Domestic Window Design and Interior Daylight in Jeddah: Designing for Saudi Women

A thesis submitted for the fulfilment of the requirements of University

of Hertfordshire in the School of Creative Arts for the degree of

Doctor of Philosophy

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Copyright Statement

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Dedication

To my beloved parents Yousra Alsirhani and Eng. Mohammed Shatwan

To my beloved sisters Dr.Israa, Maithaa, Shimaa and Maha and my brother Ali

God bless their souls

To my uncle Dr. Nasir Shatwan. “God forgive him”

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Abstract

Architecture in Jeddah city in the western region of the Kingdom of Saudi Arabia (KSA) has gradually undergone a significant shift in style, a consequence of the implementation of contemporary Western architecture after the oil boom in the country in 1970. Contemporary buildings with letterbox windows have become popular in the area, replacing the traditional appearance of local buildings characterised by the Roshan (a type of window used in vernacular Jeddah architecture), and many of the characteristics of contemporary architecture do not seem to fit the local context. As a consequence, the needs of modern Muslim women have been disregarded in favour of a new aesthetic, in the course of implementing recent changes in technology and architecture. Research on the current trajectory which architecture has recently taken in the country is needed to explore these consequences. In particular, this study focuses on window design, considering openings as pivotal element between daylight control and cultural religious and personal aspects of today's Saudi women. The aim of this study is to examine daylight and window design to better accommodate women's needs in flats in Jeddah built from 1970 to 2016. The window is analysed in this study as a pivotal element of the transition between vernacular and contemporary architecture in Jeddah, with implications for the interior quality of space in blocks of flats, including wellbeing and daylight conditions and functional and symbolic values.

The first part of my data collection is dedicated to survey photography and floor plan drawings for blocks of flats in Jeddah. Then, primary data are generated through interviews with women to understand their perceptions in relation to window design

and daylight in their living room spaces. The third dataset is based on daylight calculation, which involved computer modelling applied to interviewees' flats in Jeddah. These phases have unearthed a clear discrepancy between the design principles employed by the decision makers, and the wishes of the female population, who actually use the residential spaces for the majority of time. Whilst the former consider the amount of daylight which is sufficient, the latter perceive their homes to be dark and unhealthy. The fourth part of this study comprises interviews with architecture professionals (professors of architecture, municipality officer and architects) to determine where this discrepancy originates, and to what extent a reconsideration of design tenets or guidelines can help to resolve the issue.

The study concludes with an examination of the reasons behind the current issues of inadequate daylight and privacy for Saudi women. It revealed daylight was less than 100 lux in most participants' flats. The levels ranged between 50 lux and 70 lux, which does not meet the target for the Saudi climate. This has a negative effect on women's wellbeing and satisfaction. It also reveals that women's needs in home design are not a major consideration for architects. Also, it shows that the absence of detailed building regulations regarding window design and daylight levels is the major reason for this issue. The results show that there is a significant difference between the answers from women and the answers from professionals in terms of the small gap between buildings and daylight levels ($P=0.005$). Also, the results show that there is a statistical difference between women's and professionals' responses about whether daylight levels or measurements are considered when designing living room windows ($P=0.019$).

In conclusion, this study proposes a set of guidelines to policy makers that building regulations should be updated to consider the findings of this study in order to provide better new regulations that consider women's needs in the design of flat windows.

Key Words

Daylight, Window design, Vernacular architecture, Contemporary flats, Saudi women, Privacy.

Chapter 1

Chapter 1 Introduction to the Study

1.1 Introduction

In a sunny region people are expected to have plenty of opportunity for exposure to sunlight and daylight. However, this is not always the case in reality (Mishal, 2001, Unger et al., 2010). Reasons can vary from one area to another. In Muslim countries, the fact that women are expected to wear *hijab* means they have to wear two layers of clothes. This means that, even if they are exposed to sunlight outside buildings, they cannot derive high benefit from sunlight as *hijab* blocks it from reaching their bodies (Mishal, 2001, Naeem, 2010). According to Alzaheb and Al-Amer (2017) females participate in fewer outdoor activities than men, which results in less exposure to sunlight than men enjoy.

The analysis of design methods, processes and guides in Saudi Arabia suggests a 'male-biased' approach in the design methodology which may justify the modal logic behind the research problem and the inductive reasoning as to why this research was conceived in the first place. The lower number of outdoor activities engaged in by women when compared to men is a result of poor outdoor facilities designed by municipalities in most districts. Urban planning in Jeddah districts focuses on homes, retail, shopping malls and mosques. Outdoor activities such as small gardens between districts are not common, which means that most activities take place inside buildings (Qurnfulah, 2015). In a Muslim society such as Saudi Arabia, most women's activities take place inside buildings especially their homes. Therefore, in such a culture, home is the only place for women to be exposed to both direct and indirect daylight (Alawad, 2017).

The phenomenon of vitamin D deficiency has received a lot of attention in the field of medicine where authors have found a high level of vitamin D deficiency among Saudi citizens of different ages; however, the highest level was found among females, an issue which will be discussed in detail in Chapter 2 (Alfawaz et al., 2014, Alsuwaida et al., 2013, Alzaheb and Al-Amer, 2017, Al-Zoughool et al., 2015, Tuffaha et al., 2015). According to Alzaheb and Al-Amer (2017), females with few outdoor activities in Saudi Arabia suffer from a high level of vitamin D deficiency. Siddiqui and Kamfar (2007) have suggested that architecture planning for low income homes could be a reason for vitamin D deficiency among females in Jeddah.

As a result of the culture's accepted lifestyle, home is considered to be the only suitable place for women to expose themselves to daylight. Therefore, this work studies the relationship between window design, daylight levels in contemporary flats in Jeddah and their effect on women's daily lives. The aim of this study is to focus on how a lack of daylight and privacy through windows affects Saudi women at home; this requires an in-depth study of the reasons for current window and home designs.

This study will investigate gender issues that are peculiar to Saudi culture and how they affect the lives of housewives and female employees who spend all or some of the daytime in their flats. Mixed methods are used to analyse factors in Saudi society that prevent women from much-needed exposure to daylight. Additionally, how these women perceive their daily experiences is considered. Qualitative and quantitative methods are undertaken through in-depth interviews and daylight simulation is used to investigate the daily issues these women encounter while living in contemporary flats. My research specifically explores window design as an element that causes a lack of daylight. It investigates cultural changes and their effect on home design generally, and window design specifically, and how this affects daylight levels in flats.

The fundamental purpose for undertaking this study originates in my professional experience: firstly, as an interior designer working on the interiors of homes for Saudi women since 2010; and secondly, as a lecturer in the area of interior design at King Abdul-Aziz University (girls college) and a member of the Saudi Council of Engineers. As a lecturer, I have noticed that there is little attention paid in the literature on architecture or interior design to Saudi women suffering from lack of daylight. In spite of the fact that there are several studies focusing on daylight issues in Western or Eastern literature, these theoretical concepts and methodologies are not explored within the context of Saudi Arabia's religious, social and cultural background. Studies suggest that occupants' health and performance in interior spaces is affected by the amount of daylight in the building (Alzoubi and Al-Zoubi, 2010, Borisuit et al., 2014, Kim and Kim, 2010). My preliminary thoughts were supported by the argument that daylight is needed in homes to meet users' psychological and physical needs in addition to energy saving. However, little attention has been given to the relationship between daylight and Saudi women in contemporary homes. Similarly, little attention has been given to window design or daylight levels in residential building regulations in Jeddah, thus supporting my argument.

This study also aims to provide architects and professionals in the field of architecture with a clearer insight into the lives of Saudi women who suffer from lack of daylight inside their homes. I believe that I can provide a vital perspective through this study as a Saudi woman who understands the social dynamics of living in Saudi culture which has adopted certain modern qualities of a Western lifestyle. For practical reasons, my study specifically focuses on Saudi women suffering from lack of daylight in living rooms more than any other rooms in flats since it is the most used room during daytime as will be discussed in chapter 5. Jeddah is well-known in the Kingdom of Saudi Arabia for having a large number of rental flats in comparison to other Saudi cities where houses are dominant as will be discussed later in Chapters 4 and 5.

In addition to the in-depth interviews with professionals, regarding flat and window design, and women about their experiences of daylight in living spaces, I found that there was a significant need to explore the various issues concerning the impact of lack of daylight on women's lives. The more information female participants revealed, the more responsible I felt to convey their situation to the municipality as the regulatory body responsible for home design and controlling architecture. I realised that the municipality seemed to be unaware of the impact of lack of daylight on Saudi women and their families, especially babies, and there is little attention given to this area in the building regulations. Since this lack of awareness or ignorance is the major reason for the current situation, I decided to use my research to raise national awareness about the lack of daylight for Saudi women. By highlighting awareness of this issue, I also aim to influence building regulations to address the various needs of these women.

1.2 Research background

Daylight is a central architectural element in the current research because the alternative to daylight is the reliance on artificial lighting which can cause a significant increase in energy consumption and contribute to the problem of global warming. It has been found that intensive heat entering houses from contemporary building design in Saudi Arabia leads people to consume energy through air-conditioning systems (Dahlan and Mohamed, 2010, Taleb and Sharples, 2011). The proportion of windows to different interior surfaces, such as the wall or floor, was examined to find the best geometrical ratio between windows and interior area such as window to floor area ratio or window to interior walls ratio (Alshaibani, 2000). Other studies have examined the relationship between shading devices and daylight levels in interior space (Sherif et al., 2010, Sherif et al., 2012a, Sherif et al., 2012b). Limited attention has been given to women's needs and satisfaction in terms of daylight in Jeddah architecture, where cultural value remain a significant factor affecting various elements such as door location and room division. Therefore, this research fills this gap by investigating window design in contemporary flats in Jeddah in relation to interior daylight levels. It evaluates women's perceptions of the current daylight levels in living rooms, and window design in relation to the local cultural need for privacy.

