Revive The Night-life Integrity in Jabal Al-Natheeef  
(Informal Refugee Camp) 

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Architectural Lighting Design 
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11 April 2019
Acknowledgements

This study is dedicated to all Refugees around the world, who had lost their homes and still, they found power and resilience to move to a new land and build new homes and create new life all over again.

Arini organization, for being one of the few non-profit organizations that showed interest in tackling informal refugee camps issues.

My family and friends for the consistent love and support.

Erik, for always inspiring me in whatever I do...
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1.0 Abstract

The refugee problem is growing everywhere around the world, due to the continuous discrimination for people in their countries. Palestinians who fled to Jordan had no choice but to build their homes by themselves, and after some time, it formed what is known as informal refugee camps, that are neglected by Jordanian government and NGO organizations. The informal camps characterized by a high density of buildings, Poor infrastructure, the spread of crime, and lack to a basic need in an urban area, (access to water, education and street lighting). The main motive of this study is to evaluate outdoor lighting in the pedestrian area on a selected site in Jabal al Natheef, using qualitative and quantitative approaches, and propose lighting design guidelines that ensure social, economic and environmental sustainability.

2.0 Introduction

"Amman is a city that was shaped mostly by migration waves; refugees have almost organically sculpted it. They gave shape to the cityscapes and the urban scenery, as they started building in its margins, which later became central neighborhoods." [1] Research on refugee camps has often helped in following the process of home-making. It is a meticulous work that brings out the architect in the refugee. In older camps, the state has often interfered over time, and the built environment was rehabilitated as refugees integrated the city.

"City-making and Home-making are two scales of analysis of the refugee's know-how in shaping their living conditions and stimulating their integration with the urban fabric. The refugees' "City making" can be analyzed through the study of neighborhoods made for and by the individuals recreating their communities in exile. As these neighborhoods grow and the state rehabilitates the unofficial camps, they become part of the city and give identity to its urban scenery. As the city expands in size, what was the periphery becomes the center, and the camp becomes central to the city's geography and history. Hence, local Jordanian typologies include inventions made by the city dwellers themselves. The refugee camp, being a pretext for the state to intervene less in the area, turns into a zone of innovation where the inhabitants have no choice but to "make the city" as they find fit."[2] Due to the dense urban tissue, a sort of inward organic urbanism evolves, and the inhabitants come up with their facilities of shared space. Jabal Al-Natheef refugee camp is one of these many informal camps that was built and established by the refugees themselves. It suffers from negligence from both the municipality and non-profit organizations sides. Few studies have been made on Jabal Al-Natheef, the most outstanding study was a publication with a title of Mapping Jabal Al-Natheef done by Arini (non-profit private study and research institution; that facilitates, promotes and provides workshops in the fields of; architecture, urbanism, art, and design) which was a very helpful resource to achieve this master thesis objective.

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3.0 Background, a social approach to urban lighting

"In many situations, particularly when people are concerned about security, there is a tendency to over-light a park, plaza, street, or other public space. However, too much lighting can be just as bad as too little lighting. The key to developing a good plan is to relate lighting to the evening functions of a particular space because, in the larger view, street lighting is more than just a technical requirement, a security need, or a design element. It can be thought of and utilized in terms of how the type, placement, and wattage affect how a street or path is perceived and used." [3]

Many aspects are involved when deciding on choosing the most suitable lighting solution for an outdoor open space. Type of activities that occur, type of users, and the hours of activity in addition to opinions of users or residents that surround the area if it is the case as well as the culture of specific area plays a significant role in influencing the lighting solution choices, all these aspects must be considered under the umbrella of sustainability. In this paper, all of the mentioned above aspects will be examined of how much of an influence it could make in enhancing safety and security, Way-finding and accessibility and social interaction and behavior of users using lighting design.

3.1 Impact of lighting on safety and security

"A review by the UK Home Office of 13 UK and US studies on the interrelation between improved street lighting and crime levels documented an overall decrease in recorded crime of on average of 20% across experimental areas. This reduction was observed across the day- and night-time, supporting increased social control and community pride through improved lighting as a reason, instead of increased surveillance through higher illumination. People's perception and feelings of safety in a night-time environment often differ substantially from actual risks."[4]

In general, lit places are safer than dark areas; however, whether light above a specific illuminance further increases the safety of a place is less clear. "Overly lit nightscapes can reduce the eyes' ability to adapt to darkness and spot danger, especially in areas with varying light levels across adjacent spaces and could subjectively be associated to unsafe places."

When considering Jane Jacobs' urban theory on the importance of 'eyes on the street'. [4] The ability of more lighting to make spaces safer can be further questioned: rather than seeing lighting as a direct enabler for safety, enhanced illumination should be seen as a means to attract more people to space, thus creating safety through presence and activity. This highlights that sufficient lighting for safety requires more than a simple illumination of space. The best example that represents the impact of lighting on safety and security is Jan Jacobs Case study; East NY Tillett Lighting Design. This example is just one of the several lighting design effort based on a social exploration and approach to the design process in order to generate more human-scale strategies of lighting. In addition to the reflective materials throughout the city, the scenario proposed is also based on the reintroduction of portable lanterns, systems of personal and movable lighting that can serve lighting when and when you need it. The most important buildings and landmarks were defined; so the proposed solutions were functional and cost saving. Jan is reflecting reality by believing that lights will not make the place safer, so she kept a regular light in the safe areas and kept the dangerous areas dark so people avoid it.

