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Robyn Penhall
0710675Y

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This document is submitted in partial fulfillment for the degree: Master of Architecture [Professional]
at the University of the Witwatersrand, Johannesburg, South Africa in the year 2009.

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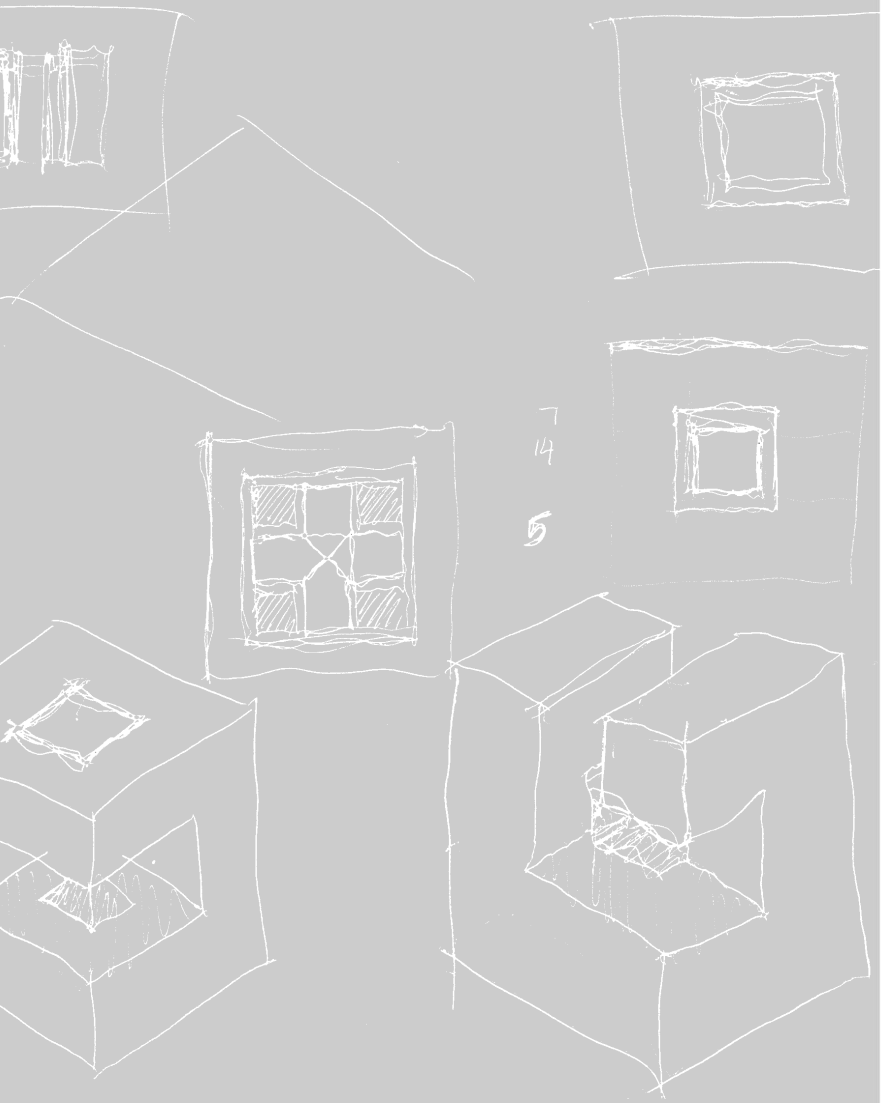




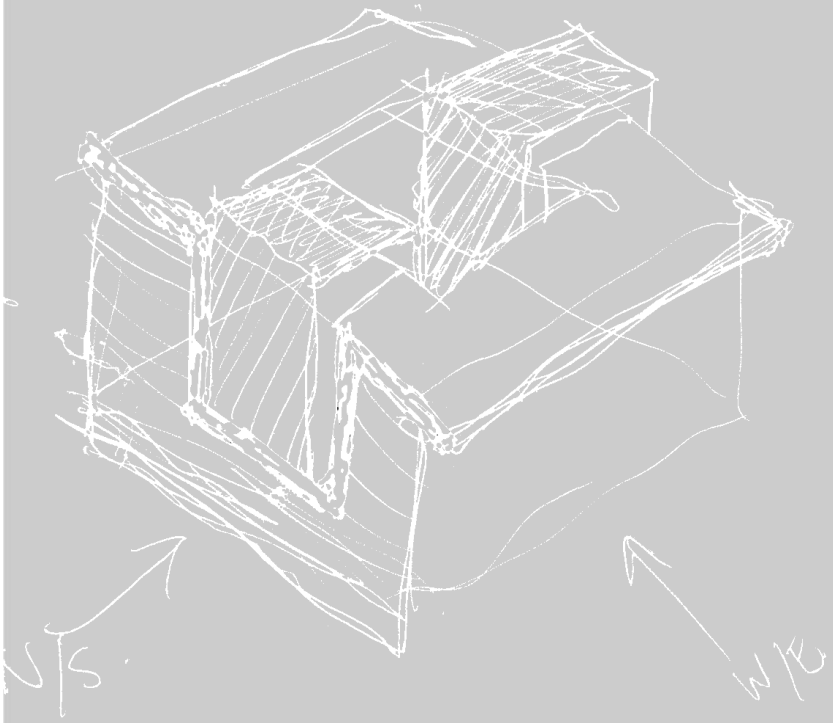
Declaration

All sources have been referenced where applicable, and can be found in the back of this document under the *Bibliography*.

I, Robyn Penhall [0710675Y], am a student registered for the course Master of Architecture [Professional] in the year 2009. I hereby declare the following:

I am aware that plagiarism (the use of someone else's work without permission and/or without acknowledging the original sources) is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of the ideas or words in my own work.

Robyn Penhall



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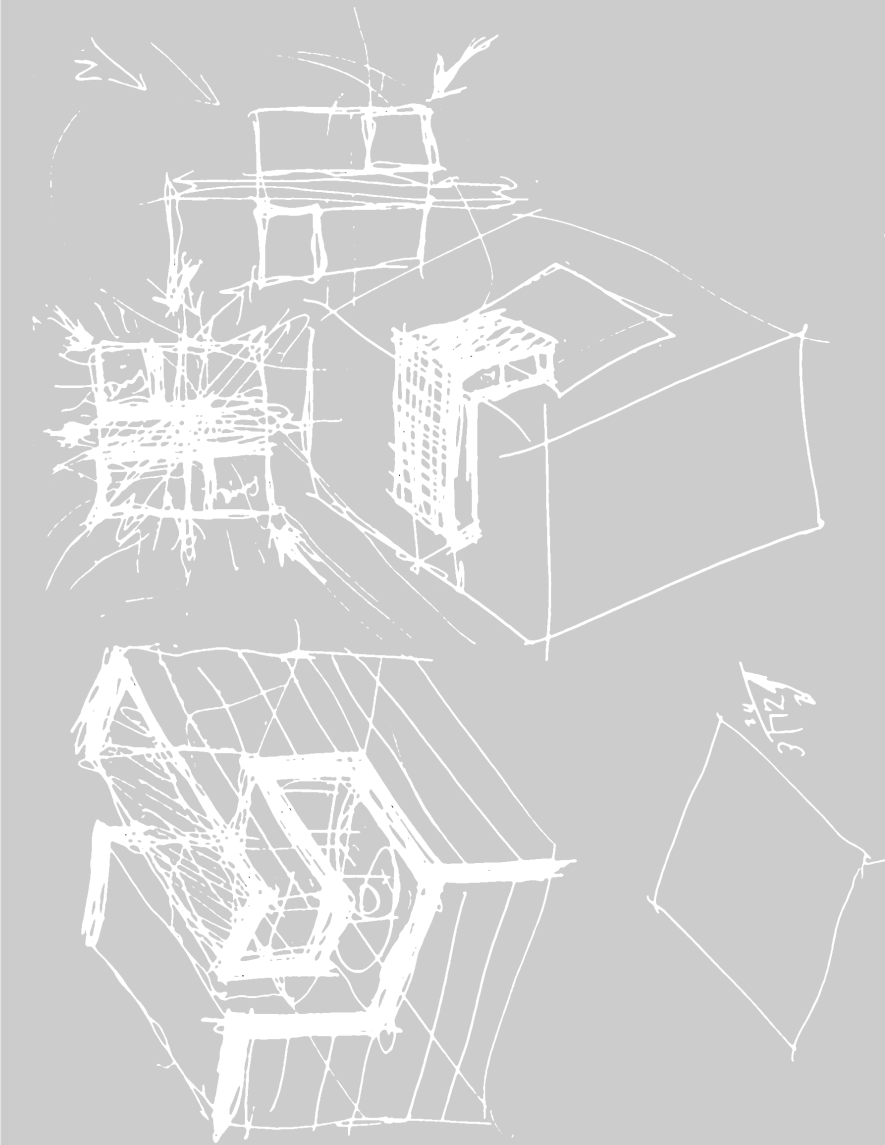
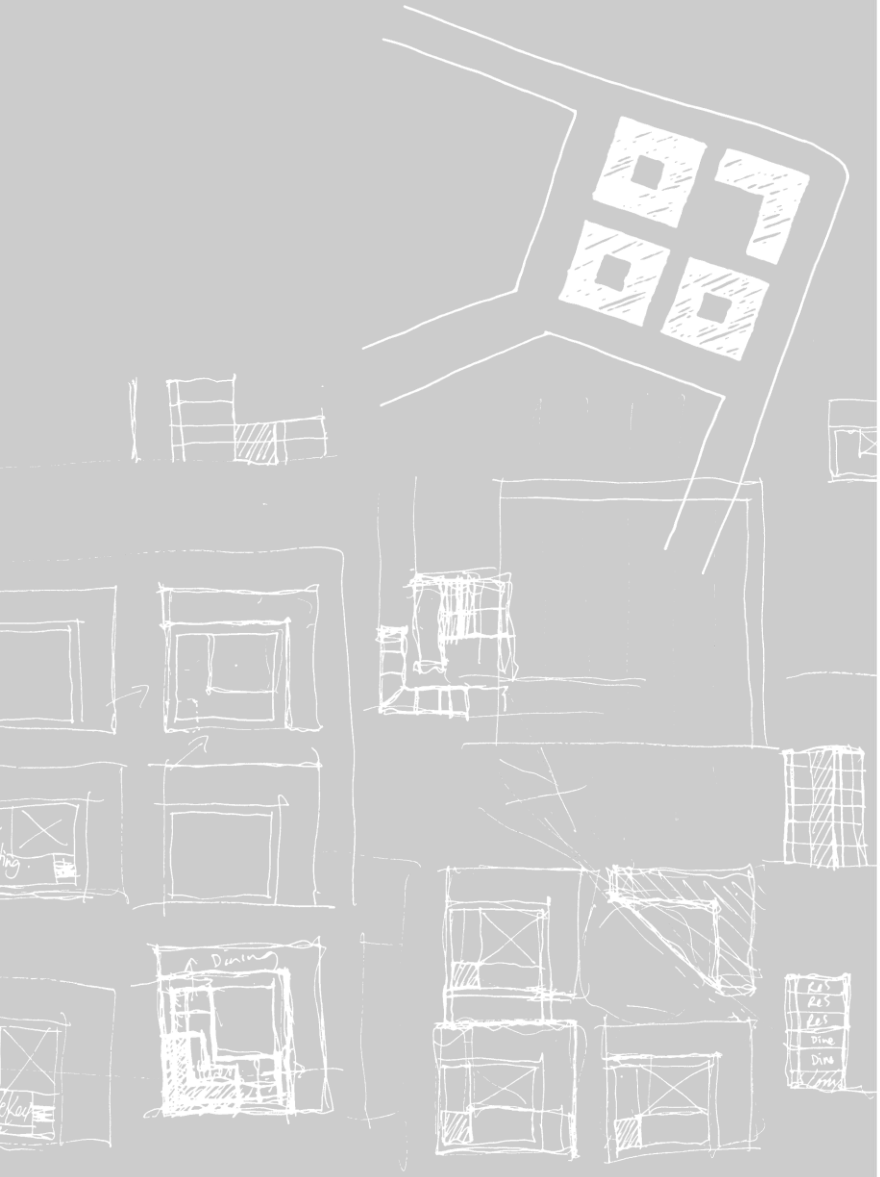






Abstract

Dubai's blue-collar migrant labour housing problem has become a controversial issue within the UAE, with SHAJARAH aiming to provide a sustainable solution.

Dubai's blue-collar migrant workers, especially those working in the construction industry, are being exploited due to their desperate financial situations by lack of adequate permanent housing, poor working conditions and insufficient wages by the construction companies they work for. Dubai's construction industry has been severely criticised by human rights organisations and the international media for its treatment of migrant workers.

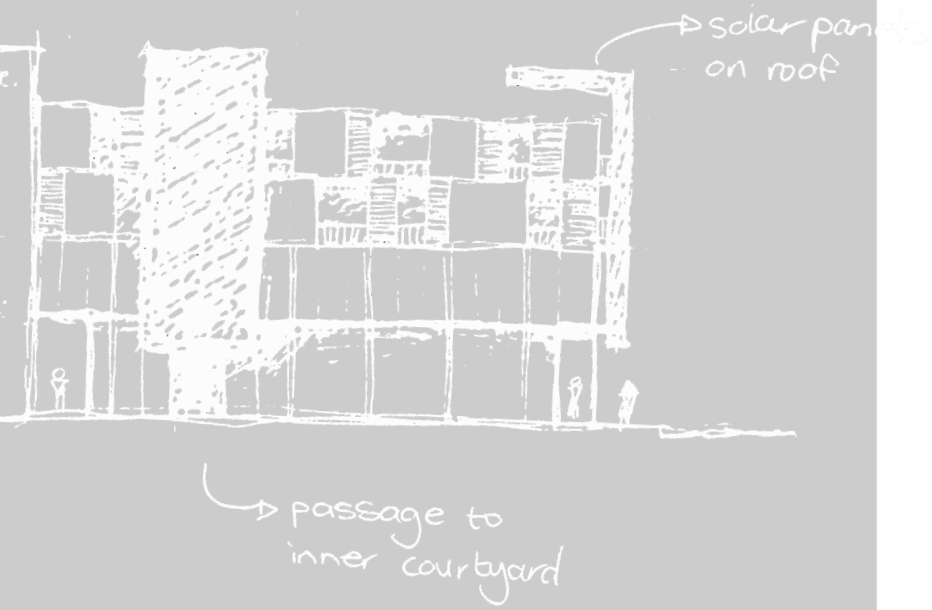
As a result, the purpose of this thesis is to investigate a sustainable, permanent and socially integrated alternative housing solution to challenge the existing overcrowded, substandard blue-collar migrant worker accommodation. SHAJARAH is a 114-hectare mixed-use and mixed-income community living housing project [Figure 1] that can accommodate almost 30,000 people in a variety of room typologies to suit different needs, preferences and financial budgets. SHAJARAH also offers residents a range of shared facilities and services to improve the living conditions, dignity and quality of life of Dubai's blue-collar migrant workers

The following research questions, which also define the purpose of the theory and case study, identify: 1) what the current state of the migrant labour accommodation problem is; 2) how the UAE government has attempted to rectify the problem; and 3) why the subsequent new labour accommodation complexes claim to be the solution by improving workers' quality of life. By analysing Omran workforce accommodation as a case study for these new complexes in Dubai that have attempted to provide more acceptable living conditions for migrant workers, it is possible to provide conclusions and recommendations on ways to improve the economical feasibility, as well as the social and environmental sustainability of these labour camps for both construction companies and the construction workers themselves.

By creating a platform for local and international architects to showcase their solutions and attitudes to Dubai's labour problem, SHAJARAH is helping to redefine the negative stigma attached to the conventional labour camp by creating an inclusive, vibrant community. It is only through the integration and co-operation of all sectors of society that Dubai can truly become the global contemporary city that it aspires to be. Besides, it is only fair that the people essentially responsible for building Dubai be afforded the same right to quality of life.



Figure 1: SHAJARAH site plan and view from street corner
(Reference: author's own 2009)





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Project Introduction

SHAJARAH is a mixed-use and mixed-income community living housing project to challenge the existing overcrowded, substandard blue-collar migrant worker accommodation by including a range of room typologies and shared community facilities.

Figure 2: Social outdoor spaces within SHAJARAH
(Reference: author's own 2009)



PROJECT DESCRIPTION

Dubai has witnessed unprecedented economic growth within the last twenty years, resulting in a massive influx of foreign migrant labour that now make up almost 80% of the city's population (Allen 2009). The unforeseen extent of Dubai's enormous population growth has resulted in a deterioration of living conditions for the city's over a million blue-collar migrant workers. However, this is not a unique problem to Dubai. In the past, the working class of Europe and America experienced the same deplorable living conditions during the 19th century Industrial Revolution, and other countries have seen similar results due to colonisation. Today, other new emerging economies such as China are experiencing similar difficulties. Yet the seemingly common resultant effect of rapid economic growth is no excuse in today's society, due to lessons that should have been learnt from the past.

As a result, SHAJARAH is a mixed-use community living housing project to challenge the existing overcrowded, substandard blue-collar migrant worker accommodation that has become such a controversial issue in the UAE. SHAJARAH can accommodate almost 30,000 people in a variety of room typologies to suit different needs, preferences and financial budgets. SHAJARAH offers residents a range of shared facilities, services and spaces to improve quality of life by supporting social interaction and environmental awareness [Figure 2].

The underlying concept for the project is to invite local and international architects to each design one of the buildings on site, guided by a set of common design principles and a development framework for the project. This will not only unify SHAJARAH as a collective whole, but also facilitate co-operation in terms of achieving social, economic and environmental sustainability. As the aim of the project is to improve workers' quality of life, the inevitable diversity and variation of each building will help to fostering a unique sense of identity and social belonging within SHAJARAH.

The decision to appoint different architects not only creates diversity and variation within SHAJARAH, but also stimulates an active interest and involvement of Dubai's society in the project and therefore the plight of the workers. By allowing high-profile designers to use the

FACTS

Site: 114 hectares

Occupants: 30,000 people

project as an experimental showcase to present their approach to the city's labour problem, SHAJARAH has the potential to become a landmark for sustainable community living in Dubai. This will inevitably draw the interest of the media and potential financial investment, and therefore also curious locals, expats and tourists. Providing opportunity for improved social interaction of the different income groups on the site will in turn help in eliminating the negative stigma of the conventional labour camp, as well as the social exclusion of blue-collar migrant workers in Dubai's society.

PROJECT OBJECTIVE

It is becoming increasing difficult and unsustainable in Dubai to maintain such a large labour force under the current labour camp conditions. Therefore SHAJARAH's intention is to provide an accommodation solution that will be financially feasible for companies and socially beneficial for the workers themselves, as well as environmentally more sustainable than the current labour camps. The opportunity exists to dramatically improve workers' quality of life, thereby increasing productivity levels and eliminating unproductive worker strikes. "Companies are now starting to realise the importance of giving their staff good living conditions rather than the poorly managed labour camps" (Shehab el Orabi, cited in Bakr 2008). By integrating the recommendations posed in this thesis, the design of a sustainable housing solution for Dubai's migrant workers has the potential to become a viable reality.

As a result, the purpose of this thesis is to investigate a socially and economically sustainable, integrated housing solution to improve the living conditions of blue-collar migrant workers in Dubai. The following research questions have guided the theory towards finding an alternative solution: 1) what is the current state of the migrant labour accommodation problem; 2) how has the UAE government attempted to rectify the problem; and 3) why does the subsequent new labour accommodation complexes – with Omran workforce accommodation as a case study – claim to be the solution to improving workers' quality of life. These three questions will subsequently lead to the evaluation on the success of the new



labour accommodation complexes, and the recommendations for further improving the sustainability of migrant labour accommodation in Dubai.

PROJECT TITLE

The word 'shajarah' means tree in Arabic [Figure 3]. A tree is made up of different elements, working together towards a greater purpose; SHAJARAH is made up of different architects' buildings, different cultures and different functions supporting each other to create an integrated community. A tree's branches and leaves provide protection and shelter; SHAJARAH is a housing project to provide protection from the harsh climate and adequate accommodation for workers. A tree grows and bears fruit; SHAJARAH will provide workers with all the facilities and services they need, as well as recreational and social spaces to 'nourish' their quality of life. A tree has roots that embed it in the ground; SHAJARAH aims to become a place that migrant workers can call their 'home away from home' by fostering a sense of belonging.

SCOPE OF THE PROJECT

Although significant attention is directed in the theory toward the construction industry, as the largest employer of migrant workers in the UAE, the aim is to provide an alternative housing model for all blue-collar migrant workers, regardless of industry sector. Furthermore, while the exploitation of workers includes insufficient wages and poor working conditions, the scope of the thesis focuses primarily on improving the living conditions of workers.

Sustainability has been considered to a significant degree during the design process in terms of economic, social and environmental principles for the context of Dubai. However, by no means does this project attempt to become a fully environmentally sustainable solution; but rather to incorporate selective sustainable principles that are most relevant and beneficial to the project in terms of both financial feasibility and environmental impact.

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SHAJARAH

Figure 3: SHAJARAH logo
(Reference: author's own 2009)

Theoretical Context

Dubai's image as a 21st century 'Mecca' for trade and tourism is being tainted by its exploitative treatment of the city's over a million blue-collar migrant labourers who make up the vast majority of the city's population, especially with regard to low-income migrant accommodation.

INTRODUCTION TO LABOUR HOUSING PROBLEM IN DUBAI

The United Arab Emirates (UAE)[1] has achieved record levels of economic growth over the last decade with the country's economy soaring by nearly 13.9 per cent in 2008 to Dhs801-billion (Kawach 2009), approximately US$218-billion[2]. This has fuelled an ever-expanding real estate and construction boom, especially in Dubai [Figure 4] – the UAE's second largest emirate and the economic and tourist hub of the Middle East. Dubai's strategic location at the crossroads of trade and commerce between Europe and the Far East attracts thousands of foreign expatriates[3] each year to its wealth of tax-free job opportunities.

This unprecedented growth in Dubai can be somewhat likened to a construction revolution. Like the Industrial Revolution in Europe and America during the 19th century which created an enormous demand for cheap labour, Dubai's economy is enormously dependent on cheap foreign labour mostly from the Indian subcontinent. As a result, the UAE has recently recorded one of the highest population growth rates in the world, with almost 80% of its population as foreign expatriates (UAE Interact 2008). In just under a decade, Dubai's total population – both locals and foreigners – has more than doubled from 826,000 in 2000 (Cooper 2001) to a whopping 1.67 million people today (Dubai Statistics Center 2009). Dubai prides itself on its multicultural population of over 200 nationalities, promoted as a 21st century global city.

However a global city is about inclusion and embracing differences. Dubai is very selective of the type of people it chooses to include, and the differences it lets infiltrate and influence its local culture. Upon closer inspection, Dubai's image as an imperturbable paradise of capital is tainted by its elitist discriminatory attitude towards the city's poor migrant labourers.

1 The United Arab Emirates is a country made up of seven emirates (states), Dubai being the second largest. It is located along the Persian Gulf on the southeast Arabian Peninsula, bordered by Oman and Saudi Arabia.
2 The UAE Dirham (Dhs) is pegged to the US Dollar at a fixed rate of Dhs3.6725: US$1 (UAE Government 2006).
3 An expatriate (in abbreviated form, expat) is a person temporarily or permanently residing in a country and culture other than that of the person's upbringing or legal residence.



Figure 4: Contextual map of Dubai, United Arab Emirates
(Reference: Triathlontraining 2005)



Figure 5: Private villa in suburb of Jumeirah
(Reference: Rustar Real Estate 2009)



Figure 7: The Greens community
(Reference: Dubai ShortStay 2009)



Figure 8: The Springs community
(Reference: UAE Real Estate & Property Guide 2009)



Figure 6: Marina high-rise apartments and retail centre
(Reference: Malec 2008)

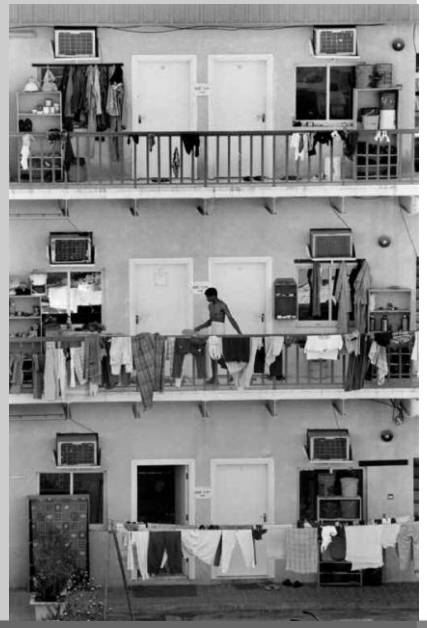


Figure 9: Typical labour camp in Sonapur
(Reference: Getty Images 2007)

Of Dubai's 1.25-million foreigners, just over one million are blue-collar migrant workers (Allen 2009) making up more than 95% of the UAE's labour force (Human Rights Watch 2007: 1), employed mainly in the construction, service and retail industries. As the largest group of migrant labourers work in the construction industry, they make up the majority of the population. Yet, these very people who are essentially "responsible for building this modern-day metropolis" (Hughes 2008) in the desert are shunted to the edges of the city to live in poverty and desperation, away from the eyes of Dubai's millions of tourists.

This contrast between rich and poor is most evident in the different accommodation for white-collar professionals in Dubai and the city's blue-collar labourers [Figure 5-9]. Dubai's western expats and educated professionals predominantly live in either large private villas with landscaped gardens; medium/high-rise luxury apartment blocks with retail and entertainment centres below; or semi-detached units in a community environment built around lakes with a wide range of shared recreational facilities and green space. Yet, the blue-collar workers are forced to live in squalor in overcrowded, unsanitary labour camps. Very little provision has been made in Dubai for low-cost (and therefore low-profit) housing for workers; almost all residential developments are aimed at high-end society.

Therefore, the underlying problem that this thesis addresses is that Dubai's migrant workers, especially those working in the construction industry, are being exploited due to their desperate financial situations by lack of adequate housing, poor working conditions and insufficient wages by the construction companies and industries they work for. They are hired under contract with the understanding that they will eventually return to their home countries at the end of their employment. They are disdainfully excluded from the rest of Dubai's society, as a temporary but necessary component in building the city. Their impermanence in the social and economic fabric of Dubai seems to be the absurd justification for the exploitation and lack of adequate provisions provided for these workers. Although many are forced to remain for longer periods as they cannot afford to return home, due to the perpetual cycle of exploitation. Unsurprisingly there has been an alarming increase in the number of strikes against low wages and poor conditions by unhappy construction workers.

The following research questions, which also define the content of this chapter and the case study, identify: 1) what the current state of the migrant labour accommodation problem is; 2) how the UAE government has attempted to rectify the problem; and 3) why the subsequent new labour accommodation complexes claim to be the solution by improving workers' quality of life. By analysing Omran workforce accommodation as a case study for these new complexes in Dubai that have attempted to provide more acceptable living conditions for migrant workers, it is possible to provide conclusions and recommendations on ways to improve the economical feasibility, as well as the social and environmental sustainability of these labour camps for both construction companies and the migrant workers themselves.

Furthermore, their impermanence is not a logical outcome for the future of Dubai. Once the construction and building has been saturated and the city has been built, Dubai is going to need an army of blue-collar workers to maintain it. It is fair to say that the number of construction workers needed in the city will decrease substantially, but Dubai will require even more workers in the retail, hospitality and service industries to support its aim of a growing tourism-based economy. At the moment, the city is catering mainly to the long-terms needs of its ever-expanding upper- to middle-class, but the city is also going to need to consider accommodating the lower classes that will become crucial to its future sustainability.

The exploitation of migrant workers is not unique to Dubai. In fact, the same situation is occurring in many developing countries, such as China. As with Dubai, the construction booms in China's largest cities like Shanghai, Beijing and Guangzhou flourish on the 150-million migrant labourers from China's own rural population (Leon 2009). Like Dubai's blue-collar migrant labourers, rural migrants living in Chinese cities are second-class citizens, living in poverty and exploited. In their 2007 report to uncover the discrimination and abuse of China's 210-million rural-to-urban migrant workers (People's Daily 2008) who are building China's economy, Amnesty International (2007) describes these poor workers as the "urban underclass", exploited by their own government, unlike Dubai's migrants who are lured to the city from poverty-stricken countries under false pretences and forced to endure inhumane conditions after incurring escalating debts which make returning home unviable.

As a member of the International Labour Organisation (ILO) which protects workers, Dubai's construction industry has been severely criticised by human rights organisations and the international media for its treatment of migrant workers. Human Rights Watch published a report entitled *Building Towers, Cheating Workers* (Ghaemi 2006), outlining their findings after conducting an extensive independent investigation into the exploitation of migrant workers by employers in the UAE. This report, which was based on extensive interviews with workers, government officials and business representatives as well as a survey of media reports in news and trade journal publications, generated so much controversy that it ultimately led the Dubai authorities to finally acknowledge the problem.

In response, the government has urged companies to improve conditions by enacting laws to protect migrant workers from exploitation. Yet the government has until recently turned a blind eye to holding offending companies accountable for exploitation. Only within the past few years has the government started to clamp down on offending companies and initiate reform in its migrant labour policies, after extensive media coverage of the shocking conditions. As a result, word has spread about migrant labour exploitation in Dubai, making it increasingly harder for Dubai-based companies to recruit migrant labour, threatening the city's future development. Consequently, a small handful of the city's major construction companies have begun building better quality camps in accordance with ILO specifications, yet the situation remains largely unchanged for the majority of construction workers in Dubai.

Property developer Nakheel[4] has attempted to create such a solution with Omran, its workforce accommodation project. Omran aims at "redefining the standard of workforce accommodation in Dubai" (Lukwaro 2008) by providing construction workers and hospitality staff with an extensive range of shared living and recreational amenities and services. However, after a guided tour of the facilities and interviews with staff involved at various levels within Omran, it is evident that – despite the enormous progress Omran has initiated – there is still room for improvement.

[4] Nakheel is a Dubai-based company and one of the world's largest private real estate developers (Nakheel 2008).



EXISTING LABOUR CAMP CONDITIONS

With Dubai's population rapidly increasing each year due to the growing expatriate population, the need to provide adequate housing is an escalating concern. However in order to address the migrant labour housing problem in the city, it is firstly necessary to determine the current state of the provided labour camp accommodation, in order to improve it. This section looks at the existing living conditions of workers, the exploitative actions of companies and the government's failed attempts to rectify the situation.

After intense international media criticism, the UAE government's attempts to initiate change have been predominantly biased towards protecting the rights of local Emirati employers over those of foreign migrant workers. The lives of migrant construction workers are closely tied to their employers, who house their workers in dormitory-style dwellings (commonly known as labour camps) on the outskirts of urban areas or in the industrial areas of Jebel Ali, Al Quoz and Al Qusais [Figure 10] so as not to tarnish Dubai's exclusive reputation.

The most notorious of these of labour camps are those that make up Sonapur, the unofficial name for the collective slave labour accommodations in Dubai's poor Muhaisnah residential area behind the Dubai International Airport on the edge of the city. In Hindi, the name Sonapur means 'the city of gold', or alternatively 'the city of the sleeping dead' (Dharmarajan 2007). The latter is aptly named as the settlement was, back in the 1950s, a burial and cremation ground. Figuratively-speaking the name is equally fitting as Dubai has become somewhat of a nightmare for the estimated 250,000 South Asian[5] migrant workers (Beard 2008) that live in Sonapur. The thousands of collective labour camps that make up the Sonapur district are not a place to call home; they are merely a place to rest their exhausted bodies after long shifts of up to 18 hours a day, six days a week (Abdul-Ahad 2008). Dubai may very well be 'the city of gold' for many Western professionals who have amassed their fortunes in Dubai's booming tax-free economy and enjoy the wealth of entertainment

[5] The majority of Dubai's migrant workers come from South Asia, mostly from India, Pakistan, Bangladesh, Sri Lanka, Nepal, the Philippines and Korea.

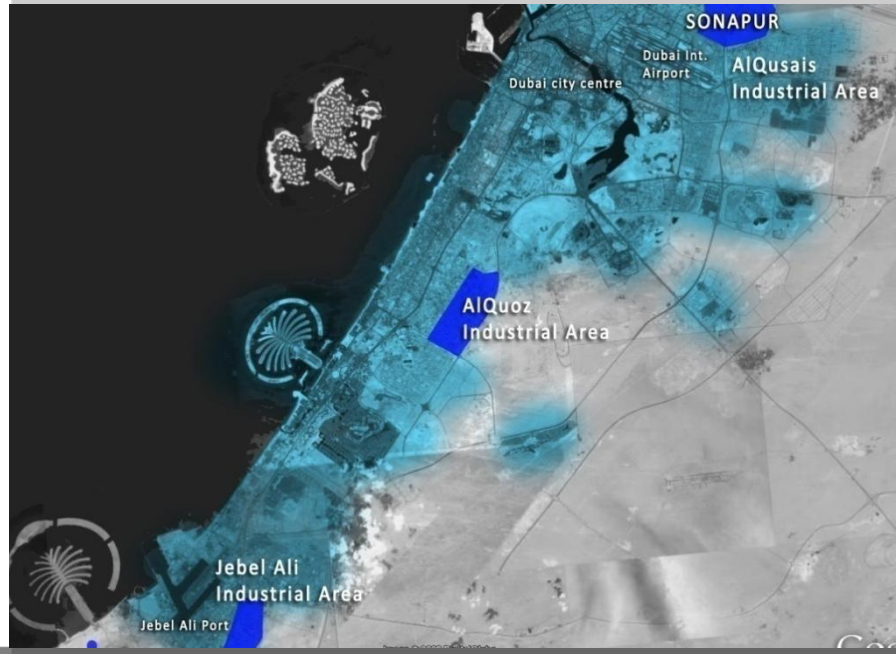


Figure 10: Map showing the location of the industrial areas along Dubai's outskirts
(Reference: adapted from Google Earth 2009)

opportunities available, but for the city's migrant workers who live in the squalor of Sonapur, that name remains scornfully ironic.

ECONOMIC EXPLOITATION

If the conditions in these camps are so bad, why do the workers stay and put up with it? The simple answer is that their situation is hopeless. The wages they earn in Dubai are often much more than what they would get in their home countries, often less than US$1 a day, which is what attracted them to Dubai in the first place; and therefore they tolerate the appalling conditions.

Despite the UAE's significant population growth, its per capita income more than doubled in 2007 to reach Dhs162,00 (US$44,000), due to the economic boom in the country. This amounts to an average daily earning of US$120 per day per capita. Yet the city's migrant construction workers earn that in a month, amounting to as little as US$4 per day (Hughes 2008). That is under 3.5% of the country's average daily earnings. Of their average Dhs450 (US$120) monthly wages, about Dhs100 is often taken for rent. Workers spend about Dhs300 on food, leaving only Dhs100 to send back home to support their families.

The construction industry contributes over Dhs58-billion (almost US$16-biilion), or 8%, to the country's total GDP (UAE Yearbook 2009: 61). One of Dubai's leading and largest construction companies, Arabtec Construction, reported a Dhs505-million (US$137-million) profit for the first half of 2008 (Arabtec 2008). Construction workers in the UAE earn abysmal sums ranging from monthly wages of Dhs390 ($106) to Dhs900 ($250) (Ghaemi 2006: 56). When considering Dubai's large construction companies raking in hundreds of millions in profit each year, the blue-collar migrant construction workers are being paid unreasonably and unjustly meagre amounts. If the majority of the population (the blue-collar migrant workers) are being paid this little, then the enormous balance is left to benefit only a small minority of already rich locals and expats whose exorbitant salaries are well above the average figures. The gap



between rich and poor in Dubai is growing ever wider with the unbalanced discrepancy in financial distribution.

As if living off such dismal amounts is not crippling enough, it is also common practice in the UAE – despite it being illegal – to withhold workers' passports and first two months' wages as security against workers leaving. The workers rely on their wages to send back home to support their families, and to repay the loans they took out to get to Dubai. Therefore, withholding their wages means they start to slip into further debt with accumulating interest. For the majority of migrant workers, returning home with even greater debt than they started is not even an option worth considering. Many do not even have enough money to pay for a flight home.

By taking advantage of their desperate financial situations, construction companies make empty promises in their contracts of good pay, yearly flights home to see their families and medical insurance, to name a few. Many of the companies do not fulfil these legal obligations and the government has previously turned a blind eye to it. As a result, many workers earn even less than they did back home and are now far worse off financially. Their situation is hopeless; they know they have to return home to escape their escalating financial debt, but they cannot leave as they do not have the money. It seems companies justify the conditions by defending that workers would be "even worse off back home - as if poverty in one place can justify exploitation in the other" (Abdul-Ahad 2008).

SOCIAL EXPLOITATION

It is as if Dubai's government is hoping that by hiding their migrant underclass on the outskirts of the city, away from the eyes of the tourists, they can deny their very existence [Figure 11]. However, as the majority of the population, these workers have a profound effect on the city's economy, as well as its local culture. Dubai's image as a first-class global city is a mere facade, in light of its migrant labour issue.



Figure 11: Workers look on from a distance, removed from society
(Reference: Abdul-Ahad 2008)



Figure 12: Workers and washing contend for balcony space
(Reference: Getty Images 2007)

Migration is an inevitable part of a contemporary global society, leading to greater multicultural diversity. This is why Dubai has been so selective of the types of people it lets infiltrate its local culture. The city is conflicted between inclusion and exclusion. The seemingly progressive western culture and its educated professionals are welcomed and included; it is the city's poor underclass that are excluded and looked down upon by the rest of Dubai's elitist society, as if poverty is a highly contagious disease. Dubai has filtered the influences that are most beneficial to its progressive image as a global city and a world leader in technological development. The city's poor migrant workers taint that image, and are therefore excluded as a temporary means of achieving the city's ultimate goal.

Although the migrant underclass do have access to the shopping centres and facilities in Dubai, it is simply made difficult for them by locating their accommodation far from the hub of activity and development. These workers cannot afford the bus fares to the city's shopping centres, let alone the expensive designer merchandise within them. Dubai caters for those with money to spend. Most of the developments in Dubai are multimillion dollar projects, aimed at wealthy investors and upper-class consumers. There is little or no provision for the poor man on the street, who in the eyes of the government, appears to be irrelevant. Their only contribution to society is their purpose as a cheap labour force to build the city. What little free time they do have is spent playing cricket in dusty open lots within their camps, or aimlessly wandering around an unfriendly city. They are not given the opportunity to contribute socially. They are confined to their labour camps, forced to manual labour six days a week and exploited into submission. These workers have been dehumanised. As one of Dubai's workers concedes, "We have no life here. We are prisoners" (Abdul-Ahad 2008).

The social conditions within Sonapur read like a male prison. There is an obvious lack of women in Sonapur. Over 75% of the population is male (Dubai Statistics Center 2009, Population Bulletin: 1), largely due to the overwhelming majority of male migrant construction workers[6]. With the demand for labour accommodation increasing and more

[6] Almost sixty % of Dubai's population is male, aged between 20-44 years old (Dubai Statistics Center 2009: 2).

residential buildings coming up for workers in Sonapur, its population is expected to rise to become the largest camp of workers in the world (Dharmarajan 2007).

These labour camps are realistically more like labour slums. In one camp, men stay ten to a 6 metre by 5 metre room in the sparse cement cinder block-housing complex (Allers 2008). Bunk beds are stacked in rows along the walls with no closets in the rooms. The water delivered to the camp is often not properly desalinated and tastes of salt. "It makes us sick, but we have nothing else to drink," complains one worker in desperation (Hari 2009). Generally, roads are gravel and sand with no kerbing and few footpaths. Balconies act as washing lines [Figure 12], due to insufficient space and inadequate facilities in the camps.