1.3 Statement of the research problem

The application of Western design ideas in Saudi Arabia has been criticised by Arabian architects as leading to a loss of local identity in the built environment (Al-Jawahrah, 2002). Roshan, which is a type of window that provides daylight, ventilation and privacy, while at the same time it provides shading from direct sun and general climatic modification, a set of important design considerations in the traditional architecture of Jeddah. The diminished use of Roshan is associated with changes in meaning and utility (Adas, 2013). This study determines the relationship between glass window designs and daylight levels in contemporary residential flats in Jeddah and examine how window designs and daylight levels in living rooms affect women negatively.

1.4 Research aim

By examining window design in contemporary flats in Jeddah, the aim of this study is to understand the extent to which the window acts as an interface between inside and outside to provide adequate daylight for women in living spaces. The study focuses on daylight levels in the living rooms of contemporary flats in Jeddah from the perspective of Saudi female users in relation to the concerns of privacy. Saudi female users are selected in this study as they are the primary users of homes, who are affected by social requirements to be responsible for home duties. The study also aims to investigate this issue from decision makers' perspectives. It aims to investigate the problem in depth in order to provide policymakers with an insight into the discrepancy between female users' perceptions and designers' perspective regarding the situation.

1.5 Objectives

1. To assess the factors that have led to changes in window designs from vernacular to contemporary residential architecture in Jeddah.

2. To analyse the architectural characteristics of windows and their control of daylight in contemporary residential buildings in Jeddah city.

3. To assess the factors that affect window designs suitable for women in Jeddah city.

1.6 Research question

How are women's perceptions of daylight in living space (Salah) affected by window design in contemporary flats in Jeddah?

1.6.1 Sub-questions

- What factors have led to current window designs in Jeddah?
- How has daylight exposure for Saudi women been impacted by changing patterns of cultural behaviour and building design?
- How do architectural work and building regulations affect window design in contemporary flats in Jeddah?
- Which window designs and arrangements are most suitable for women in Jeddah city?
- How is daylight scientifically measured and assessed?

These research questions constitute the first stage in building the research framework. Therefore, the research concentrates on investigating the meaning, importance and interpretation of daylight in the lives of Saudi females. As mentioned earlier, the importance of female social duties influenced me to investigate this subject from a female perspective.

1.7 Structure of the thesis

This research studies the relationship between window design and daylight levels in contemporary flats in Jeddah and their effect on women. The aim of this study is to focus on how lack of daylight, window designs and cultural need for privacy affects Saudi women at home, which also require an in-depth study of the reasons for current window and home designs.

Chapter 2 provides a literature review that is divided into four parts to cover all areas of this study. Part one provides a general discussion about the rules of Islam and women's lifestyles in the context of the culture and religion in Saudi Arabia. The second part explores culture, especially privacy, as a major design element that affects architecture generally, followed by a section focusing on Saudi culture. The third part examines vernacular architecture in different regions of Saudi Arabia then focusing on Jeddah city. The fourth part discusses the reasons behind the movement from vernacular to contemporary Saudi architecture, and its disadvantages. This chapter concludes, firstly, that women's lifestyles do not allow them to be exposed to daylight anywhere outside a building, and, due to the number of unemployed women, home is the only place available to them for daylight exposure. Secondly, culture and climate are major factors that control home design in both vernacular and contemporary architecture; however, providing privacy through contemporary apartment windows leads to poor daylight in interior spaces.

Chapter 3 provides a literature review that considers a range of local and international scientific studies, providing a wide range of case studies on daylight and windows, explored through the whole range of literature on the subject. Secondly, this section discusses the relationship between daylight and wellbeing in Saudi Arabia and in different regions of the world. This chapter concludes that Western and Eastern studies on daylight in contemporary buildings offer different solutions; however, these suggested designs to tackle the problem do not take into account cultural needs in Saudi Arabia. Little attention has been given to this subject in Saudi Arabia where privacy is mandatory and a fundamental factor. Finally, this research considers the fact that poor exposure to daylight affects occupants' psychological and physical wellbeing negatively, and this can also lead to major illness due to vitamin D deficiency.

Chapter 4 discusses the research methods used in this study. These methods are used to explore the relationship between window design, daylight and Saudi women in contemporary flats through four hypotheses:

- That glass windows in contemporary flats do not provide enough privacy and sufficient daylight
- That women are not satisfied with window design and daylight levels in their living rooms

- That window design and daylight measurements are not considered in building regulations
- That architects do not simultaneously consider both privacy and providing adequate daylight when designing windows in contemporary flats

This chapter provides an outline of the mixed methods, which are qualitative and quantitative, used to test these hypotheses and answer the research questions. The first qualitative methods used to explore home design in Jeddah from the vernacular to the contemporary use case studies for three buildings from different periods. The second qualitative method used to investigate women's perceptions regarding daylight and window design in their living rooms is carried out through in-depth interviews. The third part, which is quantitative, measures daylight in female participants' living rooms using a daylight simulation program. The last qualitative method discusses the discrepancy between users' and designers' points of view, considering the phenomenon through in-depth interviews with professionals in the area. Finally, ethical approval, hidden stories and issues relating to the pilot trip due to culture, safety and climate in Saudi Arabia are discussed in detail in this chapter, which influenced the data collection for each chapter as will be explained.

Chapter 5 involves case studies of residential design in Jeddah city. How flats are designed and the stages of home design, to reach the current situation from vernacular architecture in 1932 to contemporary architecture in 2016, will be discussed in detail. The results of this case study provide a clear framework on flat design generally and window design specifically in Jeddah. This chapter concludes that the notion of privacy has changed in the shift from vernacular to contemporary homes.

Chapter 6 investigates the situation from female users' points of view by interviewing Saudi women. It examines their perceptions regarding daylight levels in the living rooms of contemporary flats in Jeddah. In-depth interviews with women show how their needs and voices are not considered by policy makers in terms of daylight and flat design. It concludes that women are not satisfied with window designs in their living rooms as they do not provide adequate daylight or because particular designs affects their privacy. As a result of these findings, an investigation is highly recommended to understand why women's right to daylight is not considered by architects and municipality rules.

Chapter 7 assesses daylight lux levels during daytime, which was considered crucial for this investigation. This helps to provide a clear understanding of the accurate amount of daylight entering the living rooms of the interviewed females during different hours of the day. Also, this chapter provides a clear description of window characteristics in flats in Jeddah. This chapter concludes that daylight is not adequate in most female participants' living rooms except in some cases.

Chapter 8 investigates the phenomenon of poor daylight levels through glass windows from different professionals' perspectives. It also compares users' and professionals' perceptions regarding this issue. This chapter concludes that there is a major discrepancy between the opinions of space users and decision makers, especially architects. It shows that freedom or absence of detailed building regulations allows architects to consider landlords' requests instead of inhabitants' needs for daylight and privacy.

Chapter 9 provides a final conclusion to the thesis. This chapter concludes that there are three major issues that lead to the current issue of poor daylight and lack of privacy in contemporary flats. They are landlords' commercial approach, discrepancy between users and decision makers, and missing codes in building regulation mainly concerning small gaps between buildings. Finally the thesis will analyse and rigorously examine the conclusions highlighting areas of conceptual, methodological and interpretative agreement and disagreement with other research studies. It discusses the strengths and weaknesses of the study, research limitations and recommendations to be taken into consideration for further study.

1.8 Conclusion

Contemporary residential architecture in Saudi Arabia has impacted on window design and, as a result, this has had an impact on daylight levels in interior spaces. The need for daylight at home is significant especially for Saudi women. Exposure to daylight is essential for human psychological and physical wellbeing. If city urban planning does not provide any place for women to derive benefit from daylight and privacy, home should be a place which fulfils inhabitants' need for daylight.

This chapter has discussed the reason for undertaking this research since, to my knowledge, little previous researches have been done in this area before. It shows a gap in knowledge regarding daylight and window design in contemporary Saudi architecture, especially in Jeddah. It also demonstrates that little attention has been given to this area from users' perceptions, especially females, even though they are the major users of living rooms in the morning as unemployment among women is common in the country. This chapter demonstrates the importance of undertaking this research. It analyses how the research questions, objectives and aims have guided the thesis.

Chapter 2

Chapter 2 Literature Review

2.1 Introduction

The purpose of this chapter is to provide an extensive review of the literature discussing the research topic from different perspectives. The perspectives are local religion and culture in Saudi Arabia and how they affect or guide women's lives. It will also discuss the relation between architecture and culture, and especially privacy in international context. It also discusses the architectural considerations related to religion and culture in vernacular or contemporary Saudi architecture will be explored, mostly focusing on window design and daylight.

2.2 Part 1: Saudi family structure

2.2.1 Islamic religious rules

Islam is the Saudi religion. It began in Mecca and Medina with the Prophet Mohammed. Islam guides people's lives in Saudi Arabia. It guides people in their culture, economics, politics and all other day-to-day activities. Islamic rules are taken from Islamic *sharia.* Islamic *sharia* is framed by the Quran and the *sunnah*. The Quran is the Islamic holy book which contains God's words, and the *sunnah* are the prophet's speeches. The Quran and the *sunnah* are fundamental in guiding people's behaviour and relationship with God; it is central to the identity of Saudis (Abd Al-Ati, 1977, p.13). In comparison to other Muslim countries Saudi Arabia applies Islam in most of its activities as part of the culture (Jawad, 1998, p.29). As a result, when discussing Saudi culture, traditions or women's lifestyles, Islamic rules have to be taken into consideration.