"Do not interpret reality depending on your patterns"
3.2 Impact of lighting on social activities and people's behavior

“All light triggers physical and behavioral reactions in the human body. Illumination can have both beneficial and detrimental impacts on a person, depending on the quality, type, and intensity of light. Especially during the winter months, with shorter days and longer nights, artificial light is a powerful tool in fighting seasonal affective disorder, a type of depression caused by a lack of stimulation of the Hypothalamus via sunlight. Light has the power to completely change the experience of a place” [6]

At night, the impression of a city is created through what is illuminated.”

Light and art are powerful tools to create an atmosphere for a place; they significantly shape the sensorial experiences of the surroundings. Successful city making creates a canvas for people to explore and fill with life.” [7] As a result, Lighting can be used to determine the type and hours of activities that can occur within a space during night time. One of the strategies to regulate the hours of people's activity, is adding a dimming system to lighting fixtures, for example when lighting in an outdoor space dims down to 25% at curfew hour, people will be impacted by poor visibility and lack of safety and therefore leave the space.

3.3 Impact of lighting on way finding and accessibility

“Safe transport experiences, easy navigation, and clear way-finding are crucial elements of any urban night-time experience. It is essential to recognize that fundamentally different factors shape nighttime way-finding and navigation to those of daytime. At night, the strategic integration of light sources into the urban fabric can significantly improve people's orientation, providing guidance and direction. Nighttime way-finding offers the possibility to maneuver people's attention towards a particular direction or destination.” [8] If lighting solutions provided for way-finding considered the existing built environment as well as the activity of the users in the area, it could profoundly affect the pedestrian experience and movement from one point to another, without creating any confusion for the user in terms of navigation and orientation.

An example of way-finding projects considering human activity and site character of outdoor space is a project done by Lighting designer Meritte Manson, In a park located in Copenhagen, Denmark. The park is perceived safe to people, and the most activity that takes place in this park is jogging, so the target group was specified, and the fact that the park is considered safe lead to the decision of adding only bollards alongside the routes the people take, in order to guide their movement.

3.4 CLUE competition: Edition 05 – Light and Disruption, exploring the role of light in emergencies

Competition Objective:

Explore how light can help to prevent challenging situations and crisis or manage emergencies when they occur. In testing circumstances, how lighting designers can unlock the extraordinary potential of light for brighter lives and a better world. During an incident or emergency, it is understandable that confusion, disorientation, and even panic are likely responses. That is why, in this edition, the objective to be achieved by students and professionals asking young students and professionals to imagine how lighting can make a difference – big or small. [9]

4.0 Site Analysis

4.1 Jabal Al-Natheef Camp Overview

"Jabal Al-Natheef is an informal refugee camp, that started developing after the Palestinian/Israeli war 1948 by Palestinian Refugees who fled to Jordan for security purposes and were the first settlers of the area, using tents in the beginnings for shelter. With time people started building their own houses with the little resources they had without regarding any building regulations, which resulted in an over-crowded settlement with no public areas."[9]

Jabal Al Natheef one Sited on a hill, on one side, it overlooks the sprawling expansion of Amman. On the other side, it overlooks its historical center located in close proximity, Jabal Al Natheef nevertheless feels and is separated and disconnected from the city center; it is often remarked that only two roads lead into the Jabal. In a similar vein, the captivating sequences of scenic views experienced on walking through the narrow alleyways and steep stairways between the densely spaced houses contrast with the state of disrepair many of these spaces suffer from, and one is left wondering whether these spaces can be described as public and whether civic spaces exist at all.

4.1.1 Site Characteristics & People's needs

In reference to Mapping Jabal Al-Natheef publication done by Arini organization in 2014, the camp is characterized with:

- High Building Density
- Overcrowding
- Lack of security
- Corruption (Drug, domestic violence, prostitution)
- Narrow streets
- Unskilled labor
- Conservative social structure
- High population density
- Lack of inclusive places for people to socially interact that has socio-economic consequences.

The inhabitants of the area with an estimated population of 54,000 have the following basic needs:

- Access to water
- Housing
- Street Lighting
- Education

4.1.2 Greater Amman municipality lighting project

"It is a project that was planned to be applied in Eastern Amman in 2015 by replacing 250 Watt High-pressure sodium Street lighting with energy saving LEDs which noted that the project seeks to have 119,000 lighting units replaced with LED light bulbs. The project is part of the municipality's shift to sustainable development and seeks to turn Amman into an environment-friendly city."

The project was applied in Jabal Al-Natheef camp in February 2019. All street lighting fixtures in the camp were replaced with new energy-saving LEDs, including the pedestrian area."[10]

The government treated narrow pedestrian alleys and stairs the same way they treated cars main streets, their strategy is concluded by keeping the same electrical poles, and replacing the existing lighting fixtures with 35 Watt LED in the whole area.

4.1.3 Impact of urban fabric on social behaviour

The camp is divided into two parts, the lower camp, that is situated on the main street and has been taking care of by the municipality, and the upper camp that is neglected by the municipality and non-profit organizations, as shown in Figure 07. The whole area is dense with buildings, forcing people to use staircases as an outdoor open space that host social activities plus being used for pedestrian movement. The selected site is one of the main spaces that are used by the residents of the area as an open space, hosting social activities, and pedestrian movement.

"Spaces of movement tell a story about the places the inhabitants move through; how and why."[11] "The spaces the inhabitants of Jabal Al Natheef use to travel are not only utilitarian (streets, roads, pathways, and junctions); the spaces they travel through are the human environment, the area itself, with all its multiplicities."[12] Therefore the necessity of good lighting for these pathways and aisles was listed on the top priorities for the inhabitants of the area, alongside infrastructure, water supply, and education."[11] The selected site is located nearby a mosque that is considered a landmark in the camp, surrounded by commercial shops, one of the main reasons why people of the area consider it a node where they gather for different occasions.