Another camp in Sonapur has around fifty shabby rooms, each housing fifteen people sharing a few bunk beds. This means many workers live, eat and sleep on the floor [Figure 13], or rotate 'hot beds' after shifts. This arrangement reveals that each worker essentially gets less than a square metre of space, compared to the global minimum of 3.7 square metres according to a global analysis of international housing policy statistics (Angel 2000: 261). Workers pay Dhs2,500 (US$700) a year per room (Dharmarajan 2007), which includes access to a daily bath, cable television and the radio. Very often, the only entertainment is a television (if they are lucky) and their weekend visits to the Dubai city centre of Bur Dubai or Deira where they can use the internet cafes to speak with the families.

A typical day for migrant construction workers begins at five in the morning to wash and cook the day's meals; at 7am the bus leaves to take them to the worksite, over an hour away; and they are back at the gated and guarded camp at nine in the evening, six days a week (Abdul-Ahad 2008). Many labourers battle skin allergies from exposure to cement and have to travel into the city to receive medical treatment, which can be expensive. Their employers are legally meant to pay for their medical expenses, but almost none of them do. Additionally, workers often develop gastric problems due to extended work hours and missed meals.



Figure 13: Overcrowded rooms act as sleeping, living and eating spaces with no personal space (Reference: Beard 2008)



Figure 14: Workers eating on the floor of their cramped room
(Reference: Abdul-Ahad 2008)



Figure 15: Dinner is often prepared in grease-blackened pans
(Reference: Abdul-Ahad 2008)

Many workers who are provided with food by their employers, have to supplement the rations by buying food [Figure 14] from a local supermarket, as it is simply not enough to sustain their long labour-intensive working hours. For others whose employers do not supply daily food rations, a typical meal often consists of a few chilies, an onion and three tomatoes, fried with spices and eaten with a piece of stale bread. Inadequate food, health and safety provisions [Figure 15] are just some of the controlling measures used to exploit Dubai's migrant underclass. The attitude of temporariness can be seen directly in the quality of the provided labour accommodation. Although 'temporary' for some often amounts to years, if not decades. Regardless of the timeframe, human rights violations are not acceptable under any circumstances, especially not in selfish pursuit of greater profit margins at the expense of people's lives. Human rights campaigner Sharla Musabih (cited in Abdul-Ahad 2008) identifies that "the workers might eat once a day back home, but they have their family around them, they have respect. They are not asking for a room in a hotel - all they are asking for is respect for their humanity".

ENVIRONMENTAL EXPLOITATION

One of the biggest environmental concerns regarding blue-collar migrant labourers is working in the UAE desert heat, which can climb in excess of 50°C in the summer months. At the Iranian Hospital's emergen cy department, nurse Hasan Sabbagh confirms that around 10 construction workers were brought in on a daily basis during summer (Grzesik 2007). There have been cases of workers dying from heat stroke and other-heat related illnesses. Following this, Dubai's Minister of Labour issued a decision banning outdoor work between 12.30pm and 3pm during the most severe summer months of July and August. Subsequently, the number of heat-related casualties has declined, but many companies still refuse to abide by this law as it reduces their productive work hours.

Another environmental concern is the environmental degradation of the labour camps, which also pose an enormous health hazard to the residents. In Sonapur, litter is abundant and open

sewers are common, due to the lack of adequate sanitation. In one camp, raw sewage had leaked out everywhere, forcing workers to create a network of stepping stones to cross it and return to their accommodation blocks. One toilet block had no water supply and the latrines were overflowing with piles of raw faeces. Some toilets are merely holes in the ground. "The latrines are so filthy we cannot use them, we are so disgusted" (Allen 2009), says one worker. Authorities had declared the situation in the camp critical and fined the owner for allowing sewage to overflow into workers' accommodation, but after a month the situation remained unchanged (Allen 2009).

Government is attempting to rectify the problems, but the situation – like most issues pertaining to the labour camps – remains a problem. This indicates that the punishment and penalties invoked by the government are not enough. Stricter and harsher measures need to be put in place to stop the inhumane exploitation of workers in these camps, as well as the environmental degradation that they cause. The biggest issue is the impermanence of the migrant workers. Only in allowing them to positively contribute to Dubai's social fabric can the current situation become truly sustainable.

IN NEED OF CHANGE

The exploitation of cheap labour during an unprecedented economic boom is not a new phenomenon, nor is it limited to the Dubai context. The Industrial Revolution of the 19th century in Europe and America saw the exploitation of its mushrooming working class, due to low wages, poor working conditions and overcrowded housing. The increasing size of urban populations led to overcrowding in the cities, as rural dwellers came to seek their fortunes in the booing urban industries. Additionally, a similar situation is currently occurring in China with its influx of rural immigrants into the cities. However, Dubai's migrant labour problem is distinctive in that foreign migrant workers make up the majority of the city's population.

Like Europe and America during the 19th century industrial revolution, Dubai has witnessed unprecedented growth in a short space of time. In Britain and America, workers found

increased employment opportunities in the new mills and factories, but these were often under strict working conditions with long shifts of twelve hours or more, set by the dominating pace of machines. These new industries and the sudden influx of people into the cities gave rise to unforeseen problems around the exploitation of workers and their living and working conditions. It is characteristic with many industrialising and developing countries to be associated with the exploitation of cheap labour by taking advantage of workers' desperate financial situations, in order to maximise profits for the companies and therefore expand the economy. A similar situation is occurring in Dubai and China, only two hundred years later. Dubai is experiencing its own 'revolution' with all the problems associated with rapid, unprecedented economic growth.

Britain's 19th century poor working class lived in appalling conditions; as do Dubai's current migrant workers [Figure 16]. The housing situation for cheap labour in both 21st century Dubai and 19th century Britain reads almost identical. Both were overcrowded and unsanitary, due to the large numbers of workers living together in a small area. In Europe, existing housing was continuous subdivided and sub-let. A single room was often rented by several families. No attention was paid to reducing density of occupation, which maximised financial returns. Dingy narrow streets led to even darker alleys and courtyards that were soon foetid from the lack of airflow and accumulation of domestic waste. In Britain, towns expanded at the edges into new parishes, often built with no drainage, unpaved streets and inadequate sewage.
In Dubai, the majority of labour camps on the edge of the city offer identical conditions, where toilets regularly become overflowing cesspits, endangering the health of the workers living in the area.

Only towards the end of the 19th century when conditions in Britain had reached catastrophic limits did the government enacted laws to improve public health and living conditions in towns. Yet, like Dubai, these laws lacked credibility as there were initially no inspectors to police them. Trade unions in 19th century industrial Britain were deemed illegal until 1871 (Lambert 2009), making it virtually impossible for workers to demand higher wages and better conditions, as in Dubai. Only when the British government was put under mounting pressure



Figure 16: Labour camp in Sonapur, Dubai
(Reference: Hope 2009)

to safeguard the rights of its citizens did it appoint inspectors to uphold the laws; the same is happening in Dubai. Economically, Dubai has made enormous progress in the past ten years, but socially it has stayed behind," says Musabih. "Labour conditions are like America [and Britain] in the 19th century - but that's not acceptable in the 21st century."

Similarly to Dubai's migrant workers, Chinese internal migrants who have moved from China's rural areas into the cities in search of work and to escape poverty are often denied access to adequate healthcare, isolated from the rest of society and forced to live and work in unfavourable conditions [Figure 17]. Official statistics place the number of internal migrants in China at over one-tenth of China's 1.3 billion people (Scheineson 2009). Of China's 120 million migrant workers flooding the country's booming eastern cities, one in three work in construction (Reuters 2007). Although this percentage is much smaller than in Dubai, China's internal migrants are also confronted with discrimination and a long string of inequities. Despite reforms, the system still limits migrant access to public services guaranteed to urban residents. The majority will never gain permanent residency in the cities so, once their contract expires, they are sent back to the poor rural areas, away from the "urban centres of privilege" (Amnesty International 2007). Because of their transitory existence in China's economy, these internal migrants have become known as the "floating population" (Scheineson 2009).

Yet unlike China's internal migrant workers, "there's a heck of a lot of difference being treated like shit in your own country than being treated like one in a foreign land which affords you not even the most basic rights of expression and redressing grievances" (Filter Coffee 2008). In today's world, many people commute between countries and maintain family, social and economic links across borders. These people often hold multiple trans-cultural identities, an essential aspect of globalisation. "People need rights as human beings, not as nationals" (Castles 2000: 131). This does not mean homogenising local identities, but recognising differences and embracing their progressive influence on the creation of a global city. Dubai has remarkable potential for this, considering its multicultural population. The only



Figure 17: Migrant worker housing in Dongguan, China's manufacturing hub
(Reference: Liming et al. 2008)

thing standing in its way is its migrant labour problem; therefore something has got to change.

It seems logical that new emerging economies such as Dubai and China would have learnt valuable lessons from the mistakes of previously developing nations. However, in its rush to become significant players in the global economic market, Dubai has attempted to fast-track a century or more's growth into about a decade. In doing so, the city has neglected the fundamental lessons of the past regarding the direct relationship between rapidly expanding and insufficiently planned urban populations and the decay of living conditions. As a result, Dubai is suddenly facing a collapse in its current labour housing. The situation has spiralled out of control, ignored for too long in the hope that it will go away. However as Dubai's construction boom continues without a foreseeable end, the need for adequate low-income housing to sustain the current blue-worker population, as well as future workers to maintain its growing economy, is imperative to the city's survival.

GOVERNMENT RESPONSE

The scope of this section is to identify Dubai's attitude to the sudden influx of foreigner workers to its shores, and to establish what attempt has been made by the government to rectify the migrant labour housing problem. After facing intense international criticism and constant labour unrest over the past five years, the UAE government has recently taken a more dynamic stand to resolve labour issues and ensure the protection of workers in the country.

GLOBAL PERSPECTIVE

Dubai prides itself on its multi-cultural, cosmopolitan society that attracts expatriates and tourists from all over the world, yet at the same time strives to protect its rich cultural heritage. The rapid modernisation of the city and the preservation of local culture are of

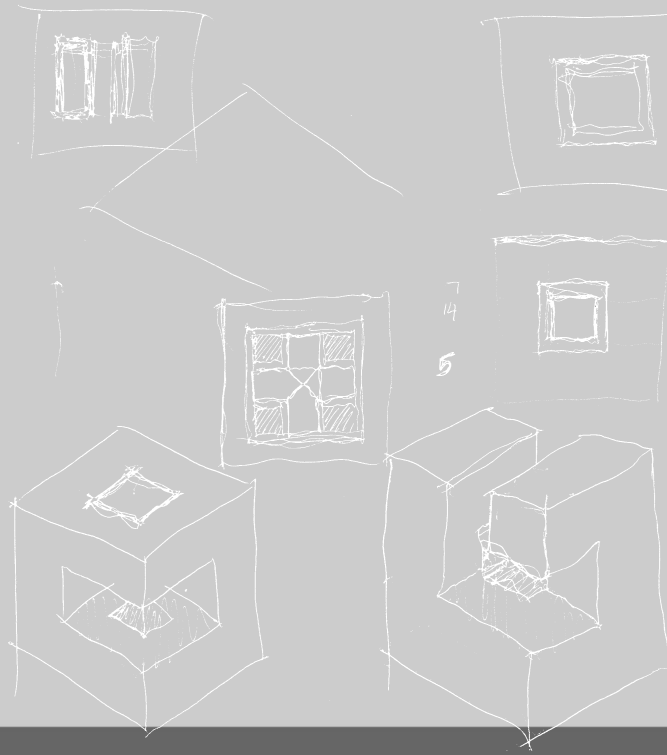


equally fundamental concern. Culture is a manifestation of global relationships and local adaptations. In today's context of globalisation, migration inevitably leads to "greater ethno-cultural diversity... transforming identities and blurring traditional boundaries" (Castles 2000: 124), which creates a contradiction between inclusion of different cultures and exclusion to protect the local culture. Each nationality brings with it additional foreign influences and values, which has sparked a cultural re-evaluation of Dubai's current local identity.

In the 21st century however, and very prominently in Dubai, values and culture have become increasingly defined by materialistic wealth – and there seems to be little regard for the people who are left behind or slowing the process. However, culture loses all meaning when it is defined purely and simplistically by material wealth. Culture is "ungraspable", a way of life and an abstract set of values embedded in local heritage and the spirit of its people. Dubai is attempting to unify Western and Islamic values into a new cultural value system that is more relevant to the contemporary Arabic city in a globalised context, and the poor Asian migrant workers do not seem to fit.

Globalisation is an international phenomenon. Therefore, cultures have had to adapt inevitably to accommodate its inescapable effects. However, these effects are not necessarily negative. Whilst there is a partial truth in globalisation's ability to universalise the world's cultures into one multicultural global society, it is more about the international sharing of knowledge and how a culture integrates that knowledge. The global should merely enhance and strengthen the local by providing a broader resource and knowledge base to better facilitate local cultural progression. Technological advancements have allowed cultures to learn from the success of others, and adapt those experiences to their own cultural contexts. The evolution of cultural identity in adapting to the constantly changing relationships around it is what sustains a culture.

Arjun Appardurai's (2003) theories eloquently convey the concept of culture as a constantly evolving perspective of complex influential scapes, and not simply a static ideal that is perpetually fixed in time. Arjun Appardurai suggests thinking of culture in terms of changing



and overlapping flows or 'scapes', rather than a simplistic static concept fixed in time. Culture is contextually dependant. Locality has become a "staging ground for identity" (Appardurai 2003: 228), where a variety of elements and influences are absorbed into the local cultural identity. This gives each locality its own individualised identity and uniqueness. Economic, political and social aspects of a specific society are all intrinsic to the way a culture functions and behaves. Thus it is only logical that culture, the manifestation of all these different scapes, would be continually evolving over time as society and technology does. This evolution is inescapable and inevitable for culture to survive. The global cultural process has become an interconnected "mutual contest of sameness and difference" simultaneously (Appardurai 2003: 229).

Middle Eastern architect Rasem Badran (cited in Alafrangi 2007: 15) argues that "Dubai is no longer a local city; it is a global city and therefore, it is responding to global needs and equipping itself with the necessary infrastructure." Trade is a powerful tool in achieving this; trade is "about culture and spreading it". Multicultural interaction is the key to the advancement of society, "like domains or layers, culture develops with circumstances and life patterns. This creates a contemporary social order established by the inclusion of newcomers. They create new patterns of life". He makes an interesting observation that "…in Arabic, *Amaar* (meaning construction) refers to human beings. There is no place without the people." Therefore the cultural identity of Dubai is simply adapting to include the multinational diversity of its people. This hybridised fusion of East and West in Dubai has led to the "beginnings of an Arabic renaissance" (Nasser Saidi, cited in Shadid 2006). Homi Bhabha (2003) addresses similar themes of the hybridised concept of "cultural negotiation" (Bhabha 2003: 195) by realigning culture with social priorities and relocating it in relation to contemporary values.

"If a culture of a city is defined by its norms and values, the people that co-habit Dubai also play an intrinsic part in that process" (The old and the new… 2006). Therefore, Dubai has been very selective of the cultural identities it allows to penetrate its traditional cultural boundaries. In an effort to become more industrialised and technologically advanced, and to



become a significant global leader, it has aspired to a westernised model of society. American fast-food chains and European fashion labels have become the norm in Dubai. The city welcomes the skills of wealthy expatriates from countries such as America, Australia, South Africa and England in order to boost its economy and add to its multicultural image. It is the poor Asian workers who are shunted into the background. These temporary workers are merely seen as an unsightly irritation, there to support and sustain the economy and the lifestyles of Dubai's elite.

However, as mentioned previously, this temporary workforce cannot remain temporary for very much longer. Once Dubai has been built and its growing tourism industry is functioning at its anticipated peak, the city is inevitably going to need a permanent workforce to sustain it. This is where globalisation and migration play such an important long-term role in Dubai's future sustainability. Seemingly, the current attitude of the locals of building Dubai and then sending the foreigners home is naive. Dubai does not have enough locals to maintain the ambitious expansion of the city. Foreign labour is therefore necessary. Permanent housing solutions that create dynamic social networks and inclusive multicultural communities are Dubai's solution to a sustainable global city.

LOCAL INITIATIVE

As a result of intense international pressure, as well as internal unrest among blue-collar migrant workers and the increasing concern of the city's expatriates, the Dubai government started to implement a number of policies, laws and procedures to improve the living and working standards of its over a million migrant labourers. The negative publicity that the city was receiving from the international media was a major determining factor in the government's decision to rectify the situation. Human rights abuse and social exclusion go against Dubai's vision as a global city and a model of cultural tolerance. Dubai's reputation was in the balance, and it could no longer ignore the problems in its backyard. In order to be a 21st century global city, Dubai had to act like one.



Therefore in November 2006, Dubai's ruler Sheikh Mohammed bin Rashid Al Maktoum[7] directed the Ministry of Labour to improve working conditions and warned the employers that the government would not accept any unjust treatment of employees or any compromise of their dignity and basic human rights. Subsequently, the Dubai government established two agencies – the Permanent Committee for Labour Affairs (PCLA) and a human rights department within the Dubai Police – to arbitrate disputes between workers and their employers. These two agencies have since played an important role in arbitrating tens of thousands of labour disputes over unpaid wages and poor living and working conditions (Ghaemi 2006: 13).

Although the situation improved to a certain degree, the conditions still remain substandard in the majority of labour camps. Warnings to companies became idle threats as very few cases were ever followed up and enforced, as workers remain fearful of losing their jobs and the money that is owed to them if they speak up against their employers. Although the 1980 UAE Labour Law explicitly requires the Ministry of Labour to institute a minimum wage, it has never been put into practice. The shortcomings of the dispute resolution mechanisms and the failure to implement a minimum wage, as well as the law's failure to recognise the right of workers to organise and bargain collectively and the explicit ban on labour strikes, strongly suggest that worker rights are not being placed foremost on government's agenda. Government policy has largely favoured employers over workers, in an effort to protect the interests of the local Emirati business owners. While UAE law governing issues regarding workers' rights are commendable when taken at face value, there is little evidence of its enforcement, prompting the need for radical reform of the system.

Additionally, the Dubai Municipality implemented a number of changes in 2006 to the list of specifications required in labour camps before a building permit can be issued (Manibo 2007). A comprehensive campaign was led by the municipality in 2007 to assess the situation in different labour camps to ensure they comply with health and safety regulations, and to

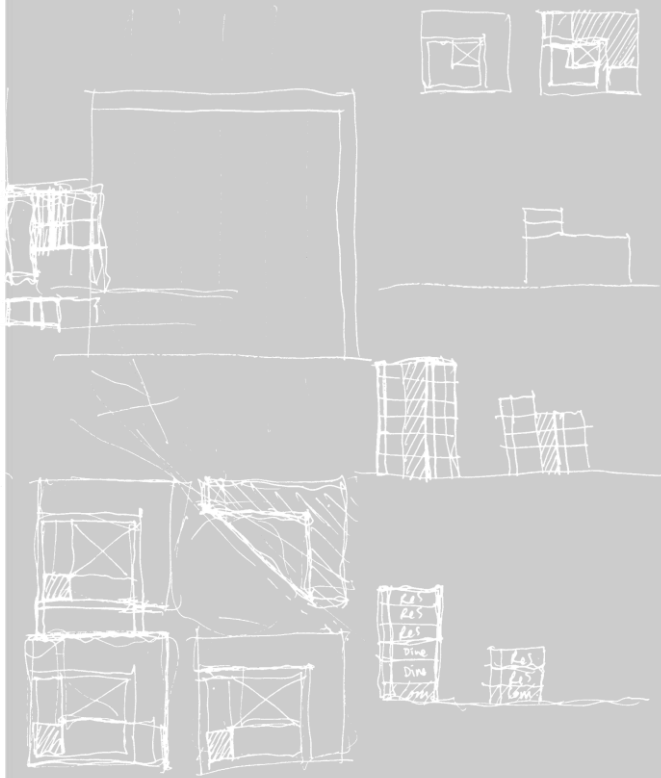
[7] His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai



prosecute those companies whose camps are found to be non-compliant (Dharmarajan 2007). According to Lt. Col. Rashid Bakhit Al Jumairi, an official with the Permanent Committee on Labour Affairs (PCLA), 19,249 workers registered complaints with the committee between March and December 2005. During this period, committee inspectors also visited 36 labour camps and found 75% of them to be well below government standards (Ghaemi 2006: 54). Further intensified inspections resulted in 100 labour camps being closed down in Sonapur after failing to meet the standards (Babu 2007), but the majority of labour camps remain poverty-stricken and in poor condition.

This is a fundamental progression in improving the living conditions of Dubai's migrant workers who are now entitled by law to a room of no more than eight people with a minimum personal space of about four square metres, as well as at least one bathroom for every eight workers. As in all other residential buildings, there has to be enough ventilation, natural or artificial light, thermal insulation, drainage, water supply, gas, electric supply, fire-safety measures, and health and environment preconditions (Egbert 2008). All rooms, kitchens, dining rooms, and other halls will have to be air-conditioned. Toilets and bathrooms will have to be furnished with clothes hangers, soap containers, exhaust fans, hot water, mirrors, and cabinets while the water tanks will have to be covered by sun shades to ensue cool water during summer. These specifications are a vast improvement to the current cramped and unhygienic labour camps in Sonapur, Jebel Ali and Al Quoz.

The 21st century has given rise to a greater awareness of environmental sustainability. Immigration can cause environmental strain by putting pressure on overused systems and resources. It is not only long-term migration, but also tourism that can be a neglected threat to the natural environment. Along with Dubai's greater long-term goal of economic growth and tourism, environmental sustainability has simultaneously become a primary focus of the UAE since it was revealed that Dubai's carbon footprint is the largest in the world per capita (Zacks 2007), largely due to its construction boom and traffic congestion. This, on top of the negative criticism regarding the treatment of its migrant workers, has made Dubai the object of international scorn, threatening the city's reputation. In keeping with Dubai's track record



of constantly outdoing its competitors to become a city of the 'biggest and best', it is unsurprising that Dubai aims to become a forerunner in the quest for environmentally sustainable living. However, the current state of its labour camps is threatening that dream.

These circumstances have led Dubai's ruler Sheikh Mohammed bin Rashid Al Maktoum to push for environmental reform. The government has woken up to the environmental impact of rapid growth. The UAE is a ratified signatory of the 2005 Kyoto Agreement (Saadeh 2007), and subsequently formed the Emirates Green Building Council (EGBC). In 2007, the EGBC launched a building sustainability assessment system for the UAE – the Green Building Code – based on the US LEED[8] rating system. This new legislative framework is currently in its final stage of completion, due for implementation later this year. It has been modified specifically for Dubai's hot desert climate (Sengupta 2008); the main modifications to the US LEED system include an increased emphasis on water conservation. Before building plans will be approved, developers, contractors and consultants will need to comply with certain minimum requirements, such as energy- and water-efficiency requirements, landscaping facilities, waste-efficiency requirements, proper site selection, and indoor and outdoor air quality requirements.

The city is also heavily investing in carbon dioxide (CO^2) recovery technology, solar power, water recycling and energy-saving cooling systems. Its massive investment in environmentally sustainable buildings is "setting the stage for one of the biggest experiments in sustainable technology anywhere" (Zacks 2007). Consequently, in order for this 'experiment to be successful, all aspects of Dubai's society have to be taken into account. This drive for sustainability will therefore have a direct impact on migrant labour housing in Dubai, leading to substantial improvements in the living conditions of blue-collar workers.

[8] LEED stands for Leadership in Energy and Environmental Design, the green building rating system developed by the US Green Building Council to encourage environmentally sustainable building and development practices (USGBC 2008).



Furthermore in January 2008, officials from over two dozen nations and international organizations met for *The Abu Dhabi Dialogue on Temporary Contractual Labour* conference to collaborate on a multilateral declaration to foster information sharing, promote capacity building, technical cooperation and interstate cooperation (Zogby 2008). The recommendations from the Dialogue aim to launch a new collaborative approach to address temporary labour and maximize its benefits for development in both the sending and receiving countries by: enhancing knowledge of labour market trends, skills and policies; building capacity for effective matching of labour demand and supply; preventing illegal recruitment practices, and promoting welfare and protection measures for contractual workers; and developing a framework for a comprehensive approach to managing the entire cycle of temporary contractual mobility that fosters the mutual interest of countries of origin and destination. These partnerships are based on the mutual interests of labour origin and destination countries with a particular focus on development. They are action-oriented and, in addition to governments, will seek to "engage other relevant stakeholders for the implementation of initiatives which will take this partnership forward in a spirit of international dialogue and cooperation" (Zogby 2008).

Ideally, these recommendations should provide benefits to all parties involved. The labour-sending countries benefit because their nationals who cannot find employment at home, are able to secure jobs abroad. The families of these workers receive regular remittances, often much greater than they could earn within their countries. Additionally, the labour-receiving countries benefit from these skilled and unskilled labourers who assist in their economic growth and development (Zogby 2008). Although the situation becomes disadvantageous when migrants are falsely lured by unmet expectations and stripped of some of their most basic human rights in their receiving countries – as is the case for the majority of migrant workers in Dubai.

Although migrant labour is not a new phenomenon, this "tidal wave of labour movement" (Zogby 2008) brings with it many problems of instability and social exclusion, as temporary contractual workers are only accommodated for short periods before returning to their home

countries once their contract expires. As temporary contractual migrant labour is a relatively new concept, and because it has grown so dramatically in the past two decades, only now are the problems of temporary contractual labour in the UAE being significantly addressed.

The Abu Dhabi Dialogue therefore represented a first effort by both sending and receiving countries to address the issues, identifying the need for global cooperation in understanding and managing population mobility. In addition to 22 Asian countries, other participating institutions included the International Labour Organisation, the Arab Labour Organisation and the European Commission. As Labour Minister Dr Ali Abdullah Al Ka'abi (cited in Absal 2008) reveals, "the level of participation indicates the priority given to labour issues by governments and the desire by many to achieve multilateral consensus".

Yet, increased government involvement is only the first phase in alleviating the migrant labour problem in Dubai. The UAE government has initiated the legal and structural framework for migrant worker policy and rights. Subsequently, it is the responsibility of construction companies and developers to abide by these government guidelines and put theory into practice by providing quality accommodation for their workers that improves not only the workers quality of life, but also their own corporate responsibility as well as the reputation of Dubai. It is the commercial 'Mecca' of the world, the Arabic business hub and ultimate tourist destination in the Middle East. Dubai has embraced the spirit of globalisation and technological advancement, resulting in unprecedented economic development over the last twenty years. Dubai is a "21st-century phenomenon, a city of perspectives" (Shadid 2006). As a result, Dubai is widely acknowledged to be the model contemporary Arabic city, but this can only be fully achieved in the eyes of international community once the problems regarding the exploitation of foreign migrant labour has been resolved.



Case Study

Omran is a labour housing scheme in Dubai, designed to improve the living standards and recreational / social facilities available to blue-collar migrant workers in Dubai.



Figure 18: Omran's prefabricated housing units
(Reference: author's own 2009)

OMRAN WORKFORCE ACCOMMODATION, DUBAI

Developed by Nakheel, Omran is as a 2.38 million square metre mixed-use labour housing scheme [Figure 18] on Dubai's west coast that will accommodate 60,000 workers once all phases are complete by 2010 (Omran 2007). According to Nakheel's senior development manager Shehab el Orabi (cited in Bakr 2008), "Omran is a workforce accommodation solution that was developed as a result of the shortage of staff housing and to improve workers' standard of living". Omran is divided into two sections – one for male construction workers (Omran South) and the other for male and female hospitality staff (Omran North) – with each section subdivided into various independent phases to be completed as the demand for this type of accommodation increases. With the first phase of both sections almost full to capacity, each housing 5,000 workers, the demand definitely exists.

In an effort to improve efficiency of the construction industry, Omran has been strategically positioned within Nakheel's exclusive Waterfront development [Figure 19] in Jebel Ali. This is in striking contrast to the previous labour camps located within the isolated and barren industrial areas on Dubai's outskirts. Its close proximity to the multitude of construction developments on the west side of Dubai means workers living close to the worksites, thereby minimising travel time and alleviating traffic congestion and the consumption of fossil fuels. Yet these practical measures appear to be more for the financial benefit of the construction companies themselves in reducing transport costs than integrating the workers into the city fabric.

Situated just north of Omran within the Waterfront, is Rem Koolhaas' Waterfront City project. One of the pillars of Koolhaas's conception of "Waterfront City is the dense social fabric and without diversity in its population and its economic, social, cultural activities, this very basic premise fails" (Unsal 2008). However by including labour accommodation within the Waterfront project, the steep division between rich and poor is only superficially addressed as a facade of integration. The Waterfront is aimed at Dubai's middle- to upper-class society, with its array of high-end residential, commercial and leisure facilities. Omran, being fenced off and guarded, is not integrated into the development but merely isolated within an



Figure 19: Map of Dubai showing location of Omran in the Waterfront
(Reference: Omran 2007 and Waterfront 2007)



Figure 20: Security checkpoint into Omran
(Reference: author's own 2009)

exclusive landscape. Although the workers' quality of life is dramatically improved by the upgrading of their living conditions and social facilities within the labour camps, these camps remain just that: labour camps. The indistinguishable rows of housing and fenced periphery contain the workers within the prison-like confinements of the camp, segregating them from the rest of Dubai's elite society. A richly diverse social fabric cannot be achieved without an integration of all sectors of the city's population.

However, it was never intended for Omran to integrate the workers into Dubai's society. Dubai's image is reliant on keeping the lower class workers hidden from the eyes of the Dubai's rich and the international tourists [Figure 20]. Migrant workers are allowed into the country on the premise that they will return to their home countries after their contracts to build the city expire. This is evident through the use of prefabricated building units which allow for the relatively fast and inexpensive construction of each phase, as well as ensuring an ease of disassembly once the majority of construction projects in the area have been completed. They are not intended as permanent residents – and like all foreign workers in the city, rich or poor – require a working and residence visa which can be effortlessly revoked by the government. Yet unlike the rich expatriates who are given every opportunity to enjoy what Dubai's cosmopolitan lifestyle has to offer, these poor migrant contract workers that are essentially responsible for building Dubai are unjustly treated and ignored.

Yet after completing a guided tour of the completed first phase [Figure 21] of Omran South with Omran's onsite facilities manager Nisar Ahmed, it is obvious that the lives of the 5,000 migrant construction workers who live in Omran have undoubtedly improved. Omran offers workers air conditioned, fully furnished rooms [Figure 22] and provides three meals a day in dedicated dining halls [Figure 23] with a number of food stations catering to different tastes and cuisines as well as outdoor hand-washing facilities. The social and recreational facilities at Omran are also surprisingly extensive, including a library, games rooms, sporting facilities, television rooms and a weekly professional laundry service. Other amenities such as a supermarket, barber shop, postal services and ATMs are also present within the facility. A large mosque, as the central focal feature of the project, is in the process of being



Figure 21: Layout of phase 1 of Omran South
(Reference: Omran 2007)



Figure 22: One of the dormitory-type rooms in Omran
(Reference: author's own 2009)



Figure 23: Extensive dining hall in Omran
(Reference: Nakheel 2009)



Figure 24: Some of the facilities offered within Omran
(Reference: author's own 2009 2009)

constructed onsite. There is also an onsite medical clinic with a doctor on duty for eight hours during the afternoon and evenings, as well as a separate isolation hall for temporarily accommodating workers who develop infectious diseases. A 24-hour ambulance service is also provided within Omran to the nearest hospital.

The low-density housing blocks are double-storey prefabricated units, with rooms on either side of a central corridor. Omran offers a range of four different room typologies [Figure 25], depending on the hierarchical rank of the worker: 1) dormitory-style *Labourer* rooms accommodating four workers in bunk beds; 2) *Junior* rooms of two workers sharing with two single beds; 3) individual *Senior* studio rooms with a single bed and space for a small sitting area; and 4) the *Executive* suites which include a kitchen/living area and a separate bedroom with a private en-suite bathroom. Only the executive suites have their own bathrooms; the other rooms share a number of communal bathrooms on each floor. All bathrooms provide hot and cold water, soap containers, non-slip flooring and exhaust fans. These seem like basic items, yet many of the labour camps in Dubai do not comply with standard services. The cost of living in Omran starts from Dhs55 per day, usually paid for by the companies, and offers all workers a minimum of nearly four square metres of personal space, which is a vast improvement on the cramped living conditions of other existing labour camps such as Sonapur.

The workers' recreational hall includes three separate television rooms offering English, Arabic and Hindi programmes. There is also a fully equipped gym with a personal trainer and adjoining change rooms. The library stocks a constantly updated collection of local newspapers from different countries to keep workers up-to-date with the latest news in their home countries. Ahmed reveals that the games room with foozeball and pool tables is undoubtedly the most popular during weekends. Outside, there is a full-sized basketball and volleyball court. The separate executive recreational hall contains the same facilities but on a smaller scale and with a swimming pool adjacent to it. At the time of the visit, a new large mosque as the central focal feature of the development was also being completed [Figure 24].

FLOOR LAYOUTS **ROOM TYPOLOGIES**

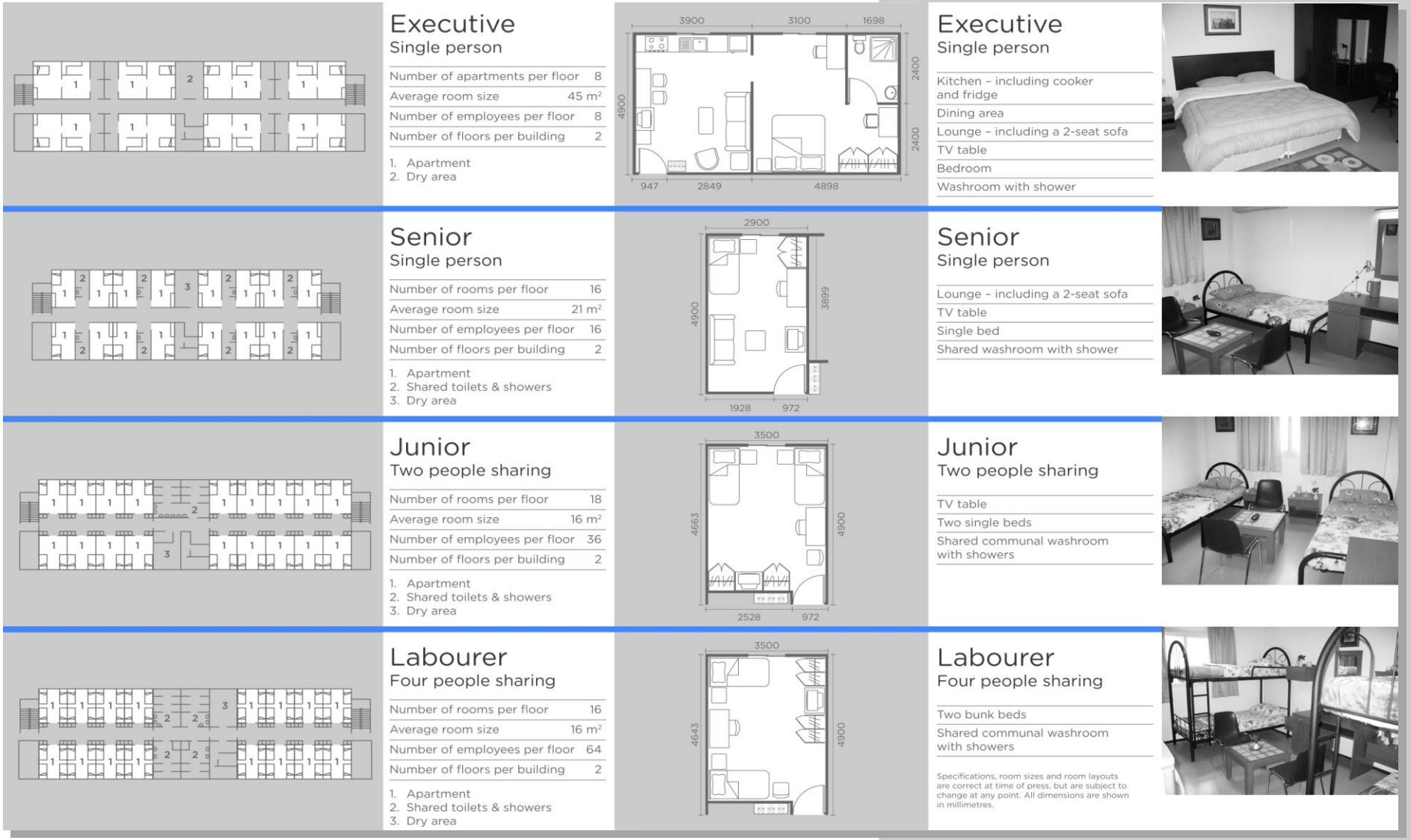


Figure 25: Floor layouts and room typologies in Omran South
(Reference: adapted from Omran 2007)

In terms of achieving a measure of environmental sustainability, Omran has also utilised environmentally sustainable materials and fittings where possible, together with the air-conditioned living spaces to improve the comfort of workers. With temperatures reaching in excess of fifty degrees during the summer months, this compromise is in direct response to the extreme desert climate. Power-saving devices automatically turn off lights after vacating rooms, and the workers are encouraged to save water.

Omran is a first attempt at rectifying this situation. It is evident that Omran has tried to find a compromise between both the wellbeing of the workers and the economic feasibility for construction companies has been taken into account when developing the facilities within Omran. In order to maintain the higher standard of living and services within Omran for both parties, workers are immediately shown an induction slideshow upon initial arrival about the facilities and procedures within Omran, and issued with entry and laundry cards in the administration block. Furthermore to avoid previous situation within labour camps of inadequate service provision, Omran has its own substation and power generators, as well as its own sewage treatment plant (STP) and water storage tanks. There are even suggestion boxes throughout Omran, encouraging feedback from the workers themselves on maintaining and improving conditions.

Although Omran has undoubtedly improved the lives of the migrant workers who live there when compared to the previous poverty-stricken labour camps such as Sonapur, Omran is still far from an ideal and sustainable solution. It is merely a starting point. It has provided an economically and practically feasible alternative for companies, and has to a limited extent implemented environmentally sustainable principles. Yet the potential exists for facilities like Omran to become merely a superficial facade for construction companies in complying with government regulations and maintaining a facade of corporate responsibility. The fundamental factor in preventing this shortfall is social integration with the surrounding community, not just social facilities within the project itself. With a few considerations and adjustments to its design, it has the potential to become a model of low-cost sustainable living.



CONCLUSIONS AND RECOMMENDATIONS

Although a vast improvement on the existing slum-like labour camps, Omran is only the starting point in fully integrating migrant workers into the city. With a few considerations and adjustments to its design, it has the potential to become a model of low-cost sustainable living, not only economically and environmentally, but also socially. Therefore, the final underlying question is how to achieve this by improving on the alternative housing model that Omran presents.

One of the socio-economic problems with migrant labour camps is that their lifespan is only short-term; they are not intended as permanent accommodation [Figure 26]. Migrant construction workers are located wherever there is a concentration of profitable building activity. At the moment, Dubai's construction industry is booming but as the market becomes saturated in a few decades, the need for construction labour will diminish, leaving empty labour camps. As contractual migrant labour, Dubai's blue-collar workers are expected to return to their home countries. There future in Dubai is not seen as long-term. However, as mentioned previously, Dubai is going to need a permanent working class to maintain the ambitious city it is currently creating. Even if the current migrant construction labourers are not intended as permanent residents, there needs to be provision for a permanent blue-collar working class in Dubai's future. Therefore by creating mixed-use labour camps that are essentially residential communities, provision can be made for these camps to be converted into low- or middle-income suburbs that will continue to thrive even once the migrant workers have left. This creates a greater long-term solution for the economic sustainability and financial feasibility of migrant labour camps.