2.2.2 Male guardian authority

Family is an important part of the Islamic religion. The religion determines duties between family members as the family is a major institution within society (Yamani and Allen, 1996, p.268, MOEP, 2006, p.301). Islam guides the social and economic demands of family members. For instance, it teaches that men have a duty to provide for female members of the family and meet their financial needs. Family members are also required to be loyal to each other (Abd Al-Ati, 1977, p.34). The effect of male financial duties on women's perceptions regarding home design will be discussed later in Chapter 5 from the point of view of women. Saudi family is structured according to age and gender; however, some cultural and tribal rules are different within the context of the religion according to different tribes. The oldest male in a family has authority over all the women within his family and over boys under a certain age (Yamani and Allen, 1996, p.82). The male guardian is the father if he is alive and his authority transfers to the husband for married women. It can transfer to a brother or son if the father or husband is dead. If none of these men is alive, this authority can be taken on by any other male in the family such as a grandfather or uncle.

All of these men are considered in Islam to be *mahram*, males in the nuclear or extended family whom the women cannot marry. The male guardian's signature and approval is required in many areas of life such as a woman's marriage, for travel and other necessities (Abukalid, 2004). For instance, if a woman wants to travel without her male guardian, he has to send electronic approval to the government. He will then receive a mobile message from the Saudi airport authorities when any women under his guardianship is travelling (Gayathri, 2012, p.12). This is a major element of family structure required by the government. However, there are many traditions that are practiced in Saudi Arabia which do not derive from religion and are, in some cases, tribal; these, however, are outside the control of the government For instance, many male guardians do not allow girls in their family to marry men from different tribes. Also, in family life decisions, women do not have the right to contribute with their guardian. In some families men's decisions dominate; they do not allow women to work in different cities or work in certain jobs due to segregation or they want their wives to stay at home as housewives only (Abukalid, 2004). This means that growth in women's jobs is very slow as men dominate the area (Syed et al., 2013).

2.2.3 Gender segregation in Islam

Mahram authority does not end with certain governmental rules. It also guides daily social activity. In Islam, a woman should not socialise with non-*mahram* men in order to avoid impropriety. In Saudi Arabia most families consider mixing between genders to be wrong and not in accordance with Islamic rules. They also consider mixing between genders in a work environment not to be acceptable according to the religion since gender segregation is governed by Saudi law, as it is in public social life (AlMunajjed, 1997, p.33).

2.2.4 Family structure in Saudi Arabia

Family structure differs according to cultures. In Saudi Arabia *alusrah* is the nuclear family or immediate family. A woman's marital status is strongly connected to her immediate family. For instance, a single girl lives with her family which may include her parents, sisters and brothers. In some cases a single girl can live with siblings. A married woman lives with her husband and children. A divorced or widowed woman lives in her parents' home or lives with her siblings. According to Abd Al-Ati (1977, p.20), the emphasis is not placed on the organisational form of the family, but rather the 'mutual expectations of the membership'. Extended families no longer live in one home as they used to do in the past (MOEP, 2005, p.315). According to the culture and religion, nuclear families in one extended family have to support each other economically when necessary, and this is still the case today. However, due to the day to day obligations for nuclear families, some people cannot provide this support to extended family members in contemporary life (MOEP, 2005, p.302). However, relationships within extended families still play a major role in Saudi life (Al Faruqi, 1988, p.41).

Home design is highly affected by this strong relationship between extended and nuclear families members as shown in Table 2-1 and Table 2-2. This will be shown in the section on vernacular homes in Chapter 4 and contemporary homes in Chapter 5 where, although some nuclear families live in separate flats, these separate flats are in one building and each nuclear family in an extended family lives in a separate flat in one building to maintain the strong familial relationship. This also works for a father when supporting his young married sons who are still in a non-stable financial situation and who are unable to rent or own a home. As mentioned before, it is the man's duty to provide his family with a home. Therefore, the father allows only his married sons to live in separate flats in his buildings, while his married daughters move to their husbands' homes.

Table 2-1 Nuclear family members

Nuclear Family structure "*Alusrea*"		
Single girl	Married woman	Divorced or widowed
• Parents • Siblings	• Husband • Offspring	• Parents • Sibling • Offspring

Table 2-2 Extended family members

Extended family structure	
• Grandfather • Father • Brothers • Uncles • Cousins	• Grandmothers • Mother • Sisters • Aunts • Nieces

• Nephews • Grandsons *All males in this group are considered *mahram* except for cousins.	• Granddaughters

2.2.5 Women's education and jobs

In 1960, the first girls' school opened in Jeddah. According to Yamani and Allen (1996, p.269) the aim of allowing girls to study was not to help them to find a job outside their homes later on. The major aim was to make "*better mothers and homemakers*". Twenty years later, the country underwent huge developments in women's rights as it began to allow women to continue into higher education. However, women's colleges and universities do not provide all majors for women as they do for men (Doumato, 1992, p.35). The choices were limited to the fields of teaching and medicine (Doumato, 2000, p.22). This has now been developed dramatically as there are a lot of majors for women such as architecture, interior design and law. Although female education began late in comparison to other countries, Saudi females have a significant enrolment rate in comparison to males in the country. Between the period of 1975 and 2002 the total rate of enrolled girls was 8% while it was only 4.2% for men (MOEP, 2005, p.325).

Since segregation between genders is important in Saudi religion, it is very important in the culture too. Therefore, jobs with gender segregation are preferable for women in Saudi Arabia. These jobs are not just comfortable for the women themselves, they are also acceptable for male guardians. Gender segregation is available in most jobs in the public sector, but it is more common in schools and universities. Therefore, these two areas are preferable for most women. This does not mean that women do not work in other jobs such as medicine and others, but the number of women in other jobs is significantly less than in schools and universities as it is found that gender equality in jobs in Saudi Arabia is very marked (Alselaimi, 2014, p.31). Similarly, Yamani and Allen (1996) compared the number of employed women in Saudi Arabia to 53 different Gulf States and found that Saudi women are most restricted by family members when it comes to going to work. However, Islam does not stop women from working as it gives women the right to launch their own businesses (Naseef, 1999, p.102). In 2003, the percentage of females employed in the entire Saudi labour force was estimated to be only 14% (MOEP, 2005, p.327). Similarly, Al-Yousef (2009) states that the number of unemployed women in Saudi Arabia is four times that of men. He compared this number to other Arab countries, and he found that Saudi Arabia has the highest number of unemployed women. He found that 78.3% of these women are university graduates.

However, as mentioned above, there are some cultural values which have overtaken religion. As a result of this, in Saudi Arabia, many women with a bachelor’s degree do not have jobs (Elamin and Omair, 2010, Moghadam, 2003, Sidani, 2005). In today's Saudi society, guardians still control the jobs of women under their authority.

This makes female education and work a subject for discussion in the country (Fatani, 2008). According to Naseef (1999) a woman's job should not consume a lot of her time and energy, thereby affecting her duties as a housewife and mother when going back home.

2.2.6 Women's duties in Islam

According to Fatani (2008), women's work does not end at work as she has major duties at home such as teaching her children moral education, helping them with their school homework, and fulfilling her husband's needs. Women, whether they are employed or not, have to maintain their families and homes. They are also required to have a good connection with their families and their husbands' families by visiting them from time to time. This creates a strong relationship between extended families and has a major effect on the entire society. This means that women are considered the foundation of the family.

Despite the male guardian's legal religious duty in accepting his female relative's marriage and social customs and duty in accepting his son's marriage, it is the woman's duty, either as a mother or a sister, to find the appropriate girl to become her son's or brother's wife. According to religious segregation, this duty falls entirely on the women (AlMunajjed, 1997, p.78). Female duties are not excluded for married women. A daughter's duties are significant in Islam. A female, either married or not, has to provide her parents with the highest level of respect as is mentioned in the Quran and *the sunnah*. This respect includes taking care of her parents at all ages, which is described as

Bir Alwaldin (Al-Hashimi, 2000, p.141). This section has explored women's lives in Islam. It has discussed how Islam and Saudi culture shapes the lives and duties of Muslim people, especially women, in Saudi Arabia.

2.3 Part 2: Culture, privacy and architecture

This section discusses culture, especially privacy, as a major element affecting architecture, specifically in Saudi Arabia. It also discusses cultural needs in Saudi architecture. Home design must consider culture needs such as space division, materials used for windows and the location of windows to provide privacy between the exterior and interior. To start this section, a definition of architecture and culture will be given. Kent (1993) defines architecture as a concrete social expression of things such as family activities, lifestyle and values. The author goes on to argue that architecture does not enclose cultural activities as architecture should be designed to adapt to culture. Culture can be strongly affected by gender according to different religious or tribal beliefs. For instance, in some religions, there are spaces which are used only by women and men are not allowed to access these spaces. Therefore, the architectural design will not consider men's needs needs as much as it might focus on women's privacy such as in Islam. The author also recognises that culture for certain groups of people or in one country can change over time. Modernisation is one of the factors that changes culture; as a result, it changes architecture (Kent, 1993, pp.10-16).