The site is characterized by high residential, rough concrete buildings between 4-5 floors, with one supermarket located in the center of the stairs, where users usually meet.

Before implementing the municipality project, lighting fixtures used in the study area were all the same type, High-Pressure Sodium 250 Watt with warm color temperature.

After implementing the municipality project in February 2019, lighting fixtures were all replaced with 35 Watt cool white energy-saving LEDs. Buildings situated in the study area, are all residential building, in addition to a small grocery store in the center of the area, which is also a reason for people to spend more time there, kids mainly used the two dead-end alleys as a playing area, and adults frequently gather next to the grocery store.

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4.2 Existing Site Situation

Figure 08, Selected Site Overview
4.3 Documentation of Physical Installations

On-Site lighting fixtures used (HPS 250W) previously were in poor condition (table 01), due to vandalism, which is a widespread norm within the area, and lack of maintenance from the municipality's side. The problem of lack of lighting has always been a big issue in all streets and neighborhoods in the camp, that lead to some unwanted social behaviors, such as, drug dealing, prostitution, in addition to the feeling of insecurity for pedestrians, especially for women.

Table 01 illustrates Lighting fixtures status before the application of the municipality project. After the application of the municipality project, all lighting fixtures were replaced/added with new cool white LEDs. The main aim of the project is to save the expenses of the energy consumed using HPS by replacing all fixtures with low energy consumption LEDs, secondly, to solve the problem of lack of lighting in the camp that people have been complaining about in the past years. Energy consumed per square meter using HPS assuming that all fixtures are working equals 4.5 w/m² on the other hand by placing the new LEDs the energy consumption equals 0.5 w/m². Table 02 illustrates Lighting fixtures status after the application of the municipality project.
<table>
<thead>
<tr>
<th>Lighting Fixture</th>
<th>Image</th>
<th>Type</th>
<th>Status</th>
<th>Specifications</th>
<th>Total Energy consumption/ m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2</td>
<td><img src="image1.png" alt="Image" /></td>
<td>HPS</td>
<td>Working Cover broken</td>
<td>Wattage: 250 watt Light intensity: 2500 Lumen Color temperature: 3000 K</td>
<td>2.5 w/m²</td>
</tr>
<tr>
<td>L3</td>
<td><img src="image2.png" alt="Image" /></td>
<td>HPS</td>
<td>Broken, not working</td>
<td>-</td>
<td>4.5 w/m²</td>
</tr>
<tr>
<td>L4</td>
<td><img src="image3.png" alt="Image" /></td>
<td>HPS</td>
<td>Working Cover broken</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L5</td>
<td>-</td>
<td>No fixture</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L6</td>
<td>-</td>
<td>No fixture</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L8</td>
<td>-</td>
<td>No fixture</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L7, L9</td>
<td><img src="image4.png" alt="Image" /></td>
<td>HPS</td>
<td>Working Cover broken</td>
<td>Wattage: 250 watt Light intensity: 2500 Lumen Color temperature: 3000 K</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 01, Documentation of Old Lighting Fixtures

<table>
<thead>
<tr>
<th>Lighting Fixture</th>
<th>Image</th>
<th>Type</th>
<th>Status</th>
<th>Specifications</th>
<th>Total Energy consumption/ m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>All lighting Fixtures, L1-L9</td>
<td><img src="image5.png" alt="Image" /></td>
<td>LED</td>
<td>Working</td>
<td>Wattage: 35 watt Light intensity: 3600 Lm Color temperature: 6500K</td>
<td>0.5 w/m²</td>
</tr>
</tbody>
</table>

Table 02, Documentation of Current Lighting Fixtures
5.0 Sources & Methodology

Referring to Clue competition motivation (ensure safety and security), and Mapping Jabal Al-Natheef publication by Arini. An important open space for the users in Jabal al Natheef was proposed to evaluate the existing lighting situation and propose guidelines for more efficient lighting in the camp.

### Process & Methodology structure

**Project Hypothesis**
Propose **Lighting design** guidelines that are connected to people by **promoting** and **regulating** their **activities** and ensure **safety** and **security**

**Site Analysis**
- Jabal Al-Natheef Camp Overview
- Existing site situation
- Documentation of Physical Installations

**Methodology**

**Quantitative Approach**
- Light levels standards in public areas (Aisles, small open spaces)- IESNA
- Light Levels Calculation (Illuminance levels)

**Qualitative Approach**
- Informal Interviews with users, Municipality, Arini organization founder
- Light Evaluation (Personal Observation)

### Results

### Discussion

### Design Guidelines & Proposal

### Conclusions
5.1 Quantitative approach

5.1.1 Light levels standards in public areas (Aisles, small open spaces)

“In all outdoor lighting applications, many factors come into play and should be considered: minimizing glare, mounting height and spacing, lighting system depreciation and life-cycle cost, conflict areas (such as between vehicles or between vehicles and pedestrians), access control and vandalism prevention, as well as the mix of commercial, industrial, and residential properties near the area to be illuminated. For example, in the presence of glare, one needs more illumination to try to overcome the adverse impact of the glare; without glare, lower illumination levels are possible, with an actual improvement in visibility. The key is that all outdoor lighting should be carefully done, with consideration given to all the relevant factors.” [13]