This lack of permanency also affects the stability of workers who view the camps as temporary lodging, as opposed to their home for the next few years. Social sustainability can only be achieved through dedicated inclusion of all sectors of society, rich and poor. The poor have as much relevance to a growing economy as the wealthy, providing the service support needed to sustain development and industries. There is little tolerance for cultural discrimination and social exclusion in a truly global contemporary city; Dubai has the potential



Figure 26: The impermanent prefabricated housing with landscaped social areas between
(Reference: author's own 2009)

to unite its diverse population by providing opportunities for social interaction and integration of the lower classes into the fabric of the city. There should not be isolated labour camps; instead integrated mixed-use housing developments that attract all cultures and financial backgrounds. Simply because financially disadvantaged workers live in a certain area does not necessarily mean that area is at a disadvantage itself; even the poorest community can have the most vibrant social character. It is in the making of social spaces that a community begins to engage and enhance its context.

Unlike the prefabricated housing solution of Omran, future labour communities need to focus on providing permanent accommodation blocks placed not in spatially efficient rows, but in configurations which promote a sense of community and place-making. The facilities provided by Omran are exceeding comprehensive in providing migrant workers with relevant facilities and services that have previously been lacking; yet it is the layout of the complex that fails to meet expectations of what a community should be. Although migrant workers are only contracted on temporary work permits, how are they expected to settle into their new home if there is no permanency? How are they meant to feel part of a supportive community when the buildings suggest an authoritative rigidity?

These questions will pose the greatest challenge for this project in designing a sustainable migrant housing solution. A pressing social concern about migration is the isolation of the migrant workers from their families, the neighbouring communities and the city of Dubai. The isolation from their existing support system in their home countries can cause many resulting social concerns for migrant workers in their new contexts [Figure 27]. In stage two of Omran, Nakheel will consider family type accommodation since there is a great interest in that type of facility. However, the potential for Omran to include family accommodation would only be realistically viable for the more senior construction industry staff, who have the financial resources to relocate their families to Dubai. The majority of migrant construction workers battle to raise enough money for themselves, let alone their entire family.



Even if their situations are temporary in Dubai, a variety of recreational and social facilities, a social network and telecommunication facilities remains crucial to the emotional stability and family connectivity of all migrant workers, rich or poor. Being part of a social community in their receiving country means feeling appreciated and cared for, which is what Dubai's migrant workers are severely lacking. Not only will this benefit the workers' wellbeing, but also the wellbeing of Dubai's global society as a whole. This means creating housing units which promote social engagement through their layout and spatial organisation. Therefore the spaces between the housing units are as important as providing all the basic necessities within. Transition spaces between the street and the living spaces help to create an atmosphere of privacy, which is unlike the majority of labour housing schemes that have workers cramped into tiny rooms with no privacy whatsoever. This is fundamental to creating spaces that the workers can retreat to after a long day on the construction sites.

Another advantage of creating residential communities as opposed to merely housing is their mixed-use function, meaning migrant workers who – as previously mentioned are among the city's poorest – have access to a variety of facilities and services whilst incurring minimal travel costs. Mixed-use projects have the potential to support walking and cycling as alternative means of transportation as facilities are located within walking distance, encouraging a more active and social environment. As recreation and commercial facilities are located in close proximity to the residential components, the need for a car is virtually eliminated within the development. Migrant workers are the poorest of Dubai's population and the majority cannot afford cars, so the promotion of walking or cycling is vital for the development to function effectively, as well as sustainably.

However, these residential communities should not be isolated islands of only migrant construction workers. They should integrate and permeate into the communities that exist around them, creating a diversity of all sectors of society. This allows workers to become involved in the fabric of the city, and not remain isolated on the outskirts, as before. By doing this, migrant workers can enjoy the opportunities that the city has to offer, and become



Figure 27: The 23 nationalities represented at Omran
(Reference: author's own 2009)

familiar with their new surroundings which will in turn transpire into a greater feeling of belonging.

As stated previously, it is also important for the communities to be located close to potential worksites. Omran has successfully achieved this to ensure shorter travelling distances for the buses that transport workers to and from work every day during peak hour traffic [Figure 28]. This reduces travel time, giving the workers more free time and also reducing the travel costs for construction companies. It is subsequent benefits such as these that support the initial cost of building these improved labour camps. This, together with the mixed-use component which has the potential to become a profitable income-generator reiterates the financial feasibility of such residential developments.

One of the many major financial concerns of impoverished migrant workers living in the UAE is the escalating cost of living. Therefore the integration of communal vegetable gardens into the design of these labour communities can encouraged workers to grow their own fresh produce, minimising their monthly food expenses. Not only will these gardens promote a sense of community through participation, but also add to the green visual appeal of the community. The produce can also be sold for a profit and shared amongst workers, promoting a sense of achievement and self-worth by taking an active role in expanding their financial circumstances.

Along with Dubai's greater long-term goal of economic sustainability, environmental sustainability has also, as mentioned previously, become a primary concern. The UAE has the second-highest level of domestic waste per capita after the United States, making recycling a priority (Saadeh 2007). According to Recycle Dubai, household waste in Dubai in 2007 reached an average of 725 kilograms annually per capita (Saadeh 2007). It is common practice within many of Emaar's[9] residential developments for households to be distributed with plastic bags and cartons to encourage the recycling of plastic, cans, glass and paper, to be

[9] Emaar is Dubai's largest real estate company (Saadeh 2007).



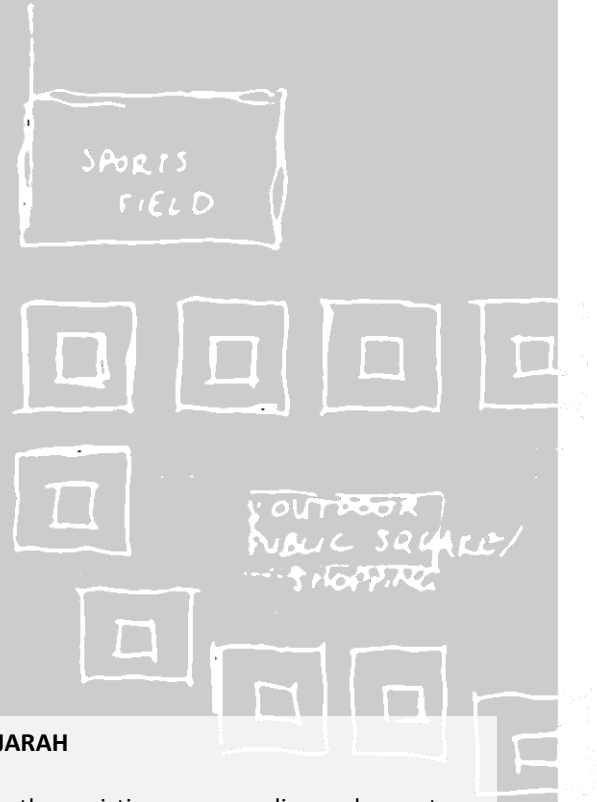
collected weekly. Dubai has the facilities for recycling paper, glass, aluminum, cans, plastic and other materials, yet there lacks sufficient incentive and convenient provision for the majority of Dubai's inhabitants to cooperate. As the majority of Dubai's inhabitants live in migrant labour camps, incorporating recycling principals and opportunities into these developments can have a dramatic effect in minimising the amount of waste produced per capita.

"It is the construction industry which is contributing largely to solid waste production and the centre of the construction activity is in Dubai," explains head of the Emirates Environmental Group Habiba al-Marashi (cited in Saadeh 2007). The demolition waste from the existing temporary labour camps can be recycled and reused in the construction of new permanent housing complexes, making the entire process more economical and more sustainable. By including recycling initiatives within the construction labour camps, the potential exists to counteract the industry's environmental deficit. The creation of migrant housing schemes with adequate sanitation and facilities that run at an acceptable capacity will reduce the damaging effects to the environment by the ill-equipped and overcrowded existing labour camps. Energy-producing sewage treatment plants (STPs) are also a possible option in minimising the waste generation in these labour camps.

What better place to initiate recycling than in the migrant labour communities who would greatly benefit from a reduction in operating costs and living expenses. Even simple solutions such as waste water collection and separate recycling bins are an improvement on the existing wastage in labour camps. Water-saving devices can be installed in all kitchens and bathrooms to minimise water consumption, and therefore overall operating costs. The opportunity to include sustainable principles into the design of future labour accommodation projects has unlimited potential. International pressure around economic, social and environmental sustainability is a present reality due to the threat of global warming, environmental degradation and the current economic crisis.



Figure 28: Workers wait to board the buses that will take them back to their labour camps
(Reference: Abdul-Ahad 2008)



ADVANTAGES OF SHAJARAH

Workers

- ✓ Better than existing overcrowding and poverty
- ✓ Different room typologies
- ✓ Range of amenities and facilities
- ✓ Provided with three meals daily

Companies

- ✓ Provide quality accommodation
- ✓ Comply with government regulations
- ✓ Close to work sites



Programme

SHAJARAH is a mixed-use and mixed-income development, offering a variety of room typologies to suit different needs, preferences and financial budgets. It also includes an extensive range of convenient shared facilities and amenities to improve quality of life and social environment.

SITE INFORMATION

The SHAJARAH site is a 114-hectare area of desert within the new Waterfront development that is currently under construction around the Palm Jebel Ali. The site forms part of the currently demarcated Omran site, the upper half that is currently demarcated as Omran North [Figure 29]. As a result, the site is already zoned for residential/commercial use. At present, the site has only been partially developed with Omran North's first phase (one of six residential clusters); the remaining site is as yet undeveloped desert. SHAJARAH's intention is to dismantle Omran and redevelop the entire Omran North site.

CLIENT

Nakheel is the developer of the Waterfront and the Palm Jebel Ali. Therefore, as the Omran site already belongs to them, Nakheel is also the client for this project. Nakheel specialises in large-scale residential and commercial developments. Nakheel's slogan is "Where Vision Inspires Humanity"; similarly they pride themselves on "making a huge contribution to the improvement of people's lives and opportunities... [through] creativity, ingenuity and daring" (Nakheel 2009). Therefore SHAJARAH aligns perfectly with the company's vision and corporate responsibility principles.

PROJECT BUDGET

Although SHAJARAH is aimed at low- to middle-income users, the project budget is not low-cost. SHAJARAH is an investment opportunity for Nakheel, as well as large companies who buy into the project to provide quality accommodation for their workforce. As a sustainable mixed-use development, the cost-saving mechanisms such as solar power and water recycling, together with the income generated from rentals over the project's lifetime, will more than cover the initial construction and implementation costs. Therefore, the focus is not on initial cost but more on overall long-term savings.



Figure 29: Location of SHAJARAH within Dubai's Waterfront Development
(Reference: adapted from Nakheel 2007)



SCHEDULE OF ACCOMMODATION

With the aim of catering to Dubai's current and future low- to middle-income demographic, SHAJARAH provides a range of facilities and room typologies to suit different needs, interests and financial budgets.

ROOM TYPOLOGIES

The different room typologies make provision for family accommodation, as well as potential future conversion of dormitory-type rooms into larger private apartments as required.

Dormitory Rooms

- Minimum 25m^2 with no more than 4 occupants
- Shared en-suite bathroom (shower, toilet and basin)

Dormitory Studios

- Minimum 30m^2 with no more than 4 occupants
- Combined living and sleeping space
- Shared en-suite bathroom (shower, toilet and basin)

One-Bedroom Apartments

- Minimum 40m^2 with no more than 4 occupants
- Living/dining area with full kitchen (fridge, hob, oven and sink) and separate bedroom
- One bathroom (shower, toilet and basin)

Two-Bedroom Apartments

- Minimum 55m^2 with no more than 8 occupants
- Living/dining area with full kitchen (fridge, hob, oven and sink) and separate bedrooms
- Two bathrooms – one en-suite (shower, toilet and basin)



SHARED FACILITIES

At a development level, SHAJARAH provides a number of shared community facilities that are located centrally each half of the site. These include:

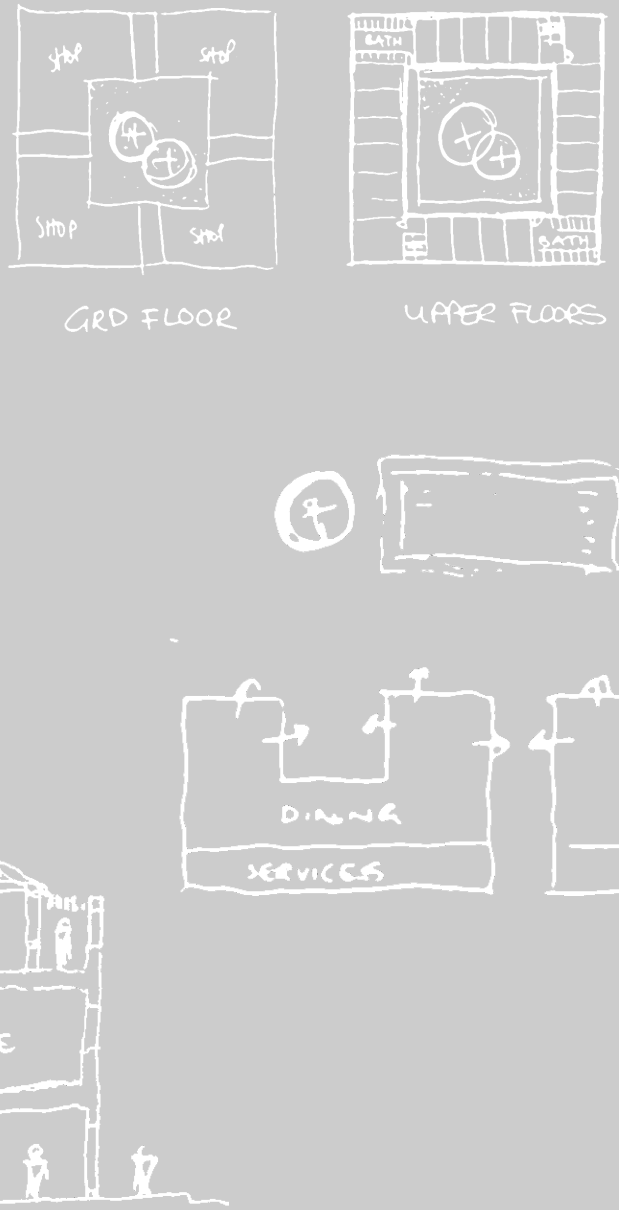
- Outdoor sports fields
- Indoor sports hall and recreation centre
- Mosque
- Clinic
- Bus station

The commercial spaces within each building are located predominantly on ground floor, and are predetermined according to building location and surrounding functions. These include:

- Library / bookshop
- Coffee shops / restaurants
- Supermarket
- Post office
- Barber shop
- Bank / ATMs

Additionally, shared social spaces located on the residential floor of each building, as well as building services, include:

- TV rooms (for different languages)
- Information Technology and Communication (ITC) rooms (computers, telephones, etc.)
- Games rooms
- Basement parking
- Separate dining halls to cater for different international cuisines
- Laundromats with drying areas
- Recycling waste chutes on every floor to basement with central collection point
- Separate greywater and sewage water plumbing, to be stored in tanks in basement
- Solar panels on roof



Site/ Context Appraisal

SHAJARAH is located along Dubai's southwest coast within the large-scale Waterfront project that is currently being developed.



Figure 30: SHAJARAH site in the context of Dubai
(Reference: adapted from Google Earth 2009)

SITE SELECTION AND CONTEXT ANALYSIS

It is vital that a site is selected based on whether the scale and type of building is appropriate for and compatible with the regional land use plans in the near future. The 240-hectare SHAJARAH site is located on the Omran North site, replacing Omran's semi-permanent workforce accommodation with a more permanent, contextually engaging urban fabric. As the two developments were both conceptualised as labour accommodation, many of Nakheel's previously mentioned reasons for locating Omran on the site also apply to SHAJARAH.

REGIONAL LAND USE

The SHAJARAH site [Figure 30] is situated within the heart of Dubai's 130-million square metre Waterfront development, designed around the reclaimed palm-shaped island of Palm Jebel Ali. The Waterfront is set to be the largest manmade waterfront development in the world at twice the area of Hong Kong (Waterfront. 2007). Positioned between the UAE's capital Abu Dhabi to its west and the commercial hub of Dubai to its east, the Waterfront lies in close proximity to prime international commerce and industry hubs: a well-networked seaport (Jebel Ali Port), an international airport (Al Maktoum International Airport) and a major free zone (Jebel Ali Free Zone). Planned as the world's largest passenger and cargo hub, the new airport is to be the centrepiece of the Dubai World Central, a district of large-scale commercial and residential developments. The airport is expected to be fully built and operational by 2017.

In addition to the high-end residential and business properties [Figure 31], Waterfront will also provide a range of affordable housing for Dubai's working middle class. The Omran workforce accommodation is the only housing solution for the poor lower-class migrant workers in the Waterfront. Therefore by locating SHAJARAH on the existing Omran site, the project takes on Omran's role within the Waterfront of providing the blue-collar workers with affordable and adequate accommodation in the Waterfront area. Yet, as mentioned previously, Omran can



Figure 31: Developments within the Dubai Waterfront
(Reference: Waterfront 2007 & OMA 2008)



Figure 32: Surrounding functions and land uses
(Reference: author's own 2009)

be greatly improved on a social level by integrating the housing into the surrounding urban fabric.

As many of the developments within and around the Waterfront are set for completion around 2018, a concentration of construction activity will be needed on the western area of Dubai for at least the next decade. The majority of migrant construction workers will return to the home countries once the bulk of construction activity in Dubai has been completed. However, the Waterfront, as well as the rest of Dubai's growing construction projects, will require a lower-middle class of workers to sustain its facilities. Once completed, the Waterfront alone is expected to create a million jobs and house 1.5 million people. This new wave of workers into Dubai will become the new residents of SHAJARAH, living in close proximity to their workplace within the many sub-developments of the Waterfront. Therefore the site's location in the heart of the Waterfront provides these developments with a long-term workforce on their doorstep, thereby minimising travel time and simultaneously alleviating traffic congestion and the consumption of fossil fuels.

NEIGHBOURING DEVELOPMENTS

The neighbouring developments to any site have an impact on its design. As the surrounding context of SHAJARAH is the new Waterfront zone, the sub-developments are generally still in either their planning or early construction stages. Therefore, little exists in the area at present, especially in the site's immediate adjacent context. However, what is known is that the majority of Waterfront developments are zoned for high/middle-end mixed-use, commercial and residential developments [Figure 32], supporting the intention of SHAJARAH to provide low- to middle-income options in the area. These neighbouring developments are generally low to medium density, with buildings ranging from two to six storeys, with the exception of Waterfront City's high-rise towers to the north of the site [Figure 33].



DENSITY

Siting of a building should carefully weigh the relative merits of concentration versus dispersal of structures. Natural landscape values may be easier to maintain if facilities are carefully dispersed. Conversely, concentration of structure leaves more undisturbed natural areas. In order to maximise shade on the site to reduce ground surface temperatures, the SHAJARAH buildings are intended to be placed close together. This concentration of higher density development has lesser impact on the site and is more sustainable in accommodating a larger number of people on the same area of land.

RE-USE LEVEL

Identifying buildings that can be re-used will reduce the amount of material required for the new buildings. This can be achieved by renovating or restoring the existing structures and converting them for new uses. If this is not possible, then the building should be deconstructed in order to salvage any re-usable material. Omran's semi-permanent housing is designed to be relatively easy to dismantle, meaning that SHAJARAH can utilise the materials from Omran in the construction of its own buildings. For example, timber from flooring and wall systems can be re-used to make items such as timber screens.

CAPACITY AND DISTURBANCE LEVEL

The ecological value and presence of natural habitats within sites can vary based on the level of disturbance caused by previous developments and activities. Avoid building on undeveloped land as much as possible and construct on land that has already been disturbed by anthropogenic activities. An unused area will not provide any economic benefits and therefore redeveloping these areas is likely to create jobs and increase land values that would otherwise not occur. A site analysis should determine the capacity for structures and regenerate.



Figure 33 Surrounding storey heights
(Reference: author's own 2009)

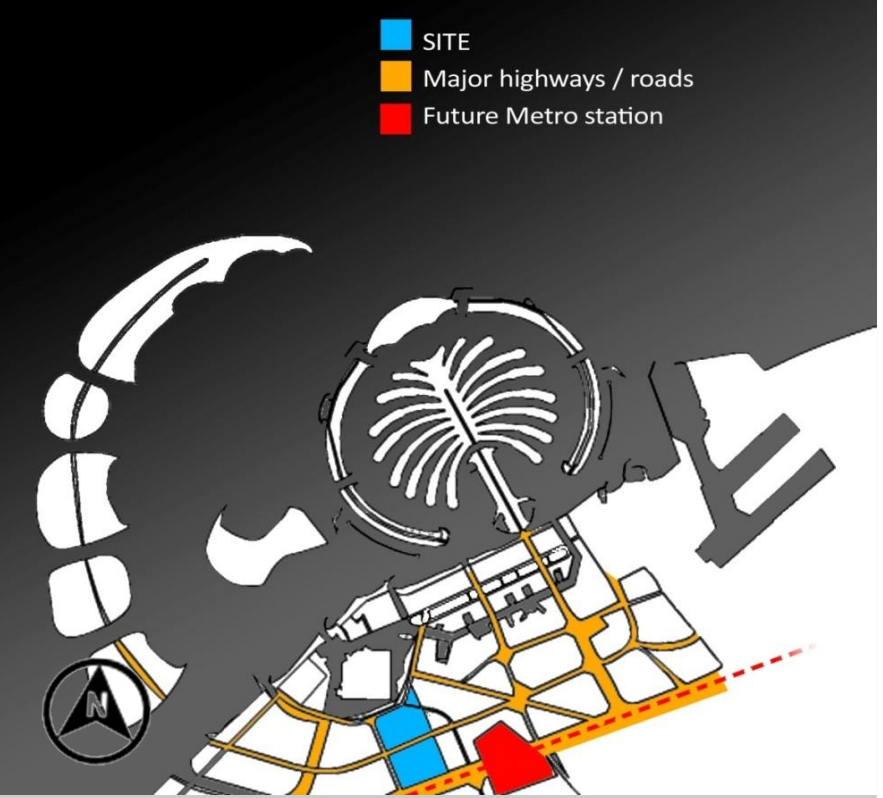


Figure 34: Surrounding transport links and routes
(Reference: author's own 2009)

As the site is already host to the first phases of Omran workforce accommodation, with the as yet undeveloped areas as featureless desert, the impact of SHAJARAH will cause minimal additional disturbance to the natural vegetation and non-existent wildlife on the site. In fact as SHAJARAH is aimed at becoming a more sustainable alternative to Omran, the project will essentially improve the impact of the development on the site.

Energy and Utilities

One of the major advantages of locating SHAJARAH within the Waterfront is advancing the latter's aim of becoming a "landmark sustainable development founded on resource efficiency, social equity, and economic prosperity" (Waterfront 2007). Within the Waterfront, energy and water conservation will be achieved through the integration of utilities in dedicated utility centres, where process streams are interlinked and waste is transformed into energy to power the city (Waterfront 2007). These are systems being tested for the first time in Dubai on such a large scale, and therefore create a more sustainable infrastructure in which to place SHAJARAH than elsewhere in Dubai at present.

PROXIMITY OF TRANSPORT LINKS

Good siting practices can maximise pedestrian access to the wide variety of onsite and offsite resources and recreational activities. Also, siting always give preference to sites located close to existing or proposed public transport links. This will reduce energy costs in transportation and travelling. The Dubai Metro's first phase is due to be opened later this year. Although the line stops short of SHAJARAH at Jebel Ali Free Zone, this is only a few kilometres away and will provide necessary links to the rest of Dubai [Figure 34]. A future extension of the line is currently being designed to run along Sheikh Zayed Road highway which forms the adjacent southern edge of the SHAJARAH site [Figure 35], meaning that a future station [Figure 36] in close proximity to the SHAJARAH site is foreseeable in the near future.



Additionally, SHAJARAH is aiming to facilitate walking and cycling by including a network of bicycle and pedestrian paths on the site, as workers generally cannot afford cars. Links between SHAJARAH and the surrounding context – mainly mixed-use, commercial and residential developments – will allow the residents of SHAJARAH access to the surrounding facilities.

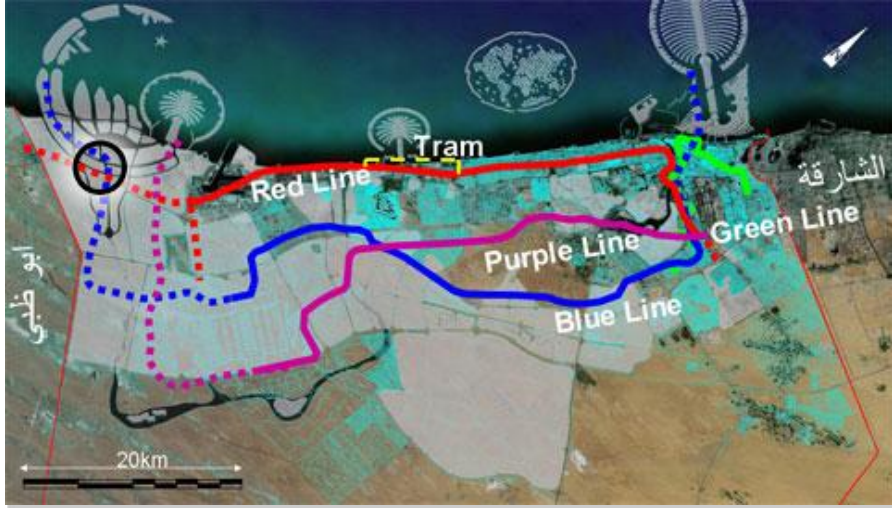


Figure 35: The Dubai Metro's proposed routes – SHAJARAH indicated on the top left in the black ring
(Reference: Dubai Metro 2009)



Figure 36: The proposed Dubai Metro stations
(Reference: Dubai Metro 2009)

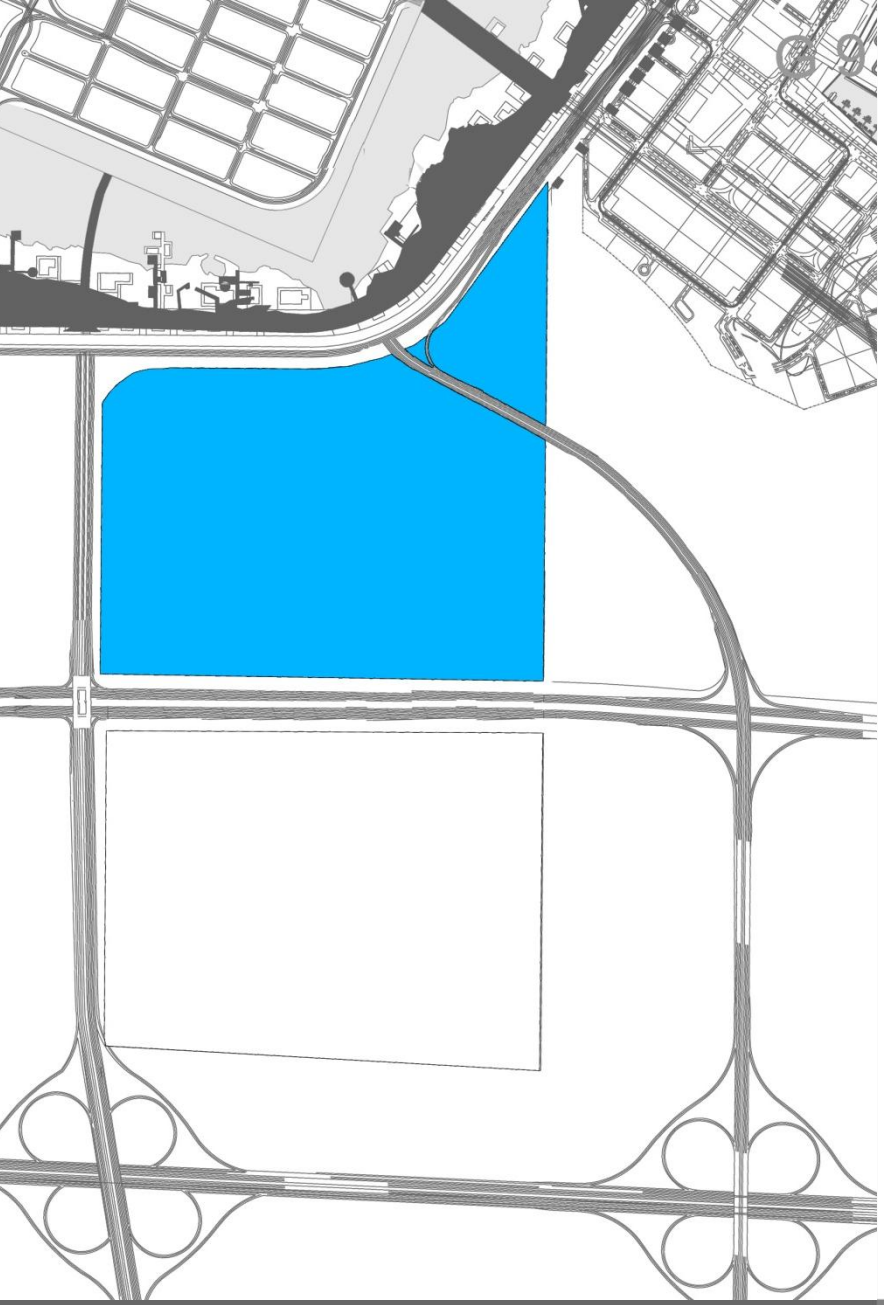


Figure 37: Site extents indicated in blue
(Reference: adapted from Nakheel 2007)

SITE ANALYSIS

TOPOGRAPHY

Topographic and hydrological impacts of proposed building need to be understood as this influences building proportions and drainage strategies.

Dubai is a low, flat country, lying only 16 metres above sea level (Dubai Dreams 2007). As the UAE is part of the eastern Arabian Desert, much of its landscape is composed of sandy desert comprising of mainly fine, white crushed shell and coral sand. Dubai lies along the Persian Gulf coast of the UAE. Dubai has no natural river bodies or oases, although numerous manmade waterways and canals such as the Dubai Waterfront – of which the SHAJARAH site [Figure 37] is a part of – have been introduced to the landscape to create meandering waterfronts. Although the site forms part of the Waterfront, the site has no direct access to any waterways; the closest canal lies to the north, across the road and behind the high-rise tower blocks that are planned for Waterfront City.

VEGETATION

It is important to retain as much existing native vegetation as possible to secure the integrity of the site. The vegetation on the site is minimal, being sparse desert grasses. Date palms are some of the few indigenous plant species that naturally grow in the desert, although none are present on the site naturally. The first phase of Omran has however planted vegetation and palm trees, and these should be replanted and incorporated into the SHAJARAH landscaping scheme. Therefore the impact of the SHAJARAH development will not negatively impact on the site's vegetation, as little exists naturally. On the contrary, by adding additional vegetation during landscaping, the green spaces on the site will be greatly increased, adding to the beautification and diversity of the surrounding environment.

HAZARDS

Seismically, Dubai is in a very stable zone. The nearest seismic fault line, the Zargos Fault, is 120km from the UAE and is unlikely to have any seismic impact on Dubai. Experts also predict that the possibility of a tsunami in the region is also minimal because the Persian Gulf waters are not deep enough to trigger a tsunami (UAE Interact 2007). However, Dubai is prone to flooding during the yearly rain season due to insufficient drainage measures. Therefore precautions and necessary systems need to be put in place to deal with runoff water.

INFRASTRUCTURE

The existing utility corridors and road network around the site is extensive [Figure 38]. Dubai's major 16-lane highway, Sheikh Zayed Road, runs along Omran South's southern edge. This provides a nearby onramp onto the highway for the company buses transporting workers. On the adjacent west edge is a major arterial spine with an onramp onto the highway at the site's south-western corner. The northern edge of the site is the waterfront road, with the waterfront-facing high-rise tower blocks on the opposite side. Another major road exists to the east of the site, but not directly adjacent to it. However, this road cuts through the north-eastern point of the site, segregating it from the rest of the site. This provides opportunity for the isolation of treatment facilities (such as the sewerage treatment plant), removed from the rest of the development for noise, smell and aesthetic reasons.

A major connective arterial road runs directly through the middle of the entire Omran site (along SHAJARAh's southern edge), providing an obvious access point for vehicles. This provides opportunity for commercial activity along this mobility corridor, drawing people from the surrounding areas into the development.

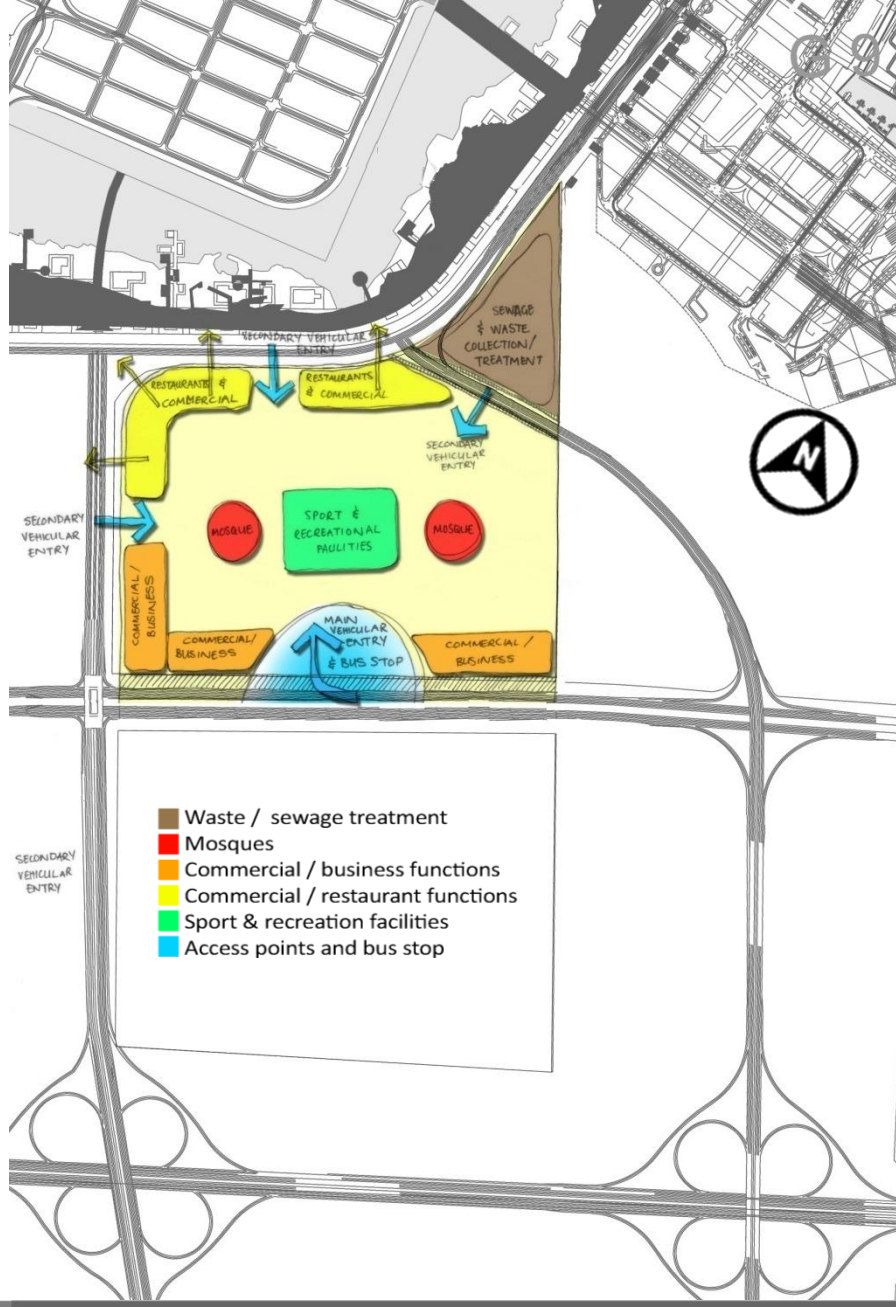
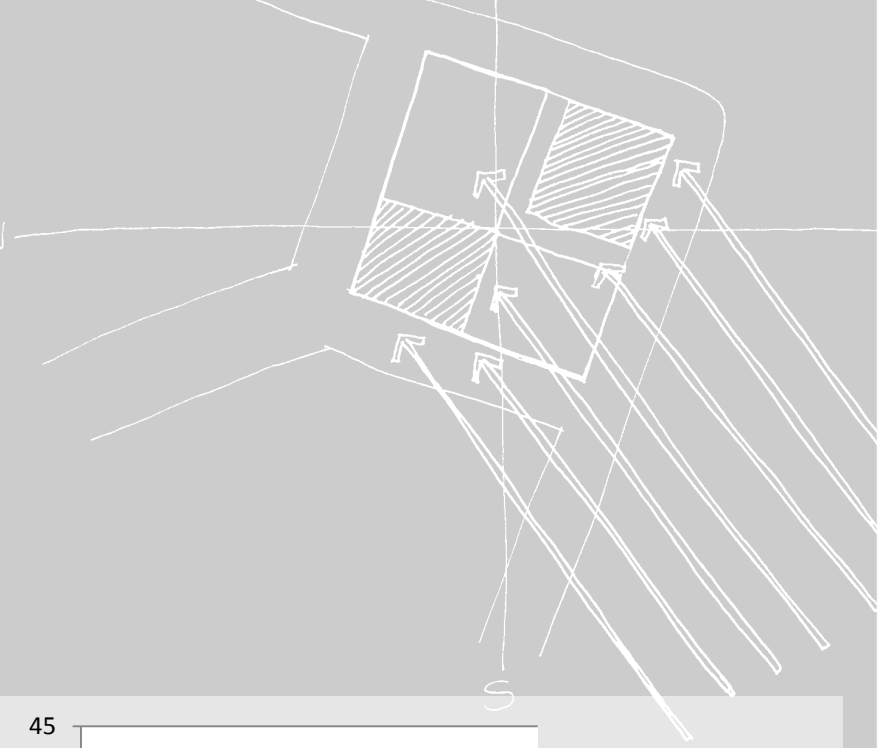


Figure 38: Site analysis diagram
(Reference: author's own 2009)



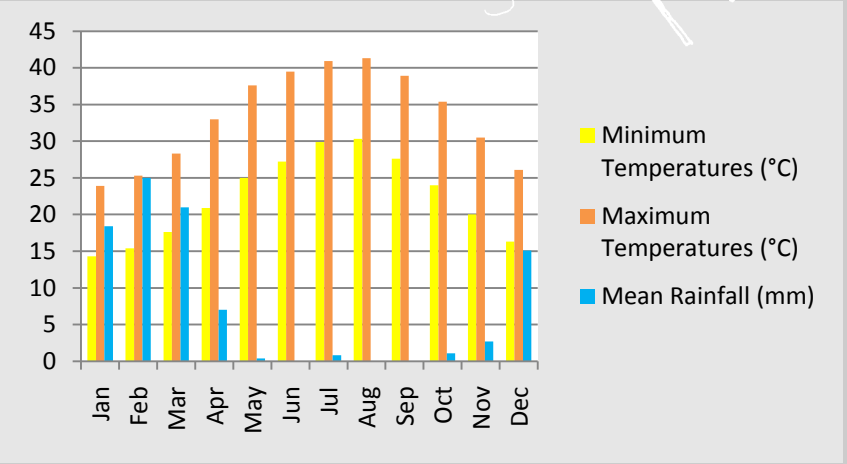


Table 1: Graph showing average minimum and maximum temperatures, and mean rainfall in Dubai
(Reference: Dubai Meteorological Office 2009)

CLIMATIC ANALYSIS

The climate of hot, dry zones is in general characterized by high temperatures (40-50°C in summer), with sharp variations in both diurnal (day/night) and seasonal (summer/winter) temperatures. Rainfall is scarce, irregular and unreliable, but may nevertheless cause severe flooding when it happens. Cold winds and dust/sandstorms prevail in winter. The solar radiation intensity is high and enhanced by the radiation reflected from the ground. Particular conditions in coastal desert regions mean that the high humidity causes definite discomfort in summer. On the other hand, the humidity tends to reduce diurnal variations and moderate temperatures (Gut & Ackerknecht 1993).