According to Altman and Chemers (1984) home architecture must consider many factors such as climate, culture and religion. They go on to assert that culture needs more attention when designing homes. Although culture is affected by religion, people from the same religion can have different cultures that shape their lifestyles according to the country they live in (Othman et al., 2015). This is also asserted by Chiu (2004, p.75) who mentions that social and cultural sustainability do not have universal standards. *"The two dimensions diverge where "social wellbeing" and "culture" respectively become the subject of sustainability".* Additionally, Heathcote (2012) considers personal and social needs mandatory in residences. In Saudi studies, sustainability mainly refers to energy consumption as air conditioning consumes a large amount of energy due to the hot weather (Al-Ajlan et al., 2006, Al-Ibrahim and Varnham, 2010, Dincer et al., 2004, Hasnain, 1998, Hasnain et al., 1999)

2.3.1 Privacy

Sissela Bok defines privacy as "*the condition of being protected from unwanted access by others—physical access, personal information or attention*" (Bok, 1989, p.10). Pedersen (1996) and Pedersen (1999) report that privacy is available in different societies and cultures with variations. Since Islam is the religion of all Saudis and it affects most areas of their lives, women are required to have privacy from being seen by men who are not *mahram*. Therefore, there is a significant need to discuss privacy. This section of the literature review investigates the meaning of privacy starting from a general perspective from different fields. Then it focuses specifically on the field of architecture internationally and locally. This will begin with defining the meaning of privacy from previous studies as some researchers have addressed this concept by relating it to individuals and groups (Memarian and Ranjbar-Kermani, 2011, Newell, 1995, Pedersen, 1997). In these studies, the core mechanism for creating privacy is through the provision of individual spaces or zones.

Privacy is a wide conceptual term. It combines different aspects of our daily lives. The concept of privacy has been defined by psychologists. This concept has also been investigated to understand the factors that shape and affect privacy (Margulis, 2003, McVeigh, 1994, Pedersen, 1996, Pedersen, 1999). Margulis (2003) investigated political threats to privacy in the literature. As a result of this investigation, Margulis defines privacy as a person's logical need for privacy for herself or himself and for his or her property. This is in agreement with Vaziritabar (1990) and Altman (1977) who described privacy as the ability to control and protect individually specific properties from others, which is considered to be the pivotal aspect of privacy (Al-Homoud, 2009, Marshall, 1970). Stealing other's privacy in the area of property can a matter for the courts in specific conditions (Margulis, 2003, McWhirter, 1994); yet, personal privacy for an individual himself or herself is not something that can be brought before the courts since this is defined under the psychological need for privacy (Kagehiro, 1990). However, this does not mean that psychological privacy is not respected legally as it has been developed and studied with regard to human rights (Bygrave, 1998).

2.3.2 Privacy in architecture

After discussing privacy from different perspectives, it is necessary to explore this concept in architecture. Hashim and Rahim (2010, p.259) define privacy as 'a two-way process involving the permeability of boundaries between oneself and others'. Another definition for privacy divides privacy into two types. There is public and private privacy. Public privacy is the privacy between inhabitants inside their homes and people outside the home. Private privacy is the privacy between family members (Despres, 1991).

Pedersen (1997) reports that providing privacy in architecture is achieved by opening and closing barriers and considers this to be a major part of architects' and designers' jobs. Others such as Altman (1977) and Edwards (2010) relate the concept of privacy in architecture to human needs, but the specification of these needs varies between cultures.

This individual private space in architecture design is required in most indoor and outdoor areas. For instance, Sundstrom et al. (1982) studied the impact of having or losing individual staff private zones on 17 staff in an office building. They found that the decrease in privacy levels in an open plan office or non-door offices results in a decrease in staff satisfaction and confidentiality at work. This is in agreement with Kim and de Dear (2013) who report that, although open plan offices are considered places that help with staff cooperation and interaction, they result in staff dissatisfaction due to the absence of individual privacy.

In terms of homes, Rybczynski (1987, p.221) describes home to be the place that provides inhabitants with comfort, coziness, wellbeing and privacy. Al-Thahab et al. (2014) mention that the concept of privacy relates to the relationship between private and public spaces within homes. In Gulf regions, Sobh and Belk (2011b), Othman et al. (2015), Sobh and Belk (2011a) confirm the importance of privacy between genders at home in the Arabian Gulf region; therefore, room segregation between men and women in reception zones is mandatory. Losing this type of privacy in the domestic setting can affect users' comfort. According to Hallak (2003), one of the biggest issues that affects the comfort of Syrian immigrants, who are Arab Muslims living in Canada, is the absence of privacy in Montreal residences.

Goffman (1990) discussed the relationship between privacy and human comfort and behaviour either when a person is alone or in public. He found that privacy is not just related to an individual's comfort. It is also connected to the expectations or reactions of others, either space owners, guest visitors at home or visitors in public spaces. As hospitality is a major part of Arab culture, these expectations and comfort in relation to privacy should not create conflict with the social value requiring hospitality (Othman et al., 2015, Sobh and Belk, 2011a).

2.3.3 Privacy within different cultures

The design of a home differs according to different cultural values and life principles. For instance, in the ruling family of Florence, home was considered a private place for women to isolate themselves from the world in the fourteenth to seventeenth centuries. During this period, men used to stay outside the home. Public space was considered private for men (Weddle, 2001). In contrast, in Switzerland, designers expressed privacy by making a space called a communal space, which they considered to be a transitional space between inside and outside, private and non-private

(Lawrence, 1990). This space is similar to a reception zone in Saudi homes. It is an area of the home that a guest can enter directly without having to move through any private zones.

In Turkey, the changes from the Ottoman Empire to a modern lifestyle, which started in the nineteenth century, affected the architectural design of elite homes. This was a result of the end of the Ottoman Empire and the establishment of the Turkish Republic in 1923. Before the nineteenth century, women's zones were located at the back of the home, where women had their living and sleeping areas. This space was called the *harem.* Men from the same family could sit in this space with their families, but only if the only women present were members of the family. The men's zone where they could have their food alone without the women and receive male guests was called the *selamlik.* On the other hand, after the nineteenth century, the concept of gender segregation and class differences in architecture changed. The *selamlik* changed to become the *misafir*, which is a reception zone, which welcomes men and women. The *harem* changed to become a living room for both genders where they could sit or eat meals. These living rooms started to have glass windows to expose men and women to the exterior world (Ozbay, 1999). This is a result of the increased number of non-Muslims who work in jobs that require contact with Western countries such as bankers, artists and people working at other jobs (Eldem, 1997). The thinking of these groups of people could be one of the reasons for the new architectural style that does not require gender segregation to the same extent that it used to be required (Ozbay, 1999).

2.3.4 Privacy and the home in Islam

Islam teaches people to respect others by controlling their vision. People should not look at inhabitants inside their homes through windows (Daneshpour, 2011, Hakim, 1986). Islam also considers home to be a microcosm of Islamic culture and civilization (Omer, 2010). Since architectural design in traditional Muslim homes was guided by Islamic rules, Omer (2010), Mortada (2011) and Othman et al. (2014) have described the three design principles for Muslim homes as privacy, modesty and hospitality. Privacy is achieved by providing a private space for the family from the outside world and providing each member of a family with a private space. Modesty is achieved by designing a space suitable for rituals and activities, which can also express the humility of Muslim style by reflecting an economical home design. Hospitality is achieved by having a zone for receiving guests such as relatives, neighbours and friends as social relationships are a major part of the religion.

These rules require privacy between occupants and people outside homes such as neighbours or pedestrians. For instance, privacy requires certain designs for windows, doors and balconies. Entrance doors must be located in a way that does not allow people to see females when someone opens the entrance door. It also requires a certain level of privacy between genders in room divisions. For instance, brothers and sisters when they become teenagers and older, prefer to sleep in separate rooms and use separate toilets. Privacy is not exclusively concerned with visual privacy; it also includes sound privacy, whereby people should not listen to the speech of others inside their homes or rooms (Memarian and Ranjbar-Kermani, 2011).

2.3.5 Privacy in Saudi architecture

Privacy is the biggest challenge that affects the creation of residential design in the Kingdom of Saudi Arabia (Al-Jamea, 2014). With regard to this, Abu-Gaueh (1995, p.271) states, *"The concept of privacy has become a subject of growing concern for people, architects, urban designers, landscape architects and social scientists involved in development projects in Saudi Arabia".* Comparing Saudi residences to houses in other countries shows that Saudi Arabia has the largest houses (Bahammam, 1998, Taleb and Sharples, 2011). Houses with a greater number of rooms are most preferred by Saudis in Saudi Arabia since they provide privacy and segregation (Rahmaan et al., 1990).

According to Opoku (2015), a home is not just a building where humans live. It should take account of interaction between people, the culture and architecture. This supports the use of Roshan windows, which allowed women to have contact with the exterior, while contemporary windows isolate us from the exterior. AlKodmany (1999) found that women use curtains to cover domestic windows for privacy. This leads to less daylight in interior rooms. This shows a architects lack of understanding of women's special cultural needs in Middle Eastern architecture (AlKodmany, 1999). However, AlKodmany's research was limited to Syrian women only, while Saudi women's demands for privacy are the highest in the world, according to (Al-Jamea, 2014).

Additionally, AlKhateeb et al. (2014), AlKhateeb (2015) argue that privacy and hospitality are mandatory in interior spaces of homes in Saudi Arabia, with divisions according to zones and space functions (AlKhateeb, 2015, Al-Wafi, 2006). AlKhateeb et al. (2014), AlKhateeb (2015) go on to find that interior zoning is affected by genders in each space. For instance, the author mentioned that guests can only access a public zone which is close to the entrance. The public zone is used mainly by men. Therefore, it is isolated with walls and doors from other home zones.

