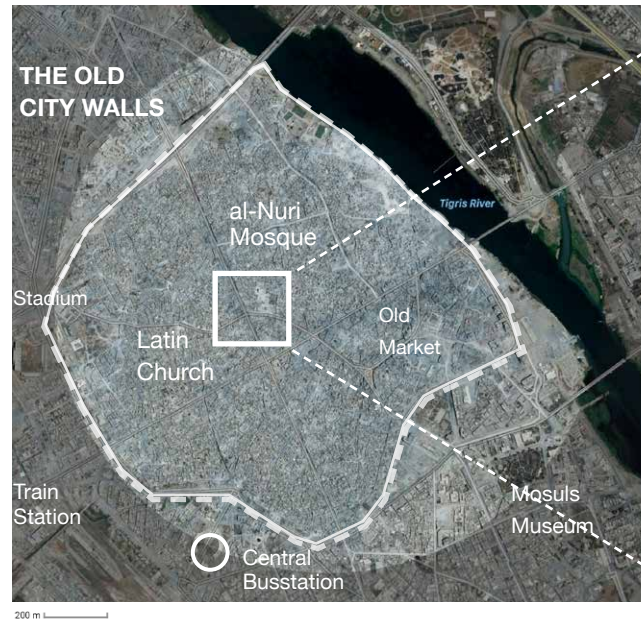
## 3.11 CHOSEN SITE

### LOCATION

My chosen site location is at the heart of the Old City on al-Farooq street next to the iconic al-Nuri mosque which was bombed at the end of the war.

The reason for choosing the old city is because it was the most damaged, over 90 % of its topography was wiped out. It was also the most densely populated, mainly with lower income families.

It is the historical city center of Mosul with medieval buildings and urban layout and inter-religious places of worships, that reflects the diversity of the Mosul and Iraq in general.



## SITE ANALYSIS

I analysed the site using open-source data found on the internet such as satellite-images, maps, published images and journalistic information found on the internet which I later matched with different locations on the site. Each image is connected to a dot on the sitemap or satellite image to give a more holistic view of the area and help understand the chosen site spatial quality and condition without visiting it.

The main reasons for choosing this site was because it was the most photographed location in Mosul by the media, due to its strategic location in the old city, and the only one where I could analyse and match the published images to their location on a map. and match the published images to their location on a map.



Image sources: 3, 5, 9 Associated Press(AP), 1, 2, 4, 6, 7 UN-HABITAT, 8 Reuters. 2017-2018.



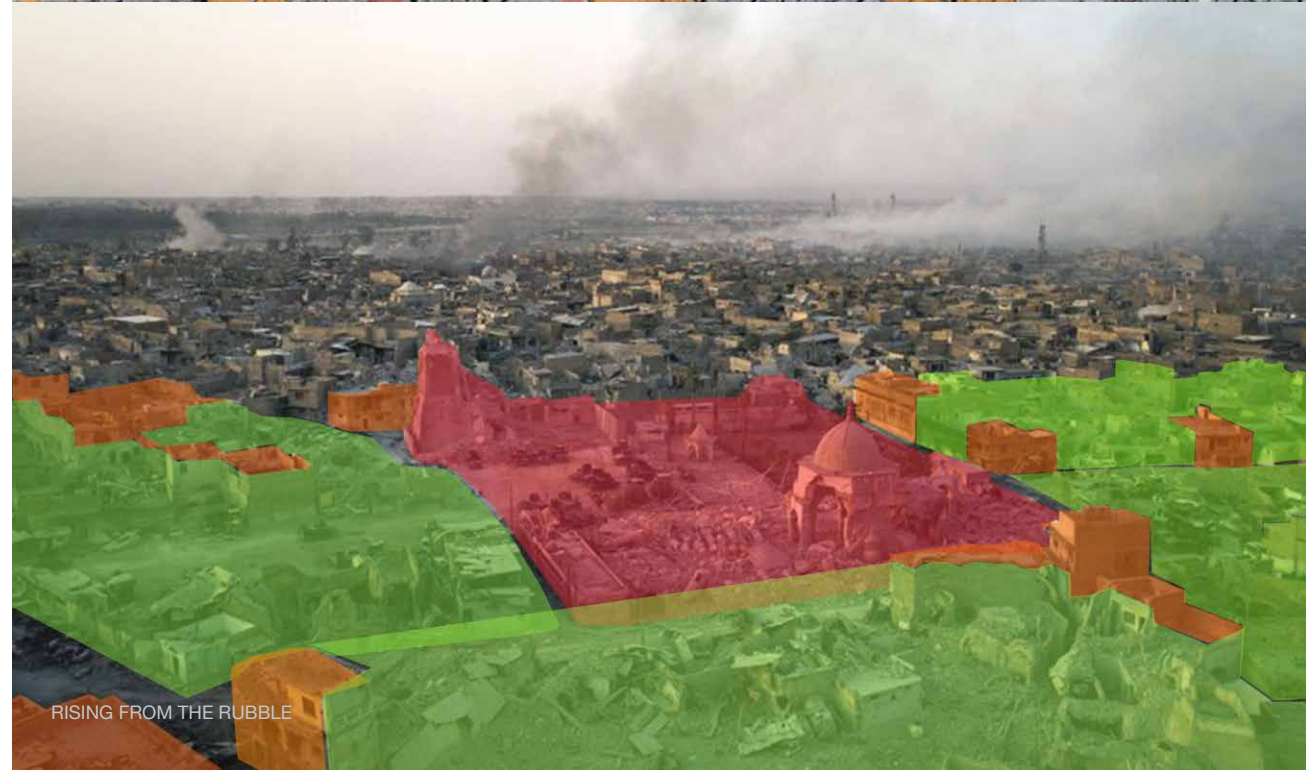
## 3.12 URBAN STRATEGY

Recommendations for the rebuilding strategy of the chosen area around al-Nuri Mosque is to:

- Build new developments in the completely destroyed areas and urban voids and utilise the previously used parking lots in a more sustainable way.
- Preserve the intact buildings and rebuild the partially damaged houses if possible as well as rebuild the historic market, museums, roads, and infrastructure of the area.
- Restore of all the important cultural heritage sites such as the iconic al-Nuri Mosque as well as other iconic religious and historical sites that were destroyed during the war and are part of the city's identity.
- Establish Support centres for collecting and recycling the rubble and assisting the returning residents in rebuilding their houses.

### Legends:

- Preservation
- Restoration
- New Development
- Helping & recycling centre



### 3.13 BUILDING STRATEGY

#### Strategy 1.

**Semi-self built house:** single family housing units, inspired by “elemental unfinished house”. It is going to be built by the local community with the assistance and supervision of local authorities and NGO’s, who will provide the affected families with the structural frame, groundwork, as well as an overall plan layout through the support centers which will be allocated in different locations around Mosul.

The families will build their houses gradually within the provided structural parameters which can be extended vertically by 1-2 level, according to the proposed layout.

Financially this can be possible through the help of public and private investors who are willing to invest in new developments for the returning refugees in Mosul in cooperation with local authorities and international NGO’s.

#### Strategy 2.

**Prefab Multifamily housing:** Is a midrise apartment building, that is 4-5 stories high, for families that cannot build their own homes. It will be built through the use of locally produced prefabricated concrete slabs. It can be developed by a third party in cooperation with local authorities and investments from the private or/and public sector. If combined with strategy 1., it can encourage positive urban densification and effective land-use with a variety of building forms and tenants.



**Strategy 1.**

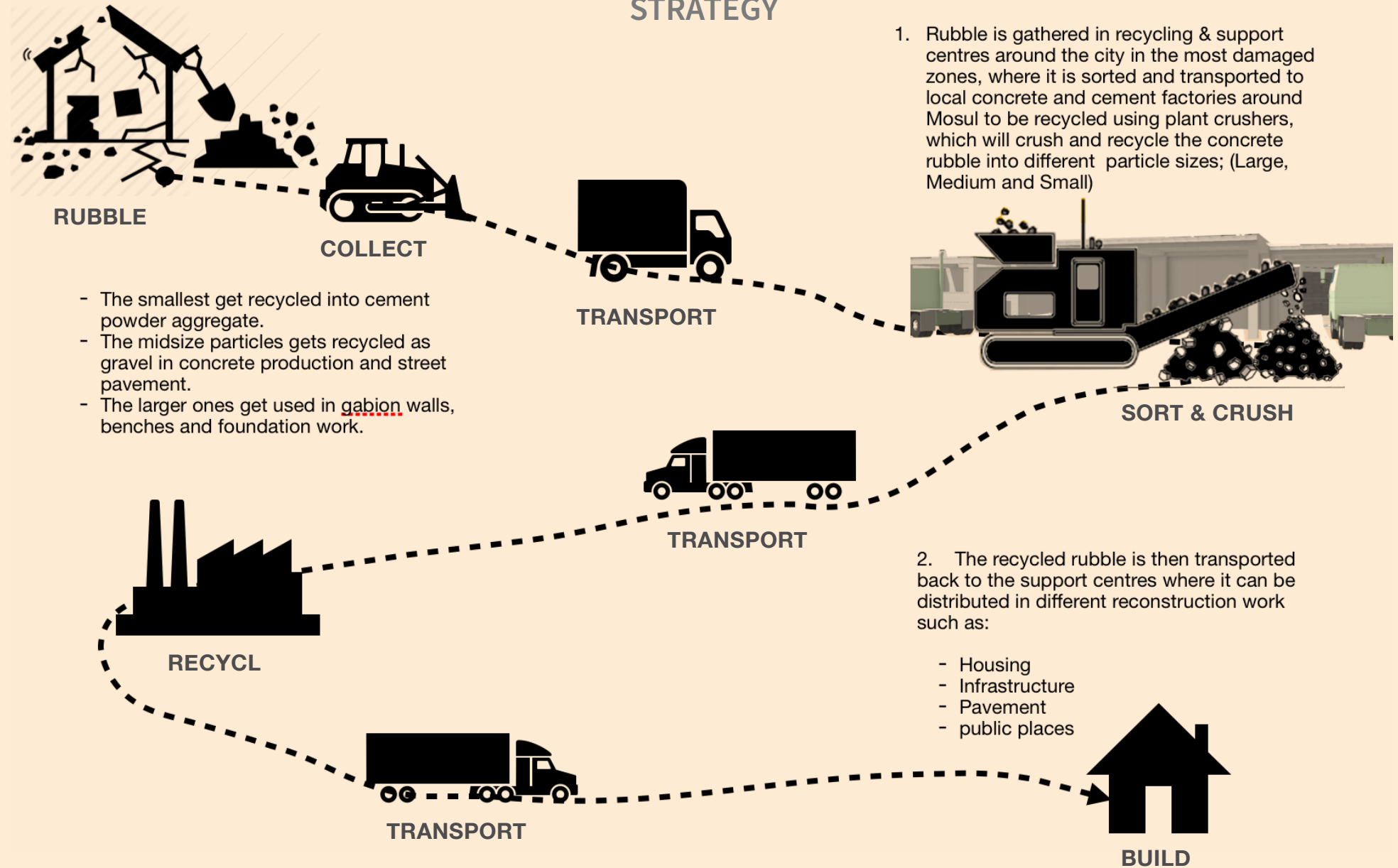
Semi-self built single family housing units being built next to a Support and Recycling centre



**Strategy 2.**

Prefab Multifamily housing

### 3.14 RUBBLE RECYCLING STRATEGY





- Recycling the rubble is crucial in the rebuilding strategy of Mosul, as it will not only help solve one of the biggest practical issue facing returning refugees in the aftermath of the war. It can also lower the cost of the reconstruction as well as reduce the environmental impact of war.



- Another crucial step in the reconstruction process is to reopen the local building industries such as the national concrete and cement plants in Mosul, especially the precast building panel factory in al-Hadbaa neighbourhood.



- The opening of the local building industries will speed up the reconstruction process by reducing the cost of transportation of imported material. It will also boost the local and national economy by generating new employment for the local working force.



- The rubble recycling will help generate new jobs by employing locals in the clearing, sorting and transporting process of rubble.



Image credit: rubble recycling post WWII in Europe, source: Deutsche Fotothek Ablagerung 1945



# 4. PROPOSAL



## 4.1 URBAN DEVELOPMENT PLAN

Past



Great al-Nuri neighbourhood, Mosul's Old town, September 2016

Present



Great al-Nuri neighbourhood, Mosul's Old town, July 2017

Future



Great al-Nuri neighbourhood, Mosul's Old town, unknown date.

Image source: destroyed monument of Mosul, Esri archgis and apple maps.