This accurately describes Dubai's climate [Table 1]. Although Dubai is essentially a desert city, its location along the Arabian Gulf coast exerts a modifying influence, experiencing less dramatic diurnal fluctuations in temperature and higher humidity than inland desert regions. Humidity can reach as high as 100%. Therefore Dubai's climate can be classified as a coastal desert climate, characterised by extreme summer temperatures, year-round sunshine, generally high humidity and infrequent, low rainfall [Table 2].

The following information is a general analysis of the climatic conditions on the site. A more focussed analysis – including solar studies to determine the impact of sun exposure on the design at different times of the year can be found under the *Design Concept* chapter, as the conceptual placement and design of the buildings was largely influenced by these specific climatic factors.

SUN AND TEMPERATURES

Dubai is in the Northern Hemisphere and therefore direct sunlight comes from the south [Figure 40]. As the landscape is essentially flat, orientation needs to be optimised so as to avoid excess sun exposure from the south, east and especially the harsh west afternoon sun.

Table 2: Annual climate and weather of Dubai
(Reference: Dubai Meteorological Office 2009)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Av. min/max temp (°C)	14.3 23.9	15.4 25.3	17.6 28.3	20.9 33.0	25.0 37.6	27.2 39.5	29.9 40.9	30.3 41.3	27.6 38.9	24.0 35.4	20.0 30.5	16.3 26.1
Mean rainfall (mm)	18.4	25.0	21.0	7.0	0.4	0.0	0.8	0.0	0.0	1.1	2.7	15.1
Mean days with rain	5.5	4.8	5.7	2.6	0.3	0.0	0.5	0.5	0.1	0.2	1.3	3.7
Mean min/max humidity (%)	44.0 83.0	43.0 85.0	40.0 84.0	32.0 79.0	29.0 76.0	32.0 82.0	32.0 79.0	34.0 78.0	31.0 84.0	34.0 84.0	38.0 82.0	44.0 84.0

Daytime summer (June to September) temperatures range from 35-47°C, and can soar as high as 50°C. Even the temperature of the sea can reach 37°C, producing extreme humidity along the coastal regions of up to 90%. At night, the temperatures drop to about 28°C. Winter months (November to April) are mild and pleasant in Dubai, with temperatures averaging at 25°C during the day and falling to as low as 9°C at night, with much lower humidity (Dubai Meteorological Office 2009).

From the graph below [Figure 41], it can be seen that Dubai's temperature range throughout the year rarely drops below average thermal comfort levels. However, the darkest red parts of the graph show that the temperature range for the majority of the year falls within and dramatically exceeds adequate comfort levels. Therefore, design in Dubai should be focussed on alleviating the heat.

WIND / SANDSTORMS

Generally, weak afternoon breezes from the Arabian Gulf (north-westerly winds) bring cool winds to the coast [Figure 39]. Being part of a desert, Dubai experiences winter shamals (dust storms). A shamal is a north-westerly wind blowing over the Persian Gulf states, resulting in large sandstorms. This weather effect can occur several times a year, mostly in summer but sometimes in winter, and usually lasts about three to five days. Ahead of an approaching shamal strong south-easterly winds also occur, bringing warm, dry desert air to the coast (Dubai Meteorological Office 2009).

PRECIPITATION

It very seldom rains in Dubai – about 22 days per year (Dubai Meteorological Office 2009) – but often when it does the result is severe flooding (typically between December and March) because the infrastructure systems have not been designed to facilitate water drainage.

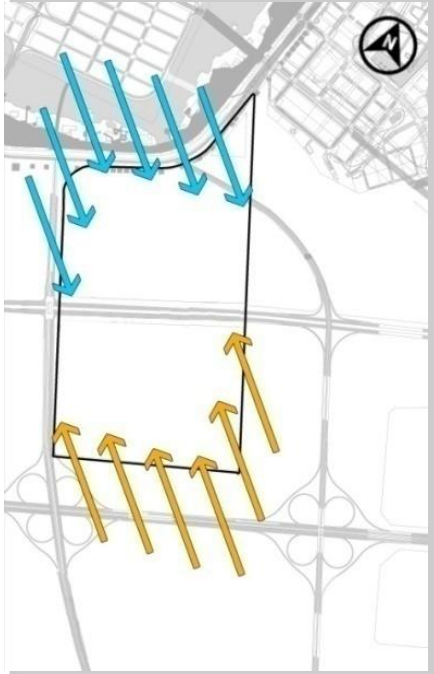
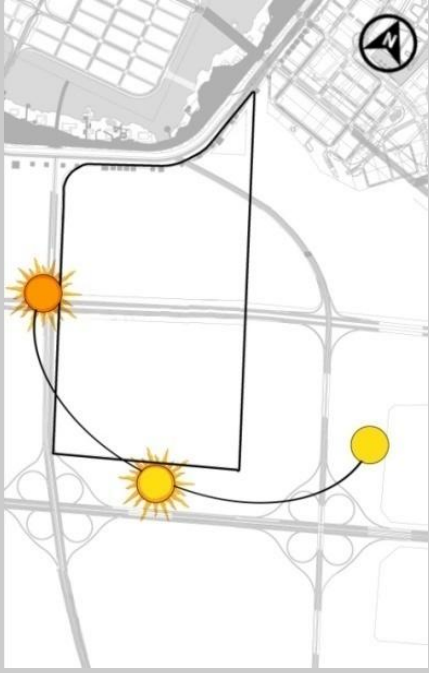


Figure 39: Wind direction on the site
(Reference: Nakheel 2007 and author's own 2009)



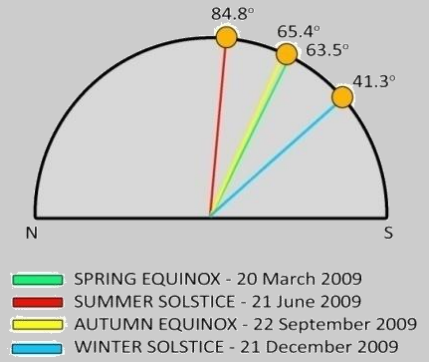


Figure 40: Sun path and midday angles on the site
(Reference: author's own 2009 & Ecotect 2009)

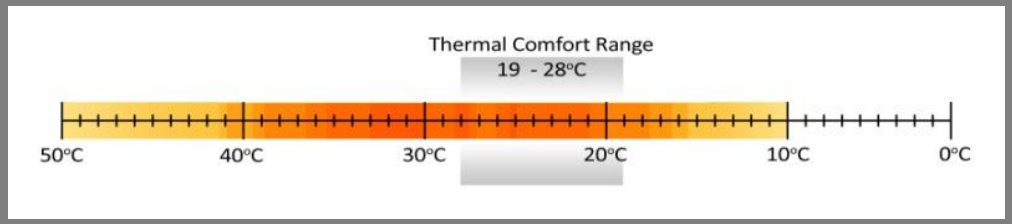


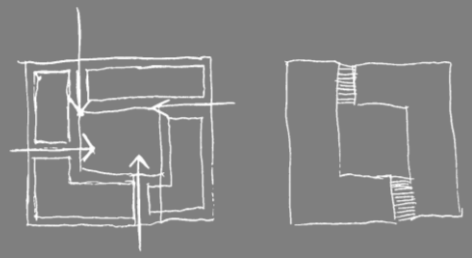
Figure 41: Graph showing extent of temperatures in Dubai outside the thermal comfort range
(Reference: author's own 2009)



Design Principles, Objectives and Strategies

This chapter focuses on the fundamental considerations when designing for a harsh desert climate in the 21st century. Valuable passive climatic responses from traditional desert architecture have been incorporated into a contemporary economic, social and environmental strategy for designing a sustainable 21st century community.





DESIGN FOR A DESERT CLIMATE: LEARNING FROM TRADITION

Settlements in hot, dry climates are characterised by their protection against the sun. Minimal sun exposure in summer and therefore compactness and shade are the main principals for building in desert zones [Figure 42]. Hence, compact planning for groups of buildings is required in order to give shade to each other and to provide a shaded network of narrow streets and small spaces in between. Arcades, colonnades, cantilevered building components, membranes and small enclosed courtyards are traditional responses to the climate; even larger public open spaces should be enclosed, inward-looking and shaded for most of the day. Of equal importance is natural lighting and ventilation. Air circulation can be improved through wind channelling in shaded narrow streets in the direction of the main wind. The location near a water source and the incorporation of vegetation is preferable.

The analysis of traditional buildings types and settlement patterns can therefore provide a good method for developing a design concept, as they tend to effectively meet the demands of the climate using passive methods. In addition, settlements are influenced by many functional, social and cultural factors, and usually respond in an optimal way to the local conditions, giving many useful indications. However, purely traditional solutions often do not meet the functional needs of today's modern day society – such as traffic and multi-storey buildings – and therefore need to be incorporated with current technology in order to find the most effective solution.

As a result, the main goal of contemporary passive climatic design, on a macro (development) and micro (building) level is to reduce the discomfort caused by the extreme heat and humidity by adapting traditional methods to suit a technologically advanced society (Gut & Ackerknecht 1993). Passive cooling devices have been utilised to a large extent in the design, however the inclusion of mechanical air-conditioning is unavoidable during the summer months because sufficient passive cooling in Dubai's intense summer heat is virtually impossible to achieve. Therefore a combination of air-conditioning during the hot summer months and passive systems for the majority of the year has been used in conjunction, to dramatically reduce the reliance on energy-intensive mechanical solutions.

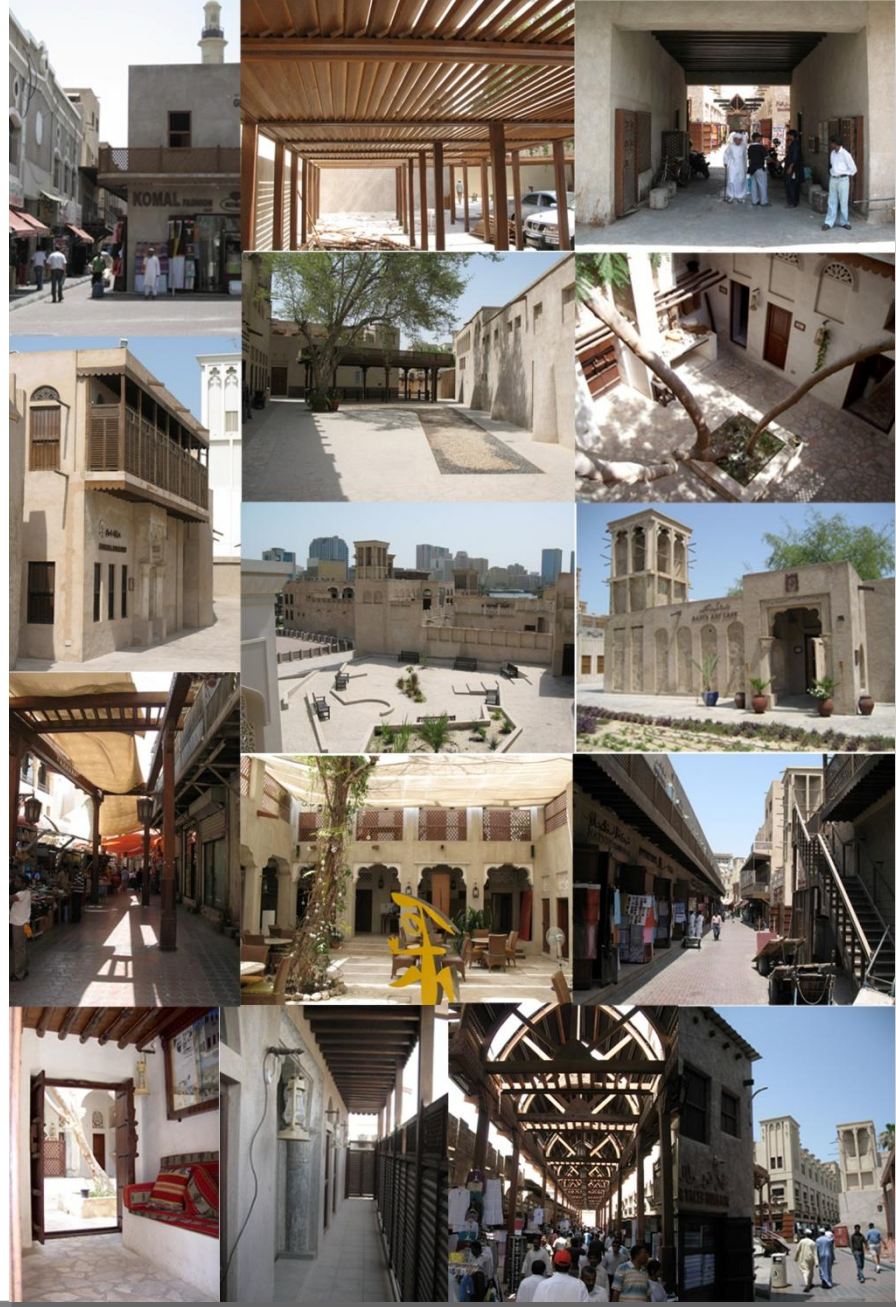


Figure 42: Traditional Arabic architecture in Dubai
(Reference: author's own 2007)





Therefore, the following passive design objectives for Dubai's harsh desert climate have been taken into consideration:

- Providing maximum shade in summer and adequate heat gain in winter throughthe use of movable, user-controlled shading devices
- Planning narrow alleys and streets, which are shaded and relatively cool, but allow cross-ventilation and adequate natural lighting
- Avoiding large exposed exterior surfaces
- Balancing day and night temperatures by adequate thermal insulation
- Planning close proximity of urban services and daily functions within walking distance
- Including green areas of plants that require little/no water to provide shade and cool air and to stabilize the soil
- Integrating water bodies, which facilitate evaporative cooling

DESIGN FOR A SUSTAINABLE 21ST CENTURY COMMUNITY

SHAJARAH's main objective is to create a sustainable community in terms of physical design, environmental conservation and social inclusivity. The *Living Planet Report* (World Wildlife Federation 2008: 14) currently identifies the UAE as having the highest ecological footprint (9.5 global hectares per person) in the world, mostly from carbon dioxide emissions.

In response, the UAE capital of Abu Dhabi has recently implemented a set of sustainable building and community guidelines known as Estidama, meaning *sustainability* in Arabic (Estidama 2008). Estidama provides a multifaceted approach to sustainable building design in the Middle East, integrating the local context and built environment with the underlining principles of minimising resource use and maintaining quality of performance. Although these have been calculated specifically for Abu Dhabi, the rest of the UAE and other Gulf countries are also encouraged to use these guidelines as they are more relevant to the Gulf environment and culture than other rating system.

Therefore as Dubai's *Green Building Code* has not yet been released, the key design objectives for this project have been based on the Estidama New Building Design Guidelines (ENBDG 2008) for designing sustainable 21st century communities according to environmental, economic and social objectives [Figure 43]. The framework has been divided according to the Estidama diagram into three sections: environmental, economic and social sustainability strategies. Each of these sections is then subdivided into the different aspects relating to sustainability. These aspects each look at the current situation in Dubai and why it is necessary to incorporate these considerations into the design of the buildings and the project as a whole. It then provides a table for each section outlining the objectives and recommended implementation strategies to be considered in the design of each bulding.

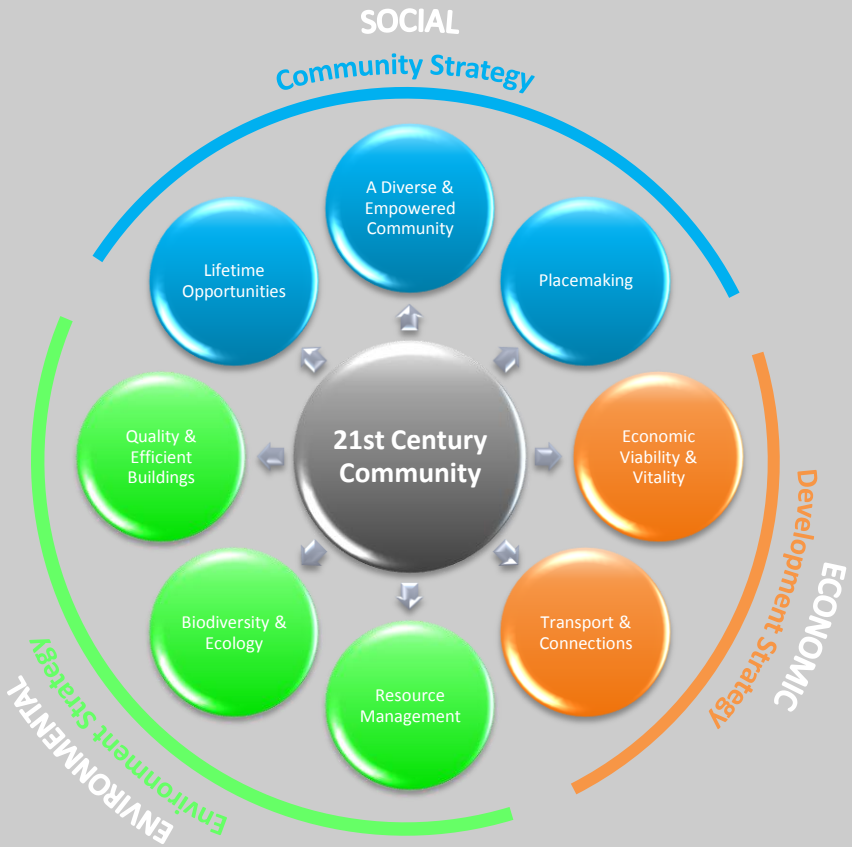


Figure 43: Estidama diagram on designing sustainable 21st century communities
(Reference: Estidama Brochure 2008: 8)

PRINCIPLE	WATER MANAGEMENT
OBJECTIVES	• Minimise water consumption through efficient landscaping and water-saving devices • Segregate water and wastewater streams to allow for efficient reuse and recycling options • Reuse and recycle grey water and treated sewage water
IMPLEMENTATION STRATEGIES	Water Consumption • Use planting schemes that incorporate either native species, well adapted drought-tolerant plants or rockeries, requiring little or no irrigation. • Incorporate low water use appliances and fixtures (flow-controllers/regulators, dual-flush toilets and waterless urinals) Water Reclamation • Incorporate segregated plumbing into the design, isolating potable water, sewage and grey water for re-use, recycling and treatment • Include aquaculture systems in which wastewater (both grey water and sewage) becomes a source of food for plants after being purified Water Harvesting • Design flat roof spaces and paved pedestrian areas to collect rainwater runoff Water Management • Water at appropriate times of day – not after 9am when water will evaporate quickly • Irrigation methods such as buried drip-feed should be utilised and timed for the early morning to reduce evaporation • Incorporate shading aspects, such as native trees or hard landscaping features into landscape design, reducing solar glare and potential for high evaporation rates

Table 3: Objectives and implementation strategies for Water Management
(Reference: adapted from ENBDG 2008)



ENVIRONMENTAL SUSTAINABILITY STRATEGY

Environmental benefits are at the very heart of sustainable building practices, and should be considered both locally and globally. The most fundamental principles of environmentally sustainable design include reducing water consumption and encouraging renewable energy use (ENBDG 2008: 8). The environmental strategy can be divided under three key subsections with key focus areas, each with its own objectives and implementation strategies:

1.) Resource Management
- Water Management
- Energy Use
- Waste Management

2.) Biodiversity and Ecology
3.) Quality and Efficient Buildings

Resource Management: Water Management [Table 3]

The UAE's water withdrawal rates (1533 % of total resources) are among the highest in the world (World Wildlife Federation 2006: 12). Being situated in the desert, the UAE has very little fresh water supply, and hence almost all its fresh water is obtained through the desalination of sea water. With Dubai's continuous population increase, the city's annual demand for water rose by 10% in 2008, according to the latest statistics released by the Dubai Electricity and Water Authority (DEWA) (John 2009). This figure makes the UAE the second largest user of desalinated water in the world (JAFZA 2009). However, the desalination process is a costly solution. Therefore the provision of adequate water supply is one of the country's key challenges. A more economically sustainable solution, such as recycling in residential buildings, can greatly reduce the demand of this precious desert resource. SHAJARAH has been designed with water scarcity in mind, impementing greywater recycling and sewage treatment systems.

Resource Management: Energy Use [Table 4]

The efficient use of energy is a fundamental consideration in all operations associated with sustainable building design. Currently, most of Dubai's electricity requirements are met by conventional gas-fired power stations. DEWA currently has a capacity of 6,676 megawatts of electricity. However, this will not be sufficient in future, as Dubai's electricity demand increased by more than 30% in 2007 and is expected to double by 2015 (Oxford Business Group 2008: 128). With an additional five new power and desalination plants, Dubai will more than double electricity production, raising it by an additional 7,500 megawatts in generating capacity (John 2009) and thereby more than doubling its reliance on the consumption of fossil fuel energy. Therefore alternative renewable energy resources are essential to reducing the UAE's fossil fuel consumption, and therefore its carbon footprint.

With Dubai's abundance of sunshine, it is surprising that the emirate has so far made little use of commercial solar energy until now. DEWA is conducting studies into the wider use of solar power, especially for use in desalination, solving two of Dubai's major problems simultaneously, shortages of electricity and water. It has also commissioned a feasibility study of a hydrogen power plant project with a capacity of 2,000 megawatts (John 2009), as well as looking into the feasibility of wind and nuclear power. According to Sheikh Mohammed, the generation of 200 megawatts of renewable energy would cut annual carbon emission rates by 1.5m tonnes (Oxford Business Group 2008: 127). By using solar power to heat water and to generate electricity, SHAJARAH can greatly reduce its reliance on conventional fossil fuels.

PRINCIPLE	ENERGY USE
OBJECTIVES	• Minimise reliance on fossil fuel-based power • Incorporate renewable energy systems • Maximise the use of available daylight to reduce artificial lighting requirement • Design to avoid overheating from solar gains
IMPLEMENTATION STRATEGIES	• Incorporate solar water-heating systems on roofs to minimise water heating costs • Incorporate photovoltaic panels into design to provide an alternative source of energy • Provide shading devices on facades and in landscaping to minimise solar heat gain and maximise shade • Include energy-efficient systems and appliances • Design for double-glazing windows/doors to reduce solar heat gain but still provide natural light

Table 4: Objectives and implementation strategies for Energy Use
(Reference: adapted from ENBDG 2008)

PRINCIPLE	WASTE MANAGEMENT
OBJECTIVES	• Re-use waste materials and equipment where possible • Onsite composting of food and other biodegradable wastes • Recycle and facilitate the recycling of waste
IMPLEMENTATION STRATEGIES	• Provide adequate space and segregated bins / chutes at source for waste sorting by residents of different types of waste (paper and card, plastics, glass, metals, and compostable organic wastes) • Segregation at central waste collection sites, which have separate waste storage facilities for different waste materials • Ensure that utilities storage such as wastewater/grey water storage and treatment areas are incorporated into design schemes to minimise their visual impact

Table 5: Objectives and implementation strategies for Waste Management
(Reference: adapted from ENBDG 2008)

PRINCIPLE	BIODIVERSITY AND ECOLOGY
OBJECTIVES	• Increase the diversity and abundance of indigenous species and habitats • Design to avoid urban sprawl • Preserve/replant existing vegetation on site
IMPLEMENTATION STRATEGIES	• Use greenbelts to create a continuous web of green space • Reduce the use of high maintenance lawns • Replant existing trees and vegetation from the Omran site • Make every space serve several functions; where possible • Use primarily native species: they usually require less maintenance and less water than exotics after establishment • Use plants to mitigate climate conditions, such as dust storms or as shading areas from the harsh sun

Table 6: Objectives and implementation strategies for Biodiversity and Ecology
(Reference: adapted from ENBDG 2008)



Resource Management: Waste Management [Table 5]

The UAE has the second-highest level of domestic waste per capita after the United States, making recycling a priority (Saadeh 2007). According to Recycle Dubai, household waste in Dubai in 2007 reached an average of 725 kilograms annually per capita (Saadeh 2007). To ensure waste production from buildings is minimised and managed correctly, the design of SHAJARAH has taken into consideration the following waste management hierarchy principles (ENBDG 2008: 122):

- **Avoid** the generation of waste
- **Reduce** the amount of material required and waste produced during both construction and operation
- **Reuse** waste materials and equipment where possible
- **Recycle** and facilitate the recycling of waste
- **Recover** energy from waste and facilitate energy recovery from waste

Biodiversity and Ecology [Table 6]

Landscaping promotes an environment that is aesthetically pleasing and increases habitat for species. Landscape designs that emphasise native trees and shrubs, as well as desert features, also help maintain the biological diversity of a region and preserve the character of regional landscapes. Construction of buildings often disturbs natural habitats and decreases the ecological value of the site. However, the SHAJARAH site is largely an empty plot in a barren desert landscape. What little natural vegetation that exists on the site is sparse desert shrubbery and no trees. The palm trees and vegetation planted by Omran will be incorporated and replanted throughout SHAJARAH.

Quality and Efficient Buildings [Table 7]

Passive climatic controls in a building can greatly enhance the indoor environment by implementing techniques to maximise daylighting, thermal comfort and natural ventilation. The wide differences between individual needs for thermal comfort require individual user-controlled systems. Individual controls can also offer substantial energy savings.

Artificial lighting generally constitutes 20-30% of all energy use in a commercial building (ENBDG 2008: 35) in the UAE. Reductions in energy use of more than 50% can be achieved with natural daylighting, advanced lighting technology and efficient lighting design. If used in conjunction with renewable energy sources such as solar power, the effect can be even greater. Good indoor lighting design considers both natural (daylight) and artificial lighting contributions to the space and the linking of both aspects to create glare free and attractive internal spaces. Access to daylight is an important aspect of building design for general health, well–being and comfort. Windows provide a link to the external climate and give building occupants a connection to the outside environment. Energy-efficient lighting also produces less heat than the conventional incandescent bulbs, thereby saving money on cooling as well as lighting costs.

Although it is necessary to provide air-conditioning for the hottest summer months, natural ventilation and passive cooling systems should be used the majority of the time to reduce the need for mechanical cooling and ventilation. Therefore a dual ventilation system of active and passive devices will be required to ensure a comfortable indoor environment all year round.

PRINCIPLE	QUALITY AND EFFICIENT BUILDINGS
OBJECTIVES	• Ensure a comfortable and safe environment • Use passive cooling principles where possible • Maintain high standards for indoor environmental quality • Provide mixed-use, adaptable spaces for efficiency
IMPLEMENTATION STRATEGIES	Lighting • Incorporate windows with louvered shading screens to control natural light and minimise glare Thermal Comfort • Ensure adequate insulation of external walls is provided to minimise internal heat gain • Provide user-controlled systems to maintain personal comfort levels • Design for adequate cross-ventilation for passive cooling Ventilation • Allow for adjustable and closable natural ventilation, to facilitate air-conditioning when necessary Acoustics • Use screens to reduce the impact of noise from external sources

Table 7: Objectives and implementation strategies for Quality and Efficient Buildings
(Reference: adapted from ENBDG 2008)

PRINCIPLE	FINANCIAL COSTING
OBJECTIVES	• Minimise the lifecycle costs of buildings • Reduce maintenance and operating costs
IMPLEMENTATION STRATEGIES	• Incorporate renewable energy and cooling systems into the design where possible that require free abundant natural resource inputs, such as sunshine for solar energy and water cooling

Table 8: Objectives and implementation strategies for Financial Costing
(Reference: adapted from ENBDG 2008)

PRINCIPLE	MATERIAL SELECTION
OBJECTIVES	• Specify produced or manufactured materials from within the UAE to reduce transportation and material costs where possible • Specify renewable and sustainable sources for materials where possible • Incorporate re-used or recycled materials • Choose building methods and materials to achieve a balance of cost-effectiveness and environmental sustainability • Specify regionally appropriate materials and construction methods that are suitable for Dubai's hot and humid climate
IMPLEMENTATION STRATEGIES	• Re-use and recycle materials from Omran to reduce the need for new materials • Use recycled aggregates from other building sites in Dubai to reduce the demand for virgin material • Re-use aluminium windows from Omran housing

Table 9: Objectives and implementation strategies for Material Selection
(Reference: adapted from ENBDG 2008)



ECONOMIC SUSTAINABILITY STRATEGY

Economic benefits can be identified at many stages of the project cycle. These benefits include reducing design and building costs, operating costs and lifecycle costs, as well as improving occupant performance and marketing advantages (ENBDG 2008: 8). The two key subsections within the economic strategy with their key focus areas are:

1.) Economic Viability and Vitality
- Financial Costing
- Material Selection

2.) Transport and Connections

Economic Viability and Vitality: Financial Costing [Table 8]

With the constant developments in sustainable technologies, sustainable building products and systems are becoming more readily available and accessible. For sustainable development to be economically justified, it must be compared to other alternatives on the basis of lifetime costs. The design of a building is typically one tenth of the building capital cost. The operations and maintenance are three times the capital cost of the building over its lifetime. Most significantly, the economic utility of the building is nine times the design, construction and operations and management costs combined. Studies have shown that the productivity of the people in the building can be increased by up to 20% through sustainable design concepts (Grosser 2005). As a result, these figures justify more than doubling the initial cost of design and construction in terms of the long-term financial feasibility.

Economic Viability and Vitality: Material Selection [Table 9]

The careful selection of site materials is an essential part of environmentally conscious design. Selection variables to be considered include toxicity in manufacture and use; energy consumption in extraction, manufacture or transport; and potential to intensify heat, glare, runoff, wind or other climatic factors.The order of priority when choosing materials is to reduce material use, reuse, and recycle. As the SHAJARAH site currently contains the semi-permanent Omran worker housing, the materials from these buildings can be recycled and reused in the design of SHAJARAH to minimise costs and the need for additional materials.

Transport and Connections [Table 10]

SHAJARAH is primarily aimed at accommodating poor migrant construction workers, very few of which own cars. Each morning a number of buses arrive at the housing complex to transport the workers to their worksites, and returns them every evening. Yet SHAJARAH's objective is to later accommodate other income groups and Dubai's future working class, and therefore vehicular traffic needs to be considered. The use of private vehicles is very high in Dubai, and therefore private car use needs to be discouraged on site in favour of alternative or public transport options.

Walking and cycling are essentially cost-effective and sustainable transport alternatives to be encouraged during the cooler months. However during the hot summer months walking and cycling outside is not favourable over long distances and needs to be considered. Mixed-use development options are beneficial as they locate retail, recreational and residnetial components in close proximity. The newly constructed Dubai Metro will run the length of Dubai, connecting commuters to most major centres. Fares will range from Dhs0.80 to Dhs5.80 (Dubai Metro 2009), making the cost of using the Metro accessible to most. The impact for SHAJARAH is highlighted in the *Site Analysis* section of this document.

PRINCIPLE	TRANSPORT AND CONNECTIONS
OBJECTIVES	• Provide easy access to public transport systems • Facilitate walking and cycling within SHAJARAH • Consider travel patterns of users, including number of trips that the development will generate, their timings and their impact on the local transport network
IMPLEMENTATION STRATEGIES	• Provide an extensive network of safe bicycle paths and pedestrian-orientated streets to facilitate walking and cycling • Provide secure cycle parking at convenient locations close to building entrances • Include traffic circles, paving, narrower lanes and avoid long roads to slow vehicular traffic and limit cars to secondary importance on site • Provide good access for delivery vehicles and provide sufficient space for manoeuvring, loading and unloading Provide easy accessibility to public transport nodes • Provide disabled parking spaces close to building with appropriate access into the buildings • Provide adequate lighting whilst taking consideration of light pollution and energy consumption. • Include a designated bus stop on site with ease of accessibility for heavy use during peak hour drop-offs (early morning and evening) • In considering the impact on the surrounding network, the area is currently being developed for major residential and commercial activity and the surrounding infrastructure is expanding to accommodate the enormous development in the area over the next decade

Table 10: Objectives and implementation strategies for Transport and Connections
(Reference: adapted from ENBDG 2008)

PRINCIPLE	LIFETIME OPPORTUNITIES
OBJECTIVES	• Design with long-term opportunities in mind • Ensure there is a need for type of accommodation • Ensure mixed-use, adaptable spaces
IMPLEMENTATION STRATEGIES	• SHAJARAH is intended to accommodate Dubai's current migrant workers, as well as its future permanent workforce • The vast majority of developments in Dubai do not cater to low-cost/affordable housing for low- to middle-income workers – SHAJARAH is creating a niche market • The modular grid and building units allow for future expansion of residential units and a variety of commercial functions

Table 11: Objectives and implementation strategies for Lifetime Opportunities
(Reference: adapted from ENBDG 2008)



SOCIAL SUSTAINABILITY STRATEGY

Social benefits of sustainability include health and welfare aspects, as well as site selection and community involvement (ENBDG 2008: 8). Socially, sustainability is about creating healthier communities and social networks. It is about creating attractive spaces that engage the user and facilitate placemaking. As a result, the three key subsections of the social strategy include:
1.) Lifetime Opportunities
2.) A Diverse and Empowered Community
3.) Placemaking

Lifetime Opportunities [Table 11]

Sustainable design does not impose building design on the site. Rather, it identifies the unique characteristics of the site, determine whether it is appropriate for its proposed use, and design ways to integrate the building with the site. The intent is to lessen the environmental impact of human activity, while using natural characteristics and climate of the site to enhance human comfort and health, and potentially provide a significant portion of the building's energy requirement. This will ensure SHAJARAH becomes a valuable asset to the surrounding community for many years to come.

SHAJARAH's goal of providing accommodation for Dubai's current and future workforce expands the projects feasibility in both the short- and long-term. Once Dubai's current migrant workers have returned to their home countries after their contracts expire, SHAJARAH will house the next wave of workers who will manage and maintain the buildings that the previous workers have built. In this way, a lifetime of opportunities arises to provide a sustainable accommodation solution, aimed at the previously neglected low to middle-income market in Dubai.

A Diverse and Empowered Community [Table 12]

SHAJARAH's aim is to provide not only housing, but a sense of community for the over a million blue-collar migrant construction workers in Dubai, who are so far removed from their social support systems and family environments. Currently, they are isolated in the industrial areas of Dubai in labour camps and given little or no room for self-empowerment. By providing a range of social, recreational and commercial facilities for these migrant workers from over 200 nationalities, a sense of community can begin to develop. Improving their quality of life means empowering them to become active participants in their surroundings and thus the city itself.

Placemaking [Table 13]

An essential element of sustainable places is the notion of placemaking. Well-designed developments encourage interaction, sustainable living and sympathy for the surrounding context. Concepts of 'place' often emphasise the importance of a sense of belonging and identity. Placemaking is about putting the community's needs at the heart of the design by creating an atmosphere of connectivity with meeting areas, resting spaces and recreational facilities to encourage interaction and create identity. Such places provide an anchor of shared social experiences between people. he relative physical 'permanence' or stability of a place helps establish its qualities as a meaningful place, as opposed to Omran's semi-permanent structures. It is essential for developments to be visually attractive, but it is equally important to integrate the character of the surrounding context in the design for a continuation of identity (Tiesdell 2004). Although the blue-collar migrant workers are from foreign countries, there too want to feel a part of the rest of Dubai and be included in the fabric of the city.

PRINCIPLE	A DIVERSE AND EMPOWERED COMMUNITY
OBJECTIVES	• Provide opportunity for personal empowerment and community development • Facilitate a sense of belonging by placing the workers' needs at the heart of the design • Provide affordable housing
IMPLEMENTATION STRATEGIES	• Community centres will support skills and educational development and encourage the occupants to expand their knowledge base • Communal recreation and social facilities will encourage social interaction and community involvement • SHAJARAH will include a diverse mix of facilities that are most needed and widely used by the workers, such as computer facilities, supermarkets, travel agents and banks • SHAJARAH will offer a range of accommodation types

Table 13: Objectives and implementation strategies for A Diverse and Empowered Community
(Reference: adapted from ENBDG 2008)

PRINCIPLE	PLACEMAKING
OBJECTIVES	• Focus on the pedestrian, safety and navigability • Include architecture in the design, as opposed to mere buildings • Provide access to green space and social areas • Create a place where residents feel at home
IMPLEMENTATION STRATEGIES	• A repetitive and logical layout pattern will ensure easy navigability within SHAJARAH • Designs will include architectural elements and features to improve the visual appearance of buildings, as opposed to rectangular, featureless blocks • SHAJARAH's design is centred around creating a variety of public/private courtyards and a pedestrianised street atmosphere

Table 14: Objectives and implementation strategies for Placemaking
(Reference: adapted from ENBDG 2008)

Design Framework

The Urban Development Framework for SHAJARAH is intended to provide an underlying set of regulatory design guidelines for architects working on SHAJARAH to ensure the project's continuity and effectiveness as a whole.

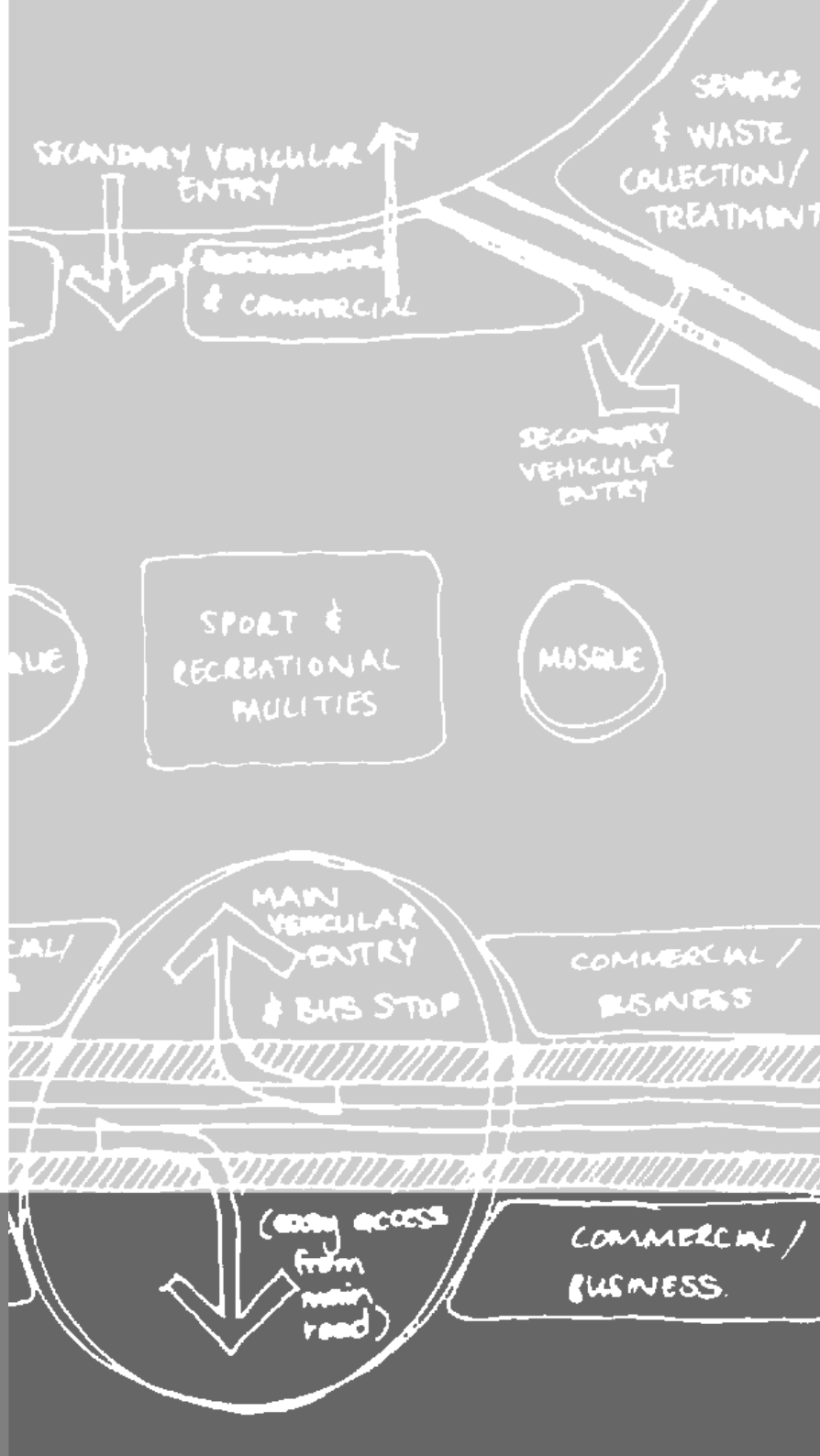


URBAN DEVELOPMENT FRAMEWORK OVERVIEW

The idea behind SHAJARAH is to allow different architects to design each of the different buildings or clusters of buildings. As SHAJARAH is such a large development with the undesired potential for monotonous repetition and uniformity, this will encourage diversity, variation and individuality by incorporating various personal and cultural influences into the design of SHAJARAH. However to ensure continuity of the project, an urban spatial development framework has been established as an underlying set of design guidelines for architects and designers. In doing this, the design principle of placemaking is enhanced with each building taking on its own unique identity, whilst complimenting its surroundings.