Saleh (1999) argues that contemporary architecture in Saudi Arabia has changed the culture. He finds in the new street and building layouts a reason for the lack of relationships between people in buildings and streets. Children in modern architecture cannot have a secure exterior space around the house, where they can play under their mother's supervision. This is due to the lack of privacy. These issues have led to a new lifestyle in Saudi Arabia. This section focused on the advantages of considering culture in architecture. It has provided a view of cultural ignorance in modern architecture in the country in terms of social interaction, privacy and sustainability. It has explored the concept of privacy and how it affects the creation of homes in different Muslim societies.

2.4 Part 3: Vernacular architecture in Saudi Arabia

2.4.1 Overview of Saudi regions

This section discusses vernacular architecture in the Kingdom of Saudi Arabia in terms of architecture, design, cultural values and climate. Saudi Arabia is a vast country as shown in Figure 2-1, with a land area of 2,150,000 km^2 (Alsaleh, 2008). The population is approximately 31,742,308 (Statistics, 2017b). It is divided into three regions: west, east and central, as a result of urbanisation (Salam et al., 2014). Each region has different architectural designs(Al-Shareef, 1996, Susilawati and Al Surf, 2011). Al-Jawahrah (2002, p.7) asserts that Saudi architectural regions are divided into four main regions: central, south, east and west, which will be discussed later in this chapter when architectural variation in different regions is considered. Vernacular Saudi architecture shares common aspects, such as privacy and climate control. Although vernacular architecture shares similar aspects, the way these aspects are implemented in home design is different according to the climate and availability of materials. Therefore, the architectural identity of each region is clear from just looking at the façades of buildings. Façade design is affected by many factors, for instance, climate, culture and available materials.

Figure 2-1 Map showing the main cities in the KSA, source: (Wikipedia, 2016)

Professor Naser Alsaleh's book *The Influences and Geographical Patterns of Traditional Architecture in the Kingdom of Saudi Arabia* is used as a major reference for a detailed analysis of vernacular Saudi architecture. Starting with the Saudi climate, Alsaleh (2008) mentions that the climate varies from the desert in the central region and coastal areas in the eastern and western regions to mountains in the southern region. Vernacular architecture in Saudi Arabia has been affected by culture and tradition in addition to other environmental factors. Since all Saudis are Muslim, religious rules have contributed to creating these traditions. Privacy is a mandatory home design, but the way it is applied varies from one area to another as will be discussed. In addition to privacy, vernacular homes in Saudi district planning are distributed around a mosque in the middle of a town or a district. This is due to tribal traditions whereby people from one tribe are required to be near one another, and this is due to non-availability of transportation like cars or public transportation. These homes are usually centered around a mosque, so all the people in the area can pray at it (Alsaleh, 2008, pp.40-42).

2.4.2 Privacy in vernacular home zoning and window design

Privacy in room divisions was and is still considered an important factor in home planning in all Saudi regions. First of all, a family's private zone contains a living room and sleeping rooms. This zone can also include service rooms like bathrooms and a kitchen. Secondly, the reception zone contains reception, sitting and dining rooms with a toilet and sink. The reception zone is considered to be a men's zone as male visitors are the major users of this zone. It is located with separate entrance doors in major homes either in flats or villas. Entrance doors should not face each other in order to provide visual privacy (Alsaleh, 2008, Bahmmam, 2002).

Privacy is also a major element in vernacular window design. For instance, a courtyard was a major element in Najd and windows were small and located in a high part of the wall for privacy and climate control from the heat and extensive daylight. Small windows in a high part of exterior walls were famous in Asir since buildings were designed in a cylinder form. However, in Jeddah, Roshan was a famous type of window. It is long and vertical since buildings were made of many floors. Roshan reduces heat and prevents glare. Since it reduces heat, it provides cooler air inside the building. Also, it is famous for its aesthetic design with its detailed patterns as will be discussed later in this chapter (Al-Jawahrah, 2002, pp.42-49, Alsaleh, 2008, pp.55-62).

2.4.3 Vernacular building materials and climate

"*The vernacular tradition has much to teach the modern designer, partially in response to climate parameters, notably sunlight with all its visual, thermal and energy implication"*" (Baker and Steemers, 2014, p.5).

There are other factors that have affected vernacular architecture in the country, such as climate and available material. The climate varies in Saudi Arabia from one region to another. This is due to its location between a latitude of 16 and 32 north. The weather is hot for most of the year with different temperatures from one area to another. It is cold in the winter; however, the winter period is considered short. According to *The Wind Energy Atlas for the Kingdom of Saudi Arabia*, the sun shines for 13 hours every day in the summer and around 8 hours in the winter (Al-nasari, 1985). The available natural materials vary from the mountain region in the Asir to the desert region in Najd and the coastal regions in the west or east. Since ceilings and walls are exposed to sunlight, they allow heat to enter the building; therefore, suitable materials must be used to inhibit heat from entering house. In Najd, mud was a major material in building and stones were used in walls with palm leaves used in the ceiling to protect from the sun's heat (Al-Jawahrah, 2002, Alsaleh, 2008, Facey, 1997). In Asir, *Kolb* mud and stone were common as Asir is a mountain region. In the western region, *Mangabi* or *Jiri* stone was a common building material since it is a coastal region (Abu-Ghazzeh, 1994, Alsaleh, 2008).

Other than the material, for traditional buildings there were some additional architectural designs used to prevent heat. Courtyards are a major part of homes in Njad; they are either square or rectangular. A courtyard has two main functions: as a microclimate regulator since it produces three air movement cycles in house providing a level of comfort to residents; and in creating privacy for the family. The walls of traditional houses in the Najd area were thick (80-100 cm base) with small openings that helped to insulate against heat in the summer (Babsail and Al-Qawasmi, 2014, Facey, 1997). In the western region, the buildings were designed so as to minimise interior heat; thus, multi-storey buildings consisting of five to six floors were common. In these buildings, functional rooms were located to face external facades, allowing air ventilation. Sleeping rooms were located on the upper floors to take advantage of the sea breeze. Also, Roshan, which will be discussed in detail later, is considered a major natural ventilation device in this region. Using huge coral columns as a structure for homes and wooden floors and walls is a design method to prevent heat (Babsail and Al-Qawasmi, 2014, Ishteeaque and Al-Said, 2008).

In Asir especially they used a unique exterior cladding for buildings called *Ragaf* or *Nataf*. They were made out of stones to protect the exterior walls from rain, and also, to protect windows from rain, so it did not enter the building (Alsaleh, 2008). In the eastern region, due to its location on the Arabian Gulf, building design was inspired by neighboring Arab Gulf countries such as the Kingdom of Bahrain, the United Arab of Emirates, Qatar and Kuwait (Vaziritabar, 1990). The weather during the summer is extremely hot with high levels of humidity. The buildings were designed with a courtyard and room surrounding them and the main material used was coral aggregate from the Gulf. The wind towers (locally called *Badgeers*) were used as a cooling technique. These *Badgeers* were three storeys in height. The walls were thick to resist the heat and the roof was made of wooden beams, and palm trunks and leaves (Babsail and Al-Qawasmi, 2014, Ishteeaque and Al-Said, 2008).

2.4.4 Jeddah and the history of Roshan

Jeddah city is Saudi Arabia's largest port and the most important commercial city in the kingdom. It is located on the Red Sea coast in the western part of the country. The climate in Jeddah is considered warm in winter with very little rain. It is hot and humid in summer (Kamal, 2014, Khodeir et al., 2012). In addition to its economic situation, Jeddah is the country's gateway to Mecca city which means it is a city for all Muslim people around the world, and some of these people remain in the country for the rest of their lives (Kamal, 2013, Telmesani et al., 2009). As a result, a mixture of cultures has emerged in the city. This mixture has influenced the identity of the historical parts of the area. This means that its vernacular architecture has been influenced by Muslims from other countries who would come and perform hajj and then stay in the city (Kamal, 2014).

Authors debate the origin of Roshan. For instance, although Kamal (2014) mentioned that pilgrims influenced the local citizens with their ideas from back home, when it comes to Roshan he claims that it is influenced by the city's border with Egypt across the Red Sea as Roshan is famous there. This is in agreement with Al-Jawahrah (2002, p.40), who states that Jeddah's vernacular architecture generally and Roshan especially are implementations of Egyptian architecture since Roshan was famous in Egypt with the name *Mashrabya.* Whilst Al-Murahhem (2008) agrees with the above two scholars that Roshan was a famous window during the *Mamluki* Empire in Egypt, she points out that this type of window was famous during the Islamic period in general. It exists in different Islamic countries, such as Iraq, Iran, and Egypt, with different names. Abu-zaid (2013), points to the influences of the Persian and Ottoman Empires on traditional Jeddah architecture. The epitome of traditional architecture is Naseef House.

Similarly, Erdoğan and Yüksek (2013) have discussed how gridded wooden windows were common in Turkey during the Ottoman Empire.

2.4.5 The definition and characteristics of Roshan

Al-Murahhem (2008) defines Roshan as an exposed wooden window. She goes on to assert that if it was flat it would be called a window, not Roshan, as shown in Figure 2-3. Hariri (1991) comments that Roshan is an Arabic name. It means an empty hole in a wall. Other authors have suggested that it is an Indian word. It is called '*Rushaandan'* in India, which means light source. The word '*Rushaandan'* is a two-part word. The first part, '*Rowshani*', means 'light'. The second part, '*Dan*', means provider (Aljofi, 1995, Al-Shareef, 1996).