————— Conservation/restoration area

..... New development area

Area size: appr. 16 sq km

Location: Old Town

Long. & lat. : 36,33° N, 43,10° E

Damage: 95 %

Number of proposed residential units: 120

Number of resident: 544-645

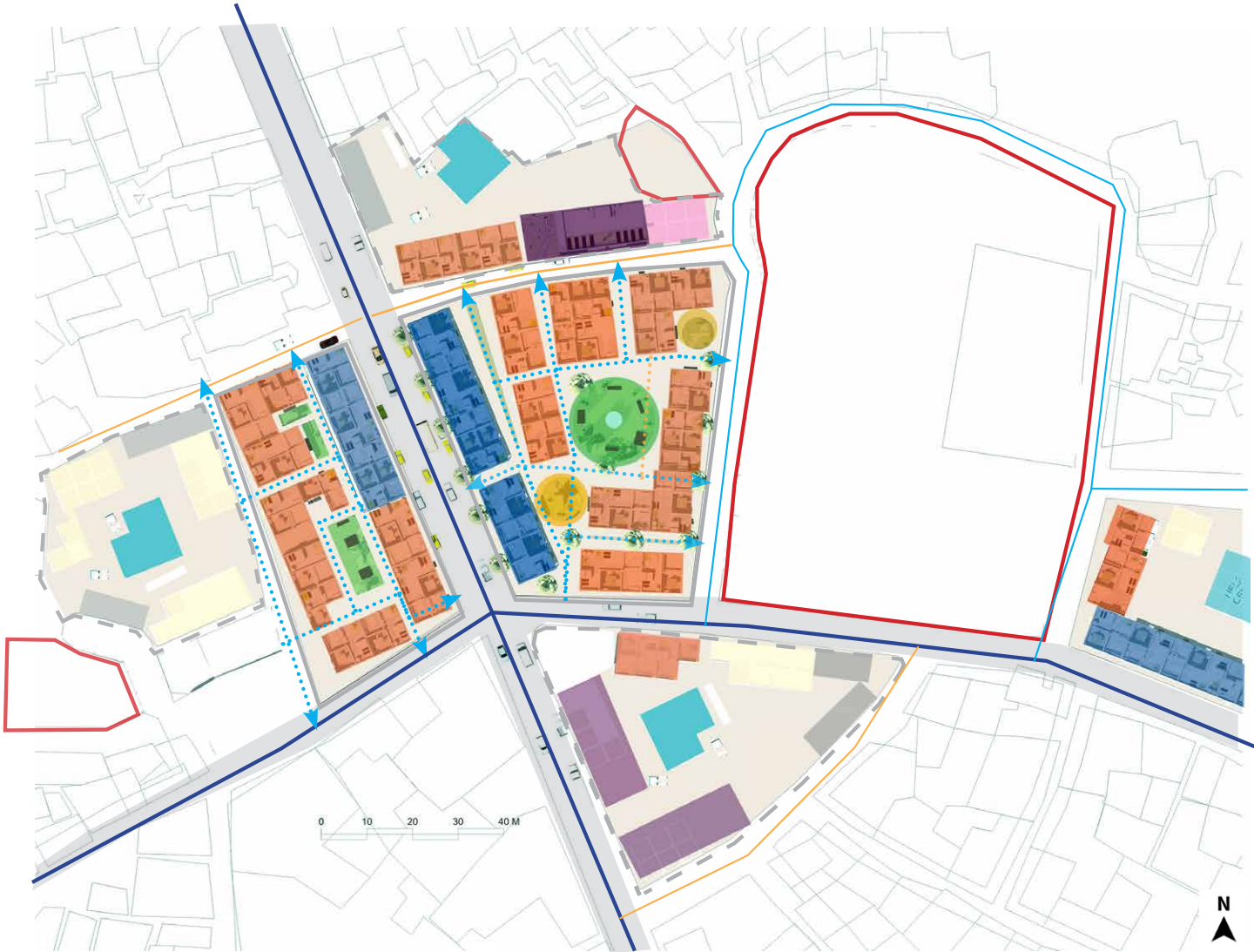
The new development plan takes great consideration of the original pre-war urban fabric and typography in terms of structure and functionality and intends to preserve its unique diverse religious and historic heritage. By not interfering with the existing buildings and only proposing to develop in the completely destroyed sites and fill the urban voids that existed before the war, to develop the area in a sustainable way and effective land-use.

Most of the new proposed development is in the previously parking lots, to densify and maximise the productive use of the scarce urban land, as well as avoid tenure issues since parking lots are a public space that is usually owned by the municipality.

The proposal is developed around the roads, to preserve the original structure of the city and mimic the natural “unplanned” urban growth.

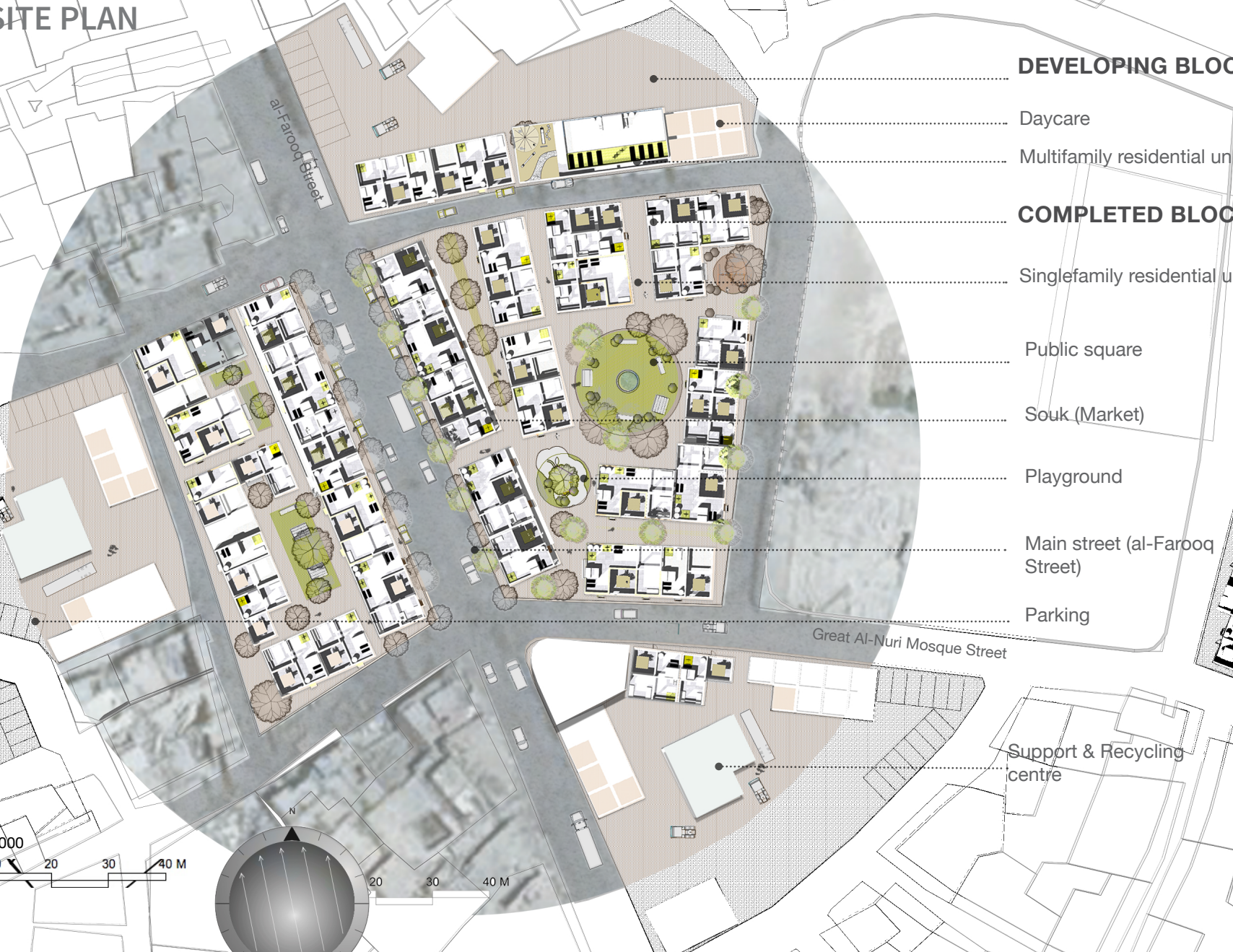
# 4.2 DEVELOPMENT MASTERPLAN

- Legends**
- Conservation/restoration area
  - Developed block
  - - - Developing block
  - ⋯ Proposed pathways
  - Existing Main road
  - Existing Secondary road
  - Proposed Secondary road
- Program**
- Single-family residential unit
  - Mixed use (commercial & residential)
  - Multifamily residential unit
  - Daycare/Nursery
  - Public square/meeting point
  - Playground
  - Urban furniture
  - Parking lots
  - Support & Recycling centre
  - Developing residential units
  - Existing Buildings





# 4.3 SITE PLAN



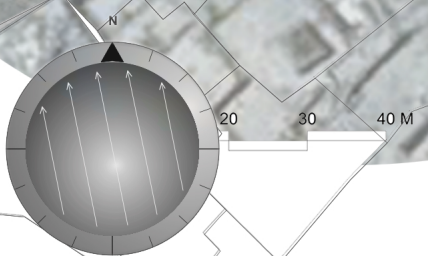
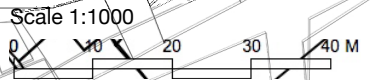
## DEVELOPING BLOCK

- Daycare
- Multifamily residential unit

## COMPLETED BLOCK

- Singlefamily residential unit
- Public square
- Souk (Market)
- Playground
- Main street (al-Farooq Street)
- Parking

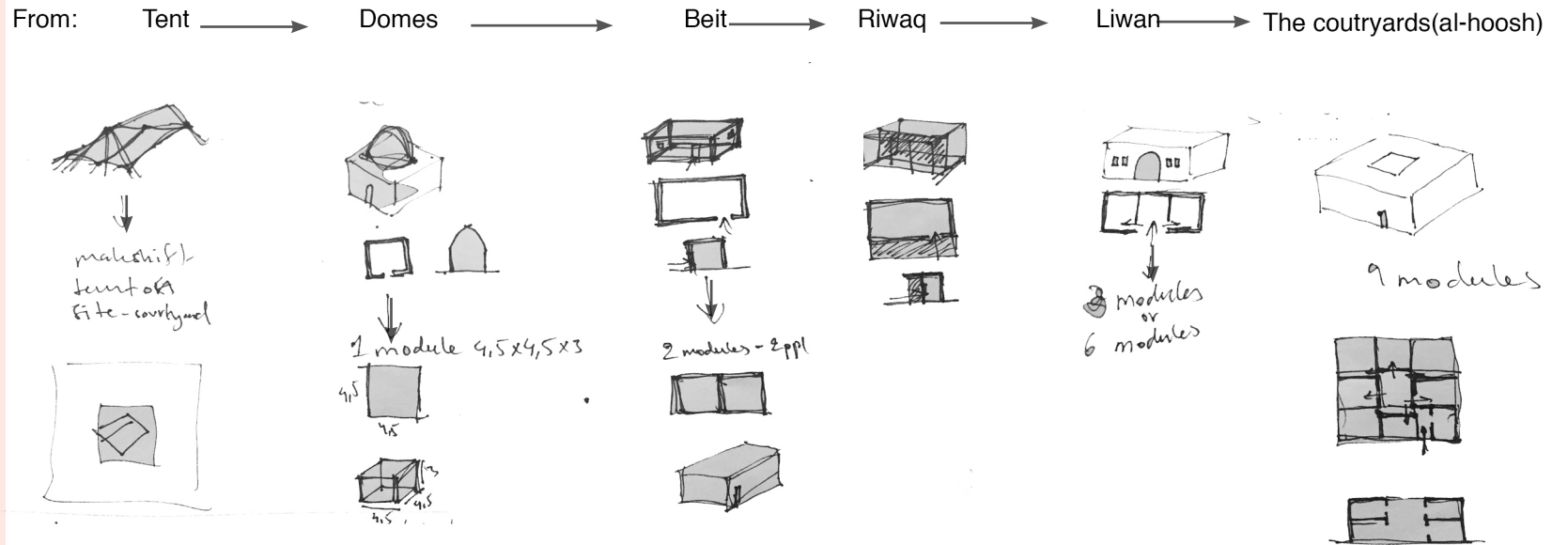
Support & Recycling centre



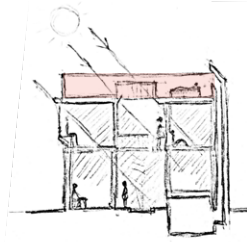
## 4.4 CONCEPT AND DETAILS

### Concept development:

The design concept was inspired by the vernacular architecture of Mosul and the evolution of traditional Arabic dwellings

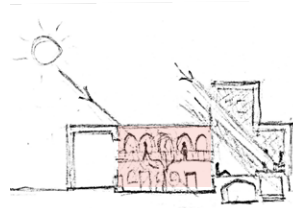


**Microclimatic benefits** of the vernacular architecture which were used in the design proposal.



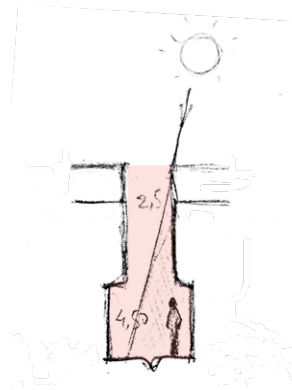
**The Flat Roof Terrace**

The flat roof with high walls is a traditional extra sleeping area in Iraq during the summer



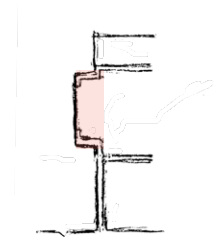
**The Courtyard**

Is the heart of the traditional Mosul house, it provide natural light and ventilation and a private outdoor space for its inhabitants



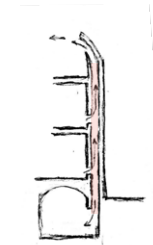
**Narrow Allyways**

The Narrow allyways is an urban vernacular structure that provide shading and protection from the elements.