Due to the absence of local outdoor lighting standards in Jordan, standards developed by Illuminating Engineering Society of North America (IESNA) organization were chosen to compare the current illuminance levels (lux) on site with the general international standards. The site need for lighting according to IESNA Lighting handbook should follow the classification: “LZ2: Moderate ambient lighting, which applies for Areas of human activity where the vision of human residents and users are adapted to moderate light levels. Lighting may typically be used for safety, security, and convenience, but it is not necessarily uniform or continuous. After curfew, lighting may be extinguished or reduced as activity levels decline. Sufficient illuminance levels that ensure visibility in an outdoor space are between 10-50 lux or less depending on the overall luminous distribution and intensity, which leads to building an understanding for the function of the outdoor space (pathway & surroundings) including, orientation, recognition, stimulation & identification and Feeling of safety and security.” [14] To achieve Visual comfort some elements in the lighting solutions provided must be considered, such as illuminance/ luminance levels, uniformity, contrast, the spatial distribution of light, color rendering and glare, In addition to the height of mounting the fixtures in accordance to the existing built environment.

5.1.2 On Site Illuminance Levels (Lux)

The measurement of the illuminance was made with ios iPhone Application Ljus. In each zone where the light poles are placed, the illuminance has been measured in different points at two different times of the day, at Twilight when all lighting fixtures are switched off, and Night-time. The illuminance levels have been measured horizontally. The purpose of the measurement is to examine whether the measured illuminance levels on site with the newly installed LED fixtures in each zone are in parallel with the outdoor lighting levels standards listed in IESNA 10th edition Lighting handbook.

The site was divided into six zones depending on the type of activity that takes place in each area. Zone 01, Zone 05, Zone 06 are considered the entrances and exits for the open space, so mainly pedestrian movement happen there, Zone 02 and Zone 03 are narrow alleys that combine pedestrian movement of the residents and kids playing area, and Zone 04 where the grocery store is located, is the area where people gather alongside the pedestrian movement.


5.2 Qualitative approach

Due to the complexity of the site, multiple aspects should be considered when proposing lighting design solutions. A qualitative approach has been made in two stages. The first stage was Informal interviews with the users; the second stage included personal observation for the light character.

5.2.1 Informal interviews

Informal interviews were done with three different categories in order to build a comprehensive understanding of the existing lighting situation.

1. **Users**: including residents, pedestrians, and people who use the site as a gathering area. To understand a non-professional perception of the site at night-time and the problems they face and their needs, in order to enhance the experience of the space for them at night-time.

2. **Layan Jabi**: Architect, Urban planner, Founder of Arini organization, and publisher of Mapping Jabal Al-Natheef book. To build an understanding of a professional perception of the site at night time and what are the most important aspects to take into consideration while planning to propose a design and make a change in these kinds of areas.

3. **Municipality**: Anas Al-Roud, Project manager of the LED project in the camp. To understand the motivation and the strategy they followed in the application of the LED project.

5.2.2 Light character Evaluation (Personal Observation)

In order to understand the on-site lighting situation, the existing light character was studied alongside the use of each zone, using four different strategies.

1. Seven light parameter to make a comprehensive evaluation of the existing lighting issues in each zone.

2. Light distribution & Glare study to understand their impact on users experience.
### 6.0 Results

<table>
<thead>
<tr>
<th>Light pole</th>
<th>Zone</th>
<th>Daytime</th>
<th>Twilight</th>
<th>Night time</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2, 2 LED Fixtures</td>
<td><strong>Zone 01</strong></td>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Lux Level</td>
<td>Point 1, Point 2</td>
<td>5.3 Lux</td>
<td>100.96 L</td>
<td></td>
</tr>
<tr>
<td>L3, 1 LED Fixture</td>
<td><strong>Zone 02</strong></td>
<td><img src="image4.jpg" alt="Image" /></td>
<td><img src="image5.jpg" alt="Image" /></td>
<td><img src="image6.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Lux Level</td>
<td>Point 3, Point 4</td>
<td>2.5 Lux</td>
<td>32.40 Lux</td>
<td></td>
</tr>
<tr>
<td>No Lighting Fixture</td>
<td><strong>Zone 03</strong></td>
<td><img src="image7.jpg" alt="Image" /></td>
<td><img src="image8.jpg" alt="Image" /></td>
<td><img src="image9.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Lux Level</td>
<td>Point 5, Point 6</td>
<td>2.5 Lux</td>
<td>9.5 Lux</td>
<td></td>
</tr>
<tr>
<td>L4, L5, 2 LED Fixtures</td>
<td><strong>Zone 04</strong></td>
<td><img src="image10.jpg" alt="Image" /></td>
<td><img src="image11.jpg" alt="Image" /></td>
<td><img src="image12.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Lux Level</td>
<td>Point 7, Point 8</td>
<td>7.5 Lux</td>
<td>49.67 Lux</td>
<td></td>
</tr>
</tbody>
</table>
6.1 Comparison Between the (IESNA) standards and the existing on-site light levels

The cold white color temperature of the LED Fixture (6500 Kelvin), gave the space quite different character at night-time. The most remarkable visual impressions were the vast contrast between dark spots and highly bright lit spots, and the arbitrary placement of the LED fixtures. Table 03 illustrates the illuminance level on different points in each zone. In comparison to IESNA standards, to ensure visual comfort in such an outdoor space, light levels should be Moderate ambient lighting to ensure visual comfort, between 10-50 Lux or less depending on the overall luminous distribution and intensity. Lux levels measured in different points varied, where it is too low in all points at twilight time, On the other hand at night-time illuminance levels, varies within the same zone, creating huge contrast between lit and dark areas and very sharp, dark shadows which resulted in visual discomfort and gave a feeling of lack of safety.
6.2 Informal interviews Results

6.2.1 Informal questionnaire with the users

There was a common perception of the new LED’s fixtures among all users. They perceived the space very dark during twilight, where they can not even see their footsteps. During the night they perceived the space very bright specifically in zone 04 where there are two light poles 4 meters away from each other, also they disliked the cold color temperature of the LEDs (6500k) was too white as they described it “similar to daylight,” in comparison to the previous HPS lights.

