Refugee settlements in Beirut, particularly Palestinian, have developed over 63 years, from being temporary shelters to deteriorated slums...The chaotic self-built constructions coupled with lack of funding and absence of building codes, regulations, and or government supervision, transformed the camps into random concrete morphologies, lacking any quality of life. On a larger scale, the camps became misery holes within the city urban fabric.

The suffering of the camps dwellers and the architectural challenge to rebuild sustainable dwelling structures, have enticed the choice of the topic.

This thesis will provide sets of design parameters for reconstructing those camps in Beirut. Hence, granting the refugees a suitable architectural substitute that compromises economic, environmental and social aspects.

The potentials of refurbishment were researched at the beginning of the study. However, due to the extremely poor unit structures and lack of urban spaces, the choice of refurbishment was dropped in favour of the reconstructing alternative.

In order to do so, camp design was investigated as on three different levels: the urban, unit and relationship between urban and unit. Indoor and outdoor comfort criteria, lessons from vernacular and other built precedents and socio-spatial camp considerations, were also studied in order to develop a starting point (base case unit).

Afterwards, the impact of different design parameters (mainly urban canyon, density, cost and geometry) were duly analysed on the urban and unit level, through simulation (using: Open Studio 1.10.0, Grasshopper and Rayman v 2.2 ) in order to upgrade the base case and select its proper urban morphology. The Burj Al Barajneh Camp, south of Beirut, was chosen as the design application site, where the upgraded base case was tailored to the density conditions of the site and simulation (ventilation, thermal and daylight) to verify the environmental efficiency of the proposal.

The results, courtyard conglomerates of different heights (maximum five floors) and generally SW oriented, were found to be environmentally and economically feasible solutions. Diverse outdoor spaces with dissimilar plot patterns were suggested.

The conglomerates are made of free running housing units (90% of the time). Multifunctional room dominated those units. A 15 % window to floor ratio of single glazed windows was a good balance between them and economical parameters. The low WFR hindered the effect of sun exposure on the units.
In order to select wall material. An insulation investigation had to be done. Simulations were carried out of whether an adaptive or inadaptive insulation strategy is better for the wall.

- Urban canyon - according to average sun
- WFR - according to Lebanese Standards tested

Upgrade the assumed Parameters

- Base case unit with materials (assumed urban canyon width)
- Base unit and urban morphology
- Density & thermal studies
The main goal of this architectural proposal is to define a series of feasible strategies that work to improve the camp living conditions and its role within the urban fabric. The main focus of the project is the residential units within the camp that occupy 96% of its total area.

“Our generation, where are we going to live? There is no place in the camp and we cannot own property outside.”

Muhammad Hamady
( Amnesty International, 2007a)

A diagram showing the camp specs (area, function distribution, demographics) and a canyon ratio comparison with the rest of Beirut.

A diagram showing the balance component criteria of camp design, on which the decisions in this project were made.
Annual summary of Beirut’s weather and the respective solar and diffused radiation. In addition to a monthly assessment of the efficiency of the passive strategies, based on criteria from literature | Data | Source: Climate Consultant 6.0 and Metronome 2015).
Diagram showing the sky view factor for different canyon orientations. (After: Grasshopper & Meteonorm v6.1)

Current CAMP Situation
Area = 83m²

Why a straight grid?
- Lower cost
- Easier to build (self built)
- Easier to control (while building, and after building, security)

BASE-CASE PLAN
Area = 102 m²

STANDARDS
Area = 110 - 120 m² - (Parker Morris)

Narrow Floor Plan
SW Oriented
Cross Ventilated
Open Plan

Multi-functional Rooms (80% of the space)

Bedroom / living area

Mousharabia

Sofa, bed

Study / room / kitchen

Diagram showing the assumed urban canyon and height limitation.

"We need the Sun from 11am to 1 pm"
-Camp Occupant

“Overlaying the occupant schedule on sun path diagram

Creating the Base Case Unit

Cross Ventilated
SW Oriented
Open Plan
Narrow Floor Plan
Multi-functional Rooms (80% of the space)

Study room / kitchen
Bedroom / living area
Sofa bed
Mousharabia

FAR = 5

9 m 9 m

Urban ratio to be tested

A diagram showing the assumed urban canyon and height limitation.
A diagram showing the overlaid occupant schedule on sun path diagram - Sun path (Source: Grasshopper & Meteonorm v6.1)

**Diagram showing the yearly heating/cooling loads for the multi-purpose room with different WFR, on three floors (After: Open Studio v1.10.0).**

A moucharabieh allows ventilation and provides different interior divisions, hence, different grades of privacy. Straw is a local cheap material and straw moucharabieh are made by the locals.

**Generic base case unit showing the interior.**
Morphology Vs. Density Studies

**Camp Area** = 389,525m² - without existing Public Amnesties
**Number of people** = 33,000 - with the Syrian Refugees
**Population Density** = 0.084
**Canyon Ratio** = W/H = 2.5 = 6m - Main streets - inclusive of Fire Safety criteria

<table>
<thead>
<tr>
<th>Urban Morphology</th>
<th>Canyon Specs</th>
<th>Population Density</th>
<th>No# of People in Camp Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Squarish</td>
<td>78769</td>
<td>30,401</td>
</tr>
<tr>
<td>C2</td>
<td>Squarish</td>
<td>89824</td>
<td>34,988</td>
</tr>
<tr>
<td>C3</td>
<td>Squarish</td>
<td>128,449</td>
<td>50,034</td>
</tr>
<tr>
<td>C4</td>
<td>Rhombus</td>
<td>95522</td>
<td>37,208</td>
</tr>
<tr>
<td>C5</td>
<td>Rectangular</td>
<td>77364</td>
<td>30135</td>
</tr>
<tr>
<td>C6</td>
<td>Rectangular</td>
<td>0.037</td>
<td>34,385</td>
</tr>
</tbody>
</table>

A table showing the morphology vs. density studies for Al Burj camp.

Finding the Urban Morphology

A diagram showing the tested urban canyon ratios (case I: H/W=2.5 case II: H/W = 1.58).

A diagram showing yearly heating/cooling loads of the multi-purpose room of the middle floor for two different canyons. (After Open Studio v 1.10.0)
Urban level Studies: Ventilation Potential

A. Orientation Criteria

Three conglomerates C2, C3, C4 showed better ventilation potential when oriented SW and the C6 showed better results when elongated vertically.

Results of a simulation showing the thermal performance of the multi-purpose room C2.A inside the courtyard conglomerate during an average winter week.

Constants:

\[ WFR = 15\% \]

\[ 40\% S - 60\% N \]

A diagram showing the ventilation potential studies for the selected conglomerates of Al Burj camp.
Interior rendering for the multifunctional room, showing the carpet walls, in winter.

Top view rendering of the courtyard conglomerate C2.A, showing the pergolas and solar panel, and circulation/overhang.

Rendering showing the interior view from the courtyard.

Interior rendering for the multifunctional room, in summer.

Rendering of one building inside the courtyard conglomerate C2.A, showing the pergolas and solar panel, and circulation/overhang.
Rendering showing the interior view from the courtyard & the ongoing outdoor activities, and materials in summer. For mPet parameters.

```
Asphalt
mPET = 22.8 °C
Concrete
mPET = 33.1 °C
```

Rendering showing the interior view from the courtyard & the ongoing outdoor activities, in winter.

```
Vinyl Tent
mPET = 17.5 °C
```

A rendered camp portion showing the different element constituting the variable outdoor spaces.