**The shanasheel**

Is a traditional Arabic bay window with perforated wood screens which provides natural light and airflow.



**The windtower**

The windtower with the wind catcher on the roof provides natural ventilation and thermal insulation

**Traditional features** which were used in the design proposal.



**The Mosulian arch**

A semicircular arch on top a long and narrow opening found on most windows and doors in the Old town.



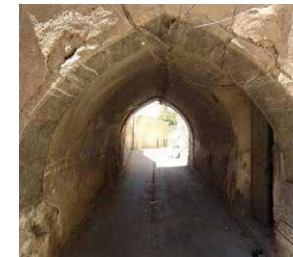
**Interior Windows**

Most of the windows face the interior usually toward the courtyard for privacy.



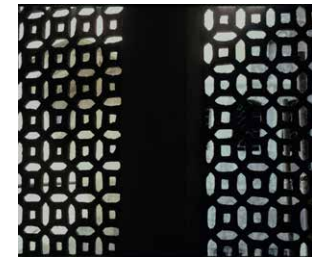
**The Iwan**

A semi-open space facing the courtyard surrounded on one or two sides by other rooms of the house.



**Passageway**

Is a covered narrow alleyway, that allows access between buildings and is an iconic feature of the Old City.



**Arabesque screens**

Is a perforated window screen with an interlaced geometric pattern that controls the passage of sunlight and air to provide natural light and ventilation as well as privacy from the outside.

## 4.5 MATERIAL & CONSTRUCTION

**The structural frame:** is made from steel and concrete molds (a local building technique), the walls are then filled with locally available and affordable materials, ranging from temporary to permanent.

**Wall filling:** tent canvas, local reed-mats, insulated metal sheets, Strawbale, adobe bricks, CEB, Q-brick, Sandbags, Rubblebags, Rubble cement precasts, gabion, clay brick, local stone, local concrete blocks, Precast concrete.



Reedmats,



Strawbale



Adobe bricks,



Sand/Rubble-bags



Gabion



Interlocking earth brick



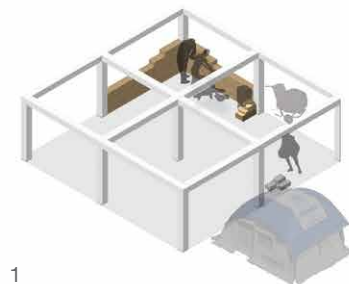
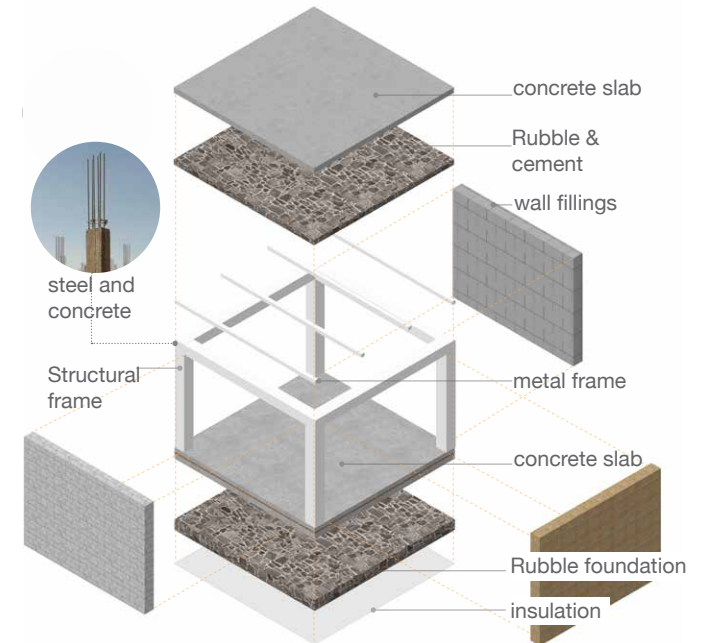
Interlocking rubble brick



local concrete blocks



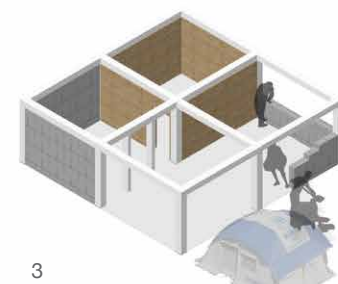
Local stone



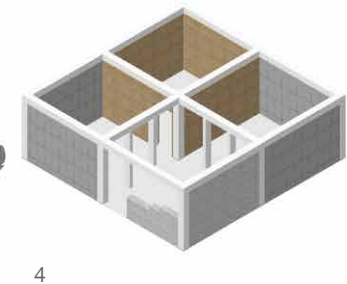
1



2



3



4

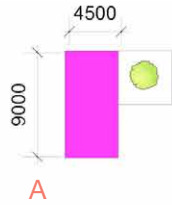
The family start building around the plot and structural frame that they were allocated by the municipality, using affordable material and a makeshift shelter where they stay until they can inhabit their house.

## 4.6 COMBINATION DIAGRAM

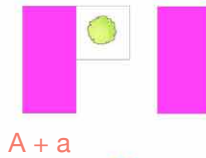
**TYPE**

**A**

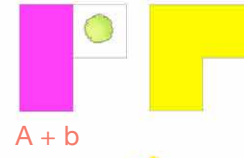
**SMALL**



A



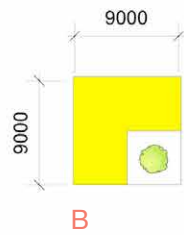
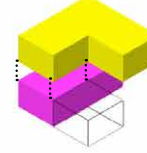
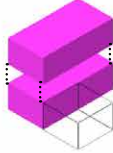
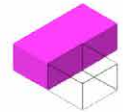
A + a



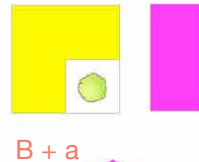
A + b



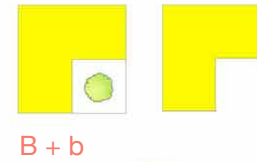
A + c



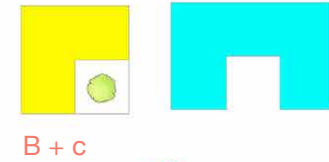
B



B + a



B + b

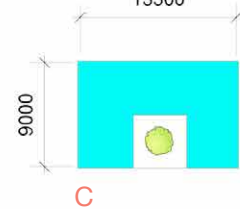
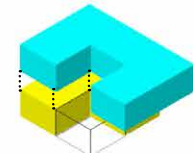
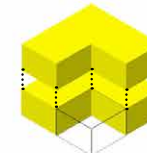
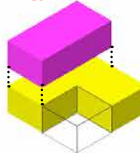


B + c

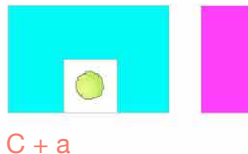
**TYPE**

**B**

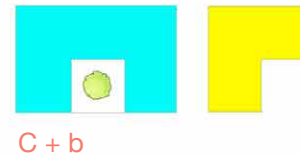
**MEDIUM**



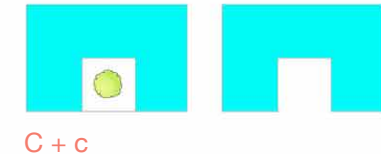
C



C + a



C + b

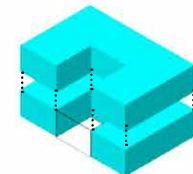
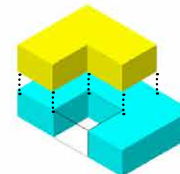
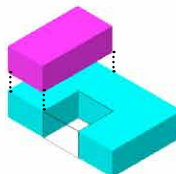


C + c

**TYPE**

**C**

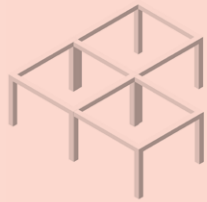
**LARGE**



# 4.7 SINGLE FAMILY UNITS

## TYPE

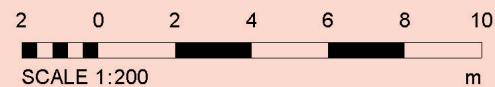
A



Studio  
60 sqm footprint including courtyard  
2 people



Using the 3 modular grid the small family of two can build one floor house with a courtyard and roof terrace for extra sleeping and living space.



## Program

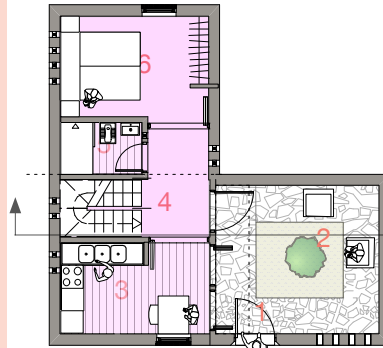
### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Bedroom

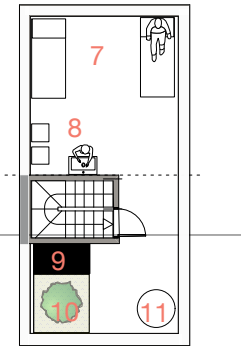
### Roof Terrace

7. Extra sleeping space during summer
8. Laundry Washing & Hanging
9. Solar Panels
10. Planting space
11. Water Tank
12. Wind catcher

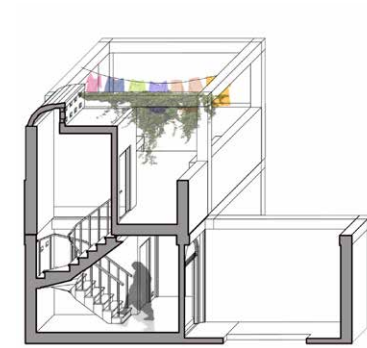
## Ground floor plan



## Roof terrace plan



## Projected Section

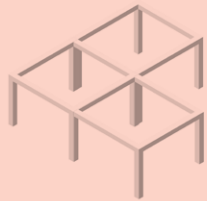


## Exterior view



## TYPE

A + a



60 sqm footprint including courtyard  
3 people



When the family grows they can build an additional floor using the same grid of 3 modules. To accommodate 3-4 people.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Livingroom

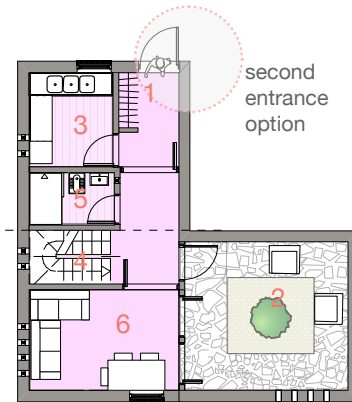
### First Floor

7. double bedroom
8. bathroom
9. staircase
10. single bedroom

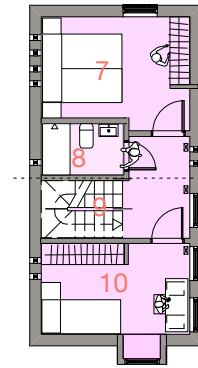
### Roof Terrace

11. Extra sleeping space during summer
12. Laundry Washing & Hanging
13. Solar Panels
14. Planting space
15. Water Tank
16. Windcatcher