Each user reacted to the new LED project differently:

1. **Residents:** People who were living on the higher floors, they complained that the high intensity from the LED light enters their rooms; therefore they Added window shielding and used thicker blinds

2. **People who gather in the area (Adults & Kids)**
   Kids found the newly lit area as an opportunity to stay up playing outside for long hours, which disturbed the residents of the area. On the other hand, adults found it very uninviting, glary and out of context, especially after being used to the yellow HPS lights for many years

3. **Pedestrians:** All pedestrians described the space safer than what it was on before, but the contrast between dark and lit areas is enormous, which made their journey, especially in zone 5,6 not comfortable and irritating.

6.2.2 Informal questionnaire with Layan Jabi Author of Mapping Jabal Al-Natheef Publication

Layan is an architect and Co-founder of Arini organization, who formed a team of architects, urban planners, and designers and published Mapping Jabal Al-Natheef book. In her opinion, the project of lighting Amman that has been done by the municipality will not work on the short and long term, because of two critical aspects that the municipality ignored:

1. Users experience and needs in this specific open space, and did not consult professionals in placing the new LED in such a small area, surrounded by residential buildings

2. Vandalism issue

6.2.3 Municipality, their motive behind the new project

Two main questions were asked to the LED project manager, Anas Al- Roud. The first question regarded their motivation behind the Led project, and The second question is whether they counseled lighting professionals while planning and implementing the project. The motivation of the project is to reduce energy consumption and expenses on the government and to end the complaints about the darkness and the safety issues from the residents’ side. “The project was planned without any communication with the residents and users, it involved three types of LED fixtures 35, 52 and 85 Watts, with the same color temperature of 6500K. New LED fixtures were placed on every Existing light pole, and the selection of wattage depended on the width of the streets. In small paths and streets (less than 6 meters) they placed the 35 Watt, in streets between (6-10) meters they placed 52 Watt LEDs, and in streets with more than 10 meters width, they placed the 85 Watt LEDs, this was the primary strategy of the municipality project without finding a need for counseling professional lighting designers.

6.3 Light Character Evaluation Results

6.3.1 Seven light parameters

Due to the arbitrary placement of the lighting fixtures, Lighting character evaluation was done on two stages. The first stage, where the general character of the space was examined, depending on personal perception of the space as a whole table 04. The second stage was more specific, included evaluating each zone independently Figure 17 in order to make a better understanding of the lighting situation in each zone, and propose the most suitable guidelines, depending on the characteristics of each zone. The result of the evaluation concluded that the site accommodate issues such as, disturbing glare, cold color temperature, high contrast between lit and dark areas, lack of consistency in lighting vital functional areas such as zone 05, zone 06 which mainly are used for pedestrian movement which resulted in lack of safety and visual discomfort.
<table>
<thead>
<tr>
<th>Factors</th>
<th>Scaling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2</td>
</tr>
<tr>
<td>Light Level</td>
<td>Dark</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Light Distribution</td>
<td>Uniform</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Glare</td>
<td>Invisible</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Shadows</td>
<td>Soft</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Reflections</td>
<td>Diffuse</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Colour Temperature</td>
<td>Cold</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
<tr>
<td>Colour Rendering</td>
<td>Unnatural</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Good</td>
</tr>
</tbody>
</table>

Table 04: General light character evaluation for the whole space

Zone 01
- Bright light level
- Uniformed light distribution
- Disturbing Glare
- Soft Shadows
- Cold Colour temperature

Zone 02
- Moderate light level
- Varied light distribution
- Disturbing Glare
- Sharp Shadows
- Cold Colour temperature
- Unnatural colour temperature

Zone 03
- No Lighting fixture
- Very dark
- Sharp Shadows

Zone 04
- Very bright Light level
- Uniformed light distribution
- Disturbing Glare
- Soft Shadows
- Cold colour temperature
- Unnatural colour rendering

Zone 05
- Dark Light level
- Varied light distribution
- Disturbing Glare
- Sharp Shadows
- Cold colour temperature
- Unnatural colour rendering

Figure 17. Light charterer; 7 Light parameters evaluation for each zone
6.3.2 Light Character Evaluation; Light distribution and Glare Study

Figure 17, illustrates on-site lighting distribution map, where fixtures are distributed without an understanding of the use of each zone, 35 Watt LEDs are placed all around the pedestrian regardless of the small area of each zone. Light is distributed in a varied way leaving some area in complete darkness. Journey two Figure 20 illustrates that the choice and placement of the lighting fixture in the narrow alley (2 meters width) is not suitable, in addition to the lighting trespass that the residents encounter. The opposite alley does not include any lighting fixtures and left in complete darkness. Journey 04, Figure 22 explains the High contrast that pedestrian going down or up the stairs face between dark and lit areas as well as the problem of glare.