This will ensure that architects uphold the vision of SHAJARAH through a generous framework that allows for a degree of flexibility when incorporating the recommended implementation strategies set out in the previous *Design Principles, Objectives and Strategies* chapter. The framework includes:

- Site coverage
- Height restrictions
- Street edge conditions
- Parking
- Materials and finishes
- Roof forms
- Internal circulation
- Spatial depths
- Individual space requirements
- Cooling systems
- Water management
- Energy solutions
- Waste recycling
- Landscaping
- Signage



KEY OBJECTIVES

The objectives of the Urban Development Framework highlight the key considerations for the project. By defining site-specific responses to both the surrounding context identified in the *Site and Context Appraisal* chapter and the proposed community-making objectives, the design framework aims to:

- Integrate SHAJARAH into its surrounding context
- Create a mediating transition between the high-rise towers and low-rise residential suburbs surrounding the site
- Ensure continuity of the project, with enough room for individual identity
- Include all necessary functions, services and facilities
- Identify landmark buildings on the site
- Define open/public space within SHAJARAH
- Create a pedestrian-friendly street atmosphere to encourage walking and cycling

KEY CHARACTERISTICS

SHAJARAH has been planned as a sustainable community in terms of economic, social and environmental consciousness. These three factors, each with their own design considerations, have led to the creation of an urban development framework characterised by:

- An interconnected network of streets and footpaths
- Pedestrian-friendly street atmosphere
- Daily needs within walking distance
- Supportive public transport links
- A central focus of an open public square
- Density increased from edge to centre
- Various degrees of public and private space
- Continuous street edges with pedestrian focus
- Inner courtyards within each cluster of buildings
- Shared utilities of water and waste treatment/management





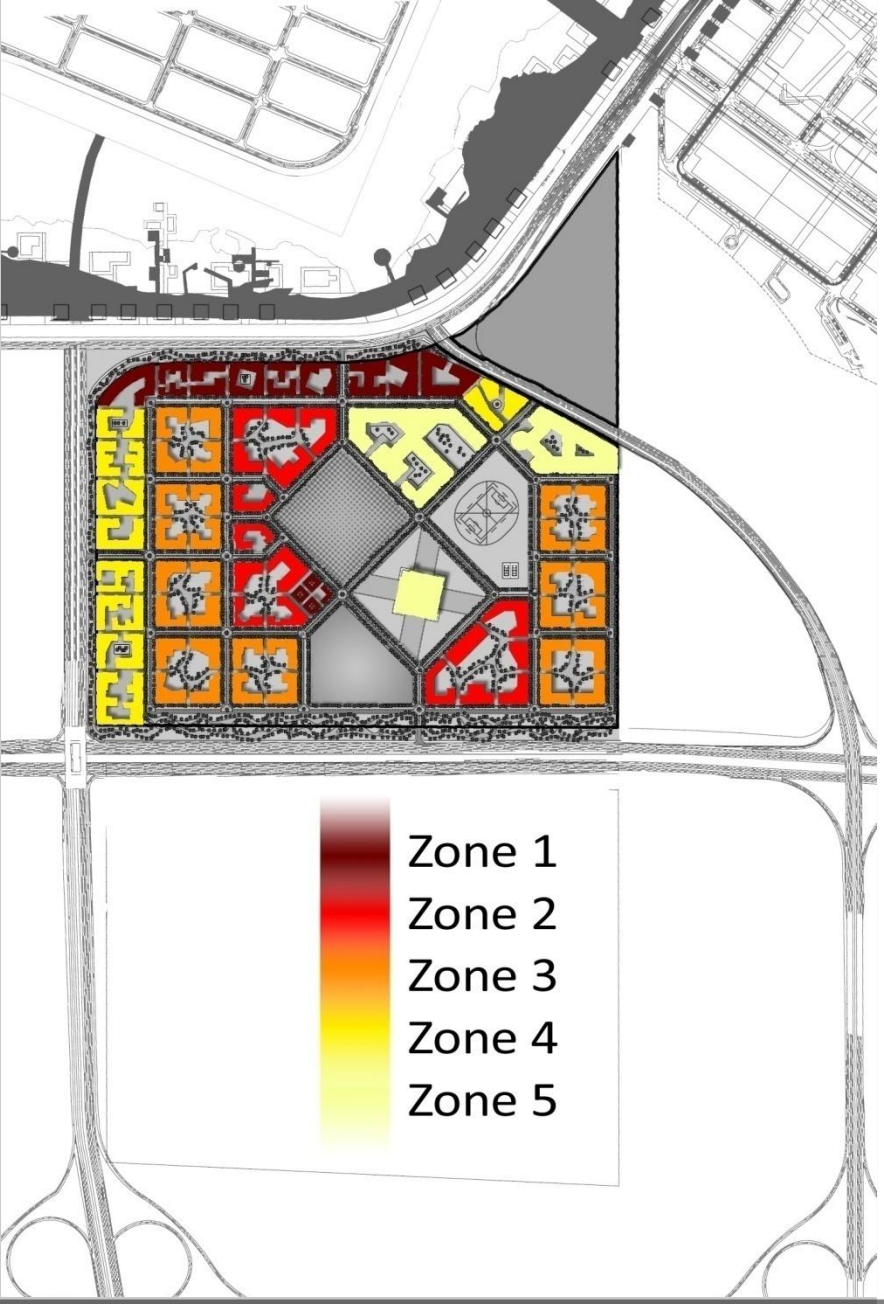


Figure 44: Five zones within SHAJARAH
(Reference: author's own 2009)

ZONING

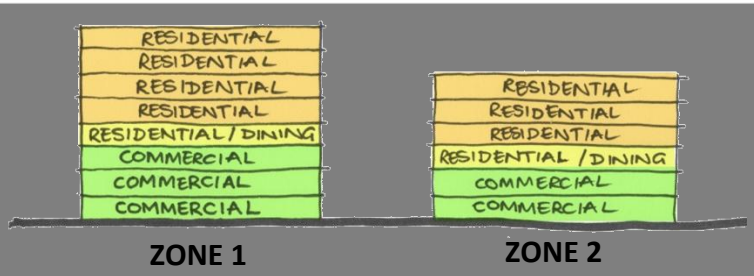
In terms of site planning, the site has been divided into five zones [Figure 44]. Each zone is characterised by its building uses and heights [Figure 45], which have been defined in response to the surrounding context (see *Site/Context Appraisal* chapter).

ZONE 1: HIGH COMMERCIAL EDGE

Height: 8 storeys (max. 30m)
Accommodates: 600 residents per building (500 for landmark buildings)
This zone is situated along the north-western edge of the site, running along the Waterfront Boulevard. As the buildings in this zone are directly opposite the high-rise towers of the Waterfront across the road, they are the highest in SHAJARAH as a mediating transition from the high-rise towers. These buildings have a largely commercial/business focus on the lower three floors, with residential accommodation on the upper floors. Additionally, there are two buildings in the centre of each half of the site that are designated as landmark buildings. Due to their prominent position adjacent to the public square and community facilities, they also stand higher than their surrounding neighbours and contain more commercial functions.

ZONE 2: COMMERCIAL / RESIDENTIAL

Height: 6 storeys (max. 23m)
Accommodates: 500 residents per building
Buildings in this zone largely form the periphery of the central open public space on each half of the site, and act as an indicator for site's central focus. As this zone is the next highest on the site, it continues the gradual fall of heights across the site from the highest north-west edge to the public centre to the lower edges. This zone also pulls the commercial functions further down into the centre of the site around the public open square for easy accessibility for all the site's users. These buildings contain a balanced mix of commercial activity of the two lower floors and the residential components on the remaining upper floors.



ZONE 3: RESIDENTIAL

Height: 4 storeys (max. 16m)
Accommodates: 400 residents per building
Zone 3 is situated on either side of Zone 2, as a further step down in building heights towards the site edges. These buildings are entirely residential in focus, with the ground floor as semi-private social and dining space for the living units above.

ZONE 4: LOW COMMERCIAL EDGE

Height: 3 storeys (max. 12.5m)
Accommodates: 300 residents per building
This zone is situated along the south-western and south-eastern edges of the site, opposite the road from proposed low-rise residential developments and as a buffer from the highway respectively. It is therefore fairly low-rise in relation to the rest of SHAJARAH and, like Zone 1, acts as a mediating transition from the low-rise residential suburb across the road to the medium-rise buildings within the centre of SHAJARAH. It also has a commercial element on the ground floor, with the two upper floors as residential accommodation.

ZONE 5: COMMUNITY BUILDINGS

Height: 3 storeys (max. 15m)
Zone 5 buildings house community-based functions such as clinics, schools and community development centres. They are located near the central public square yet close to the edges of the site for easy access and use by surrounding developments.

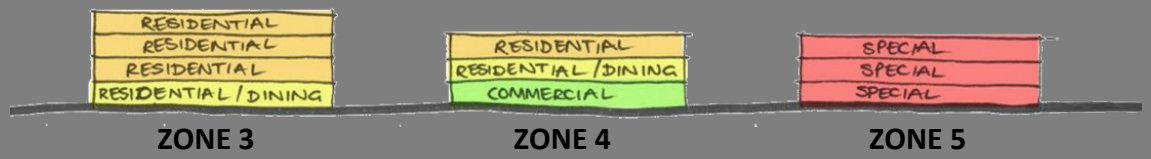


Figure 45: Heights of each building zone
(Reference: author's own 2009)





DESIGN GUIDELINES

SITE COVERAGE

The maximum land coverage of each building on its demarcated plot within SHAJARAH depends on its use:

- 60% for residential and commercial buildings
- 40% for mosques
- 70% for schools/community development centres
- 80% for clinics

HEIGHT RESTRICTIONS

Heights have been calculated according to set floor-to-floor heights of 4.5m for ground floor and 3.5m for all upper levels, with an extra metre for roof parapets. Each zone has its own height restrictions, due to location on site, neighbouring buildings and surrounding context:

- Zone 1 High Commercial Edge – 30m (8 storeys)
- Zone 2 Residential / Commercial – 23m (6 storeys)
- Zone 3 Residential – 16m (4 storeys)
- Zone 4 Low Commercial Edge (3 storeys)
- Zone 5 Community Buildings – 12.5m (3 storeys)

SPATIAL DEPTHS

Based on suitable daylighting principles, the preferred depths should not exceed:

- 9m for residential spaces
- 18m for commercial spaces
- Depths for public service buildings (clinics /schools) vary depending on nature of use

STREET EDGE CONDITIONS

The street edge conditions are as follows:

- At least 80% of the building's street facades should be right up against the build-to line.
- A variable allowance has been made for setbacks and encroachments. However these should not exceed 1.5m from the build-to line.
- The angle of the bulk plane shall be 45° from the middle of the street [Figure 46]. This is to reduce the towering effect of buildings and create a more human scale along the street.

PARKING

Every building has at least one of its edges along an internal street. Therefore each building is accessible by vehicle on ground level, as well as cycling paths and pedestrian footpaths. A minimal amount of street-level parking is provided for in the site design along all street edges.

The individual parking basements provides concealed access to each building for delivery vehicles, as well as parking for building users. A minimum of one car bay per unit is to be provided. All residential circulation cores should be accessible from basement level.

Each building shall also include lockable bicycle storage areas, as well as separate male and female changeroom facilities close to bicycle storage areas to encourage cycling as an alternative transport method.

INDIVIDUAL REQUIREMENTS

Where practicable every residential unit should have direct access from a living space to a northerly facing outdoor living space. Additionally, each resident is entitled to:

- At least $5m^2$ of personal space
- A bathroom (toilet, shower and basin) shared between a maximum of 4 people

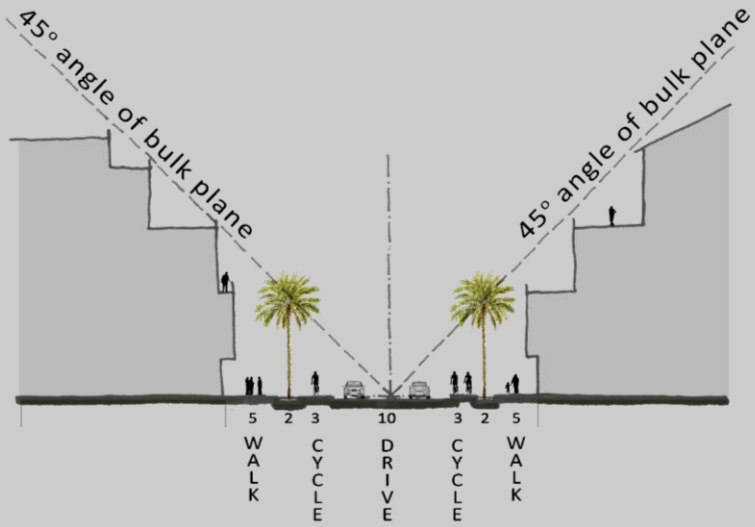
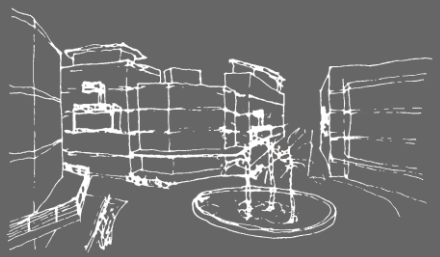
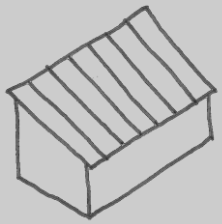
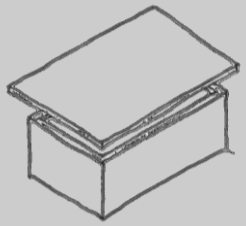


Figure 46: Diagram showing angle of the bulk plane setback
(Reference: author's own 2009)

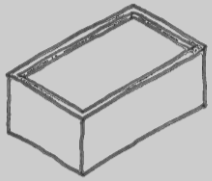




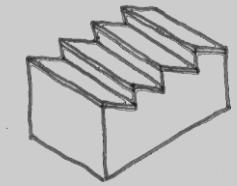
MONOPITCH ROOF



DOUBLE ROOF



FLAT ROOF



SAWTOOTH ROOF

Figure 47: Specified roof forms
(Reference: author's own 2009)

ROOF FORMS

A variety of roof forms [Figure 47] on site is encouraged to create a varied skyline, although the most effective roof form in coastal desert climates is the double roof system with a heavy ceiling and light roof structure above. Therefore roofs should be flat concrete construction or with a pitch of not more than 25°, or a combination of the two. Sawtooth roof forms and other steeper pitched roofs can be utilised at certain sections of the building, provided they are not visually dominant on the facade.

INDIVIDUAL SPACE REQUIREMENTS

Each person living in SHAJARAH is entitled to:

- At least $5m^2$ of personal space
- A bathroom (toilet, shower and basin) shared between a maximum of 4 people

SPATIAL DEPTHS

Based on suitable daylighting principles, the preferred depths should not exceed:

- 9m for residential spaces
- 18m for commercial spaces
- Depths for public service buildings (clinics /schools) vary depending on nature of use

INTERNAL CIRCULATION

Each building is to contain at least two entrances to encourage ease of accessibility, and interaction between public and private areas. Multiple entrances are advantageous in improving planning adaptability for future use. Each residential/commercial building should also contain a minimum two circulation cores situated near entrances, each core containing at least two elevators and a staircase to each floor including the basement and roof levels.



MATERIALS AND FINISHES

A palette of building materials, finishes and detail elements has been selected for SHAJARAH to ensure visual continuity of the project [Figure 48]. Each building should utilise some or all of the prescribed materials and elements at the architects' discretion, in a manner that is suitable to each design. A variety of materials should be used to give variety of colour and texture. Other material choices may be used, provided that they compliment the existing palate and that they constitute a maximum of 5% of the overall building materials. Materials and finishes include:

- Rendered concrete (variety of finishes and textures)
- Stone/blockwork cladding
- Painted plaster cladding (earthen tones)
- Galvanised steel
- Double glazed windows and shopfronts
- Sun-treated natural timber
- Sun-screening devices

LANDSCAPING

The street edges and common property within SHAJARAH will be landscaped as per design. Each building shall be responsible for the remaining open space left on it site. As these spaces collectively form an inner semi-private courtyard in the centre of a cluster of buildings, these spaces will primarily be used by the surrounding building occupants, but should also be accessible to all SHAJARAH users. Therefore these spaces should be free of restrictive movement barriers such as fences and walls. These spaces should also include shaded green areas and benches to encourage lingering and social interaction.

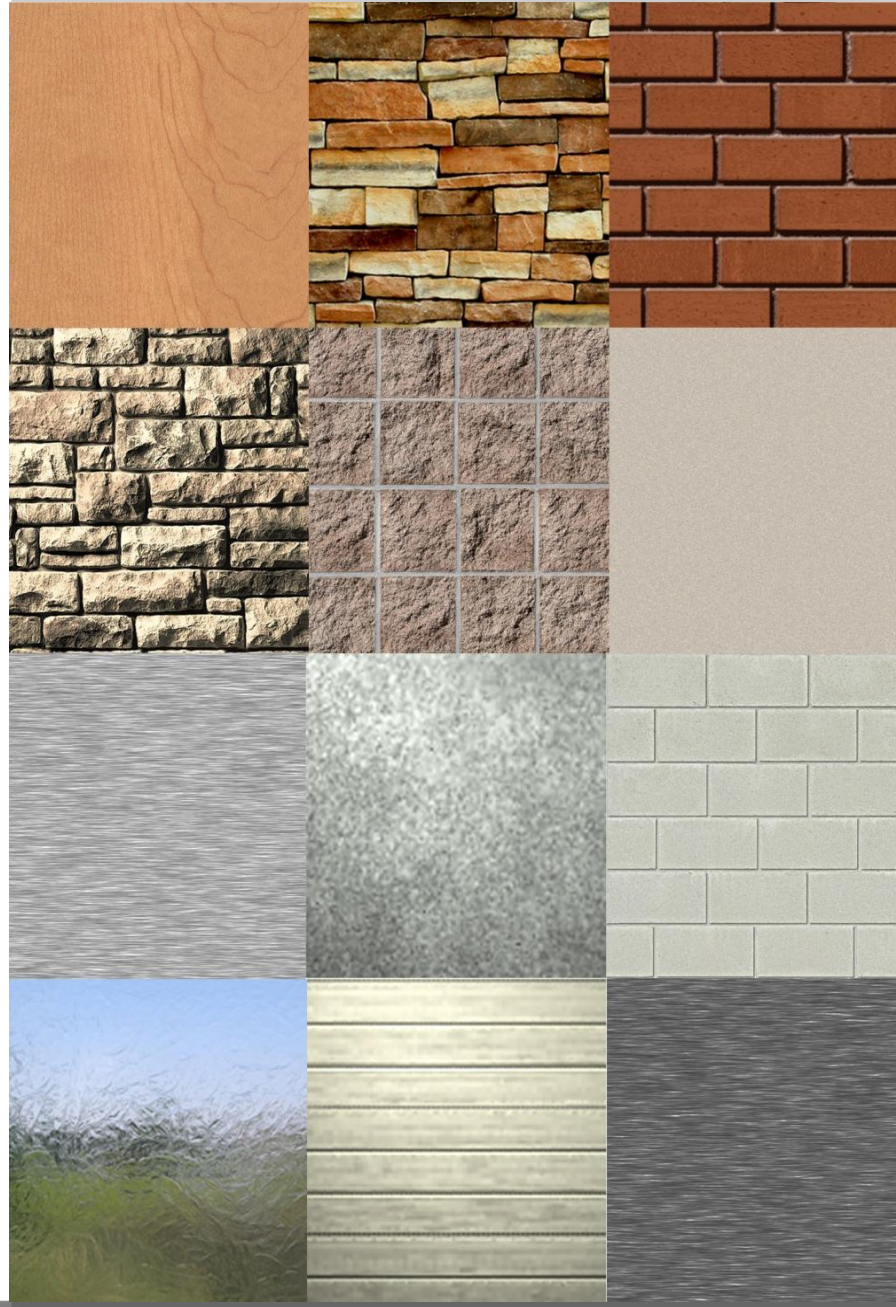


Figure 48: Palette of materials
(Reference: Autodesk 2009)

ENERGY SOLUTIONS

Photovolatic cells/panels to meet the buildings energy requirements shall be incorporated into the design of each building. These can be located on the roofs or integrated into the facades of buildings. The optimal stationary angle to most effectively harness solar energy in the UAE is 51.5^{o} (MACS Lab 2008) to ensure that sufficient winter sun is collected. Solar power should be the primary energy source of each building, with provision made for connventional coal-power electricity in case of emergencies or shortages.

Additionally, solar water heaters shall be used to provide hot water to each building. These will be located on roofs and concealed from view.

COOLING SYSTEMS

The use of passive design principles is encouraged as much as possible in the design of each building. However, both passive and active cooling systems shall be integrated into each building's design. Air-conditioning should be used only during extreme summer months, with passive cooling techniques described in the *Design Principles, Objectives and Strategies* chapter providing the buildings' cooling requirements for the remainder of the year.

WATER MANAGEMENT

Each building shall separate its potable water, greywater and sewage plumbing. The sewage will be pumped to SHAJARAH's Combined Waste and Sewage Treatment Plant (CWSTP) on the northern-most point of the site. The greywater shall be collected and filtered in storage tanks in the basement under each building to supply the site's irrigtaion needs.



WASTE RECYCLING

SHAJARAH's CWSTP will be the main collection point for all waste generated onsite. Waste will be separated into six types for re-use and recycling:

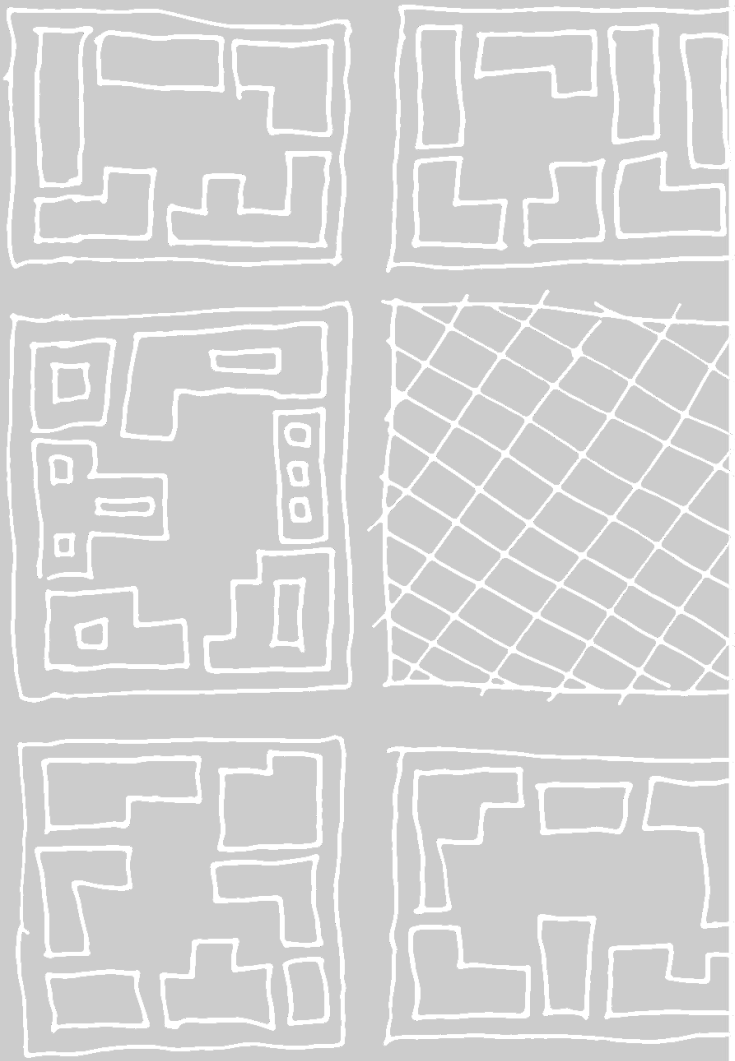
- Paper and card
- Plastics
- Glass
- Metals
- Compostable organic waste
- Non-recyclables

However in order to make the system cost-effective and efficient, building users should sort their own waste to eliminate the need for additional sorting. Therefore, each building must contain adequate space for segregated bins/chutes. Central waste collection bins shall be provided in the basement under each building, so as to be discretely concealed from view until bi-weekly removal to the CWSTP.

SIGNAGE

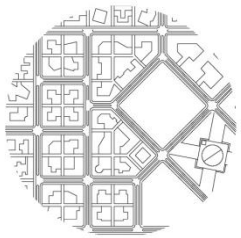
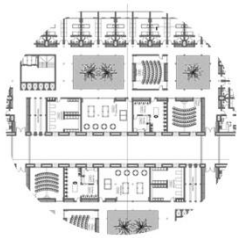
The proliferation of building signage is discouraged. Ideally, the design of the building will make provision for tastefully designed and located signage for commercial spaces on ground floor.





Design Concept

SHAJARAH uses the more holistic Open Building Concept of approaching design on four environmental levels: the urban precinct; the building; the unit; and the element.





In defining a concept, SHAJARAH has used the Open Building Concept (Kendall 2006). Open Building is a more holistic approach to architectural interventions that uses "a process of designing and building on environmental levels":

- the Urban Precinct
- the Building
- the Unit
- the Element

Each level has incorporated the relevant design principles of environmental, economic and social sustainability, outlined in the *Design Principles, Objectives and Strategies* chapter, into the design concepts. As a result, many of the following concepts briefly refer to their inclusion in the design but do not elaborate on their implementation strategies which have been previously discussed, unless uniquely specific to the individual design concept.

THE URBAN PRECINCT LEVEL

Higher Density Living: The buildings in SHAJARAH are between 3 and 8 storeys, resulting in more sustainable higher densities than the typical suburban model. With more people, a wider variety of public facilities becomes more feasible. Additionally as SHAJARAH is replacing part of Omran workforce accommodation, the project needs to accommodate the 30,000 occupants planned for the site. Therefore, taller buildings allow the same number of people to be accommodated, and still provide the necessary facilities. Transport is also an enormous factor in the higher density living concept, as buses need to pick up workers from one central point; urban sprawl is not efficient for this.

Resource Management: The site's Combined Waste and Sewage Treatment Plant (CWSTP) is located on the northern-most tip of the site [Figure 49]. This placement allows the other surrounding developments to use the CWSTP as a central recycling depot for the greater Waterfront area.

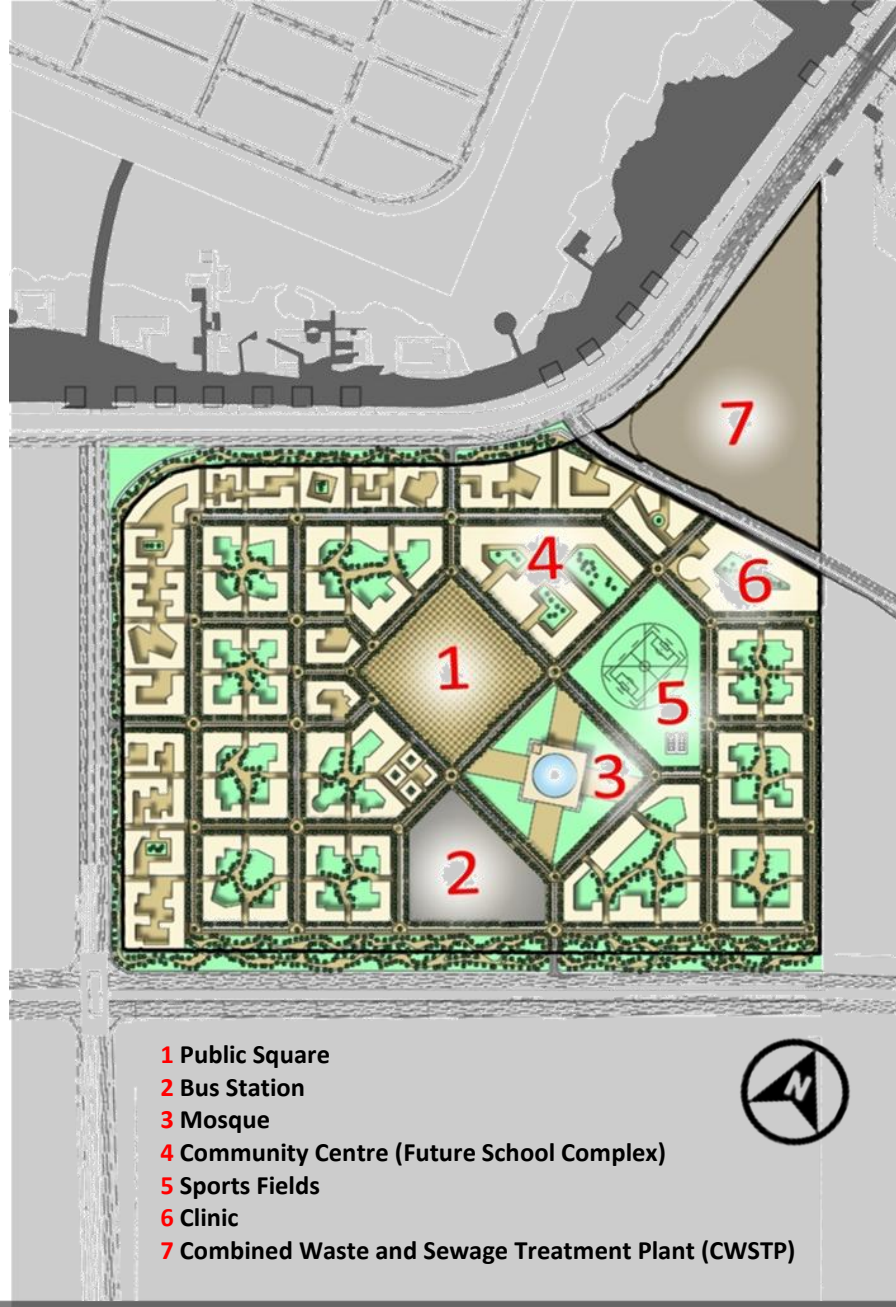


Figure 49: Preliminary site plan
(Reference: author's own 2009)

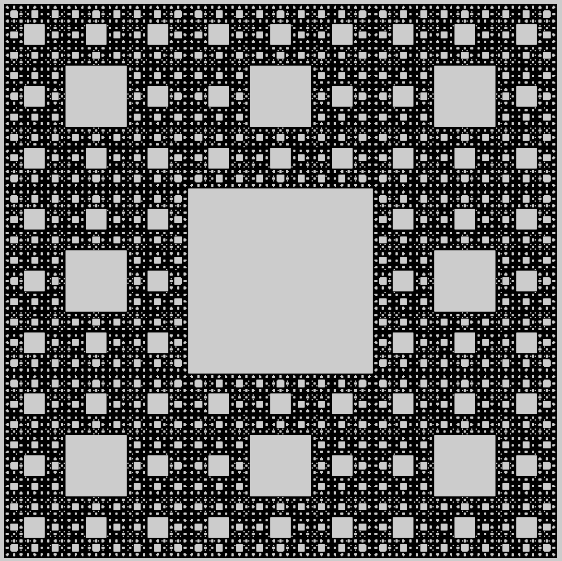


Figure 50: Sierpinski Carpet
(Reference: Helie 2009)

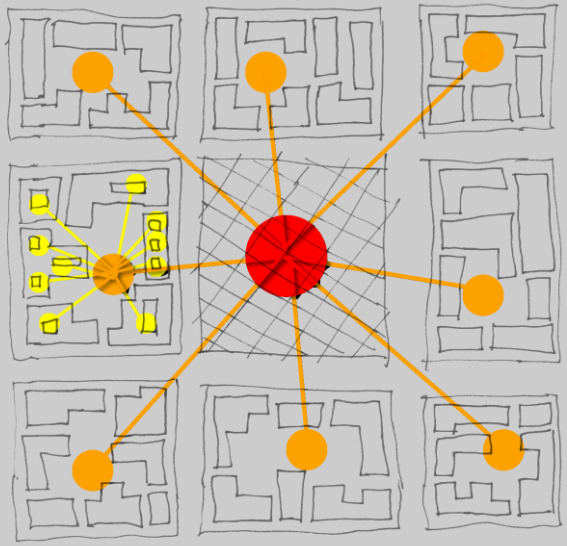


Figure 51: Hierarchy of open space
(Reference: author's own 2009)

Placemaking: Place-making is a way of creating spaces that enhance a sense of community and belonging. A hierarchy of public/private spaces that serve different purposes and scales of community is beneficial in achieving this. The large open public square is intended as a gathering space for the entire community, where major events and celebrations happen. On the opposite end of the scale is the intimate private courtyard, a sanctuary away from the bustling streets and outside world. Between these two is the street or the open space in the middle of a cluster of buildings, conducive to more intimate social interaction. It is a combination of these various enclosed public/private spaces that shape the traditional Arabic city. The use of courtyards and public squares in traditional Arabic architecture and urban planning is prevalent, and therefore provide useful and effective lessons in place-making, as well as effective climatic response.

Hierarchy of Open Space: This notion of different degrees of public/private space and scale of social interaction is effectively conveyed in the Sierpinski Carpet concept [Figure 50]. The Sierpinski Carpet works on the principle of continually subdividing space to create infinite levels of scale. This creates a hierarchy of courtyard spaces of different sizes and degrees of privacy. The public square would be the largest open space in the middle of the image, perpetually subdivided into smaller and more intimate courtyard spaces within buildings.

The Sierpinski Carpet concept provides solutions for solving spatial layout and place-making at a variety of scales. It creates opportunity for a variety of different sized courtyards and public squares, linked by a network of narrow pedestrian-friendly streets [Figure 51]. With a relatively tight configuration of buildings, each space is uniquely defined by its adjacent edges, size, shape and degree of publicity/privacy [Figure 52]. Each cluster of buildings has its own semi-private courtyard, whilst still being a part of the larger community within an even larger social structure. This impression of belonging to a series of communities at a variety of levels helps to foster a sense of belonging and inclusion, as well as more intimate community identity within a large development. Each building has its own courtyard, functioning as both a separate entity and a valuable piece of a larger puzzle [Figure 53].



Figure 53: Initial rendered concept sketch of social intersections
(Reference: author's own 2009)

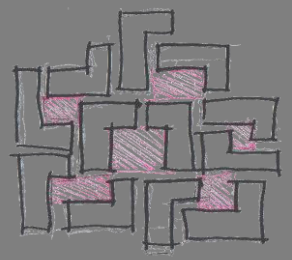


Figure 52: Concept sketch of courtyard spaces created between buildings
(Reference: author's own 2009)

Pedestrianised Streets: In order to facilitate walking and cycling as alternative transport options within SHAJARAH, all facilities are within 700m walking distance. Additionally, designated bicycle paths and wide buffered pavements make walking and cycling safer by prioritising pedestrians and cyclists over cars [Figure 54]. All intersections are raised to pavement height to create a continuous pedestrian realm. Planting and trees along the road edges not only creates a more visually appealing street atmosphere, it also helps to buffer the pavements from the cars and provides shade to the pavements and cycle paths [Figure 55].