Alitany et al. (2013, p.8) provide a detailed description of Roshan: *"The term Roshan can be traced as far back as 1100 AD and in North Africa, Egypt and Yemen has come to be known as Mashrabiya. The Roshan is a large projecting three-sided wooden structure on a building's façade, with a recognizable latticed component. A typical Roshan is about 2.4-2.8 m in width, 0.4 - 0.6 m in depth, and 2.7-3.5m in height although this can vary considerably".*

Similarly, other papers show that Roshan can be up to 3 meters high and 2.3 meters in width. The depth of Roshan can be 1.9 meters, as it is used for sleeping, so couples can sleep together in it. In addition to its size, Roshan provides a high level of privacy with its movable wooden blinds, which make it a place for private activities, such as sleeping (Salloum, 2013). The majority of buildings in old Jeddah contain Roshan. There are two types, as shown in Figure 2-2. There is a small Roshan, which just covers one opening in one room. In contrast, the famous type of Roshan is the type that goes from the ground floor to the top floor. It creates openings on all floors. Both small and big Roshan contain three sections as shown in Figure 2-3. They contain a top, centre and bottom. The top section works as a shading device for the centre part. The top section ends with a belt that contains a pattern. The middle part, which is central, can be opened. It also has small holes for ventilation and privacy. Finally, the bottom works as a support for the two upper sections (Hariri, 1991).

Figure 2-2 Different Roshan sizes

Figure 2-3 Roshan at Naseef House, Built 1881, Jeddah

2.4.6 The function of Roshan

It is argued that this type of window has cultural and sustainable advantages. It provides interior spaces with daylight, natural ventilation and privacy (Adas, 2013, Kamal, 2014). This makes Roshan an identifiable feature of the western region of Saudi Arabia, generally, and Jeddah, specifically (Hariri, 1991, Susilawati and Al Surf, 2011). Roshan is also considered an interior extension. Inhabitants use it for sitting in and looking out at a street from. It is used for sleeping, as ventilation passes through it (Salloum, 2013).

There have been a few studies that have focused on Roshan as a culture-valued window, such as Hariri (1998) and Al-Murahhem (2008). Hariri (1998) and Adas (2013) urge Jeddah's history to be preserved by keeping Roshan. On the other hand, Al-Murahhem (2008) claims that new students in interior design find Roshan old fashioned, and it does not match contemporary lifestyles. However, women's opinions regarding Roshan have remained unstudied in previous literature, but will be introduced in Chapter 5.

This section has provided a general overview of vernacular architecture in different regions of the Kingdom of Saudi Arabia. It has examined specific historical and cultural factors that characterise the vernacular architecture in Jeddah city.

2.5 Part 4: Contemporary architecture in Saudi Arabia

This section explores the economical, educational and cultural changes that have informed contemporary architecture in the Kingdom of Saudi Arabia. Dr. Hani Al-

Jawahrah, a professor in architecture, classifies, in his book *From Vernacular Architecture to Skyscrapers*, the factors that have created changes in the building environment in the Kingdom of Saudi Arabia. The first factor is the oil boom in 1970 in Saudi Arabia, a development point in Saudi Arabia. The resulting economic growth led to many changes and development in many sectors in the country and residential design is one of these sectors (Al-Jawahrah, 2002, Nukity, 2003). Secondly, educational development and allowing women to study made people more aware of the world and resulted in a wish to emulate the lifestyle of the developed world (Al-Jawahrah, 2002, Nukity, 2003). As a result of these changes, building codes changed in the city and new regulations must now be applied to any new home to be built in the country (Al-Jawahrah, 2002).

According to MOJ (2015, pp.1-30) the building regulations for contemporary domestic architecture in Jeddah cover many areas such as the exterior material of the building, the air conditioning system, electricity, water pipes, staircase, gap between buildings, the type of concrete for columns and beams, and some other construction details. There are also regulations for the size of the light well and window size. However, some of these regulations, such as window size and lightwell, which are related to this study, are not implemented in reality as landlords and contractors do to follow the architectural drawings that have been approved by the municipality; this issue will be discussed later in Chapter 8. There are some important design elements that are not covered by the regulations, such as glass type, which will be discussed in Chapters 7 and 8.

By 1992, around 77% of the land mass of Saudi Arabia became urban areas. People started to move from towns to cities and towns developed in previously rural areas and became part of big cities (Nukity, 2003, p.19). A real estate development fund give citizens 70% of the money needed to build a home and individuals refund this money with no interest; this is considered one of the factors that has helped people to build modern homes (Bahamam, 2018). Similarly, Gadou and Quazi (2009) find that land grant policies and non-interest loans in the last four decades have been the main factor in the urban expansion of buildings in major cities in the Kingdom of Saudi Arabia since Jeddah city is the main focus of government concerns to develop living standards as the western gate for the country.

Al Surf et al. (2012) argue that economic growth has led people to change their lifestyles. They assert that modern lifestyles have become lavish and have a high energy demand (Al Surf et al., 2012). Aramco Compounds, the Saudi-American oil company, first inspired Saudi civilians to change their residential design to Western architectural styles. It is argued that this inspiration was supported by Saudi building regulations (Al-Wafi, 2006, Bahammam, 1998).

One factor that has led to the implementation of Western architecture in Saudi Arabia is allowing non-Muslim and non-Saudi architects to design buildings in the country (AlHumaidi, 1996, Al-Jawahrah, 2002, Al-Wafi, 2006). For instance, the American architect Kodac Rolac and Partners designed the academic and administrative area of King Fahd University of Petroleum and Minerals (Al-Jawahrah, 2002). Similarly, AlHumaidi (1996) states that Western architects were instrumental in the lack of traditional architectural elements in modern homes. This concurs with Al-Sallal (2010) that implementing Western building standards in an eastern desert climate has created daylight issues in buildings. He points out that fully glass façades provide intense daylight inside buildings.

Al-Wafi (2006) states that Hajj inspired Saudi architecture in the past, but after the introduction of western media such as newspapers and TV in 1985, people were inspired by Western lifestyles; media influence people's clothes, food and architecture. On the other hand, education is important. Since 1968, architecture education has focused on contemporary designs inspired by Western architecture; it has been focused on providing for clients' new lifestyle needs more than thinking or caring about cultural and architectural heritage (Abu-Ghazzeh, 1997).

On the other hand, King Fahd University of Petroleum and Minerals' main aim in education is to develop students' architecture skills to enhance vernacular architecture. In this university, students study many courses such as *Architecture of Saudi Arabia*, *Special Topics in Regional Architecture* and others (Al-Qawasmi, 2015). Dr. AlQawasmi discussed his experience of teaching three courses in this area during the period 2013-2014. A questionnaire was given to students on these courses to report back on their experiences. The result showed significant improvement in students' awareness of vernacular architecture in the region. It also showed great usage of vernacular designs in contemporary architecture.

Additionally, since 2005-2006 things have started to change with the launch of the Prince Sultan Bin Salman Award for Urban Heritage. This award encourages university students and researchers to participate and work together to solve issues around architecture and interior design in Saudi Arabia. The competition had six sessions up to 2015 (Saudi Commission for Tourism and National Heritage, 2015). Al-Jawahrah (2002) mentions that people have become better informed and value traditional architecture more due to media coverage and the *Aljenadria* Festival, which informs people about traditional life in many respects.

2.5.1 Types of contemporary homes in Saudi urban areas

Development in Saudi Arabia affects housing designs in different ways. Thus, the construction of different types of houses such as flats and villas adopted foreign designs from the mid-1950s. There are three common types of houses in Saudi Arabia: detached villas, semi-detached villas and flats (Al-Otaibi, 2006, Bahammam, 2015). There are different factors affecting individuals' choices for their houses among these neighborhood characteristics; a growing family looks for a place to accommodate their families and fulfil their needs in terms of locations, prices, and facilities such as children's schools (Al-Otaibi, 2006). Villas can be defined as detached housing units with open space surrounding them, and these open areas are faced with walls which are more than two meters in height. The introduction of villas in a contemporary style happened after the Arab American Oil Company (ARAMCO) started up (Hakky, 2012). Some early studies argue that villa-type -housing lacks privacy and sociability (Fadan, 1983, Akpinar, 1992). Akpinar (1992) surmised that villas reduce social involvement especially for women, isolating members of the family due to increased numbers of rooms. However, owning or renting a house costs a lot more than renting a flat due to the big difference in size between the two residence types.

According to Bahammam (2015), the current changes in Saudi Arabia and the cost of living demands mean that owning a house can be difficult, which causes people to rent flats. He states that that the three factors that cause people to struggle to own a house relate to economics, building technical criteria and cultural values as shown in Table 2-3. A flat is a type of mid-size dwelling, which is usually rented by a nuclear family in Saudi Arabia. These flats contain fewer units compared to villas, which consist of a masculine reception quarter (*majlis*), and women's inner spaces. Some of these flats are in buildings located on commercial streets, thus, the first ground may be rented by offices and shops (Mubarak, 1999).

Table 2-3 Factors affecting ownership of a house (Source: (Bahammam, 2015)

Factors affecting ownership of a house		
Economics	Building technical criteria	Cultural values
• Low income • High percentages of unemployment • Length of period	• Land size is big which leads to high cost • Detached house or flat blocks' land size (500 m^2 – 750 m^2)	• Home size represents family wealth and generosity • Designing big homes with a lot of rooms

of getting governmental loans • Continued increases in land prices	• Villa land size (612m2 – 2130 m^2) (Aljuwair, 2002)	(some rooms are repeated) • Lack of awareness regarding saving

2.5.2 Flat issues

Contemporary architectural design in Saudi Arabia reduces women's social interactions with the exterior. Contemporary building policies in Jeddah force people to leave two metres clear on three sides of the building and 4 metres in front of the building as shown in Figure 2-4 and Figure 2-5. This rule has many negative effects on buildings. The rule on two side yards for buildings was introduced to ensure air ventilation for buildings. However, it separated buildings, which leads to extensive heat in interior spaces during the summer. Additionally, the side windows are covered with curtains most of the time to ensure inhabitants' privacy and to avoid intense sunlight. As a result, the heat increases the need for extra air conditioning systems to cool interior spaces. Therefore, it should be reduced (Dahlan and Mohamed, 2010). It could be the case evidence that building regulations in Jeddah city were inspired by non-Muslim countries seeking to urbanise. Hence, they were applied in Jeddah's buildings without any amendment to match cultural values or climate (Salagoor, 1990). Salagoor goes on to argue that building regulations are the main reason that privacy has been eroded in contemporay dwellings that have balconies and glass windows as shown in Figure 2-6.