## Ground floor plan



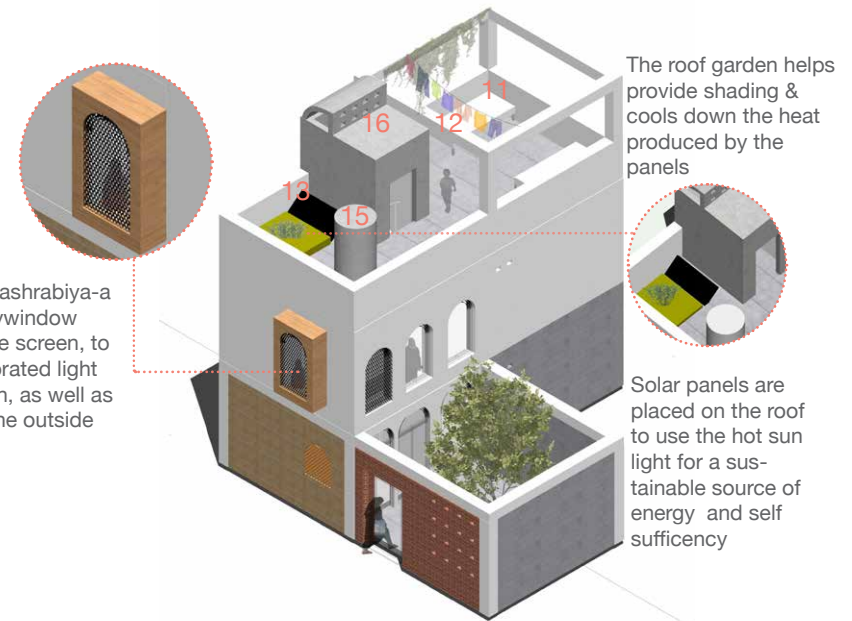
## Roof terrace plan



## Projected Section



## Exterior view



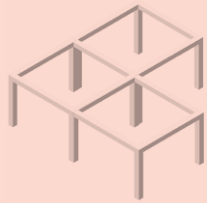
2 0 2 4 6 8 10

SCALE 1:200

m

## TYPE

A + b



60 sqm footprint including courtyard  
5 people



The 3 modular grid the can be extended further on the upperfloor with a room around the courtyard to accommodate 5 people.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Livingroom

### First Floor

7. double bedroom
8. double bedroom
9. bathroom
10. staircase
11. single bedroom

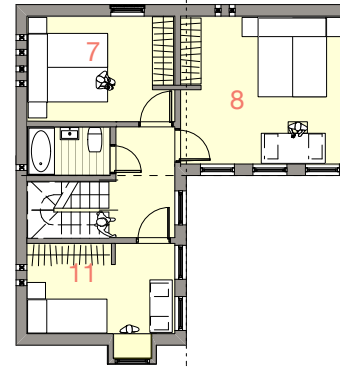
### Roof Terrace

12. Extra sleeping space during summer
13. Laundry Washing & Hanging
14. Solar Panels
15. Planting space
16. Water Tank
17. Wind catcher

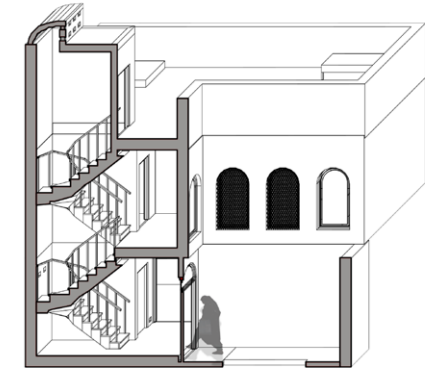
## Ground floor plan



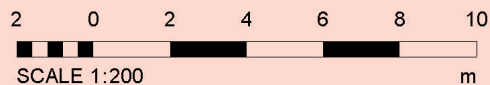
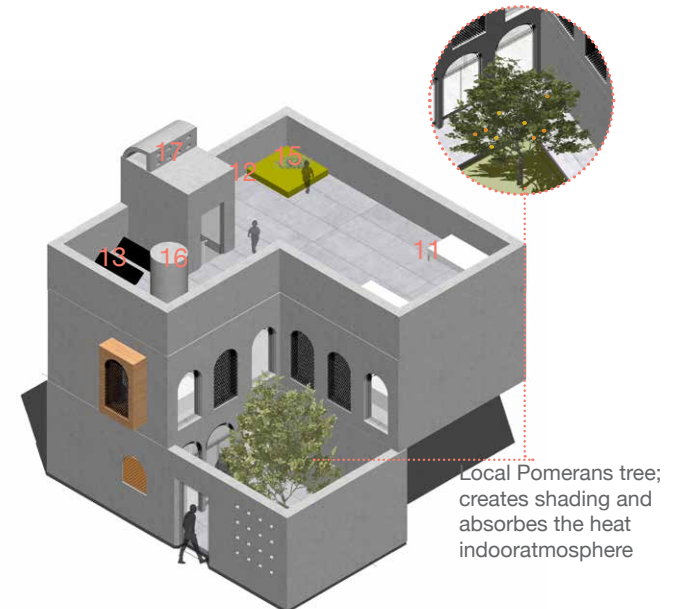
## First floor plan



## Projected Section



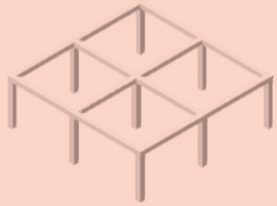
## Exterior view



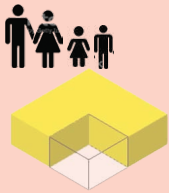


## TYPE

B



81 sqm footprint including courtyard



Using the 4 Modular grid a small family of 3 can build 1 floor with a living room, courtyard and roof terrace.

## Program

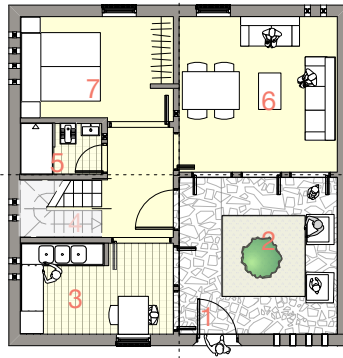
### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Livingroom
7. Double bedroom

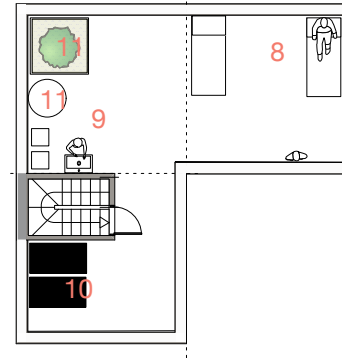
### Roof Terrace

8. Extra sleeping space during summer
9. Laundry Washing & Hanging
10. Solar Panels
11. Planting space
12. Water Tank
13. Wind catcher

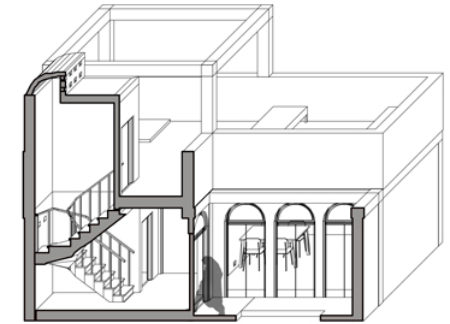
## Ground floor plan



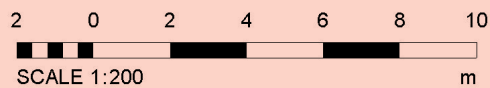
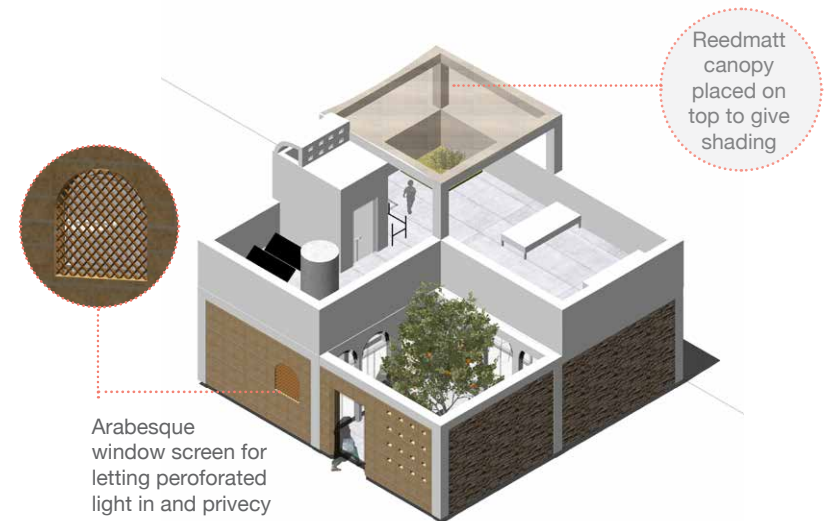
## Roof terrace plan



## Projected Section

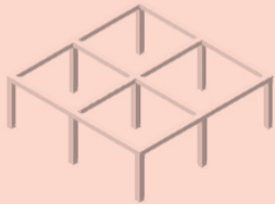


## Exterior view



## TYPE

B + a



81 sqm footprint including courtyard  
5 people



The 4 Modular grid can be extended vertically with a floor to accommodate 5 people of 2 or 3 generations.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Bedroom
7. Livingroom

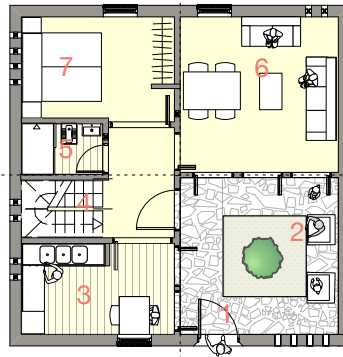
### First Floor

8. Double bedroom
9. Bathroom
10. Staircase
11. Single bedroom

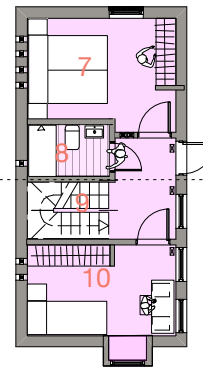
### Roof Terrace

12. Extra sleeping space during summer
13. Laundry Washing & Hanging
14. Solar Panels
15. Planting space
16. Water Tank
17. Wind catcher

## Ground floor plan



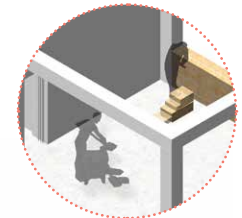
## First floor plan



## Projected Section



## Exterior view



building an additional space on the roof terrace



View of the room interior with mashrabiya window



2 0 2 4 6 8 10

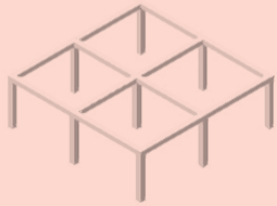
SCALE 1:200

m

PROPOSAL

## TYPE

B + b



81 sqm footprint including courtyard  
7 people



The 4 modular grid the can be extended further on the upperfloor with a room around the courtyard to accommodate 7 people of 2 or 3 generations.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Livingroom

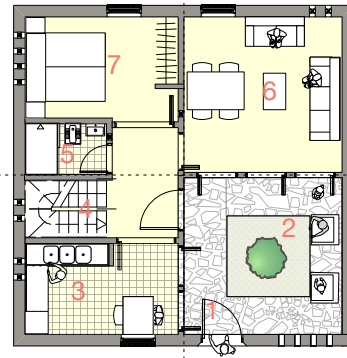
### First Floor

7. double bedroom
8. double bedroom
9. bathroom
10. staircase
11. single bedroom

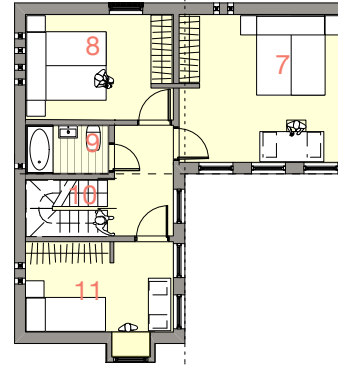
### Roof Terrace

12. Extra sleeping space during summer
13. Laundry Washing & Hanging
14. Solar Panels
15. Planting space
16. Water Tank
17. Wind catcher

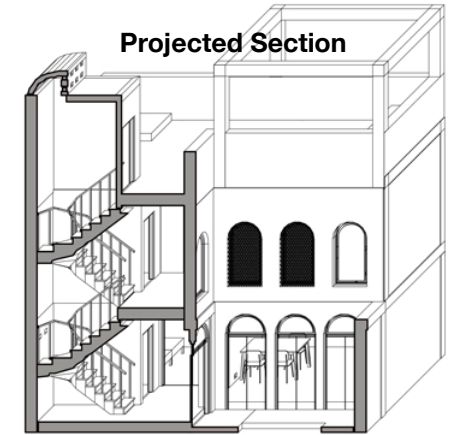
## Ground floor plan



## First floor plan

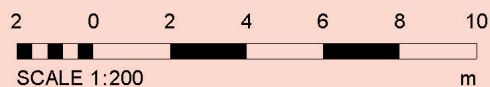


## Projected Section



## Exterior view

water tank, to collect and save water. The elevation helps distribute the water through gravity, saving both land space and cost of extra appliances.