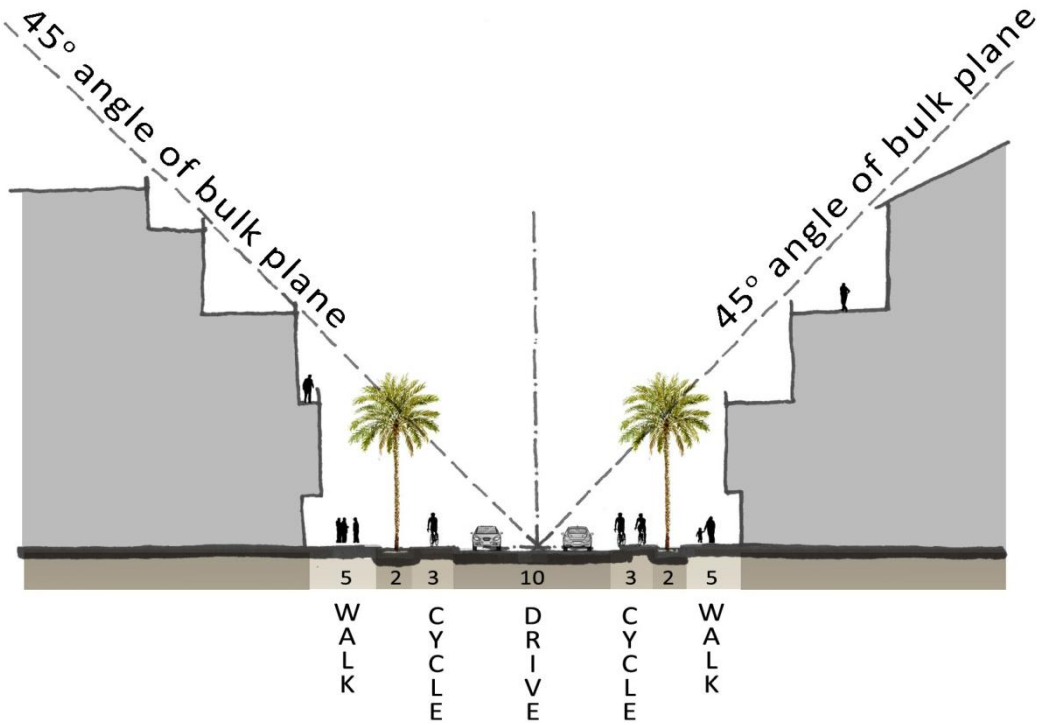


Figure 55: Street widths and building setbacks create a more pedestrian friendly environment
(Reference: author's own 2009)

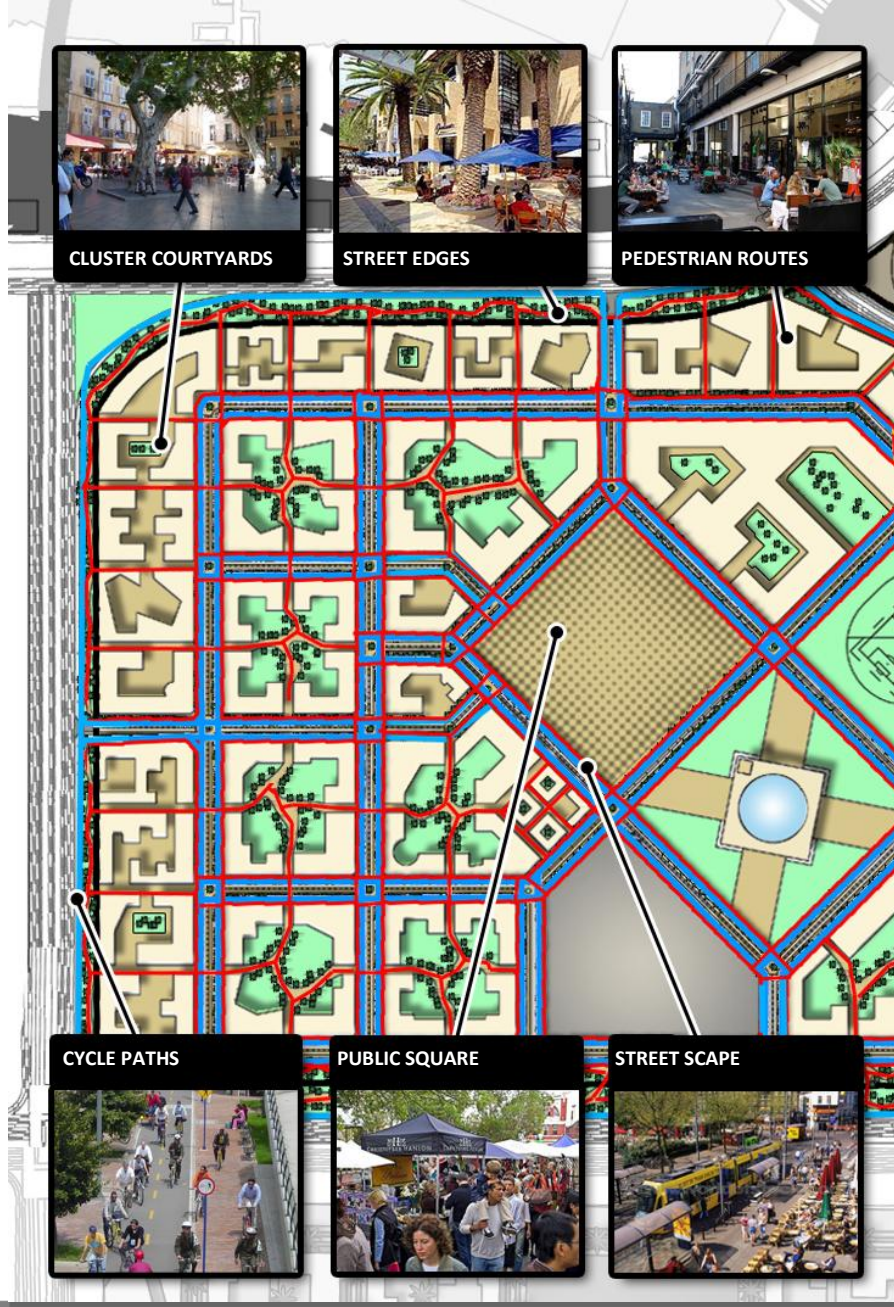


Figure 54: Movement routes and edge conditions
(References clockwise from top left: Vamantis3 2005; Hotel and Restaurant 2003; Rashbre 2007; Naveen 2009; Murphy 2005; Stock Connection 2009)

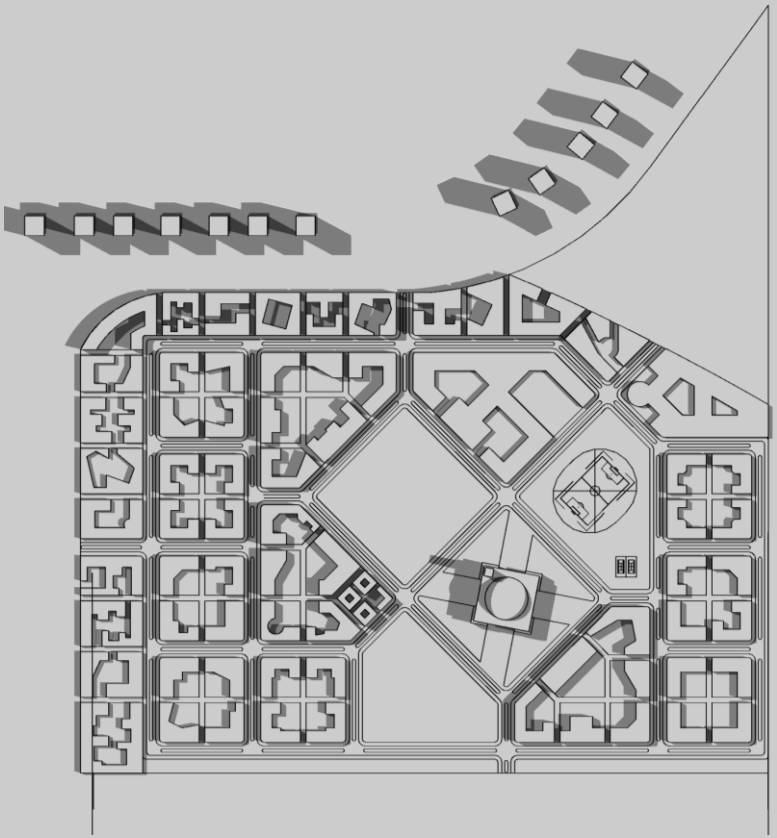


Figure 56: Shadow range at 9am, midday and 3pm during Summer Solstice (21 June)
(Reference: author's own 2009)

Basement Parking: Each urban block in SHAJARAH is responsible for its own basement construction that shall contain all parking bays. This helps to create a more pedestrian friendly environment at ground level by minimising the presence of cars. The basement also contains each building's waste collection bins and waste water storage tanks, with basement ceilings high enough to accommodate trucks and delivery vehicles. This ensures that unsightly services are hidden from public view, and removes the need for heavy service vehicles on the streets above.

Larger Stand Sizes: Stand sizes in SHAJARAH are typically just over 5000m^2. The decision to create larger stands is to allow the opportunity for individual stands to continue the Sierpinski Carpet concept and break up the individual building designs into smaller linked buildings with a series of intimate, interconnected courtyard spaces. In doing so, each stand becomes its own permeable cluster community, as opposed to an isolated building.

Grid Diagonal to East-West Axis: The grid network within SHAJARAH runs parallel to the adjacent main roads. This is not only for spatial practicality; it also supports the dynamic movement of air across the site from the prevailing northwest and southeast winds. Moreover by orienting the grid pattern diagonally to the east-west axis, the sun exposure and shade is better distributed on the streets and surrounding open spaces.

Maximising Shade: As winters in Dubai are relatively mild, it is the summer months that pose the greatest challenge to the design. Ideally, sun exposure on the streets and courtyards should be minimised in both summer and winter. The solar studies illustrate the shadows onsite created at extreme times of the year (summer and winter solstices) [Figure 56-57]. Winter shadows are close to optimum conditions with the vast majority of streets and courtyards benefitting from shade. Streets have been set at 30m to maximise winter shade [Figure 58]. However, it can be seen that there is very little shadow cast by buildings during summer as the sun is almost directly above. Therefore sun shading devices such as pergolas, canopies and trees should be introduced into the design of individual courtyards and open spaces to maximise shade during summer where very little relief from the harsh desert sun is available.

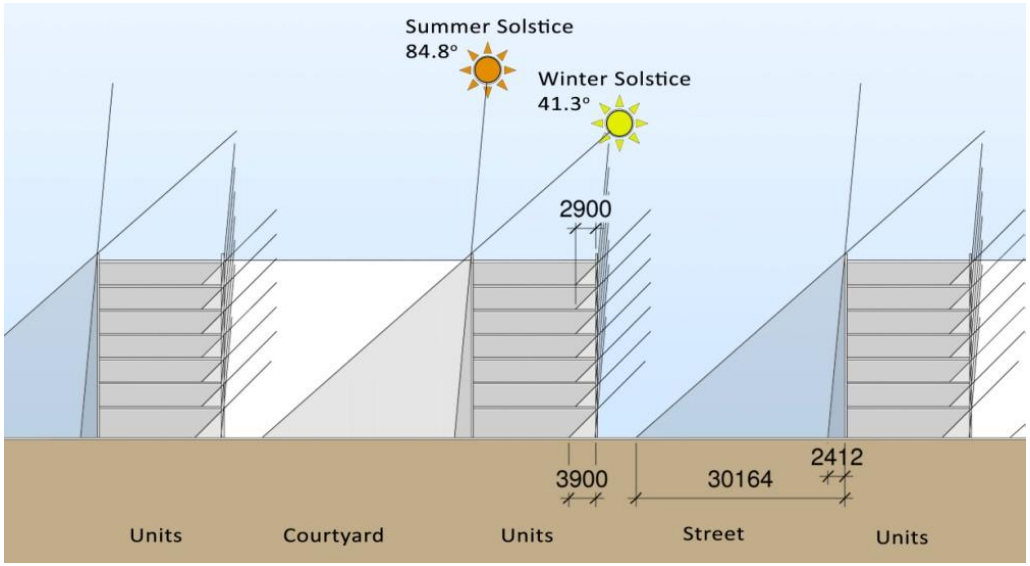


Figure 58: Impact of sun angles on buildings and streets
(Reference: author's own 2009)

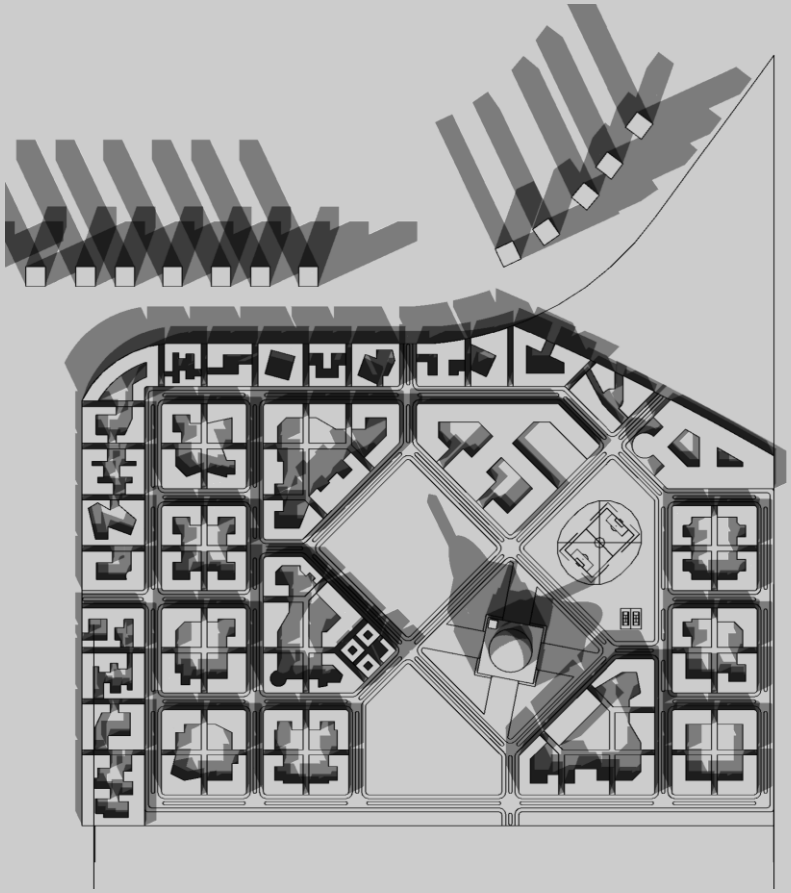


Figure 57: Shadow range at 9am, midday and 3pm during Winter Solstice (21 December)
(Reference: author's own 2009)

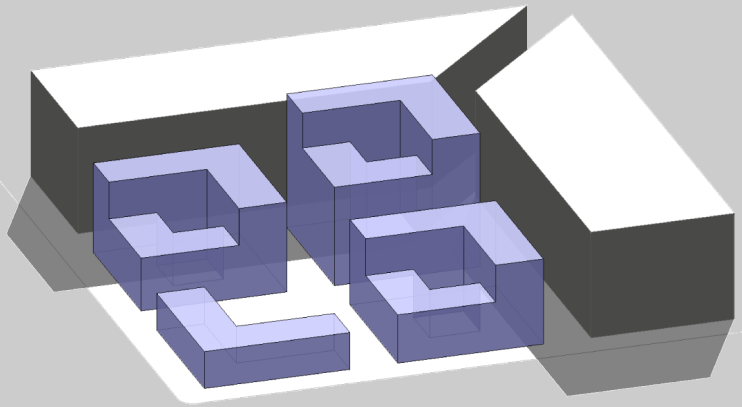


Figure 59: Conceptual massing of the buildings on site
(Reference: author's own 2009)

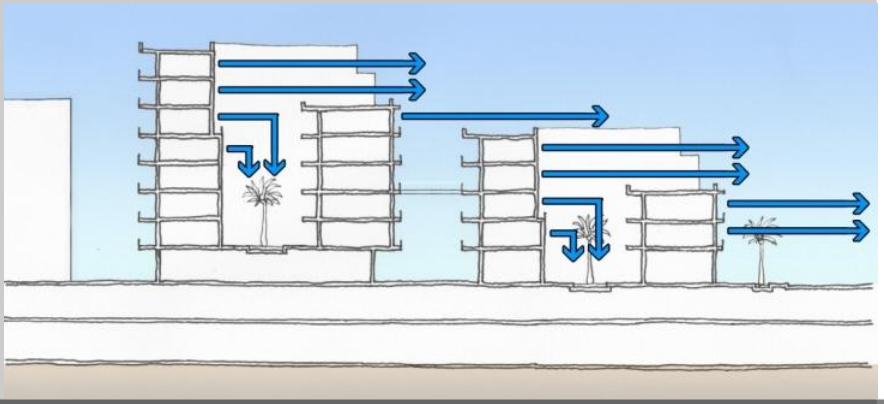


Figure 60: Section showing stepped heights and afforded views
(Reference: author's own 2009)

THE BUILDING LEVEL

The building level design concept expands on many of the precinct level concepts but at a smaller scale. A series of courtyard spaces is also created; shade is still maximised; and the ground floor is a continuation of the public pedestrian realm.

Building Form: As mentioned previously, the building design is actually a cluster of smaller buildings [Figure 59]. From the diagrams at the bottom of the page [Figure 61], the main bulk of the site has been divided into four separate buildings: three residential courtyard buildings anchored along the back of the site and an L-shaped corner building that holds site together and creates partial enclosure of a larger public courtyard space. As the buildings are on a corner site with the large open public square and bus station directly opposite the streets, the buildings step down from eight storeys at the back to two storeys at the corner. This ensures that the taller buildings are located further back, providing shade for the open spaces in front of them and stepping down towards the corner to create a more gradual, mediating transition between the vertical and horizontal planes.

Responding to Views: As the street corner is orientated along the north and east edges of the site, the corresponding facades lend themselves to being opened up to the views across the site without allowing direct sun to penetrate the building. The stepped heights also afford the taller building at the back views over the top of the smaller buildings in front of it. This allows each residential unit a view, either out over SHAJARAH or into the courtyards below as shown in the section on the left [Figure 60].

Location of Functions: The residential units have been placed on the upper four levels of each building, to allow the living spaces to benefit from the views and natural lighting [Figure 62]. The common areas – laundromat, IT and communications (ITC) room and games room – are located just below the residential units on the fourth floor of the tallest building. This floor is linked to the two other courtyard buildings by a sky-bridge, so that all residential units have easy access to these shared facilities. The gym is located below the common areas on the third floor.

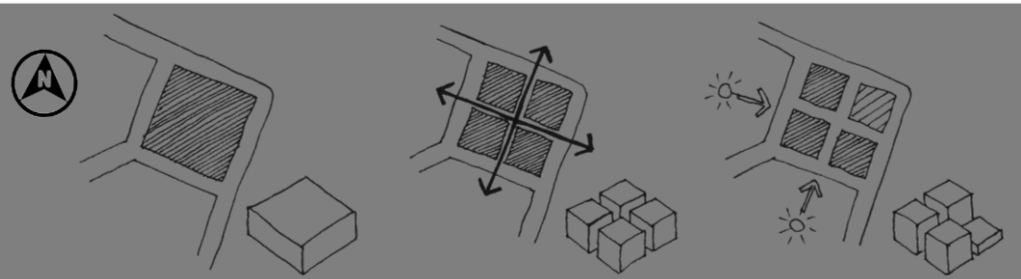




Figure 61: Section highlighting the location of functions within the buildings
(Reference: author's own 2009)

The dining halls are located on ground floor of the two lower courtyard buildings and on the first floor of the taller building. This allows the dining halls to become part of the public domain with access to their own semi-private courtyards. Tables can spill out into the courtyards or onto the pavements for outdoor dining during the cooler months, much like street cafes [Figure 63].

The ground floor of the taller building contains a supermarket. Although it is situated at the back of the site, the pedestrian route between the site's adjacent buildings intersects the site at this corner from the central courtyard space of the larger urban block. This placement creates a more centralised convenience store for the surrounding buildings without taking up space on the more prominent street edges. The corner of the supermarket facing the partially enclosed courtyard contains a bicycle rental, bicycle lock-up and change room facilities.

The double-storey L-shaped corner building is a public commercial building with a bakery/coffee shop of the ground floor and a second-hand bookshop on the first floor. These two functions within the building interact with each other through a double-volume in the centre, becoming more of a reading lounge than two separate functions.



Figure 63: Initial concept sketch of the courtyard spaces
(Reference: author's own 2009)

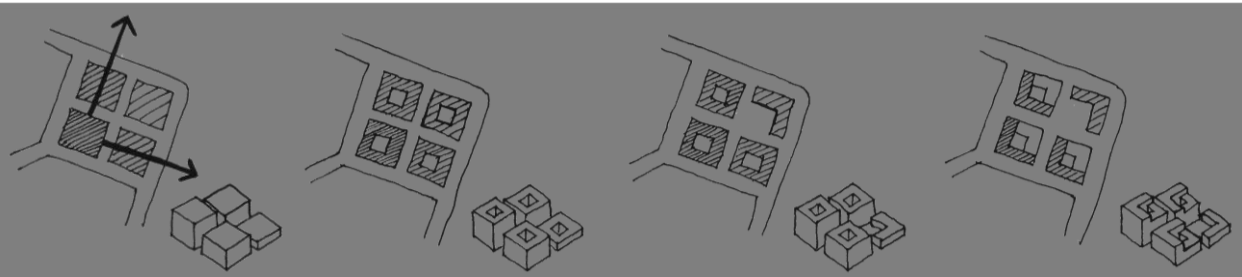


Figure 62: Diagrams showing conceptual progression of form
(Reference: author's own 2009)

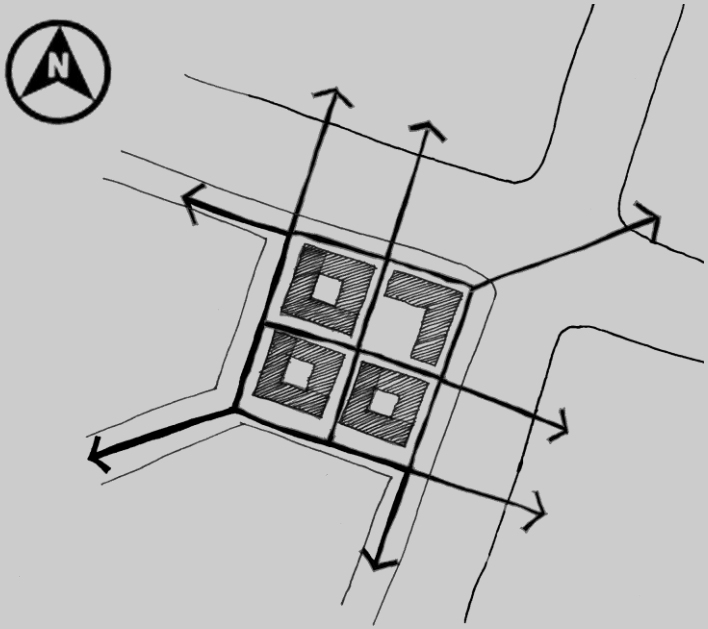


Figure 64: Conceptual site plan showing pedestrian movement routes
(Reference: author's own 2009)

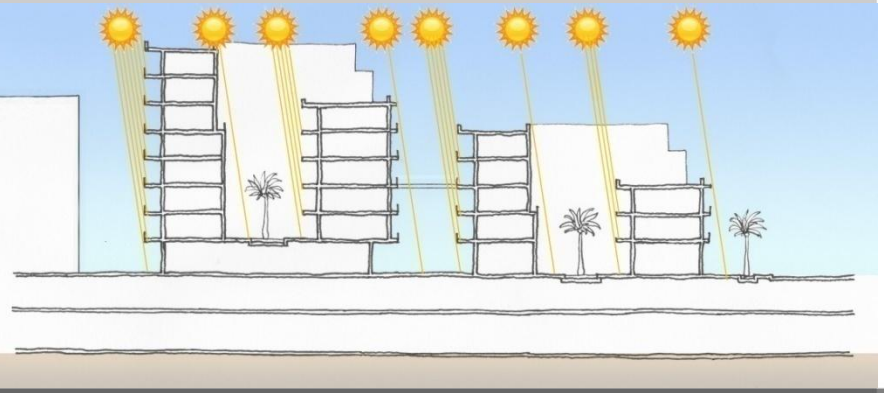


Figure 65: Section showing the penetration of extreme summer sun angles on facades
(Reference: author's own 2009)

Continuing the Public Realm: This commercial corner building fronts both the street corner and the partially enclosed public courtyard, drawing the public into the site. The partially enclosed courtyard is envisaged as a large open space for bustling weekend flea markets and lazy roadside cafes, under the protective covering of a lightweight solar canopy. The corner site will experience a heavy amount of pedestrian through-traffic with the open public square to the north, the bus station to the east and the mosque diagonally opposite [Figure 64]. As a central site within SHAJARAH, the street corner is a continuation of the public realm.

Solar Orientation: Habitable spaces have been placed along the north and east faces of the building, along the outer facades and within the courtyard [Figure 65]. As these facades do not receive direct sun, balconies and large openable, double-glazed windows and doors [Figure 66] have been incorporated into the design to allow these facades to open up for natural ventilation during the cooler months [Figure 70]. Circulation spaces are located along the south and west facades, providing protective overhangs to minimise solar penetration into the habitable spaces [Figure 67]. Service and utility spaces are located adjacent to the circulation spaces to provide another layer of insulation between the harsh sun and the living spaces beyond.

Water Management: As water is such a precious commodity in the desert, waste water recycling is favourable, especially for landscape irrigation. Potable water, greywater and sewage should be separated so that greywater can be reused for irrigation, sewage can be treated at the CWSTP. Water ducts have been placed strategically so that all kitchens and bathrooms have access to one of these ducts, ensuring no water is wasted at SHAJARAH [Figure 68].

Recycling opportunities: Recycling chutes are located on each floor near the circulation cores to encourage residents to separate their waste [Figure 69]. These chutes take the waste to the basement where it is stored until collection to the CWSTP.

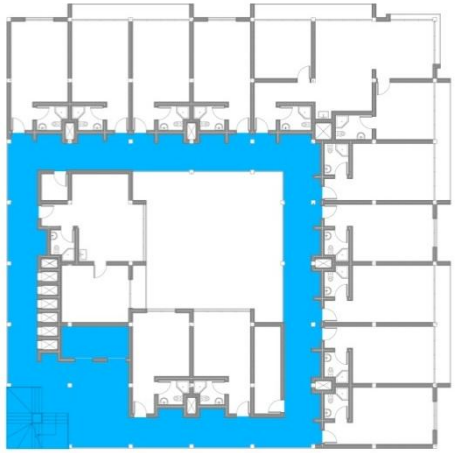


Figure 66: Circulation on typical residential floor
(Reference: author's own 2009)

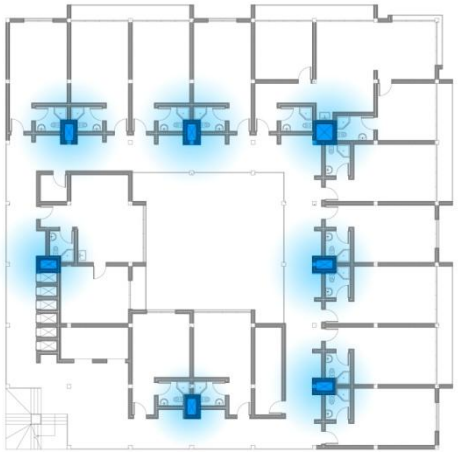


Figure 67: Water ducts and utility spaces on typical residential floor
(Reference: author's own 2009)

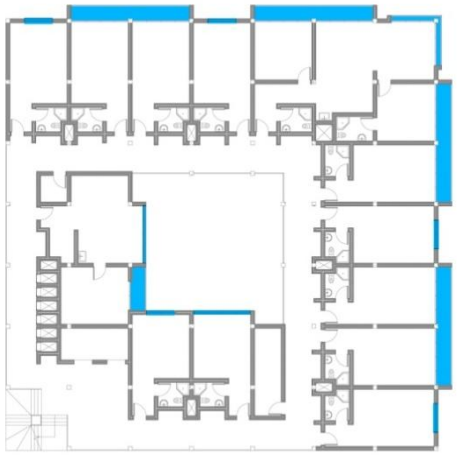


Figure 69: Balconies and folding doors on typical residential floor
(Reference: author's own 2009)

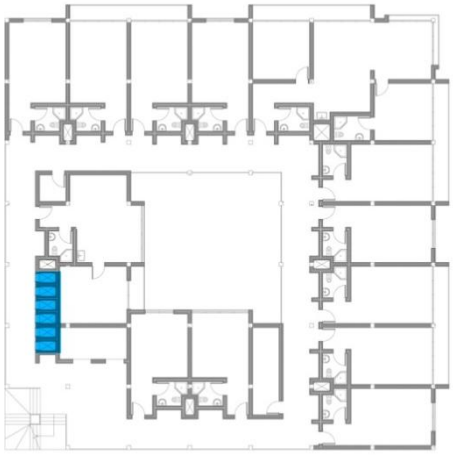


Figure 68: Recycling chutes on typical residential floor
(Reference: author's own 2009)

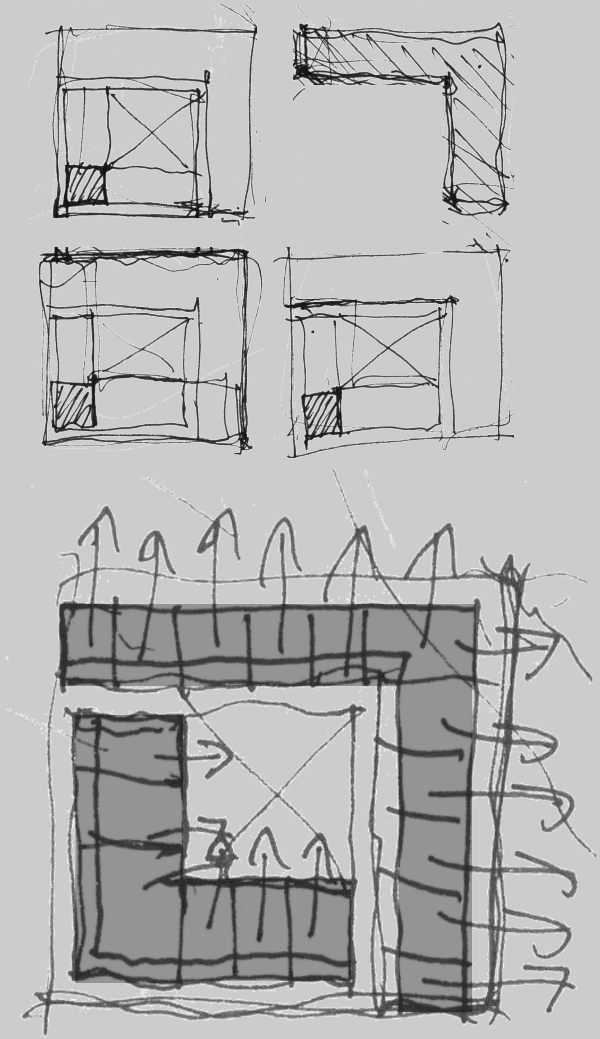
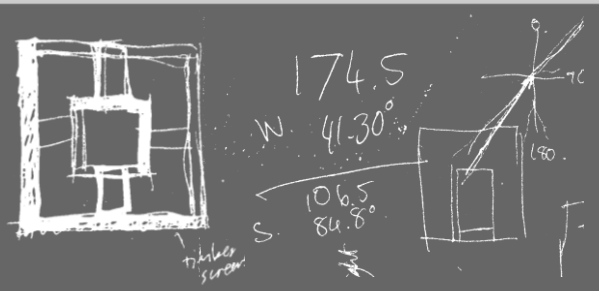


Figure 66: Concept sketches of placement and orientation
(Reference: author's own 2009)



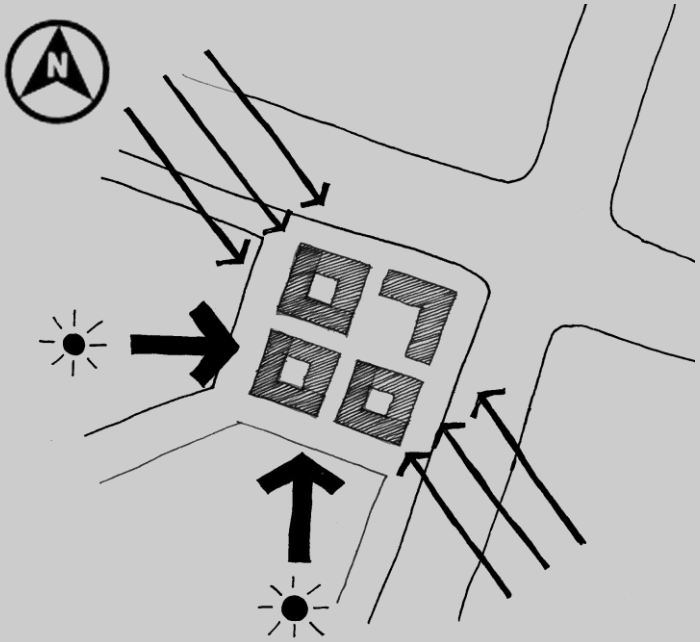


Figure 70: Conceptual site plan showing sun and wind directions
(Reference: author's own 2009)

Courtyard Cooling Effect: The courtyards contained within the three residential buildings have been designed to create a shaded, private outdoor space for the building's users. The courtyard within the tallest building has been raised form ground level to the first floor to allow the supermarket more space below and to reduce the height of the courtyard. The stepped building heights also help to form a protective shield against the harsh south sun [Figure 71], whilst still allowing the courtyards greater access to indirect north light.

As well as providing an enclosed outdoor space, the courtyards also function as passive cooling devices within the design [Figure 72]. Cool afternoon sea breezes from the northwest are channelled down into the courtyard spaces by the facades, acting as wind-catchers. The air cools on its way down as it passes the cooler, shaded facades. Trees help to provide shade, creating a cooler microclimate within the courtyard and aiding in the cooling of air. The cooler air is then drawn into the rooms by cross-ventilation. The air absorbs heat in the room, before it is evacuated through open windows. Undesirable warm desert air from the southeast either passed straight over the building or is obstructed from entering the courtyard by the taller south- and west-facing corridor spaces.

Ventilated Double-Skin Solar Roof: The flat roofs of the three residential buildings provide opportunity for solar energy harvesting. Details of the ventilated double-skin solar roof are explored in greater detail under the *Element Level* section of this chapter.

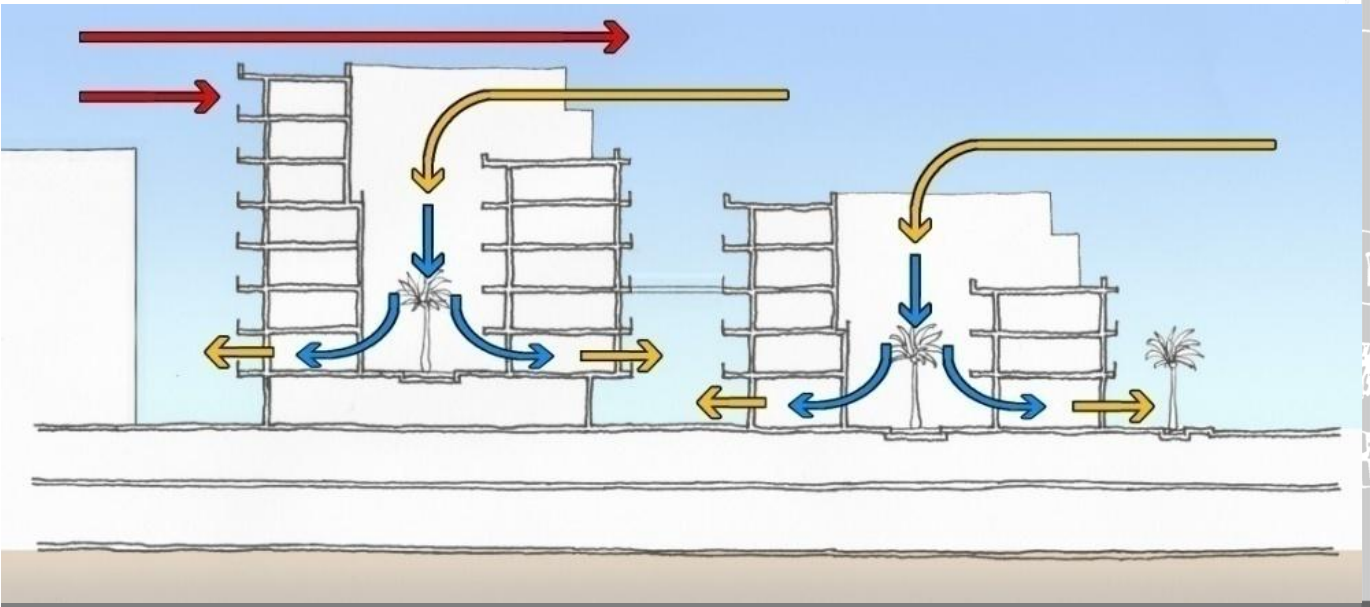
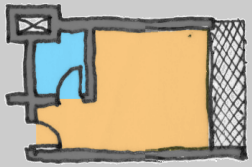
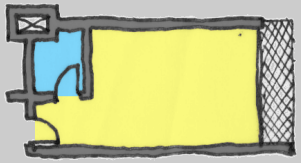


Figure 71: Section showing passive cooling effect within the courtyards
(Reference: author's own 2009)

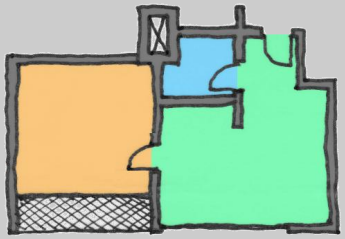


DORMITORY ROOM

Bedroom
Combined sleeping/living
Living/dining/kitchen
Bathroom



DORMITORY STUDIO



ONE-BEDROOM APARTMENT



TWO-BEDROOM APARTMENT

Figure 72: Conceptual unit typologies
(Reference: author's own 2009)

THE UNIT LEVEL

The building can accommodate up to 492 residents in four unit typologies [Figure 73] to suit different needs, lifestyles and budgets:

27 x Dormitory Rooms

- Minimum 25m^2 with no more than 4 occupants
- Shared en-suite bathroom (shower, toilet and basin)

54 x Dormitory Studios

- Minimum 30m^2 with no more than 4 occupants
- Combined living and sleeping space
- Shared en-suite bathroom (shower, toilet and basin)

21 x One-Bedroom Apartments

- Minimum 40m^2 with no more than 4 occupants
- Living/dining area with full kitchen (fridge, hob, oven and sink) and separate bedroom
- One bathroom (shower, toilet and basin)

9 x Two-Bedroom Apartments

- Minimum 55m^2 with no more than 8 occupants
- Living/dining area with full kitchen (fridge, hob, oven and sink) and separate bedrooms
- Two bathrooms – one en-suite (shower, toilet and basin)

Personal Space: The design criteria for each living unit, stated in Design Framework, provide each resident with at least 5m^2 of personal space. As a result, units have been designed so that each room is at least 20m^2 and therefore able to accommodate up to 4 people. There is one bathroom (shower, toilet and basin) per room in each unit, meaning no more than 4 people share one bathroom, as stipulated in the Design Framework.

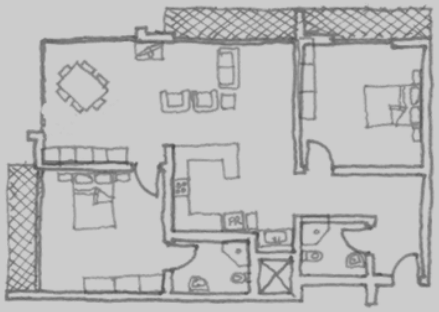
Flexibility: This means that, for example, a two bedroom unit can either be rented out by a family of two parents and up to four children, or two couples, or eight workers. Therefore the design considerations of each unit allow for flexibility of occupation [Figure 74]. At present, it is likely that 4 workers will occupy each room using the unit as a larger dormitory with a

a common room, with very few units being used as family accommodation. However, in the near future when many of the construction migrant workers leave Dubai, longer-term workers will occupy the units, possibly bringing their families to live with them. As a result of these different occupant configurations, a number of different options are available using the four basic unit typologies.

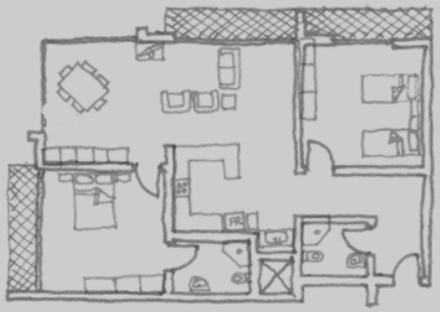
Outdoor Indoor Spaces: Additionally, each unit has the opportunity for outdoor living, either through an openable facade, a balcony or terrace area. These spaces extend the living space to the outdoors and provide views into the courtyards or across the SHAJARAH site. Although large expanses of glazing are not favourable in hot climates due to heat gain, a compromise has to be made in favour of views, natural lighting and cross-ventilation. Therefore, double-glazed windows and folding doors with a protective solar film are used throughout the design to achieve this balance. Double-glazing is a regulatory requirement in Dubai due to its insulating effectiveness in reducing heat gain and thereby cooling costs. Pergolas have also been incorporated into the design on the higher level roof terraces to reduce the direct solar heat gain on the outdoor floor surfaces and minimise solar glare.