Figures 18-22 illustrate the glare issue that users face in every route they intend to take.
6.4 Synthesis of Results

In reference to the Site analysis, Methodology (Qualitative, Quantitative approaches) and the Results. The main four factors that anticipate creating the site’s character are

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weakness</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Location</td>
<td>Limited area (500m²)</td>
<td>Cultural Identity</td>
<td>Acceptance of people</td>
</tr>
<tr>
<td>Important Node</td>
<td>Highly dense area with buildings (4-5 Floors)</td>
<td>Different type of users</td>
<td>(Vandalism)</td>
</tr>
<tr>
<td>Grocery Store</td>
<td>Fragile Infrastructure</td>
<td>Different activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atmospheric Lighting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Participatory Design</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustainability</td>
<td></td>
</tr>
</tbody>
</table>

Diagram 03, SWOT Analysis

7.0 Discussion

In reference to the site analysis, qualitative and quantitative studies, that aimed to investigate what mainly are the strengths, weaknesses, opportunities and threats on site, in order to provide lighting design guidelines that enhance lighting situation on site, in accordance to people’s culture, under the umbrella of sustainability (social, environmental, & economic). The municipality LED project does not serve people’s needs, while it does not provide safety in the area, the glare problem that users are exposed to indoors and outdoors at night time. In addition to the vandalism problem that the municipality disregarded. The only aspect the project is concerned about was energy consumption, which is an important aspect that addresses economic sustainability, but it is not enough to make the project functional, and aesthetically pleasing for the users. Therefore a set of recommendations were concluded in order to propose lighting design guidelines that could be followed in order to provide a lighting design proposal with a holistic approach (Functional, aesthetically pleasing & sustainable).

Recommendations

- Availability of lighting during twilight period
- Regulation of the intensity of light levels at different hours of the day
- Elimination/reduction of Light Trespass
- Lighting objective for each zone
- Use warmer light colour temperature, that corresponds to people’s preference
- Understanding of lighting in order to give them a sense of belonging.
- Consistency of lighting solutions where it is needed to ensure visibility and safety
- Addressing the issue of future vandalism
- Taking into consideration energy consumption
- Propose new ideas, like integrating lighting solutions in urban furniture, using affordable local materials
- Take into account the infrastructure limitations
- Taking into consideration the limited area that does not allow for a variety of lighting solutions
- Include users opinions and culture in the provided solutions (participatory approach)
Spaces of movement tell a story about the places the inhabitants move through, how and why. The spaces the inhabitants of Jabal Al Natheeef use to travel are not only utilitarian (streets, roads, pathways, and junctions); the spaces they travel through are the human environment, the area itself, with all its multiplicities. Therefore this study addresses all spaces of movement in Jabal Al-Natheef, because they have a deeper meaning for the people, beyond just movement. The guidelines concluded from this study could be addressed to multiple organizations including architects, urbanists, sociologists, engineers, and most importantly the municipality, in order to apply those guidelines in all movement spaces in the camp, and any other informal camp with a similar situation.
8.0 Design Guidelines

8.1 Design Guidelines; Design Approach

“Design in the built environment requires that it should be structurally viable, that it serves some useful purpose and that it be aesthetically pleasing and in harmony with the place history and identity in some way. Structure and utility but no beauty results in a warehouse, structure, and beauty but no utility results in sculpture, and with utility and beauty but no structure the result would be a well-designed hand tool only.”[15]

Following up with the Vitruvian triangle theory, that include guidelines for designing with a holistic approach, by combining "Structure, Utility, and Beauty;"[16], could lead to achieving lighting guideline with a holistic approach the addresses all issues in Jabal al Natheef camp, and the theory could be taken a step further by addressing the importance of people's opinion.

Based on the informal interviews with the users, it is concluded that there is a strong connection between users and the camp. Therefore Participatory design is the best method to approach all of the aspects, whereas, giving a connection between the design proposal and the users, by considering their way of thinking, needs, and taste. Image 12 illustrates a simple lighting installation that has been done by the residents of the area, and it includes simple bulbs connected by wires across the street, complementing it with colorful paper pieces. What is worth mentioning that these kinds of installations that are done by the people of the camp, are rarely exposed to vandalism, and residents regularly maintain and take care of the bulbs, by replacing them in-case they stopped working.

"From human factors to human actors" [17] including people’s opinion with Vitruvian triangle guidelines is the most reliable method to provide lighting design guidelines specifically in Jabal al Natheef camp addressing: functionality, beautification (aesthetically pleasing), sustainability.

Figure 23 illustrates lighting design guidelines.

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8.2 Lighting Design Objective

The lighting design objective is to provide lighting guidelines that are efficient in terms of functionality, beautification (aesthetically pleasing) and sustainability as they are the main pillars that result in a design with a holistic approach in addition to including peoples opinions. In order to provide efficient lighting guidelines, there must be an understanding of the activities that take place on-site. Although the site is considered quite small in area (500 square meters), users consider it as a valuable open space, due to its strategic location linking two main streets and acting as a bridge between the commercial area and the residential area. The fact that different users use the site as well as hosting different types of activities is an essential aspect to consider for the functionality of the lighting proposal. The site is accessible from two sides, one access from the commercial street and two accesses from the residential area, therefore it is frequently used by pedestrians that want to move from one area to another. The grocery store is located in a central location between all the accesses to the site, creating a node for people to socialize. Kids use the two dead-end aisles as a playing ground.
According to the use of each space, offered Lighting design guidelines objective should correspond to a type of activity that takes place in each space. Access points and the grocery store act as landmarks that give the site its unique character, therefore type of lighting proposed to be identity lighting, that highlights the site landmarks. The central node where people gather around the grocery store as well as the dead-end aisles (kids playing area), host the main social activities; as a result lighting solutions proposed to address the social activities that happen. Central circulation throughout the site takes place on the three main stairs which demand spatial lighting intersecting with the social and spacial lighting. Types of lighting are related to each other, a certain light could be for example spatial and social, there is no absolute spatial light without being affected with social and identity lighting and vice versa.