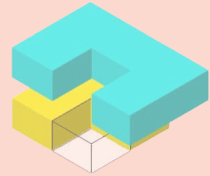


## TYPE

B + b



81 sqm footprint including yard  
7 people



The 4 modular grid the can be extended further on the upperfloor around the courtyard to accommodate 7 people of 2 or 3 generations.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom
6. Livingroom

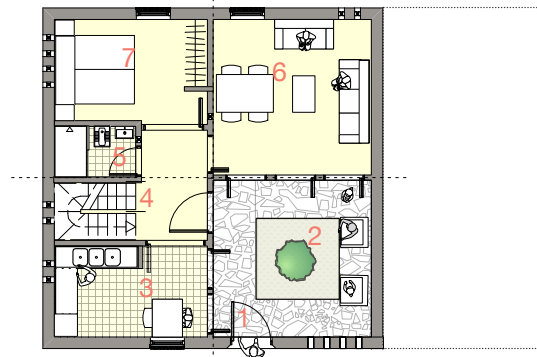
### First Floor

7. double bedroom
8. single bedroom
9. single bedroom
10. single bedroom
11. bathroom
12. staircase
13. single bedroom

### Roof Terrace

14. Extra sleeping space during summer
15. Laundry Washing & Hanging
16. Solar Panels
17. Planting space
18. Water Tank
19. Wind catcher

## Ground floor plan

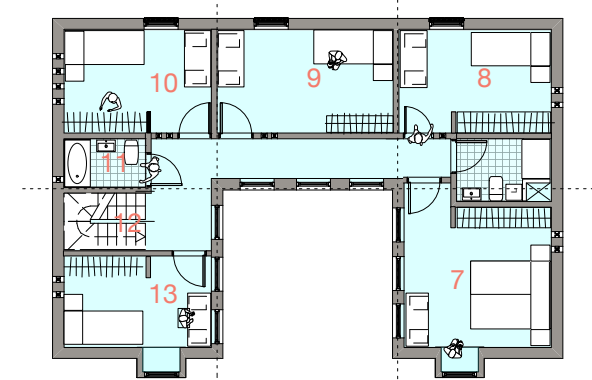


## Projected Section

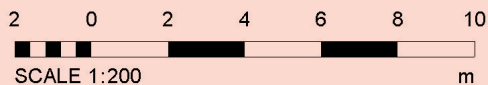


The empty space below will allow for a passage underneath in a dense urban context

## First floor plan

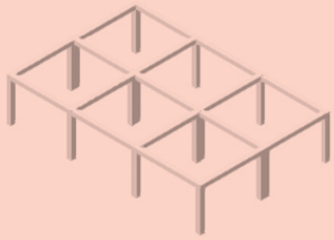


## Exterior view

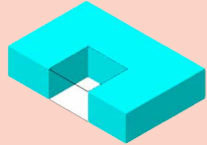


## TYPE

C



121 sqm footprint including courtyard  
6 people



The 6 modular grid is the largest single family housing unit, where a big family of 2-3 generations, can build their own 1 floor house around a courtyard according to the principles of the vernacular architecture in Mosul.

## Program

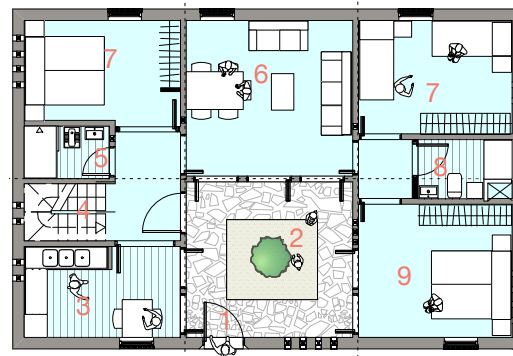
### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom1
6. Livingroom
7. twinbedroom
8. Bathroom2
9. doublebedroom

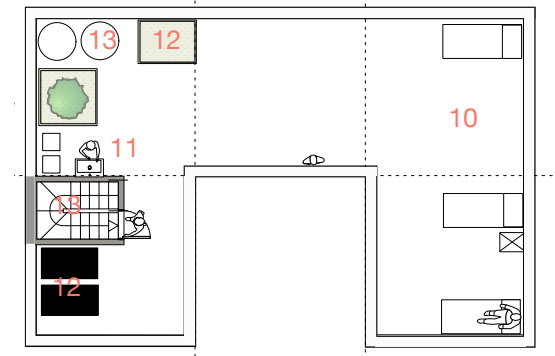
### Roof Terrace

10. Extra sleeping space during summer
11. Laundry Washing & Hanging
12. Solar Panels
13. Planting space
14. Water Tank
15. Wind catcher

## Ground floor plan



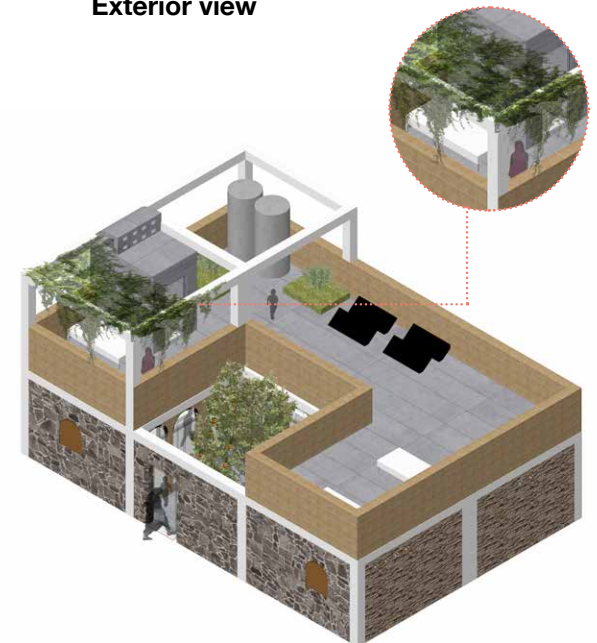
## First floor plan



## Projected Section



## Exterior view

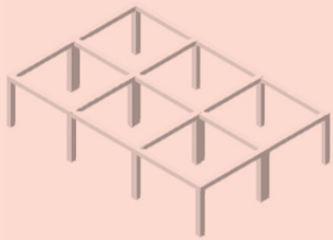


2 0 2 4 6 8 10

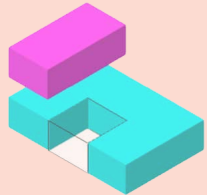
SCALE 1:200 m

## TYPE

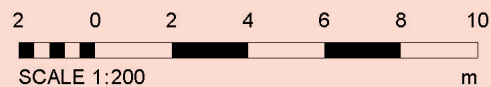
C + a



121 sqm footprint including courtyard  
9 people



The type C house can be extended gradually depending on the needs or original size of the family if combined with the with type b floor plan.



## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom1
6. Livingroom
7. twinbedroom
8. Bathroom2
9. doublebedroom

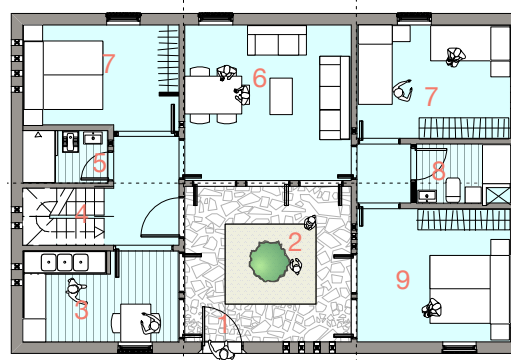
### First Floor

10. double bedroom
11. bathroom
12. staircase
13. single bedroom

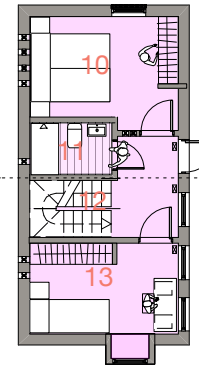
### Roof Terrace

14. Extra sleeping space during summer
15. Laundry Washing & Hanging
16. Solar Panels
17. Planting space
18. Water Tank
19. Wind catcher

## Ground floor plan



## First floor plan



## Projected Section

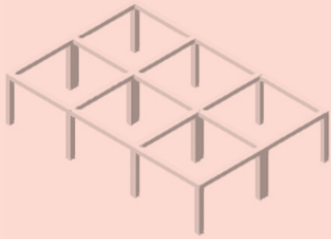


## Exterior view

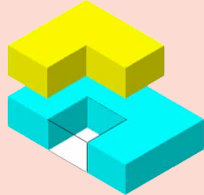


## TYPE

C + b



121 sqm footprint including courtyard  
11 people



The type C house can be extended further when combined with b type floor layout.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom1
6. Livingroom
7. twinbedroom
8. Bathroom2
9. doublebedroom

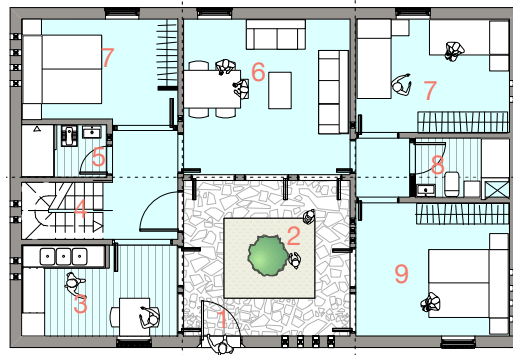
### First Floor

10. double bedroom
11. double bedroom
12. bathroom
13. staircase
14. single bedroom

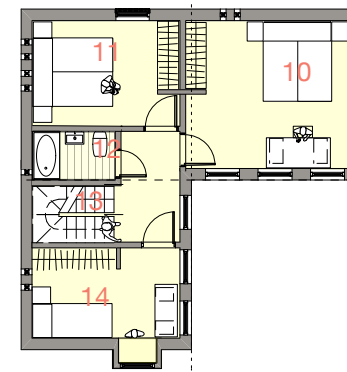
### Roof Terrace

15. Extra sleeping space during summer
16. Laundry Washing & Hanging
17. Solar Panels
18. Planting space
19. Water Tank

## Ground floor plan



## First floor plan



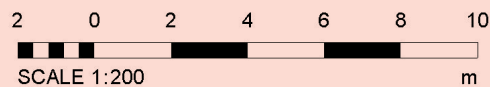
## Projected Section



## Exterior view



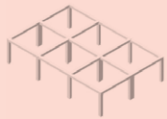
windows are facing the courtyard and are covered with perforated screens to protect the privacy of the household



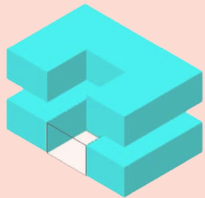
RISING FROM THE RUBBLE

## TYPE

C + c



121 sqm footprint including yard  
12 people



When the house reaches its full potential with 2 floor around the courtyard, it can accommodate up to 12 or more people of 2-3 generation.

## Program

### Ground Floor

1. Entrance
2. Courtyards
3. Kitchen
4. Staircase
5. Bathroom1
6. Livingroom
7. twinroom
8. Bathroom2
9. doubleroom

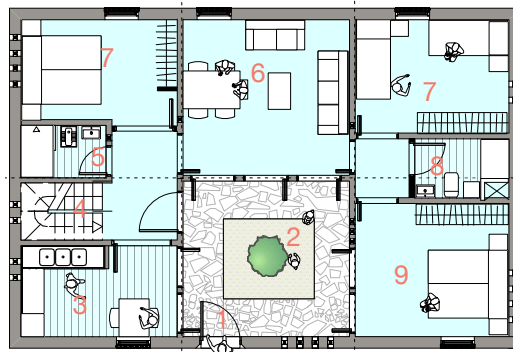
### First Floor

10. doubleroom
11. bathroom
12. singleroom
13. singleroom
14. singleroom
15. bathroom
16. staircase
17. singleroom

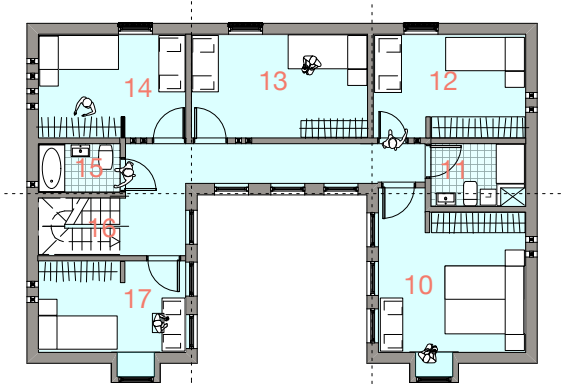
### Roof terrace

18. solar panels
19. Watertank
20. extra sleeping space
21. Laundry
22. plantig space

## Ground floor plan



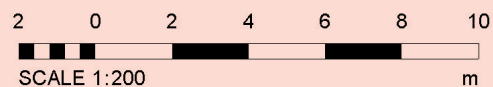
## First floor plan



## Projected Section



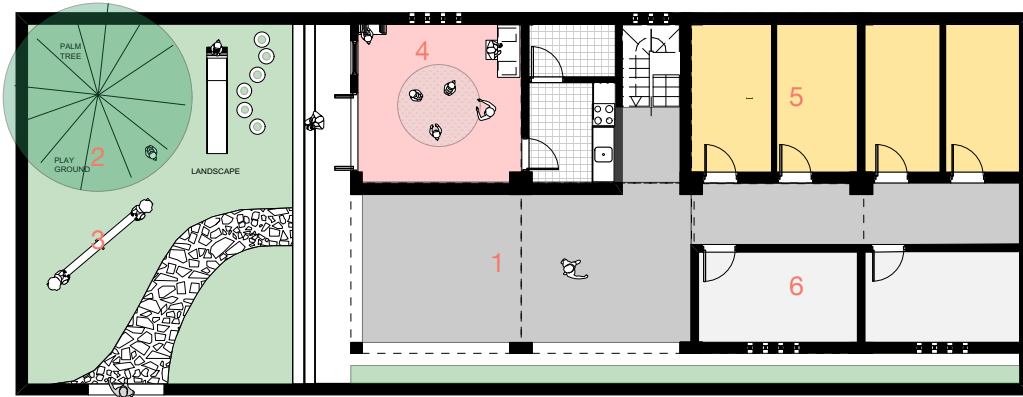
## Exterior view





## 4.8 MULTIFAMILY HOUSING

Ground floor plan



### TYPE D

2C X 2 4 families of 4 people

For the purpose of urban densification and affordable housing I have designed this second option of a mid-rise multifamily housing to accommodate more families in the same space. Using the same grid system but a different building strategy, where a third party is involved in completing the building using local prefabricated concrete.