OPTION 1: Dormitory Apartment (8 workers)



OPTION 2: Shared Apartment (2 couples)



OPTION 3: Family Apartment (family of 6)

Figure 73: Different configurations for a two-bedroom apartment
(Reference: author's own 2009)

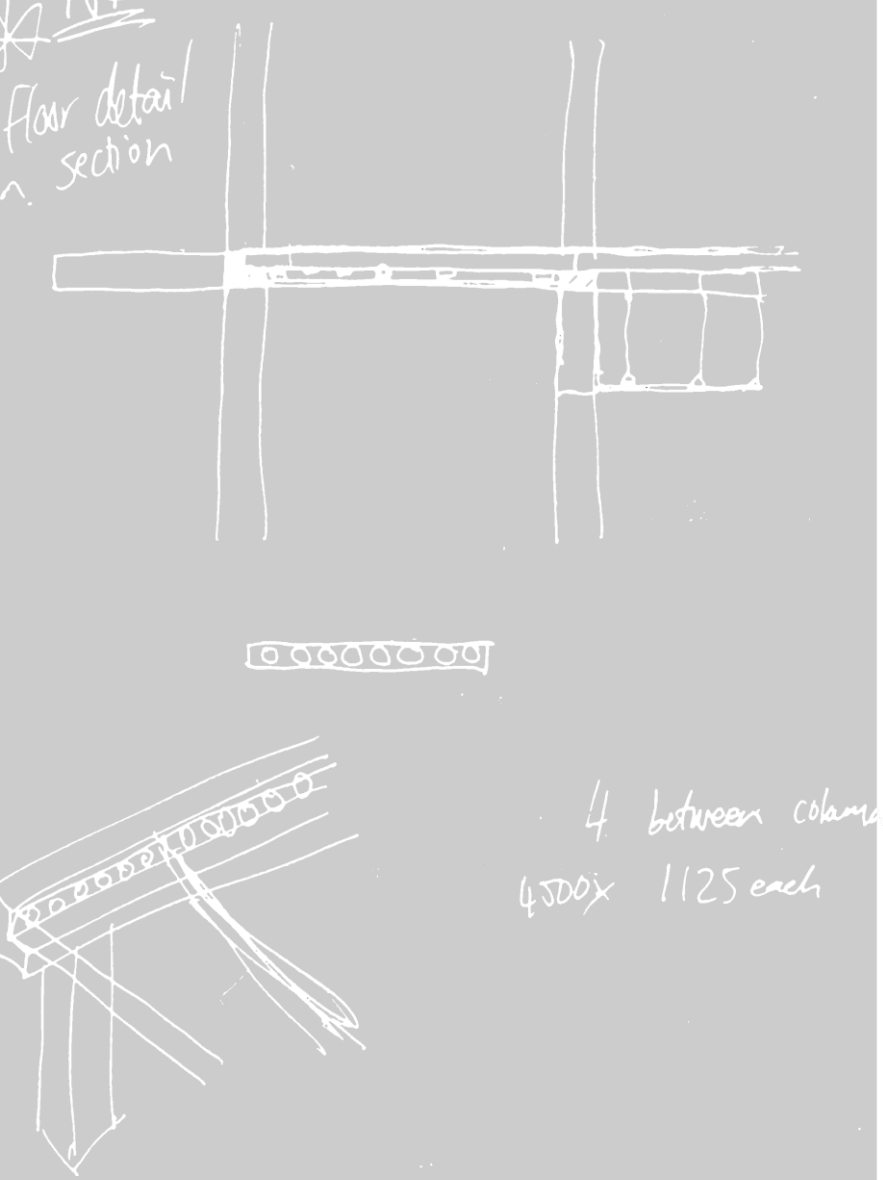
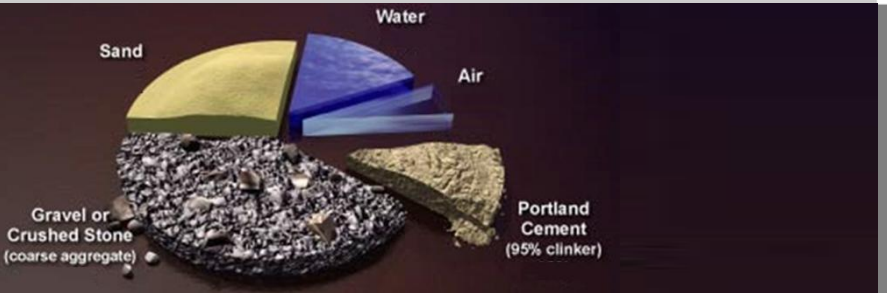


Figure 74: Conventional concrete mix
(Reference: Cool Climate Concrete 2007)



THE ELEMENT LEVEL

STRUCTURAL CONCRETE FRAME

The versatility, durability and cost-effectiveness of concrete make it a key component in today's built environment. Concrete is reasonably energy efficient; however, it is the energy-intensive cement that deems concrete unsustainable [Figure 75]. Cement production is one of the most energy intensive manufacturing processes. EcoSmart Industries have found a solution to both improve concrete performance and make it a green material by maximising the replacement of cement with supplementary cementing materials (SCMs), such as industrial by-products like fly ash (pulverised fuel ash or PFA) from coal-burning power stations (EcoSmart Concrete 2009) [Figure 77]. Fly ash pellets are also a common alternative to conventional stone and sand aggregates in creating lightweight concrete without compromising structural integrity. Doing this improves the cost, physical performance and constructability of conventional concrete. It has been proven to be effective in some of the harshest environments in the world, and has been tested and implemented in the UAE's hot climate where it performs best. As a result, its use in Dubai's construction industry is growing as a more effective and sustainable alternative to conventional concrete.

Using EcoSmart Concrete [Figure 76] for the structural frame (columns and floors) has many advantages over conventional concrete mix, especially in the UAE (EcoSmart Concrete 2009):

- **Increases workability** – it is easier to pump and work, especially in high temperatures
- **Enhances long-term strength** – over time, it has a significantly higher compressive strength (it continues to gain strength beyond 40MPa after 56 days)
- **Reduces permeability** – pore space is minimised by using SCMs
- **Increases durability** – it reduces thermal stress and cracking
- **Gives a better finish** – fly ash makes lighter coloured concrete with fewer bug holes and honeycombing for a visually superior architectural aesthetic in a wide variety of finishes (acid-etched, sandblasted, smooth-as-cast, exposed-aggregate) to achieve the desired appearance

- **Performs best in hot climates** – its workability is easier and its strengthening process is accelerated by hot temperatures
- **Supports longer spans** – its improved strength can support longer spans and requires less structural support
- **Resists corrosion** – it is effective in coastal environments in resisting salt corrosion
- **Requires less maintenance** – since it becomes stronger and more impermeable with time, it may not need to be repaired/patched as often
- **Produces lighter concrete** – fly ash pellets are a common replacement for conventional aggregate in lightweight concrete and can reduce the dead weight by up to 25% (Lytag 2009)
- **Uses less water** – it uses less water in production (a key concern in Middle Eastern countries)
- **Costs less** – SCMs are cheaper than Portland cement, since they are industrial by-products. Also, its higher ultimate strength can lead to further material cost savings
- **Is environmentally sound** – replacing much of the cement content with reclaimed industrial by-products as SCMs reduces greenhouse gas emissions, energy-use and water usage associated with the production of concrete and helps reduce the need for industrial landfill
- **Contributes to green building rating targets** – by using SCMs, the green rating of concrete can be improved by up to 70%



Figure 75: EcoSmart Concrete
(Reference: Cool Climate Concrete 2007)

LIGHTWEIGHT INFILL WALLS

Despite its improved performance, EcoSmart Concrete remains relatively heavy. In typical desert climates, this thermal mass is beneficial in storing heat during the day and slowly releasing it at night when the desert temperatures drop below comfort levels. However, Dubai is a coastal desert city and therefore experiences less dramatic diurnal fluctuations in temperature and higher humidity than inland desert regions. Because of this, lightweight construction is required to reduce thermal massing, yet at the same time provide adequate mass for sufficient thermal insulation.

Figure 76: EcoSmart Concrete mix
(Reference: adapted from Cool Climate Concrete 2007)

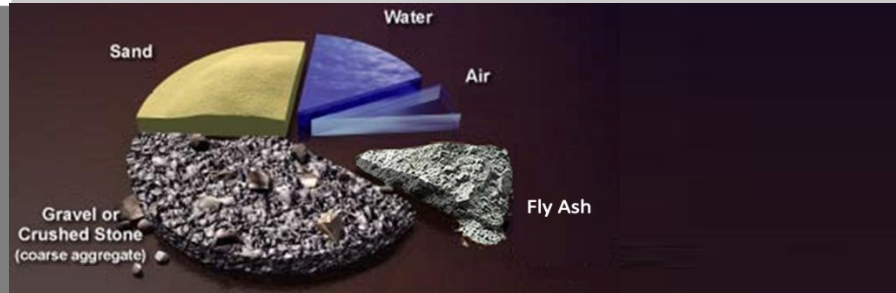




Figure 77: Lightweight polystyrene concrete block
(Reference: Foam Lite 2009)

A way to reduce the massive structural load of concrete is to replace some of the course aggregate in EcoSmart Concrete with expanded polystyrene (EPS) [Figure 78]. The amount of recycled EPS aggregate can be increased to as much as 80% [Figure 79], considerably lighten of the dead weight in concrete by up to 88% (Foam Lite 2009), as well as improving its thermal insulation capabilities. As the polystyrene aggregate reduces the structural capabilities of the concrete, it cannot be used for the structural frame of the building but is the most effective and flexible solution for the infill walls in reducing the building's dead weight, and increasing thermal and acoustic performance.

Like the stigma attached to conventional concrete, polystyrene is also seen as an unsustainable material because it is non-biodegradable. However, it is the disposal of polystyrene packaging waste and crockery that poses the greatest environmental problem, not polystyrene construction materials that 'disappear' into buildings. Globally, approximately 65% of the demand for polystyrene products comes from the construction industry, with 35% from packaging (Emirates Industrial Bank 2007: 2). Expanded polystyrene can contain up to 50% recycled polystyrene. Therefore, by recycling the packaging waste back into the production of polystyrene for insulation purposes, the major waste concern associated with polystyrene can be greatly reduced so that the material becomes an environmental asset and not a pollutant.

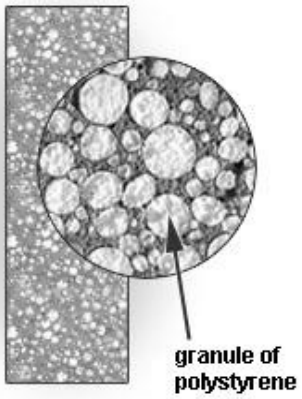
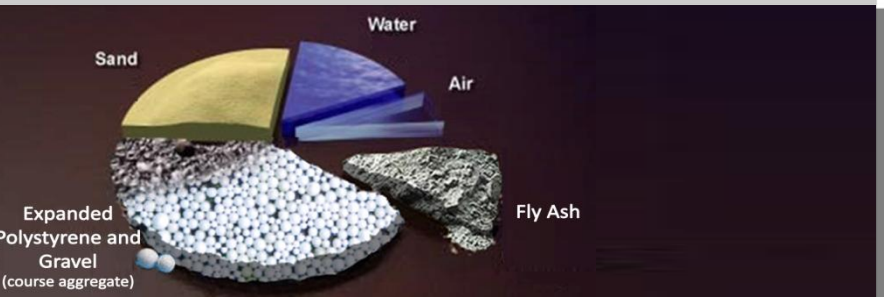


Figure 78: Section through lightweight polystyrene concrete
(Reference: Salben Stroy 2009)

By using a combination of polystyrene aggregate and the fly ash in EcoSmart Concrete [Figure 80], the environmental, economic and social benefits of using concrete is increased dramatically.

Figure 79: Polystyrene concrete mix
(Reference: adapted from Cool Climate Concrete 2007)



Environmental Benefits

Reduce

- **Thermal efficiency** – lightweight concrete contributes to reducing cooling costs
- **L onger lasting structures** – reduces energy needs for maintenance and reconstruction
- **Less waste** – made-to-order concrete means less construction waste
- **Reduced runoff** – permeable concrete pavements and interlocking concrete pavers can be used to reduce runoff and allow water to return to the water table

Reuse

- **Flexibility** – a modular structural frame is adaptable to a variety of occupants

Recycle

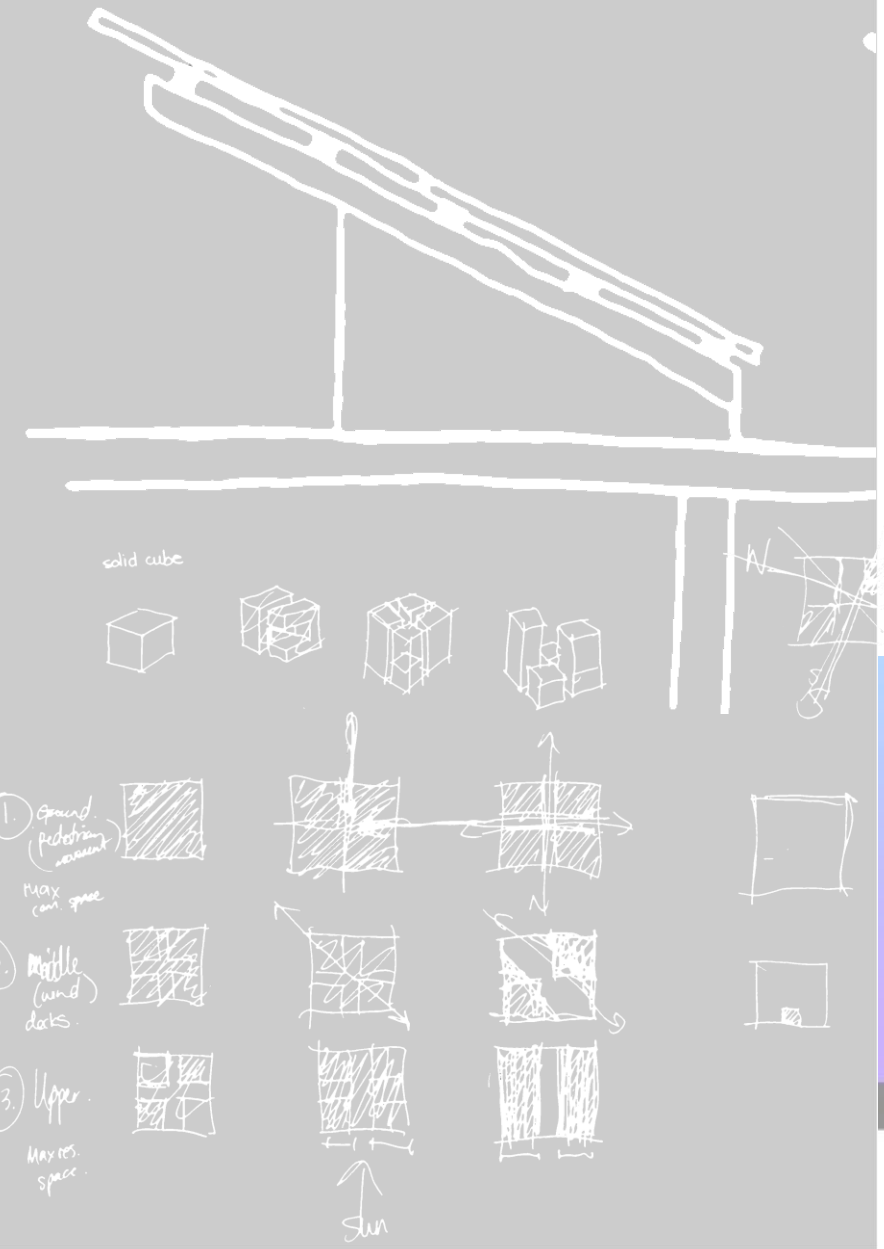
- **Recycled materials** – industrial by-products like fly ash from can supplement the use of cement in concrete mixtures while improving product performance

Economic Benefits

- **Low transportation costs** – EcoSmart Concrete is available locally in Dubai
- **Cost-effective and competitive building material** – lighter blocks means faster construction times, saving money and providing earlier return on investments
- **Less maintenance** – it can be pumped with less wear-and-tear on equipment
- **Lower operating costs** – the thermal efficiency results in less need for active cooling
- **Lower lighting costs** – due to reflectance of material
- **Buildings last longer** – resistant to wear and tear, severe weather, rot, insects and fire
- **Improved finishes** – polished concrete floors do not require carpeting, and exposed concrete walls do not require paints or sealants

Social Benefits

- **Better indoor air quality** – no off-gassing, toxicity or Volatile Organic Compounds (VOCs) to contribute to sick building syndrome
- **Safety** – fire, wind, vibration, sound transmission and seismic resistant (Lehigh Northwest Cement 2009).





SOLAR ROOFS

As mentioned previously in the *Building Level* section, the flat roofs of the building provide opportunity for the inclusion solar panels in the design. Fixed solar panels in Dubai should be set at an optimum angle of 25° to be about 95% effective, with an annual irradiation of about 2400kWh/m²a ()Mueller 2005: 3). Therefore, a second sawtooth roof form has been incorporated into the design above the flat roof using a 25° incline that faces south [Figure 81]. The solar panels are then fitted to the exposed faces. This second skin is open on two sides, allowing air to pass freely between the two roofs to prevent excessive solar heat build up during the day. The shaded space between the two roofs will be used to contain the solar water-heater tanks, which only need to be used during winter as the outside summer heat alone provides sufficient hot water temperatures.

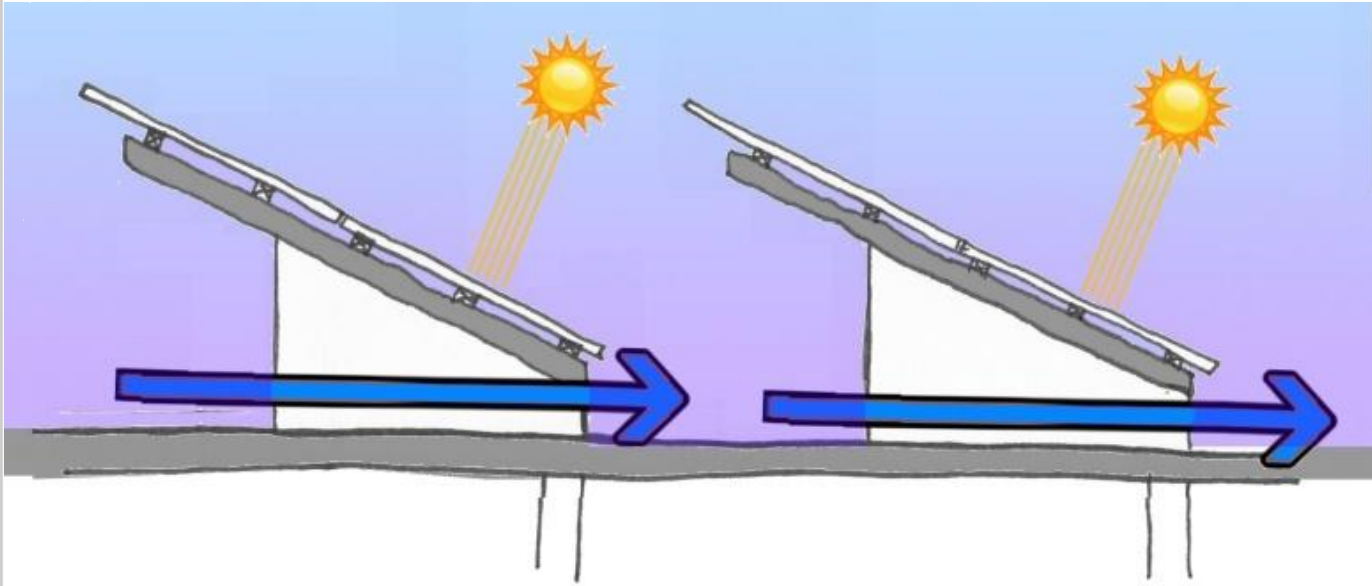


Figure 80: Ventilated double-skin roof with solar panels
(Reference: author's own 2009)

COURTYARD CANOPY

Another roof element in the design that facilitates the generation of solar energy for the building is the solar canopy over the partially enclosed public courtyard [Figure 82]. The canopy is an 11.5m high structural steel frame that supports 144 glazed panels embedded with photovoltaic cells. The combination of opaque cells and transparent glass creates a dappled lighting effect beneath it, eliminating severe glare on the ground surface and shielding the courtyard from overexposure to direct sun.

ROOFTOP VEGETABLE GARDENS

The stepped buildings allow the roof spaces to be inhabited. Outdoor living spaces, as well as rooftop vegetable gardens have been incorporated into the design. Not only do these vegetable gardens provide food that can be used by the dining halls kitchens, they also help to insulate the living spaces below from excessive solar heat gain.

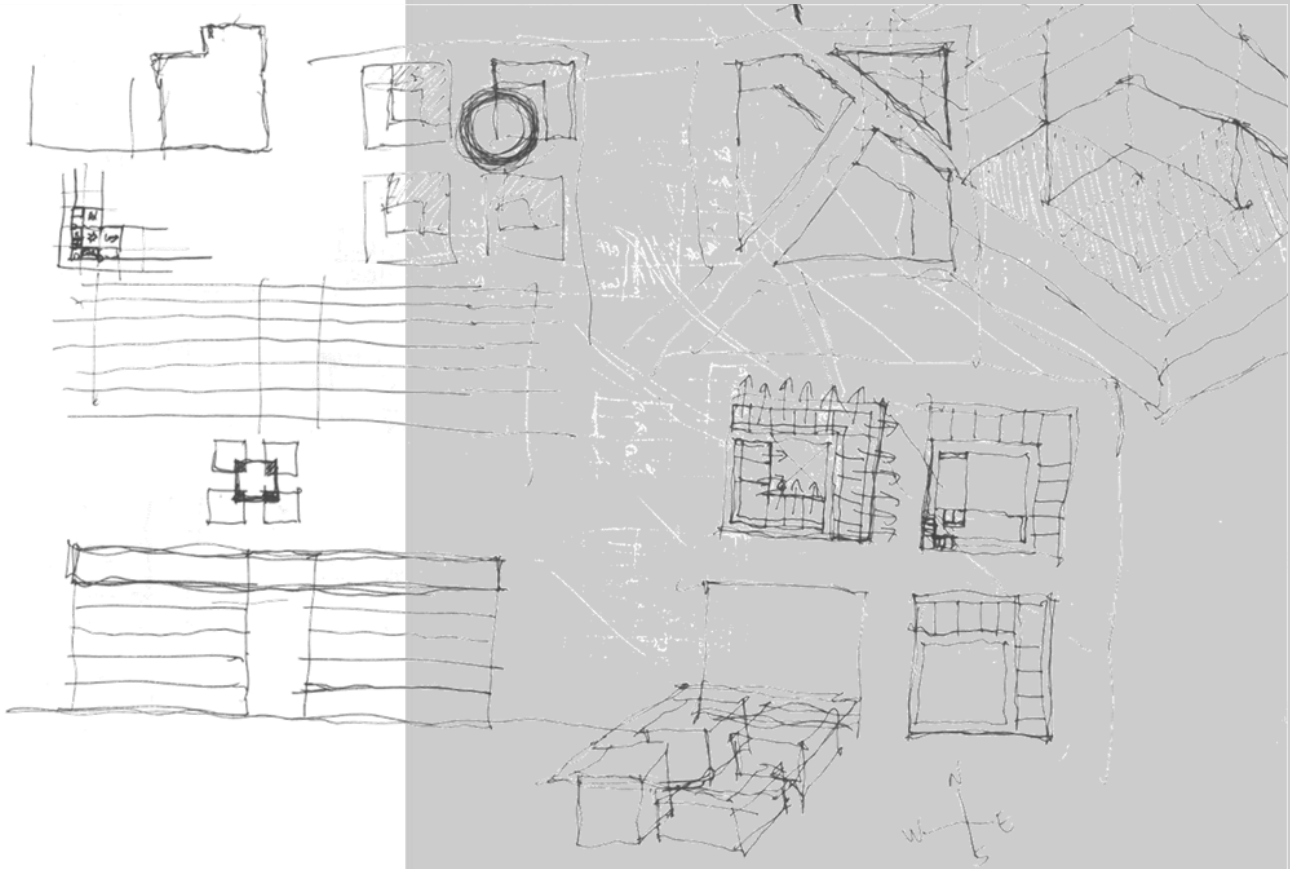


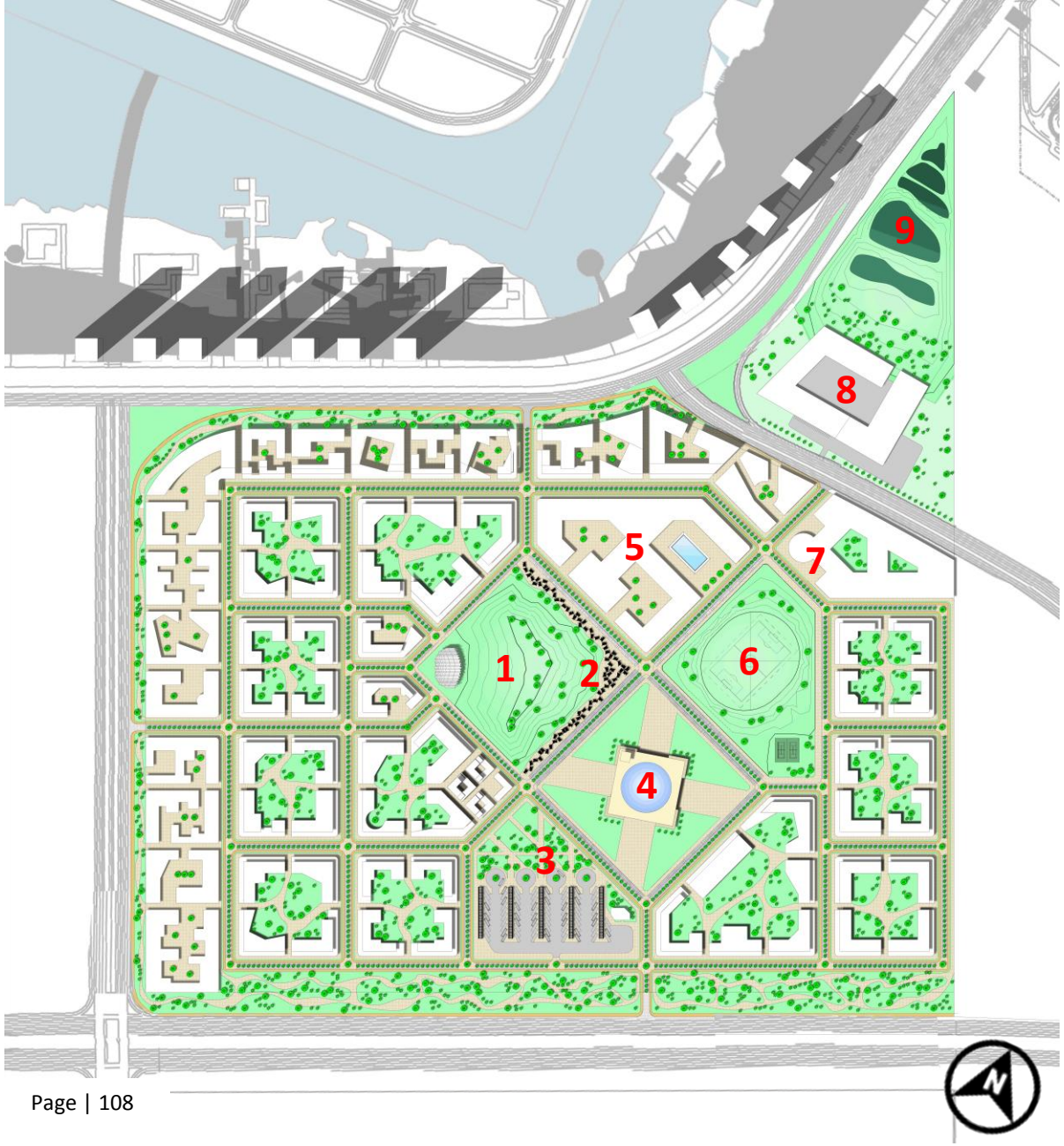
Figure 81: Concept sketches for courtyard roof canopy and rooftop vegetable gardens
(Reference: author's own 2009)

Design Development

SHAJARAH's final design integrates the considerable range of design concepts, theories and principles into a unified holistic model for low-income housing in Dubai that embraces sustainable community living.



Figure 82: View of SHAJARAH within the Dubai Waterfront
(Reference: adapted from Waterfront 2007)



1 **Outdoor Amphitheatre**
2 **Shaded Promenade (Weekend** Fleamarket)
3 **Bus Station and Park**
4 **Mosque**
5 **Community Centre (Future School Complex)**
6 **Sports Fields**
7 **Clinic**
8 **Combined Waste and Sewage Treatment Plant (CWSTP)**
9 **Wetland and Reedbed Filtration Dams**

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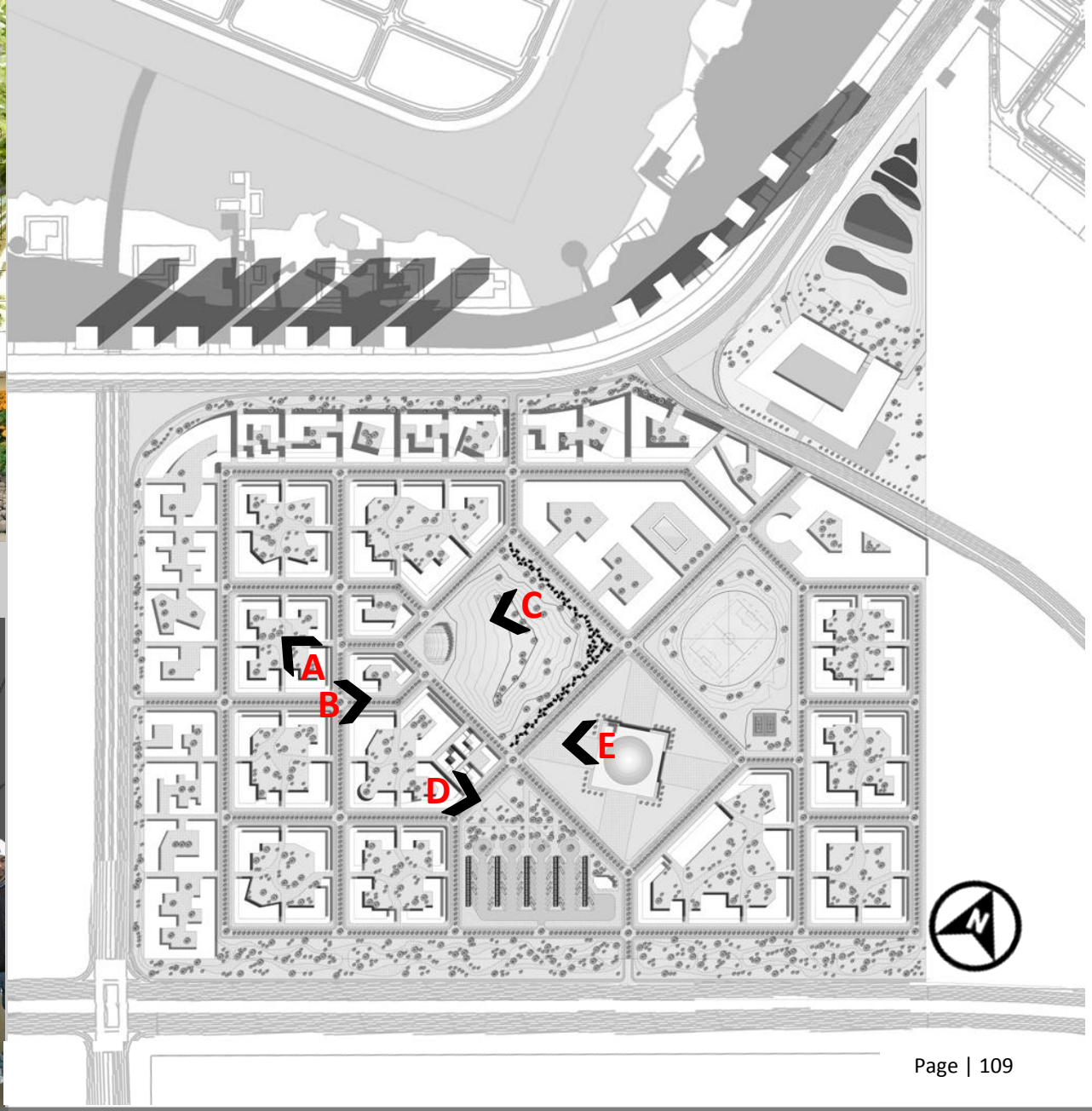

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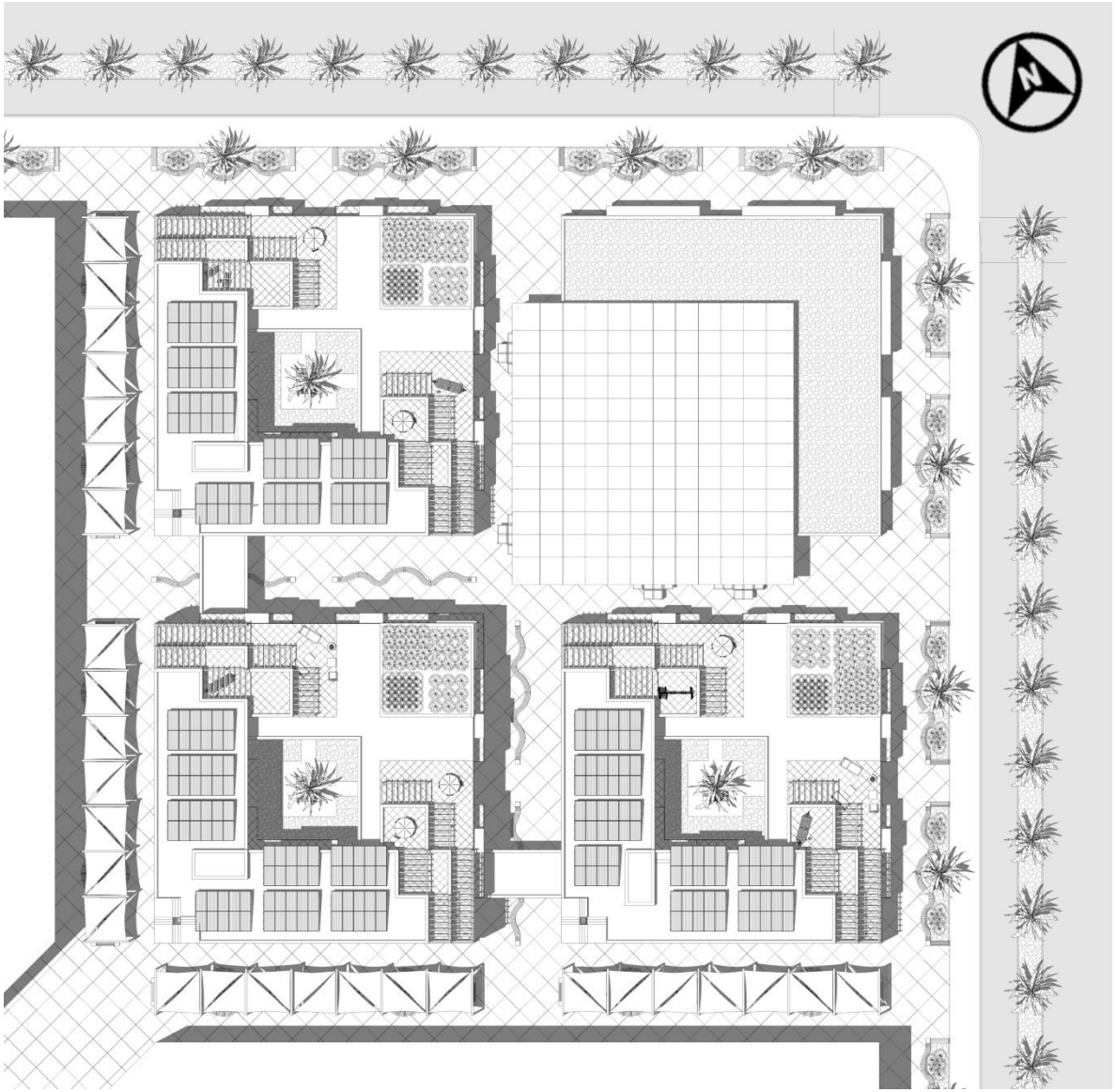

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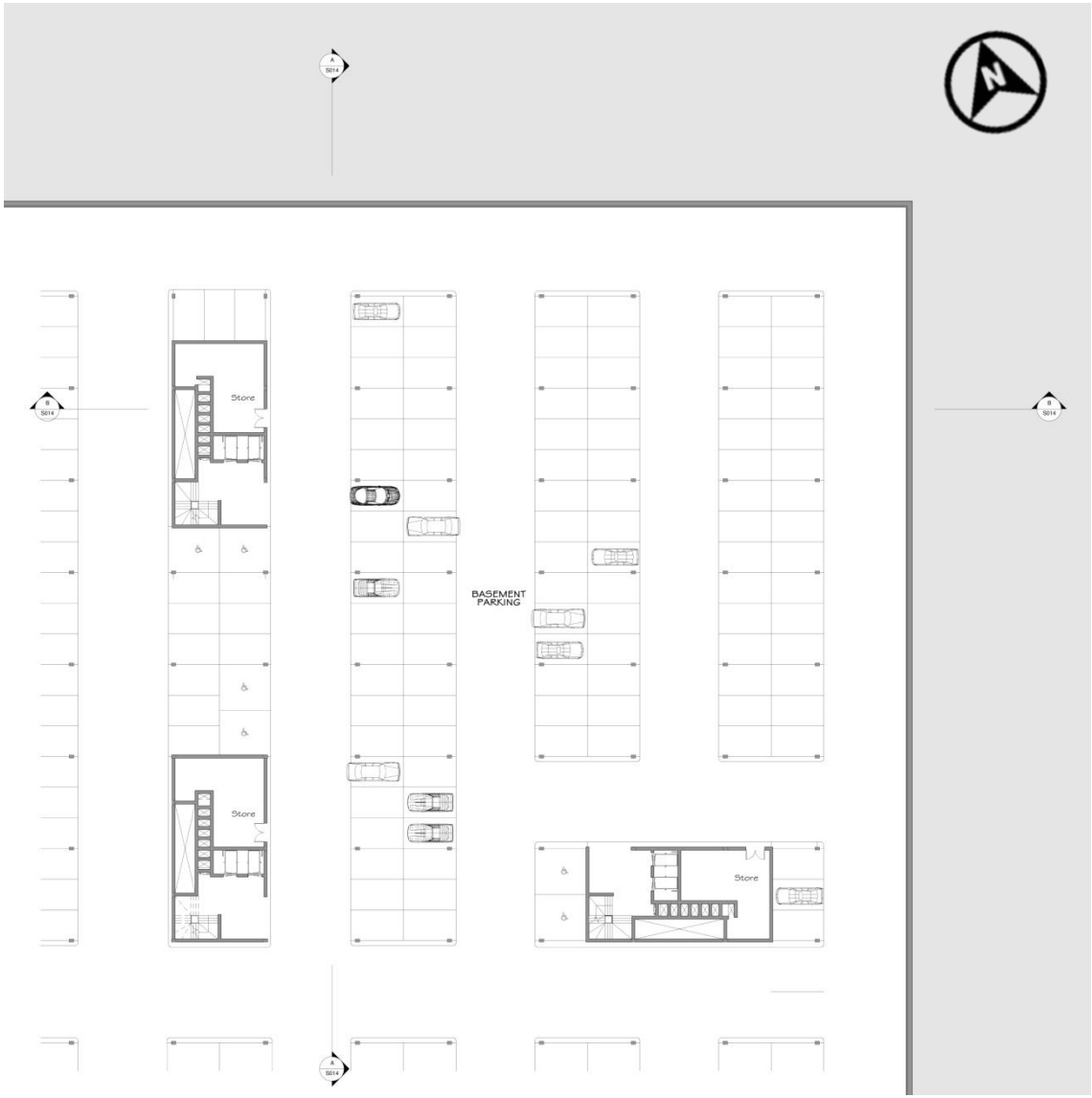