Figure 26 explains different types of users in relation to different activities, and accordingly, Figure 27 explains lighting design objective in each zone.

### 8.2.1 Lighting Design Objective; Functionality

The functionality of lighting is related to visibility, safety & security, and navigation & orientation. In reference to the results of each of the on-site illuminance levels (table 03), light character evaluation (table 04, Figure 17), and the informal questionnaire with the users, The main on-site lighting issues highlighted are; too bright or too dark light levels, varied light distribution, disturbing glare, sharp shadows, very cold colour temperature, poor colour rendering, and light trespass. Therefore it is concluded that the existing lighting solutions are inefficient in terms of functionality.

The issues could be minimized and addressed by introducing guidelines for lighting solutions including:

1. Low level of illumination
2. Uniformed Light distribution
3. Lighting control strategy
4. Diffused Lighting
5. Low mounted fixtures
6. Warm light color temperature

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level of illumination</td>
<td>Between (10-50) Lux depending on the activity</td>
</tr>
<tr>
<td>Uniformed Light distribution</td>
<td>Depending on type of activity (Functional, social)</td>
</tr>
<tr>
<td>Lighting control strategy</td>
<td>Applying dimming system at different times of the night, and sensors</td>
</tr>
<tr>
<td>Diffused Lighting</td>
<td>Shielding for all light fixtures</td>
</tr>
<tr>
<td>Low mounted fixtures</td>
<td>Integrated Hidden lights and bollards</td>
</tr>
<tr>
<td>Warm light colour temperature</td>
<td>Less than 4000 Kelvin</td>
</tr>
</tbody>
</table>

Table 05. Functional Lighting Guidelines
8.2.2 Participatory Design; Beautification

Beautification is defined by how the users are satisfied with the lighting solution aesthetically, and how does light relate to the identity of the space. Referring to the results of the informal interview, users are not satisfied with the new LED project, not only because of the inefficiency of the lighting fixtures but also because of cold white light color temperature (6500 Kelvin) of the fixtures. Users perceive the current light color temperature very white, glary and bright, it made the area look dull (poor color rendering), and it does not comply with what they are used to (HPS) lights and what they use at their homes (2000-2700 Kelvin). Studies have proven that exposure to white lighting affects human health and the ecology of the space. “Blue light has an impact on wildlife, vision and its high scattering properties in smoke and fog.” Also, it affects the circadian rhythm of plants and animals artificially altering their biology, and it provides subconscious lighting cues that may lead to inappropriate behaviors. The blue light components increase the impact of glare up to 10X that of amber light.”[18]

“White LEDs, when unshielded, will undermine the night vision. With a compromised night vision, people are less able to see into dim areas, reducing safety by limiting the awareness of the surroundings (creating hazards) and affecting the ability to navigate at night. This lack of visibility also reduces the sense of safety and security.” [19] According to the functionality guidelines, it is recommended to use a warm light color temperature. However, to achieve the participatory design approach, the user’s experience and preferences must be included. Light color temperature recommended is between 3000K in the central node increasing gradually to 4000K at the access points to ensure eye adaptation to street lighting which is 6500K, where it gets warmer while accessing the site from each access point, giving the central node the warmest light color temperature, and creating an atmospheric feeling for people who gather in the central node. Responding to the activities that happen in both dead-end aisles, that include kids activities, colorful RGB lights are recommended to be used at a particular time of the day to create a playful dynamic atmosphere and connection with all users as it represents the Jordanian and Palestinian flag colors.

Figure 29, Light colour temperature Selection

Another idea to enhance the proposed lighting guidelines aesthetically is to propose urban furniture with integrated lighting fixtures. Due to the limitation of the space in the area, there were not many options for urban furniture that could fit in the space without affecting the use of the space for movement from one point to another. Therefore, the most convenient idea was to place outdoor benches on the existing stairs and integrate diffused hidden lighting with warm color temperature 3000K. According to the architecture of the buildings in the dead-end aisles (playground area), while windows are placed on the first-floor level (7 meters high from the outdoor ground floor level). There is an opportunity of adding string lighting as a reflection to the street light installation done by people, mentioned earlier figure 24, using RGB lights, in order to break the dullness of the aisles, and make use of the small space (2 meters wide).

8.2.3 Participatory Design; Sustainability

Three aspects of sustainability (Social, Economic, and Environmental) were taken into consideration when proposing design guidelines. Social sustainability was the main focus of this study, applying human-centric approach using participatory design, by hearing out users opinions and needs, at the same time provide functional lighting solutions that correspond to their own culture and identity, in addition to considering the impact of lighting on users health, all three strategies, are a step towards social sustainability. Economic sustainability was achieved by proposing low energy consumption LED fixtures in the needed areas for lighting, and introducing smart lighting fixture with lighting control strategy with an integrated astronomical clock. Table 05 explains lighting control strategy.

<table>
<thead>
<tr>
<th>Twilight</th>
<th>Astronomical clock, All fixtures to be switched on gradually until the sun sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night time (Sunset- 9:00 pm)</td>
<td>100% full intensity of all lighting fixtures including RGB fixtures</td>
</tr>
<tr>
<td>Night time (9:00-12:00pm)</td>
<td>100% full intensity of all lighting fixtures. RGB to be switched off, keeping the functional white fixtures switched on</td>
</tr>
<tr>
<td>Night time (after curfew 12:00 am)</td>
<td>All lighting fixtures dimmed down to 50%. Movement sensors to control navigation fixtures placed on stairs. The luminaires work with full intensity when they detect movement, and they dim down to 50% when the area is empty.</td>
</tr>
</tbody>
</table>

Table 06, Lighting Control Strategy
Finally, Environmental sustainability, which was addressed by eliminating the most on-site standing out issues which are light pollution and light trespass. Referring to the functionality guidelines, it was proposed to use low level mounted fixtures and to add shielding to all fixtures. Those two principles could highly minimize light pollution and light trespass that residents suffer from. 