This part has clarified that the changes in architecture from vernacular to contemporary in the Kingdom of Saudi Arabia Saudi Arabia result from several factors. The main factors are economic growth, which introduced Western architectural influences and education focused on business rather than cultural values and municipality regulations. After discussing the four parts of my literature review. I have established that there is a gap in the existing literature on the relation between need of privacy for Saudi women and the design of contemporary residences in Saudi Arabia. My thesis aims to address this gap, through which I attempt to offer an original contribution. I do this in chapter five, six and eight of my thesis document.

Figure 2-4 Contemporary homes in Jeddah with a small gap between buildings

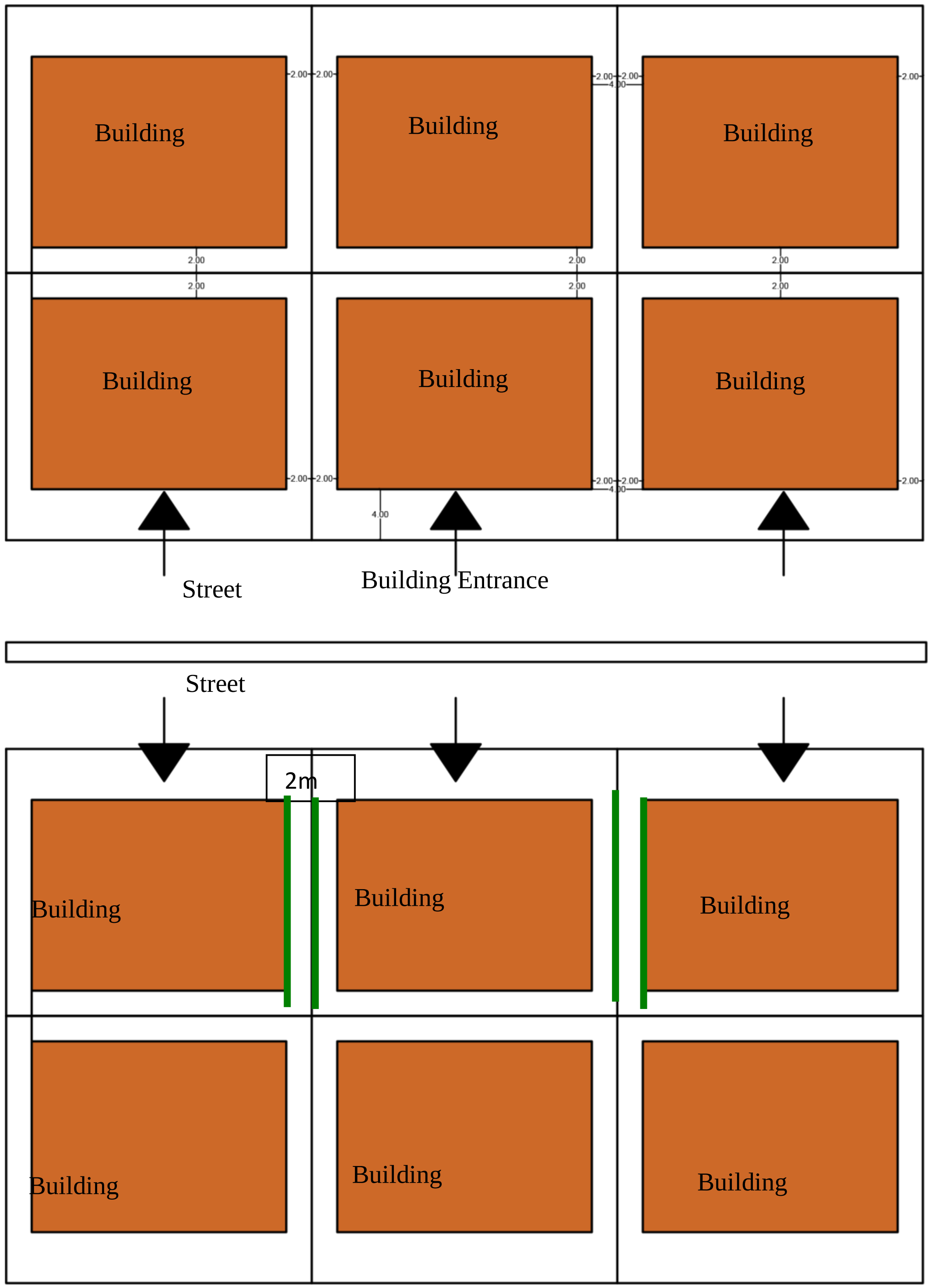


Figure 2-5 Site plan shows the 2 meters gap between buildings

Figure 2-6 Privacy problems with balconies and windows in Jeddah

2.6 Conclusion

This chapter has investigated four areas starting from Saudi family structure and how Islam guides family life and different gender duties. It has demonstrated that since it is the male's duty in Islam and Saudi culture to provide a home for his family, this, as a result, makes home choice mainly a man's responsibility. However, Chapter 6 will explore women's perceptions regarding this, and how it affects their needs and satisfaction levels at home. It is important to understand Islamic religious rules regarding families and women's duties and Saudi culture in order to understand the identity of Saudi women, in general, and to understand women's rights and needs in home architecture in particular. This first section of this chapter discussed how women's lifestyles are shaped by Islam and Saudi culture. It was shown that women's duties result from the expectation that they will create strong family connections. These duties affect women's nuclear families, extended families and society as well.

The literature review showed a strong relationship between women and architecture in vernacular Saudi homes. It is crucial that women's identity is taken into account in contemporary architecture, but this literature review enabled me to expose an existing gap in this area. Therefore, the impact of poor daylight in contemporary residences on women's daily lives and wellbeing needs to be investigated in this study as well as men's authority in this situation. Although a lack of daylight will affect people in general, factors behind religion and cultural barriers, which shape the identity of Saudi women, need to be explored. Although, there are few barriers preventing women from managing their social lives and careers, when women cannot solve the issue of getting enough daylight at home, impairment can be considered a disruptive factor, which might affect their daily lives and wellbeing as will be discussed in Chapter 5. It is also vital to explore the current architectural situation from economical and educational perspectives as will be achieved in Chapter 8.

The second section discussed how culture and the need for privacy affects architecture. It concluded that architectural design must take into account different cultural needs in home design. In Saudi Arabia, privacy is the most significant cultural requirements in home design. The third part of the literature review explored vernacular architecture in different regions of the Kingdom of Saudi Arabia. It then examined specific historical and cultural factors that make up vernacular architecture in each region. It was found that material, culture and climate are the major factors that guide home design in each region. Although home design varied during the vernacular period, the cultural need for privacy was significantly considered in window design in all regions. The fourth section investigated the reasons for architectural changes in the country from vernacular to contemporary times and how this affects occupants' needs in terms of privacy. It showed that economic growth and Western inspiration have been major factors in these changes. This point will be investigated in detail from the perspective of decision makers later in Chapter 8. The fifth section explored the factors that affect the amount of daylight in interior spaces such as exterior obstruction and reflection.

To draw further conclusions on this issue, this research requires women to be interviewed about their needs and satisfaction with window design in terms of privacy and daylight in living rooms, since these are the most used rooms during the morning and afternoon. In order to explore this issue, it is important to discuss to what extent daylight has an impact on buildings and how the lack of daylight can affect human wellbeing as will be discussed in the next chapter.

Chapter 3

Chapter 3 The contribution of daylight in architecture and human wellbeing

3.1 Introduction

The previous chapter investigated the human side of the study in terms of how religion and culture affect the lives of women in Saudi Arabia. It also discussed how these factors have guided architecture from the vernacular to the modern in Saudi Arabia. Since the study investigates daylight in Saudi homes and how it affects women, and since little attention has been given to daylight and wellbeing by Arab scholars, the literature review in this chapter will discuss issues arising from international Western and Eastern scholars. It will also include Arab studies in this area. It is important to discuss the scientific side of this research which focuses on daylight and architecture, and daylight and human wellbeing. Therefore, this chapter will discuss daylight in architecture as it relates to factors such as window design, shading devices, and light wells in international studies and in studies with a Saudi context. Then, the importance of daylight for human wellbeing as discussed by international scholars and Saudi scholars will be considered.

3.2 Daylight

"Natural daylight in interiors has two main characteristics: It is extremely pleasant to humans, and it is a free energy" (Parise and Martirano, 2013, p.162).

Since my study focuses mainly on pleasantness of dwellings for humans rather than energy, this section investigates common design factors that offer daylight in residences such as exterior walls, windows, light wells and atriums. It also discusses factors that affect daylight levels in interior spaces in terms of colour and material reflectance, exterior obstructions, exterior reflectance, room zoning and shading devices. There is a need firstly to discuss the meaning of daylight as described by different scholars. According to Kubba (2012), daylight, as a natural resource, has been available for millions of years, and is used globally by people as their principal source of light. It is also defined as achieving the required free natural light source in an interior space through techniques that control the light level entering the space (IESNA, 1993). A similar definition is given by Meek and Van Den Wymelenberg (2014, p.1) who define daylight as the use of natural sources of light such as sunlight, skylight or diffuse overcast skylight illuminance. It is a combination of both direct and indirect sunlight during the day. It helps human vision to work well in indoor spaces, and is still recommended over artificial lighting because it enhances people's wellbeing and productivity (EREC, 2001).