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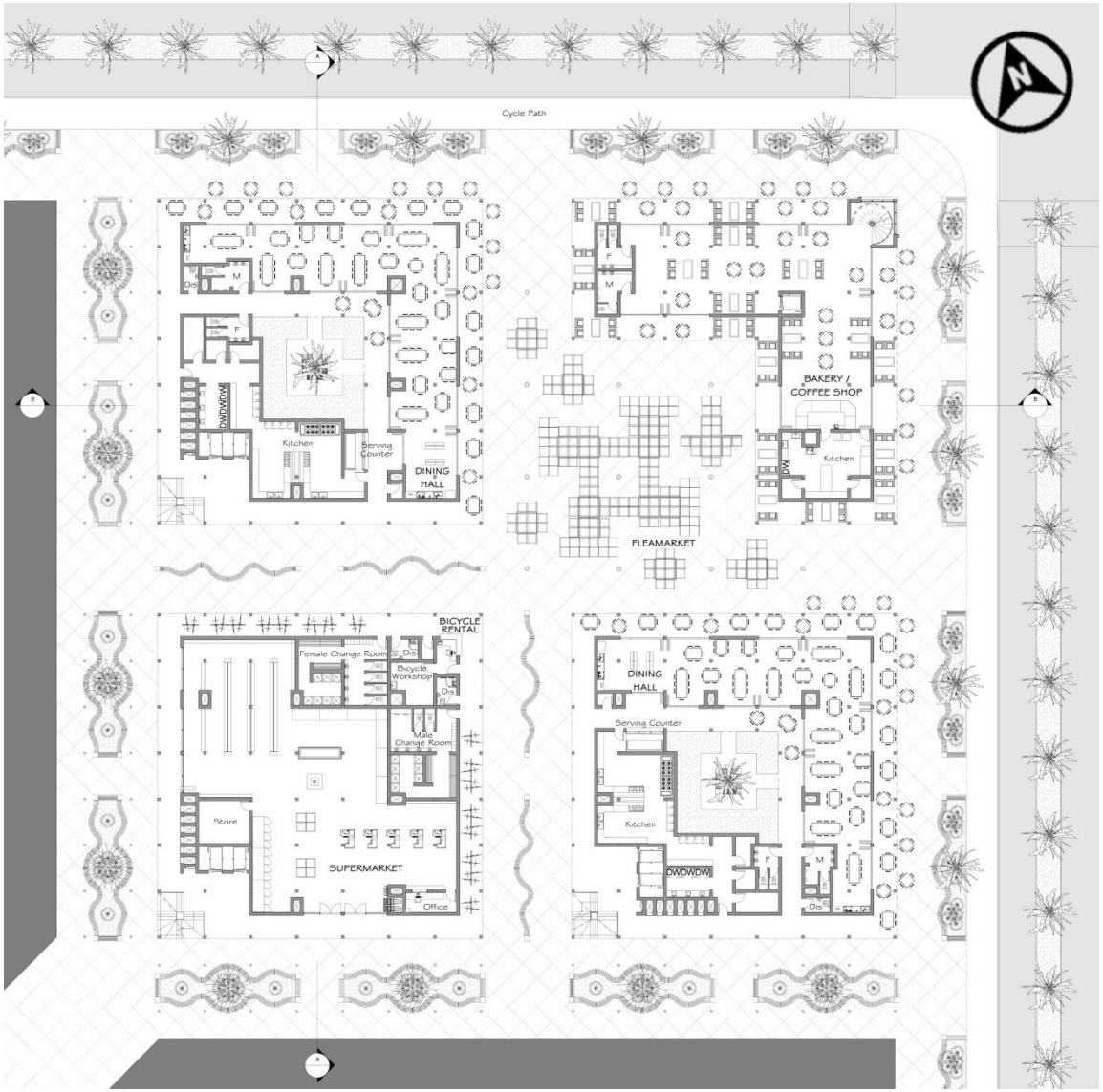

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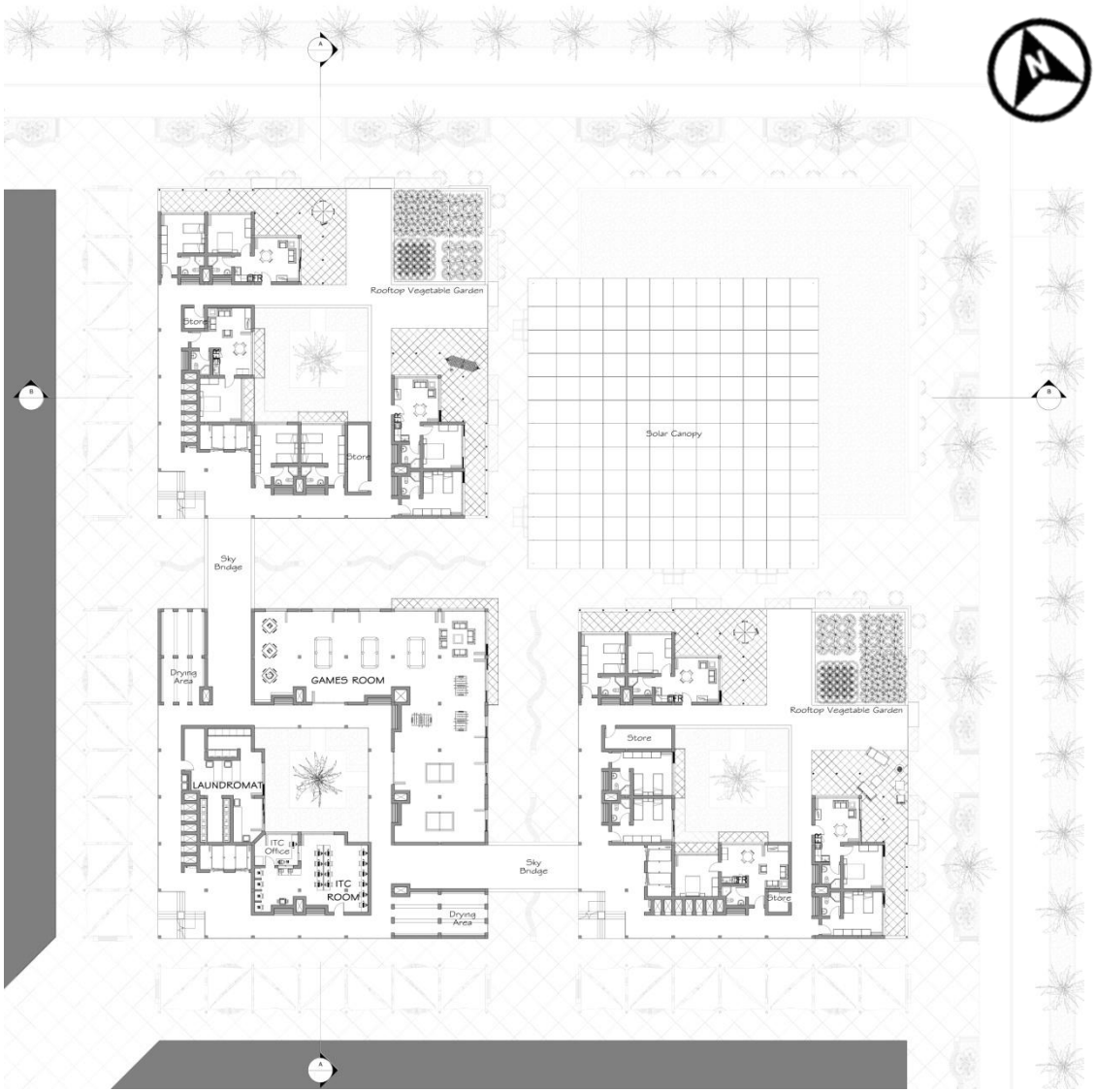

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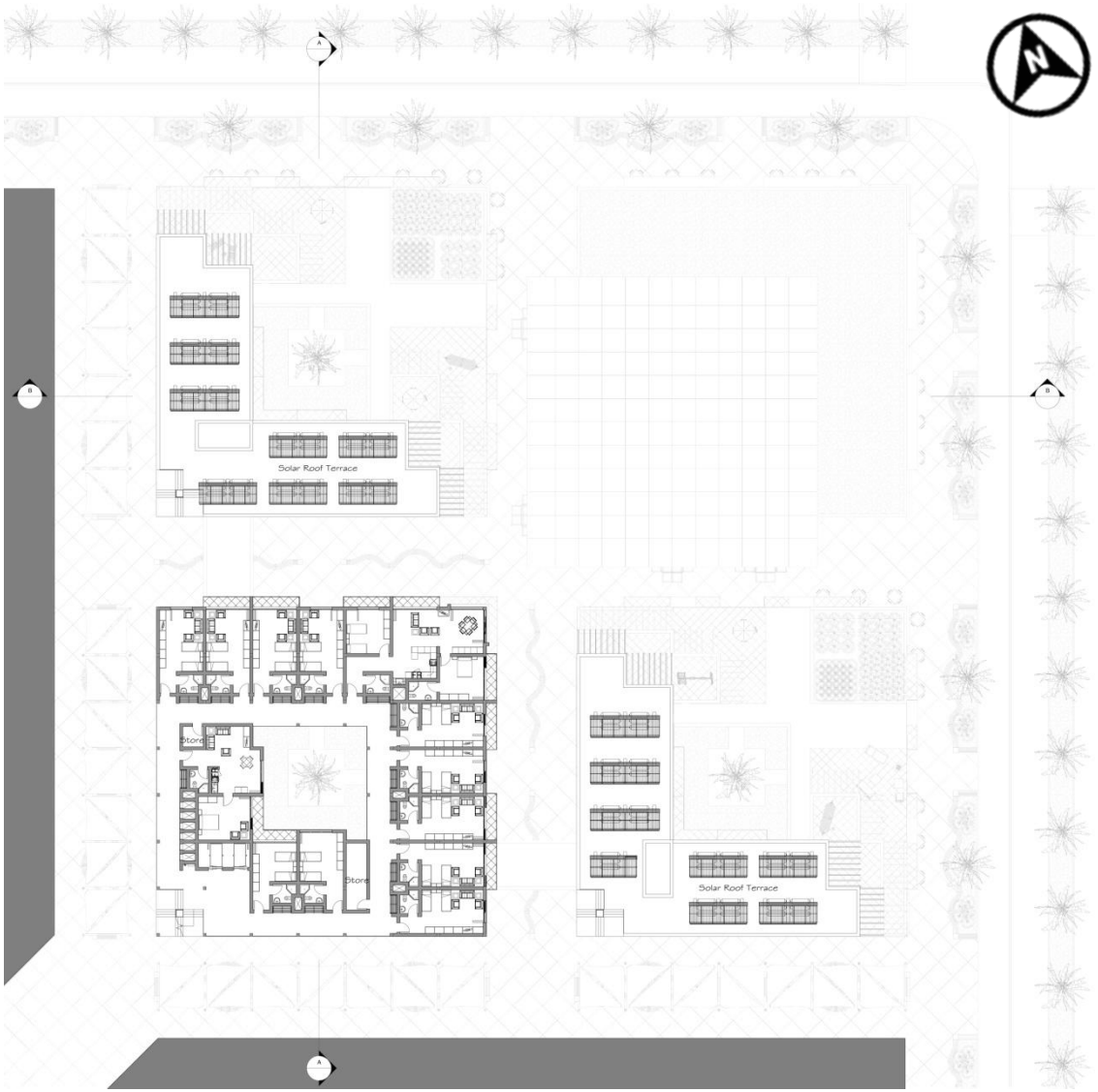



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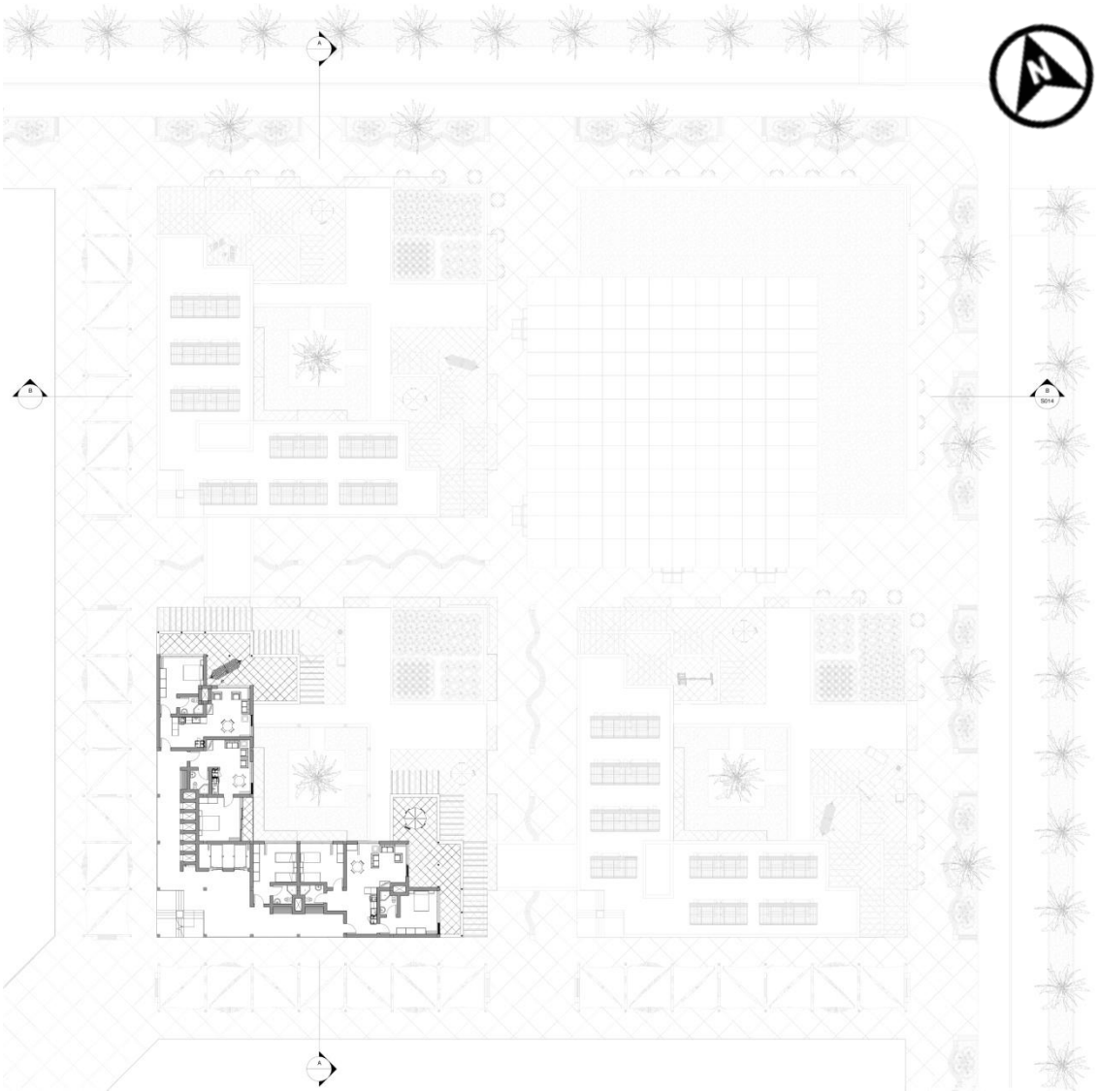



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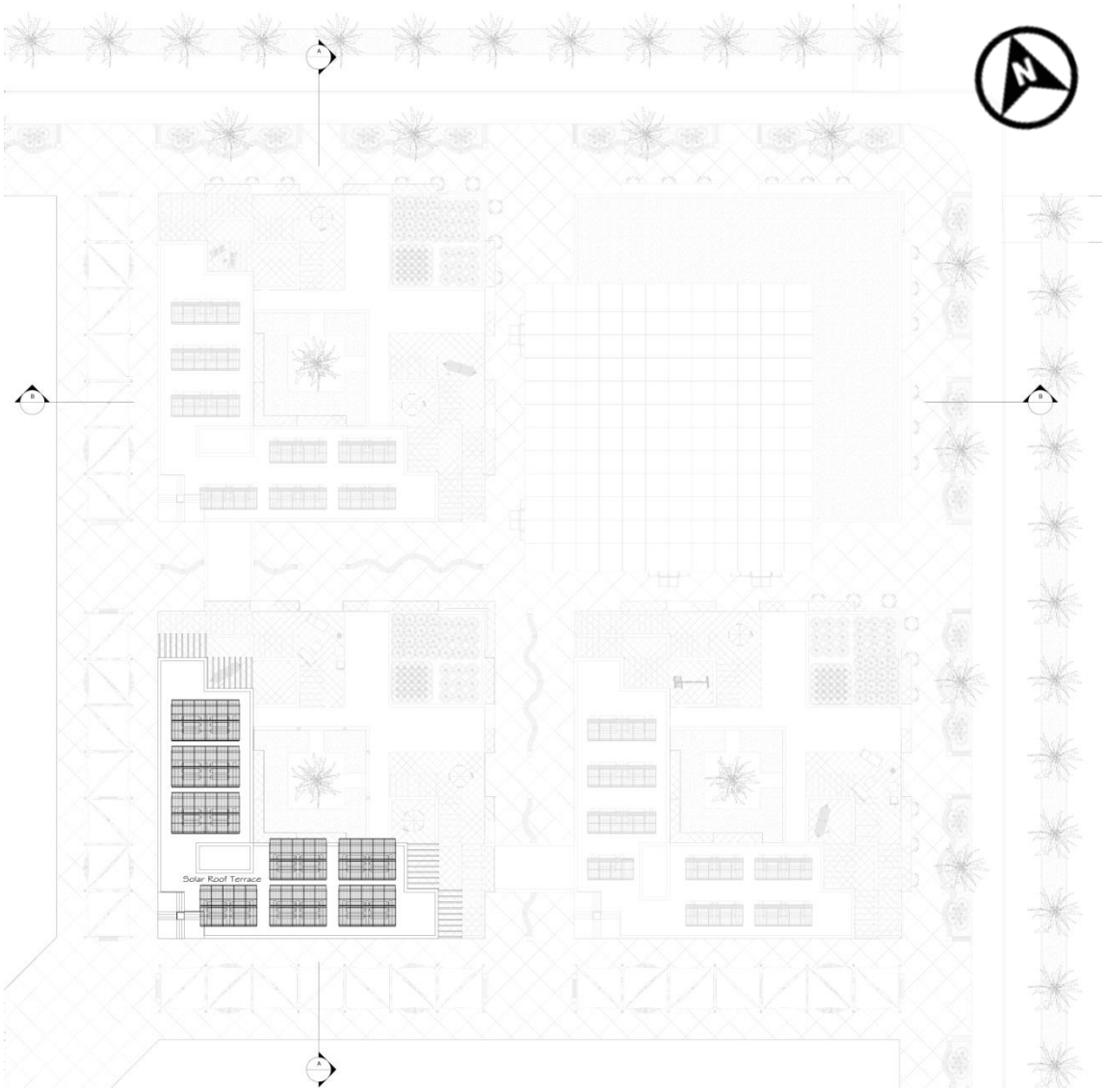

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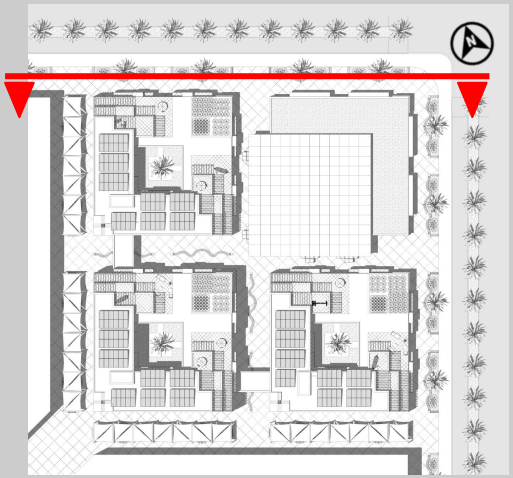



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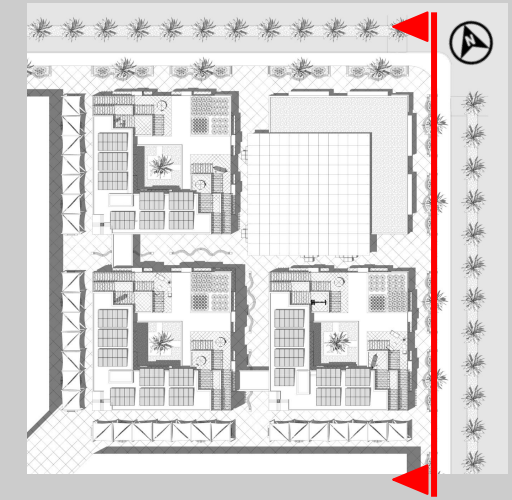



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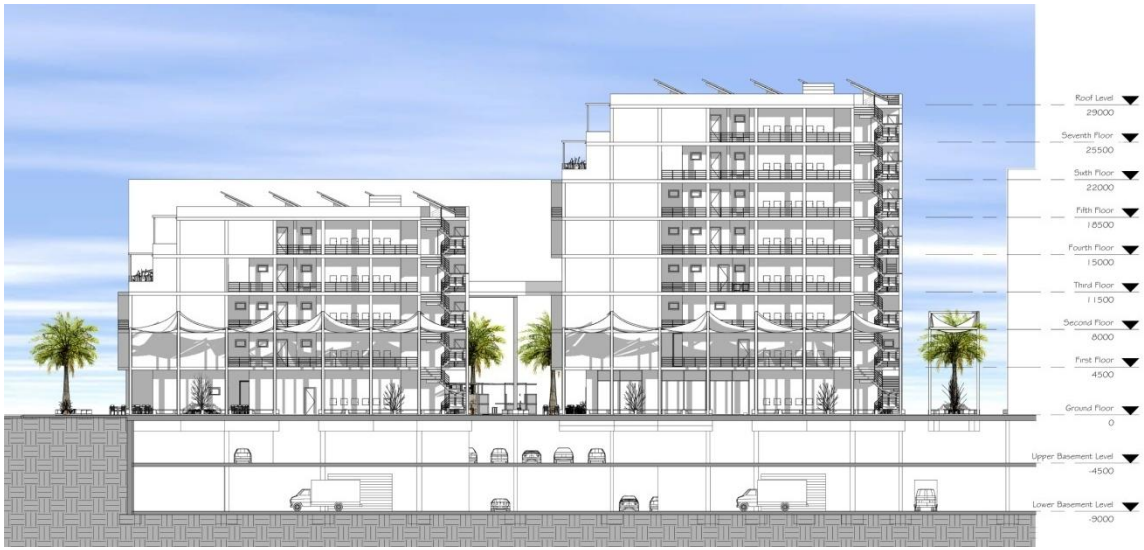

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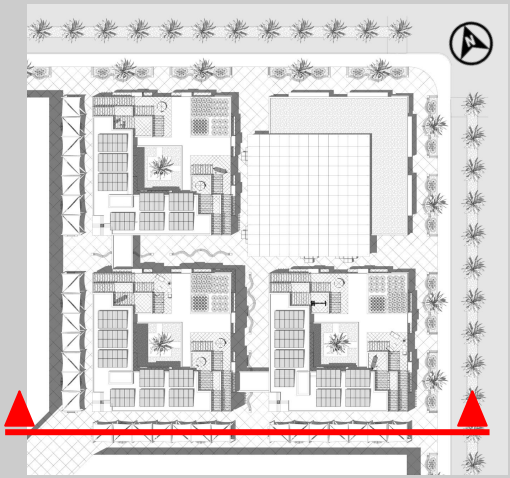

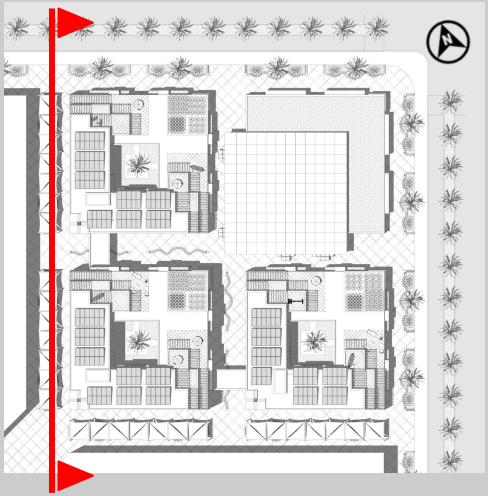

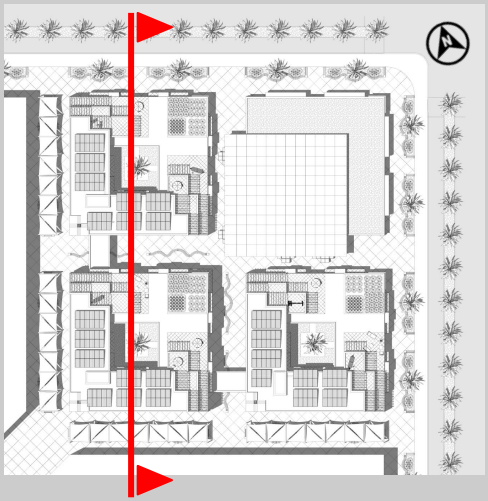



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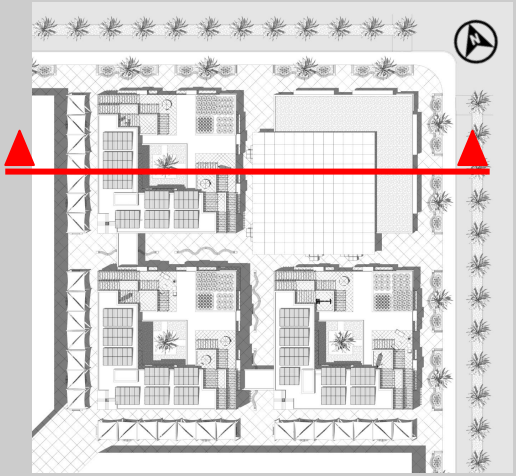



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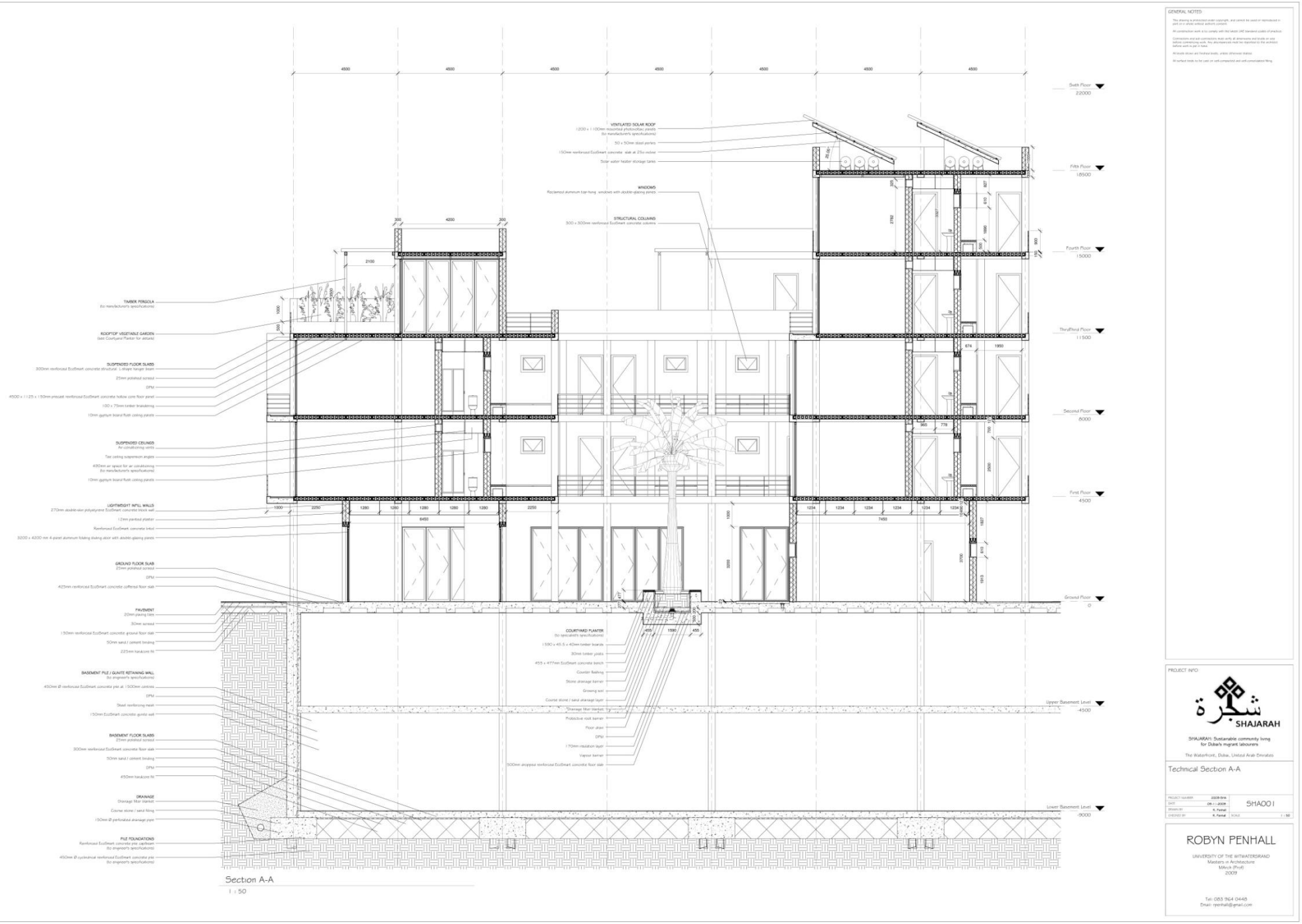

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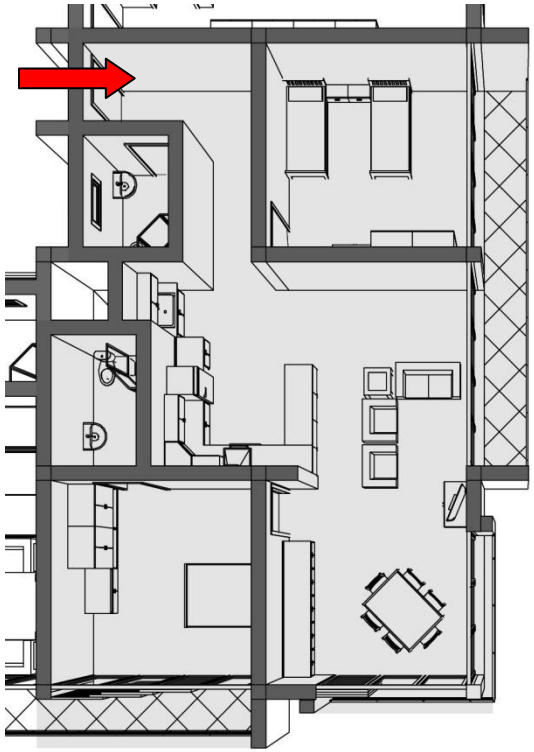
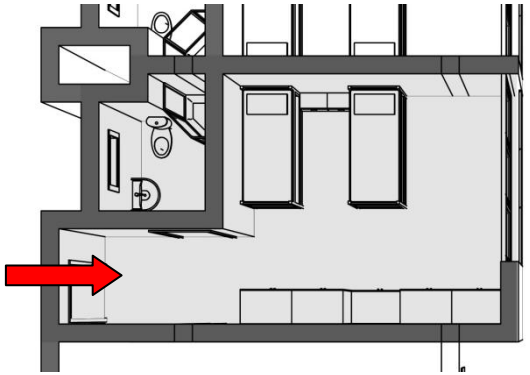
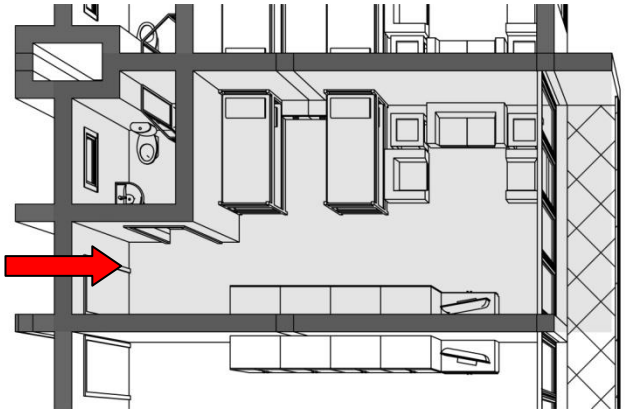


TWO-BEDROOM APARTMENT
Living/Eating/Kitchen Area
Main Bedroom with En-Suite Bathroom
Second Bedroom
Second Bathroom

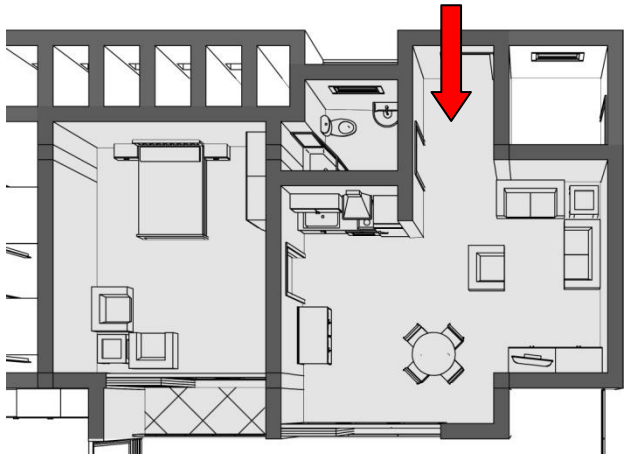
DORMITORY ROOM
Bedroom
Bathroom



DORMITORY STUDIO
Bedroom/Living Area
Bathroom



ONE-BEDROOM APARTMENT
Living/Eating/Kitchen Area
Bedroom
Bathroom



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Conclusions and Recommendations

Although migrant labour contracts are usually only for a few years, SHAJARAH is envisaged as a long-term development with constantly changing occupants, accommodating the present and future working classes that will sustain Dubai's growing economy.



Exploitation of a city's poor working class for financial gain is a recurring result of rapidly expanding economies, despite the routine infringement of basic human rights. Dubai is no different. Although with past examples such as the 19th century Industrial Revolution in Europe and America, it is inexcusable that a 21st century city should be experiencing the same unjust labour practices as two-hundred years ago. Due to the immense development happening in Dubai, migrant labourers from Southeast Asia form the vast majority of the city's blue-collar workforce, hoping to benefit from Dubai's economic boom. However, because these poor migrant workers are seen as short-term labour to grow the city – their insignificant social status tolerated for the sake of the progress – their needs (especially with regard to housing) are largely ignored in favour of greater financial profits. They are forced to live in overcrowded and unsanitary squalor due not only to their desperate and helpless financial situations, but also due to lack of corporate conscience and government support.

However, this egocentric attitude of the Dubai government and companies in the UAE towards blue-collar migrant labour is having an unanticipated effect of Dubai's image as the rising 'Mecca' of trade and tourism in the Middle East. With more than 80% of the city's population (over a million people) living in appalling poverty, the situation cannot be ignored for much longer.

As the majority of developments in Dubai are aimed at Dubai's wealthy residents, there is very little option for lower income groups in terms of affordable, quality accommodation. Although migrant labour contracts are usually only for a few years, SHAJARAH is envisaged as a long-term mixed-income development with constantly changing occupants, accommodating the present and future working classes that will sustain Dubai's growing economy. Sustainable principles have been incorporated into its design where appropriate to not only protect the surrounding natural environment, but also to preserve the long-term economic feasibility of the project and foster improved social integration. These have been considered in a more holistic approach at four scales: the urban precinct, the building, the individual unit, and the element/material (such as ventilated solar roofs, or sustainable lightweight concrete).

The urban framework for the 114-hectare project sets up flexible design guidelines for development within SHAJARAH, allowing each architect the freedom to experiment but still maintaining a collective and cohesive unity of the project as a whole. Public facilities like the mosque, sports fields and recreation centre are located centrally in SHAJARAH for easy accessibility of all residents. As each building also contains its own recreational facilities for building occupants such as games rooms, internet and laundry facilities, the recreation centre is intended to be converted into a school complex in the future, once more long-term residents and families begin to occupy SHAJARAH. Facilities such as the clinic and outdoor amphitheatre are intended to support the surrounding developments in addition to SHAJARAH residents, drawing the public into the development for improved social interaction. Necessary functions such as supermarkets, post office, banks, travel agencies, internet cafes and restaurants are also located throughout SHAJARAH to provide residents with what the need within a 700m walking distance.

Bulk angle setbacks from the street as well as mixed-use ground floor requirements ensure the pedestrian realm supports a humanised scale and pedestrian-orientated commercial environment. Wide pavements, cycle paths and single vehicular lanes throughout SHAJARAH encourage cheaper and more sustainable transport alternatives, set in tree-lined streets and shaded green parks. Greywater and sewage treatment at the site's Combined Waste and Sewage Treatment Plant to supply SHAJARAH's landscape irrigation needs. Further sustainable living principles are encouraged through the inclusion of bicycle storage and change rooms, as well as recycling chutes in each building.

Environmentally, SHAJARAH takes valuable lessons from both traditional Arabic architecture as well as contemporary architectural technology to effectively minimise the impact of the harsh desert sun and moderate the climate through passive design principles. The cooling effect of traditional courtyard architecture has been incorporated into the design of the building to benefit from the cool sea breezes. Simple shading devices such as louvers screens on the east facade allow the spaces to be climatically controlled by the users for personal



comfort. Large openable north and east facades also allow maximum light and natural ventilation during the cooler months, as well as spectacular views over SHAJARAH.

SHAJARAH does not aim to simply provide adequate housing; it aims to provide a better quality of life and foster a sense of community belonging, all of which are severely lacking for Dubai's current blue-collar migrant labourers. How can one be expected to live in a country that exploits one's financial vulnerabilities and shuns one's social existence, yet still expects sustained commitment and dedication? The short-term presence of migrant workers should not determine the degree of acceptance into society. These blue-collar migrant workers are as much responsible for Dubai's success as the wealthy executives that control it, and they deserve the same right to quality of life as their wealthier expatriate counterparts. The permanence of SHAJARAH as a long-term housing solution for Dubai's working class means that despite the length of contracts, migrant workers can begin to feel like they are part of a greater social community, making the transition away from their comfort zones and support systems less traumatic.

By incorporating mixed-income into the project, SHAJARAH can appeal to a wide sector of the population that has previously been neglected. Not only migrant labourers, but also students and young families that do not have the financial capabilities to afford the luxury townhouses and apartments, will find a range of accommodation options to suit their needs, lifestyles and budgets. The flexibility of the units means that each unit has the potential to accommodate a range of occupants: from a group of workers living in dormitory-style accommodation, to young couples co-operating to share expenses, or young families looking for safe and affordable accommodation. Units without kitchens have the opportunity of using the dining halls in each building, or alternatively the numerous restaurants and cafes throughout the project. In this way, flexibility of living options is provided on a number of different levels.

It is only through social integration that Dubai's migrant labourers can become a beneficial addition to society, and not a shunned majority. The location of SHAJARAH in Dubai's prestigious Waterfront development is intended to showcase mixed-income living, which will

hopefully infiltrate into the surrounding developments. It is recommended that developments like SHAJARAH be adaptable to a variety of occupants to support long-term change, lifestyle choices and cultural differences. Like it or not, Dubai has grown considerably over the past few decades, and the only way to sustain the economic wealth is to accommodate an extensive working class to maintain it. Dubai prides itself on being a cosmopolitan city, boasting more than 200 nationalities. Never before have so many different cultures simultaneously interacted with each other than in today's technologically advanced and geographically limitless world, and Dubai is an extreme case By providing a permanent yet adaptable platform like SHAJARAH for all those diverse cultures to successfully live together in an environmentally, economically and socially sustainable way, Dubai can truly be the global city it aspires to be.



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