The housing unit will contain 3 floors which will accommodate 4 families on the 1st and 2nd floor as well as communal spaces on the ground and roof level.

### Program

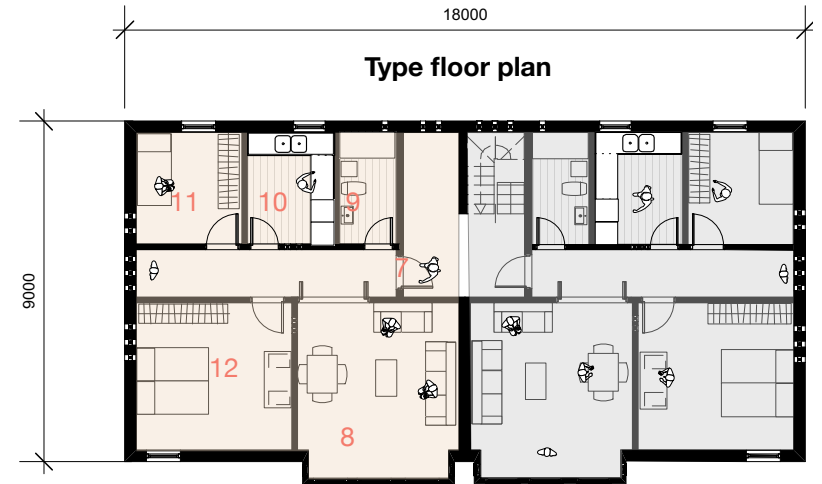
#### Ground Floor

1. Entrance /communal space
2. Garden
3. Playground
4. Daycare with utilities
5. Storage
6. Workshops

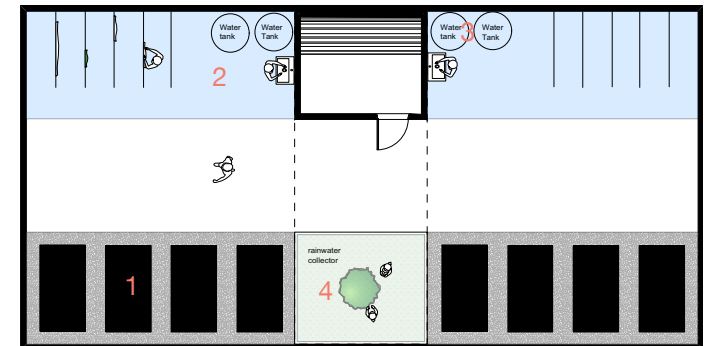
#### Type Floor (flat1)

7. Entrance
8. livingroom with Shanasheel
9. bathroom
10. Kitchen
11. single bedroom
12. double bedroom

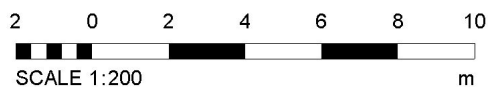
Type floor plan



Roof plan

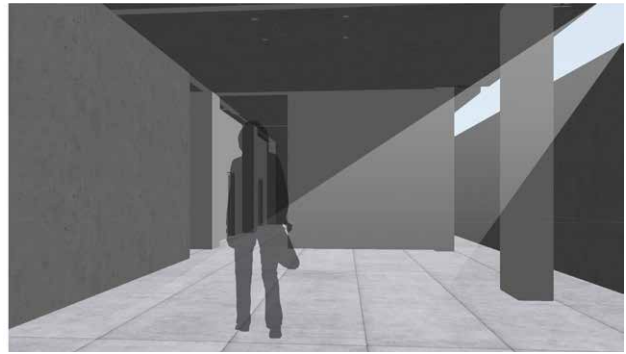


1. Solar Panels
2. Laundry space
3. water tanks
4. Roof Garden/ rainwater collection





Entrance & Daycare



Communal/entrance area



Livingroom

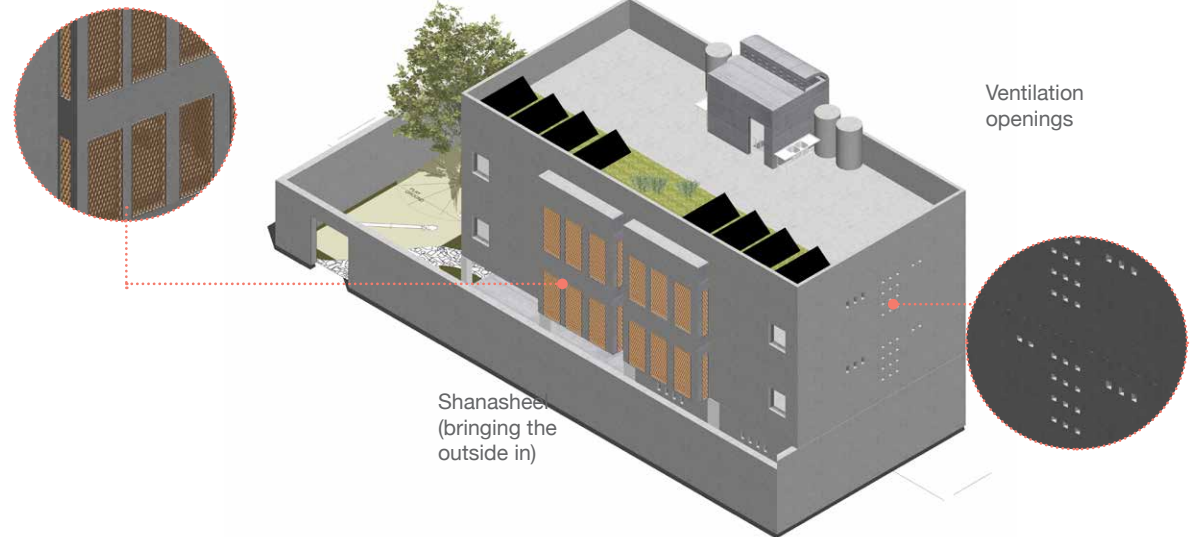


Section scale 1:200

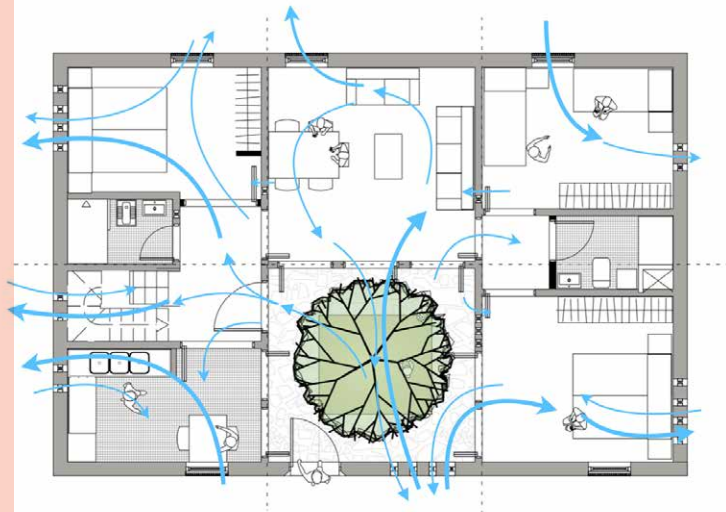
### Projected Section



### Exterior view



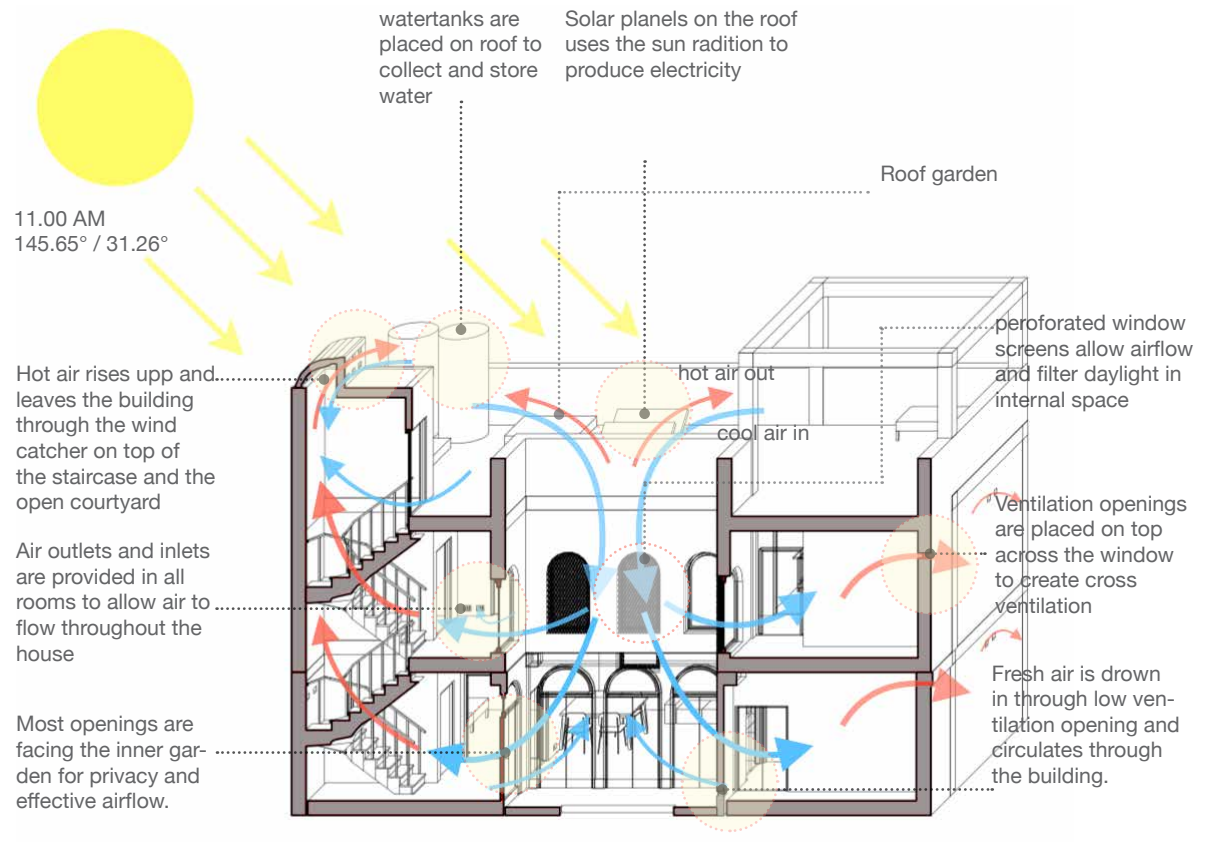
## 4.9 SUSTAINABILITY DIAGRAM “LIFE SUPPORT SYSTEM”



Air flow in the house promotes natural cross ventilation with air inlets and outlets placed across each other