Guidelines with a holistic approach include all three aspects; functionality, beautification and sustainability, each aspect affect the other in order to come up with a most efficient design to minimize all site issues and guarantee users comfort and satisfaction.

**9.0 Conclusions**

The municipality LED (35 watt) project, that have been applied in the begging of 2019 all around the streets of Jabal al Natheef (vehicular & pedestrian streets), addresses only economic sustainability, which according to table 01 and table 02, was successful in reducing the total energy consumption on-site to (0.5 w/m²) in comparison to the previously installed HPS (250 watts) fixture (4.5 w/m²). Realistically referring to the qualitative and quantitative approaches, the LED project did not solve the camp’s lighting issues, while it disregarded visual comfort and the problem of vandalism. Although the newly installed fixtures were not exposed to vandalism yet, according to the informal interviews, it could happen at any time. The reasoning behind the vandalism, according to Layan Jabi and the municipality lighting project manager, was that it is a common norm in those informal camps without giving a specific reason for it. This study proves that multiple reasons caused vandalism including visual discomfort, lighting trespass and lack of privacy that people suffered of inside their homes due to the placement of the fixtures on a 9 meters high electrical pole in such a small pedestrian area, dense with residential buildings. 

Looking back at mapping Jabal al Natheef workshop (personal experience in 2014), at data collection phase with Arini organization, street (pedestrian, vehicular) lighting was a prominent issue in the camp, the team included architects, urban planners, and engineers without including lighting designers. During the workshop, the solutions that were discussed regarding lighting included, replacing the broken fixtures and develop a design for the installations that integrates a steel cage that could eliminate the vandalism issue.

Comparing lighting guidelines that have been concluded from this study with the suggested solutions by Arini organization workshop, gives an indication to the importance of the role of lighting designers and that lighting is a complex topic needs to be addressed in a holistic way of analysis and design by professionals.

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Design objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level of Illumination</td>
<td>Functionality, Beautification, Sustainability</td>
</tr>
<tr>
<td>Uniformed Light Distribution</td>
<td>Functionality, Beautification</td>
</tr>
<tr>
<td>Lighting control Strategy</td>
<td>Functionality, Sustainability</td>
</tr>
<tr>
<td>Diffused Lighting</td>
<td>Functionality, Beautification, Sustainability</td>
</tr>
<tr>
<td>Low mounted fixtures</td>
<td>Functionality, Beautification, Sustainability</td>
</tr>
</tbody>
</table>

Table 07, Lighting design guidelines objective
10. Bibliography


Figure 01. Jabal Al-Natheef Camp, Amman, Jordan (View from Ras Al-Ain Street)

Figure 02, 03: East NY, Tillett Lighting. Train station area that is considered one of the landmarks.
https://www.tillettlighting.com/east-new-york

Figure 04, 05 (FÆLLEDPARKEN, Copenhagen, DK, 2011)
https://www.sweco.dk/en/

Figure 06, scenic view from Jabal Al-Natheef
Photograph, Captured by the author

Figure 07, Jabal Al-Natheef Upper Camp Site Plan
Created by the author

Figure 08, Selected Site Overview
Created by the author

Figure 09-14 Site views
Photographs, Captured by the author

Figure 15, Zoning Strategy
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Figure 16, Illuminance Levels
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Figure 17, Light charterer; 7 Light parameters evaluation for each zone
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Figure 18, Light Distribution Map
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Figures 19-23 On-Site Glare Study
Created by the author

Figure 24 illustration for future application for lighting design solutions in movement spaces
Created by the author

Figure 25, Jabal Al-natheef Local lighting installation
Photograph, Captured by the author

Figure 26, Local Lighting installation celerating a religious holiday
https://www.amazon.com/Decoration-Festival-Decora-tive-Crescent-Light%EF%BC%88Yellow%EF%BC%89/dp/B07QW5DMYL

Figure 27, Illustration of different types of users in relation with different types of activities in each zone
Created by the author

Figure 28, Illustration lighting design objective in each zone
Created by the author

Figure 29, Light colour temperature Selection
Created by the author

Figure 30, String Lighting Installation Example
https://www.lightingever.co.uk/white-ball-string-8-modes-with-430014-rgb-uk.html

Figure 31, Outdoor Benches Lighting Example
Table Bibliography

**Table 01, Documentation of old Lighting Fixtures**  
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**Table 02, Documentation of Current Lighting Fixtures**  
*Created by the author*

**Table 03, On-Site Illuminance Levels**  
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**Table 04: General light character evaluation for the whole space**  
*Created by the author*

**Table 05, Functional Lighting Guidelines**  
*Created by the author*

**Table 06, Lighting Control Strategy**  
*Created by the author*

**Table 07, Lighting design guidelines objective**  
*Created by the author*

Diagram Bibliography

**Diagram 01, Methodology & Design Process**  
*Created by the author*

**Diagram 02, Qualitative approach structure**  
*Created by the author*

**Diagram 03, SWOT Analysis**  
*Created by the author*

**Diagram 04, Participatory Design Guidelines**  
*Created by the author*

**Diagram 05, Participatory Design Guidelines**  
*Created by the author*