Longitude: 36,33 N  
Latitude: 43,10 E

Rise:	06:18:30	68.74°
Noon:	13:12:53	179.8°
Set :	20:07:17	291.05°

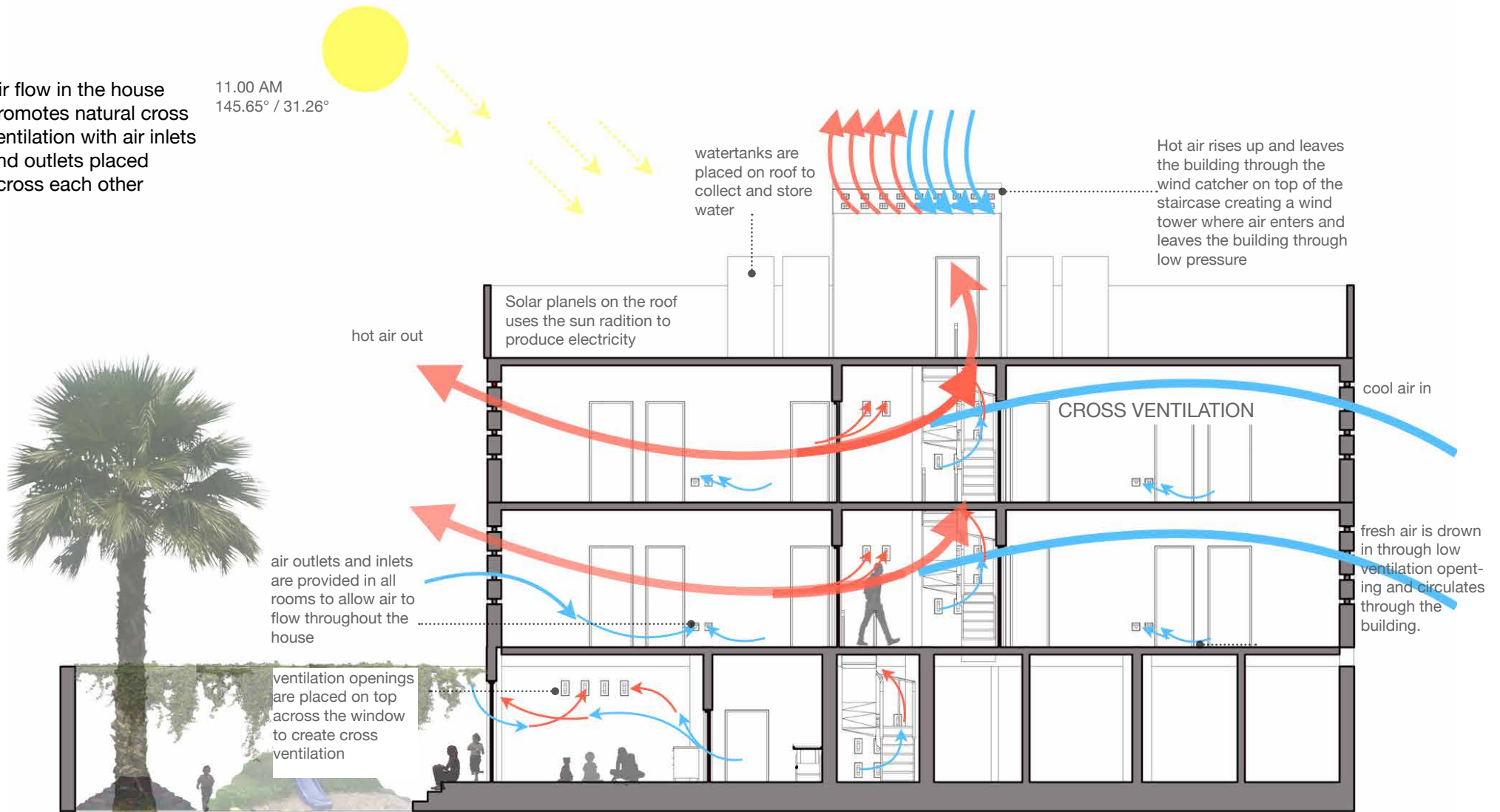


The courtyard house is inspired by the vernacular architecture as response to local climate and customs.

The inner courtyard: creates natural and cross ventilation and a private outdoor space. The high walls and vegetation creates privacy and shadows which cools the air during the hot summer days.

Air flow in the house promotes natural cross ventilation with air inlets and outlets placed across each other

11.00 AM  
145.65° / 31.26°



## 4.10 URBAN PERSPECTIVES

The new neighbourhood block rises from the rubble of the old city in the background. though new, it bares the same characteristic of the old traditional houses in Mosul; low-to mid rise houses with roof terraces and inner courtyards



Helping centres will be allocated on each block to provide assistance and construction materials and manuals for the people to build their houses.

After the block construction is completed the helping centre plot will transform into a public square where the neighbours can share different activities



Souk (Market)

Playground

Main square

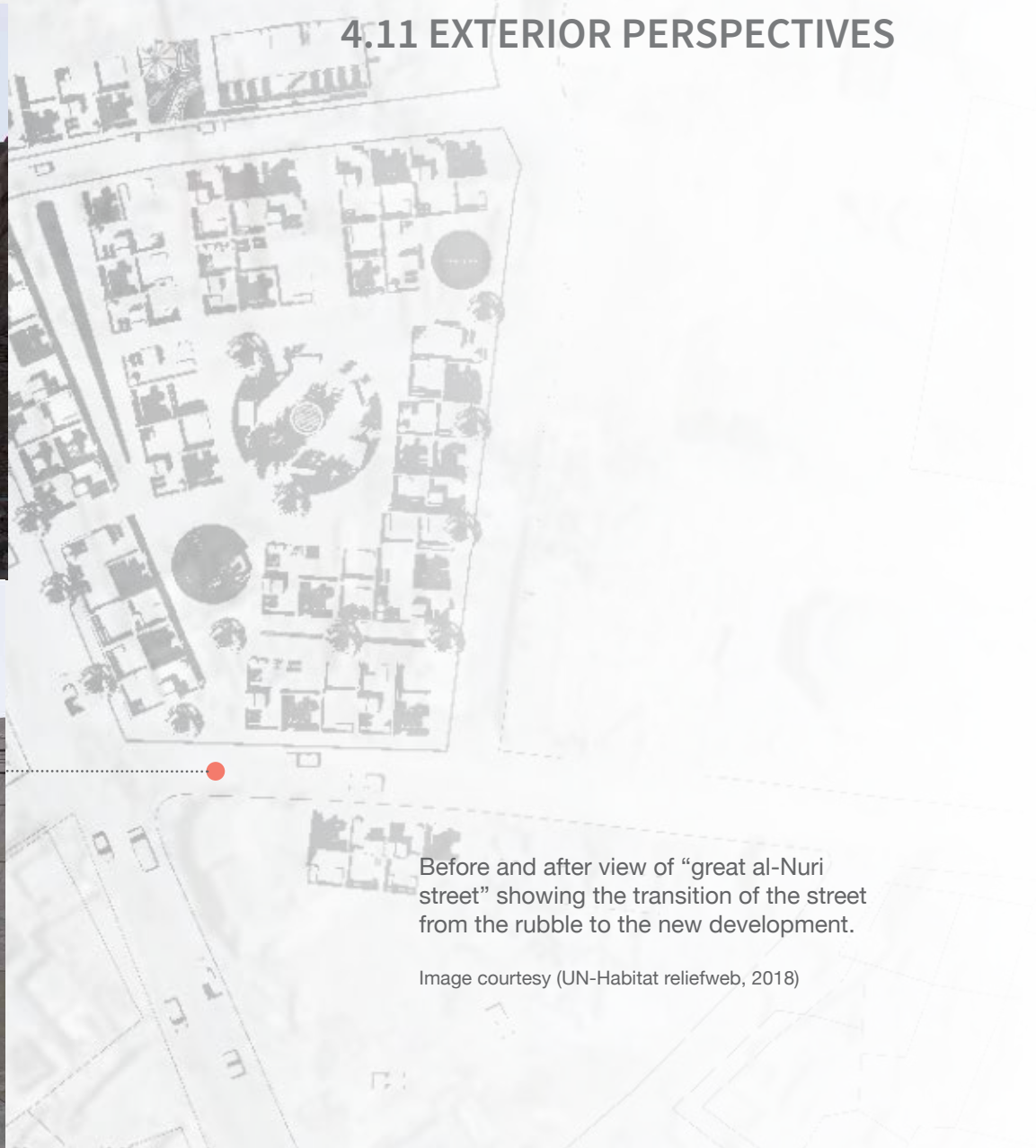
Passage  
footpath/allyways & pas-  
sages are part of the new  
block proposal to keep  
the original characher of  
the neighbourhood.

Souk (Market)  
The buildings facing the main  
roads are raised one level  
above ground to allow for a  
commercial area on ground  
level (according to pre-war  
urban typology)

Support &  
Recycling  
centre

PROPOSAL

## 4.11 EXTERIOR PERSPECTIVES





After

**Great al Nuri Street**  
The new development proposal leaves room for variation in terms of a mix of functions (commercial/residential), building material, height (between 1-4) levels, as well as plot size (between 60-120 sqm), to improve and preserve the vernacular urban structure of the city.





**Souk (Market)**

The buildings facing the main roads are raised one level above ground to allow for a “souk” or market on ground level (according to pre-war urban typology) in the area.



### Main Street

View of the main “al farooq” street, showing the new “Souk” or commercial area on the street level of the new block development, which is characterised by lively streetlife and commercial transaction that expands the pre-war urban function of the neighbourhood and support the local economy





**New allyway**  
A view of an alleyway in the new housing block which is inspired by the characteristic narrow alleyways of the old city.



Playground made from recycled metal from the rubble.

“ I really want the United Nations to participate and bring experts from America, Japan, or Germany who can do things like make gardens for the children, because the children should stop playing in rubble.”

(Abulrahman, Mosul to the percept journal, April 22 2018)

### Playground

The playground is an important element in the healing and rehabilitation process of the children in the war-torn town and should be at the centre of any new development in the area. As children need a stimulating place where they can play and be active. Currently, there are no safe places for children to play at in the old town and many are forced to stay at home or risk detonating a bomb by playing in the rubble. (UN-habitat, 2018)



### The Main Square

View of the main public square, located at the centre of a developed residential block. The square is intended to be a meeting point and recreational space for its residents. With a water-pool in the middle to improve the outdoor climate, and benches made from rubble cages (gabion). The crushed rubble is also used in the paving of the ground.

## 4.12 INTERIOR PERSPECTIVES









perforated window screens,

highrise wall

The design proposal aims to create a comfortable indoor climate using vernacular architectural elements such as perforated window screens, inner courtyard, wind tower and highrise wall to provide natural ventilation and lighting and prevent overheating

Multifamily dwelling:  
Inneryard with garden and  
small playground for chil-  
dren and families. The yard  
is enclosed by high walls for  
shadowing and privacy. To the  
right there's a daycare or small  
nursery for children.

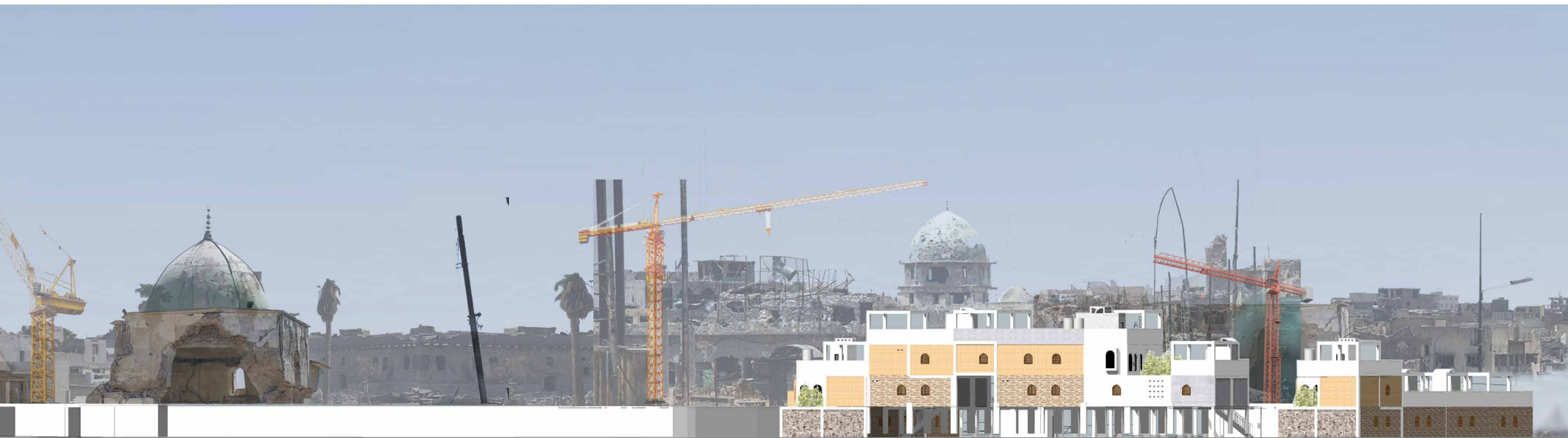


## 4.13 ELEVATION



### North elevation

The elevation shows how the new proposed neighbourhood development rises from the rubble of the old city in the background. The new proposal tries not to interfere and blend in with the existing pre-war topography, by keeping the same features of the old traditional houses in Mosul; low-to mid rise building with roof terraces and inner courtyards which are not higher than 4 levels. Preserving the skyline of the city.





# 5. CONCLUSION

Refugee girl from Mosul playing in De-  
baga refugee camp, Nineveh province,  
Iraq, 2017. Source:© Alamy

## 5.1 CONCLUSION

When I started to write this thesis one year ago, the war had just ended and the humanitarian catastrophe unfolding. No one could predict the scale of destruction and human cost to be that devastating. It was hard to imagine how this once ancient and diverse city could rise again from the rubble. However, my faith in its people's resilience and willingness to live and rebuild their city was strong. Mosul's refugees are indeed returning (Reliefweb, 2018) and rebuilding their houses on their own as well as volunteering and helping each other to rebuild their city, but they need our support.

The destruction of Mosul is too great and will take years and an enormous amount of money and effort to rehabilitate, as it was here that the largest urban battle since WWII was fought. Rebuilding it should be a top priority and a united humanitarian effort by the international community the same way the war against ISIL was. Despite promises, very little support has reached the people there from local authorities and International organisations. They still lack access to basic infrastructures such as running water and electricity. The Old City is still uninhabitable and covered by rubble, reeking corpses and undetonated weapons, which makes the rebuilding efforts very difficult and dangerous.

Due to corruption, scarce financial resources and buildable land in the city, alternative building methods are needed to resettle the returning refugees. I, therefore, propose the establishment of "Support and Recycling Centers" across the city's

destroyed blocks in order to collect and recycle the rubble and provide basic assistance for the vulnerable returning families to rebuild their homes. I also suggest the rehabilitation of the local cement and concrete industry, especially the prefabricated concrete slab factory, to utilize the local resources and speed up the rebuilding process.

A clear urban recovery plan similar to the post-WWII "Marshal Plan" in the reconstruction of Europe is needed to rebuild Mosul, with a fixed timeline and goals that should be executed in collaboration with local authorities, NGO's and the local community.

As architects, we have the ability to reshape our future cities and urban environment to be more sustainable and inclusive. We can help local authorities and NGO's in rebuilding the destroyed cities, by providing sustainable and innovative design and building solutions to the most vulnerable people to rebuild their homes and cities after war or disaster. The solutions should be affordable, sustainable and fit the local context and encourage a circular economy and self-sufficiency.

Due to the huge damage to the existing house structures, a new housing development is necessary for the Old City to accommodate the urgent need to resettle the returning refugees. However, the new development should aim to maintain and continue the architectural and urban tradition of the city, using local knowledge and resources. Hence why I developed a proposal which tries to balance the need for affordable and fast

solutions with the desire to maintain the cultural identity of the city, through the incorporation of some of the old architectural and urban features in a new design that fits current needs and condition.

I hope that this thesis will inspire the local authorities, communities and NGO's to design and build affordable post-war housing without jeopardizing the cultural identity and heritage of the city.

*"I found myself asking whether, at another time in history, we would have reacted differently to what happened in Mosul. Would we have reacted as we did after the liberation of Europe after World War II, flooding it with assistance to rebuild and recover?"*

(Angelina Jolie, UNHCR, 19 June 2018)

# 6. BIBLIOGRAPHY

- Abd El-Khalek, A., UNHCR (11 August 2017), *Hope Amidst Ruins*, retrieved from <http://www.unhcr.org/news/latest/2017/8/598d69314/hope-amid-ruins-displaced-iraqis-return-west-mosul.html>
- Al-Jameel, A. Hassan, University of Mosul, (2012) Re- Implementation of Courtyard in Modern House Architecture in Iraq. I *International Conference on Theory of Architecture, ARCHTHEO 12*, (October 2012) Istanbul, Turkey, page 2-16, publication at: <https://www.researchgate.net/publication/304783905>
- Alcantara, C., Karklis, L. and Uhrmacher, K. (July 14, 2017) *How war ravaged the city of Mosul: in satellite images*, The Washington Post Online, Retrieved from [https://www.washingtonpost.com/graphics/2017/world/war-torn-mosul-july/?utm\\_term=.a0dafa67c015](https://www.washingtonpost.com/graphics/2017/world/war-torn-mosul-july/?utm_term=.a0dafa67c015)
- Anand, K.B., and Ramamurthy, K. (2005). *Development and Evaluation of Hollow Concrete Interlocking Block Masonry System*. The Masonry Society Journal. 23:1, 11-19.
- A year on from battle, Mosul's healthcare system is still in ruins. (9 July 2018 ). *Médecins Sans Frontières Press Release*. Retrieved from: <https://www.msf.org/year-battle-mosuls-healthcare-system-still-ruins>
- Carrié & Magid, (22 April 2018) theintercept, *Destroyed and Saved*, Retrieved from: <https://theintercept.com/2018/04/22/to-defeat-isis-the-u-s-helped-turn-old-mosul-into-rubble-but-wont-help-rebuild-it/>
- Chmaytelli, M., Reuters, (2018), *Allies promise Iraq \$30 billion, falling short of Baghdad's appeal*. Retrieved from: <https://www.reuters.com/article/us-mideast-crisis-iraq-reconstruction-ku/allies-promise-iraq-30-billion-falling-short-of-baghdads-appeal-idUSKCN1FY0TX>
- Cockburn, P. (2017 July 19 ), *The massacre of Mosul*, The Independent, Retrieved from: <http://www.independent.co.uk/news/world/middle-east/mosul-massacre-battle-isis-iraq-city-civilian-casualties-killed-deaths-fighting-forces-islamic-state-a7848781.html>
- Dabrowska, K., & Hann, G. (2008). *Iraq: Then & now: A guide to the country and its people*. Chalfont St. Peter: Bradt Travel Guides.
- Dr. Ali. Y. Aljuboori (June 2017) *A Reflection On Three Years Of Occupation By Isil*, ASOR, Retrieved from <http://www.asor.org/news/2017/07/3rd-anniversary-isis/>
- Hayder Haraty, (2015), *The Iraqi traditional courtyard house: Morphological exploration*, Retrieved from <https://www.slideshare.net/HayderJShakir/the-iraqi-traditional-courtyard-house-morphological-exploration>.
- How the battle for Mosul unfolded. (2017 July 10). *BBC Online*. Retrieved from: <http://www.bbc.co.uk/news/world-middle-east-37702442>
- Iraq profile - timeline. (21 May 2018). *BBC Online*. Retrieved from: <https://www.bbc.com/news/world-middle-east-14546763>
- Iraq Key Figures*, (18 June 2018) OCHA Iraq, United Nations office for coordination of humanitarian affairs. Retrieved from <http://www.unocha.org/iraq>
- Iraq Humanitarian Response Plan 2018. ( Feb. 2018). *UNHCR Reliefweb*, Retrieved from: [https://reliefweb.int/sites/reliefweb.int/files/resources/English\\_2018\\_HRP\\_ExecutiveSummary\\_IRQ\\_Final.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/English_2018_HRP_ExecutiveSummary_IRQ_Final.pdf)
- Liebelt, J. (2010 August 10 ) *Out of the Ashes A New Look at Germany's Postwar Reconstruction* Retrieved from <http://www.spiegel.de/international/germany/out-of-the-ashes-a-new-look-at-germanys-postwar-reconstruction-a-702856-5.html>
- Mallowan, M., (2015), Encyclopædia Britannica, "Nineveh", Retrieved from [www.britannica.com/place/Nineveh-ancient-city-Iraq](http://www.britannica.com/place/Nineveh-ancient-city-Iraq).
- Maini, S. (2010). *Earthen Architecture in the World*. Auroville Earth Institute. Retrieved from [http://www.earthauroville.com/?nav=menu&pg=earth-world&id1=26&lang\\_code=en](http://www.earthauroville.com/?nav=menu&pg=earth-world&id1=26&lang_code=en)
- Mandilawi, A. S. Hasan, (14 May 2017) *Effect of Daylight Application on the Thermal Performance of Iraqi Traditional Vernacular Residential Buildings*. The University of Arizona. Retrieved from: <http://hdl.handle.net/10150/267572>
- Mark, J. J. (2018, March 13). *Mesopotamia*. Retrieved from <https://www.ancient.eu/Mesopotamia/>
- McKnight, J., Dezeen (6 April 2016) *Alejandro Aravena makes housing designs available to the public for free*. Retrieved from <https://www.dezeen.com/2008/11/12/quinta-monroy-by-alejandro-aravena/>



*Mosul damage assessment.* (June, 2018). Ipsos Public Affairs and World Bank. Retrieved from: <https://ip-soswb-dna.maps.arcgis.com/apps/Cascade/index.html?appid=08411a5da50f49d6b1ee560e8a1c75e1>

Mosul still a pile of rubble one year on. (5 July 2018), NRC, *Iraq Press Release*. Retrieved from: <https://www.nrc.no/news/2018/july/mosul-still-a-pile-of-rubble-one-year-on/>

Mosul Weather. (20 June 2018) *World Meteorological Organization (WMO)*. Retrieved from <https://public.wmo.int/en>

Mosul Debris: Preliminary Quantification. (30 July 2017). *UN-habitat, Mosul Portal*, Retrieved from [http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/08/170821\\_PrelimDebrisQuantification.pdf](http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/08/170821_PrelimDebrisQuantification.pdf)

Multi-Sector Damage Assessment. (7 July 2017) *UN-habitat, Mosul Portal*. Retrieved from: [http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/07/170713\\_Damage-Assessment.pdf](http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/07/170713_Damage-Assessment.pdf)

O. Chen, (10 Oct. 2008), *Inhabitat, Affordable and still Green: Sandbag Houses by MMA Architects*, Retrieved from <https://inhabitat.com/sandbag-house-mma-architects/>

*Oxfam in Haiti: One Year After.* (2012) *Oxfam Canada*, Retrieved from: <https://www.oxfamamerica.org/static/oa3/files/oxfamexchange-spring-2011.pdf>

Old City of Mosul. (17 August 2018) *UNESCO Centre du patrimoine mondial*. Retrieved from <http://whc.unesco.org/fr/listesindicatives/6355/>

Petersmann, S., DW (09 July 2018) *Iraq: Danger amid Mosul's ruins* Retrieved from: <https://www.dw.com/en/iraq-danger-amid-mosuls-ruins/a-44455986>

Reardon, C. (16 June 2018) *Angelina Jolie visits West Mosul, where Iraqi families are returning home to ruins*, Retrieved from: <http://www.unhcr.org/news/latest/2018/6/5b25de9f4/angelina-jolie-visits-west-mosul-iraqi-families-returning-home-ruins.html>

Rodgers, L., Stylianou, N. & Dunford, D. (2017 August 7), *Is anything left of Mosul?*, Retrieved from <http://www.bbc.co.uk/news/resources/idt-9d41ef6c-97c9-4953-ba43-284cc62ffdd0>

Shokrollah Manor, (1987) *Evolving The Tradition*, Chalmers University Of Technology, School of Architecture, Department of Housing Design

Shaw, D., (2017 Jul 24) *Nine things you need to know about Mosul*, Retrieved from <http://blogs.redcross.org.uk/appeals/2017/07/nine-things-need-know-mosul/>

THANOON, Abdul-Wahid, A., (N/A) *Iraq, Popular Architecture Of The Old City Of Mosul The Architecture Of The Traditional House*. Retrieved from <http://www.ayk.gov.tr/wp-content/uploads/2015/01/THANOON-Ahmad-Abdul-Wahid-POPULAR-ARCHITECTURE-OF-THE-OLD-CITY-OF-MOSUL-THE-ARCHITECTURE-OF-THE-TRADITIONAL-HOUSE.pdf>

The Mobile Factory, *Happy Homes from Deadly Debris*, Retrieved from: <https://thefactory.org/>

Rebuilding Iraq's liberated areas: Mosul's Housing. (2017). The Rifat Chadriji Prize. Retrieved from [https://docs.google.com/presentation/d/10oa5U-8AVTx808nirPiW\\_4mK26ZTgKY3rP1LA2gkoeag/edit#slide=id.g1ba2436f20\\_1\\_12](https://docs.google.com/presentation/d/10oa5U-8AVTx808nirPiW_4mK26ZTgKY3rP1LA2gkoeag/edit#slide=id.g1ba2436f20_1_12)

Under Siege. (July 2017). *UN-habitat Mosul Portal*, Retrieved from [http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/05/UN-Habitat\\_MosulCityProfile\\_MEdRes\\_170409\\_V6.pdf](http://unhabitatiraq.net/mosulportal/wp-content/uploads/2017/05/UN-Habitat_MosulCityProfile_MEdRes_170409_V6.pdf)

Younger, M (2014). *Rubble Rousers*, Retrieved from: (<http://standardissuemagazine.com/voices/rubble-rousers/>)

Woods, L. (1993). *WAR AND ARCHITECTURE*. Pamphlet Architecture 15, New York: Princeton Architectural Press