Another study by Reinhart and Galasiu (2006) provided five definitions for daylight. They provided a definition for daylight in relation to four areas of architecture generally: lighting energy saving, daylight for energy consumption in buildings, daylight and load management, and daylight and cost. For architecture, they define daylight as creating an interaction between daylight and architectural design that promotes the provision of space for users with an interior environment that is visually stimulating, health-giving, and productive. For lighting energy saving, daylight is defined as the replacement of artificial light, which helps in reducing energy consumption from artificial light. The definition of building energy consumption is using daylight to create building designs that reduce and control a building's energy consumption from sources such as heating, cooling or artificial light by using a fenestration system and responsive electric lighting. In load management, it is the "*dynamic control of fenestration and lighting to manage and control building peak electric demand and load shape*" (Reinhart et al., 2006, p.8). Finally, daylight in relation to cost is related to creating a building that has an advance daylight strategy that helps to reduce operating costs and leads to increased output and productivity.

Urban populations spend most of their time inside buildings, which isolates them from the natural environment (Mohelnikova, 2010). Mohelnikova asserts that the interior atmosphere could be uncomfortable for occupants if it does not provide proper daylight. However, achieving the required amount of daylight in interior spaces is not a simple task as it can affect occupants' comfort or production in the space negatively when daylight is not in an accepted range (Alzoubi and Al-Zoubi, 2010). It is argued that there are many design factors that affect the quality and quantity of daylight in indoor areas, such as window location and size, zones within the room, colour and the materials used for interior furniture (Das and Paul, 2015, Littlefair, 1991).

3.2.1 Windows and daylight

Windows are a major architectural element that have many advantages. One of their important advantages is in providing daylight and ventilation in interior spaces, which has a great impact on occupants' comfort (CIBSE, 1999, p.27, Gao et al., 2014, p.1). Although, there are different sources of daylight such as skylights, windows remain the most popular architectural element allowing daylight to penetrate inside buildings (Jelle, 2013). Windows are considered to be a worldwide daylight technology and main source of natural light, natural ventilation and a view of the outside (Freewan, 2015, Jelle, 2013). Window design is responsible for the amount of daylight entering an indoor area (Cammarano et al., 2015, McMullan, 2012, Mohelnikova, 2010, Baker and Steemers, 2002, Szokolay, 2008). The most common material for contemporary windows is glass and this has been the case since early times when humans discovered glass (Jelle, 2013, Zerwick, 1990).

According to CIBSE (1999), since daylight affects occupants' well-being, satisfaction and production, the major rule for daylight is that it should allow buildings to function. However, it is essential to know the function of the space in order to decide what amount of daylight is required. Although a standard window height of 2.5 m in a room that is 3.75 m in width can allow daylight to reach up to 6 m as shown in Table 3-1, to ensure the necessary amount of daylight there is no one window design as latitude affects sunlight levels. It is important for this issue to be studied from one region to another. For instance, when the sun's path is higher in the sky, it is easier to control daylight as in the Mediterranean areas. On the other hand, it is difficult to control sunlight when the sun's path is lower such as in Nordic countries (CIBSE, 1999, pp.1-8). Therefore, the dimensions in Table 3-1 are suitable for the UK's latitude only. More investigation is necessary to find out if it is right for other regions at different latitudes.

Table 3-1 Daylight depth with different room sizes and window heights (CIBSE, 1999)

Room width	3m	10m
Window height		
2.5	4.5	6.7
3	5	7.7
3.5	5.4	8.6

3.2.2 Window orientation

According to Littlefair (1991, pp.1-6), building orientation has a major impact on interior daylight. He asserts that windows should be south-facing to maximise light ingress. This is in agreement with the Chartered Institution of Building Services Engineers in London CIBSE (1999, p.11) which reports that locating a window so that it has a southerly orientation is best for homes. Similarly, Sudan et al. (2015) studied daylight and window orientation and daylight quantity for clear sky conditions considering direct and diffuse light in living spaces in Varanasi, India, during the period January–December 2013. The study found that a southerly oriented window gives maximum daylight levels while a northerly oriented window gives minimum levels in the northern hemisphere. In contrast, Hegazy and Attia (2014) studied daylight in hot Cairo weather where the winter temperature ranges from 19°C to 29°C in the morning and 11°C to 5°C at night. In summer, the temperature can reach 40°C in the morning and remain at 20°C at night. Study of the four orientations demonstrated that the eastern and northern façades provide the highest level of daylight in comparison to the western and southern ones.

Although daylight is important, a designer should also consider window orientation and heat. Aboul-Naga et al. (2000) conducted a study in Al-Ain city in the United Arab Emirates in two-storey residential buildings with different orientations, where the temperature is considered hot. They found that a north-easterly window orientation provided enough daylight and reduced heat in the interior space, which led to reduced energy consumption. Additionally, the study recommended reducing glazing areas and providing shading devices for a window if it is designed to be in a west or east facing area. Similarly, since building orientation can influence the quality and amount of daylight, building surfaces facing south are exposed to direct sun rays. In this case, shading devices are highly recommended to avoid overheating. In contrast, northerly oriented windows provide daylight without sun rays and heating. An easterly and westerly orientation required shading devices and designer attention to glazing to avoid overheating and intense sun (Freewan, 2015). Therefore, a shading device must often be used as will be discussed in the next section.

3.2.3 Shading devices and reflection

Large windows can provide daylight, but create high demand on cooling systems due to heat. They can also create glare or intense daylight in interior spaces. In contrast, small windows reduce heat; at the same time, they reduce daylight levels in interior spaces (Meleki, 2012). Therefore, window shades are a design solution to intercept the sun rays before they reach interior spaces through windows and reduce heat. Shading devices provide thermal and visual comfort (Lim and Kim, 2010). Some authors who have studied daylight in interior spaces suggest the idea of shading systems to allow daylight penetrate while preventing interiors from heat and glare (Al-Rasheed, 2010, Alzoubi and Al-Zoubi, 2010, Freewan, 2015). This is an area of consensus between researchers. Although big windows may be considered the easiest solution to providing daylight, they can affect visual comfort and increase heat. It is not a simple task to provide the required amount of daylight needed for different activities with daylight windows only. Therefore, shading devices are a solution to provide the required daylight while preventing heat and glare (Lim and Kim, 2010).

Some authors argue about the best type of shading. For instance, Taleb (2011) prefers horizontal shading because it increases ventilation levels. On the other hand, Edmonds and Greenup (2002) find that shading devices can be an obstruction to daylight reaching interior space in some areas such as sub-tropical Brisbane, Australia. Edmonds and Greenup found that, for daylight in office buildings, there was less than 500Lux in summer periods, which is the required amount in for such buildings.

A lightshelf is a horizontal and exposed shading system. It can be used in the inner, outer or both parts of the window, and it is placed in the upper section of the window. It has many advantages, such as blocking direct sunlight and minimising the hot air entering the room, and reducing glare (Freewan, 2010).

A study by Hegazy et al. (2013) of daylight in the hot climate of Cairo found that natural light from a southern façade in interior spaces is affected by window to wall ratio, glazing and shading in urban Cairo residential buildings. The authors found that different glazing and shading in most window to wall ratios failed to obtain the required natural light on the first floor. Daylight did not reach 300 lux, which is the target luminance for the study. A basic window with no shading provided the highest level of daylight compared to the others; however, it did not even reach the required daylight level. Additionally, a basic window with no shading provided the highest level of natural light on the highest floor, 12 m from the street. However, it affects the thermal temperature inside the room negatively. The used shading and glazing showed low daylight levels in interior space, but they reduced energy consumption as they prevent from extensive heat.

According to Freewan et al. (2008), curved ceilings help to enhance natural illuminance in interior spaces when combined with a lightshelf. In the study, the authors examined different ceiling geometries from March to May in office buildings in a sub-tropical Jordanian climate at 30.5^{o} N and 36.2^{o} E. The experiment was done on a physical model and provided positive results. However, the walls and ceiling in the experiment had high reflectance of 70% to 81% respectively.

A study of an administrative building in Dammam city found that reflected light from exterior factors, like reflection off a neighbouring building, is a good source of daylight in hot and humid regions such as Saudi Arabia. The author goes on to assert that direct daylight could create high heat levels, while a skylight provides low luminance in interior spaces (Alshaibani, 2015). The exterior reflectance and colour have a great impact on indoor light illuminance (Kobav and Bizjak, 2005, Batterjee, 2010).

Measuring reflection or contrast from interior materials could be more effective than window design (Hensen et al., 2012). This makes it clear that internal reflectance can have a great impact too as colour is considered to have a great effect on light reflection in interior spaces. For instance, light colour has a great impact on light diffusion in a space where a dark colour does not (Debs and Moaad, 2008). Similarly, according to Batterjee (2010), colours in interior spaces affect light diffusion. She asserts that the lighter the furniture surface colour, the more light diffusion accrues in the room.

Lu et al. (2016) argue that a large interior obstruction affects the amount of natural light in an interior space. The authors investigated the effect of interior obstructions on 51 southern-facing small residential spaces in China. They found that "*In facade design, the suggested placement of wide solid walls is at least 600 mm higher than the required working plane so that the daylight level on the working plane can reach 800 lux, and 500 lux daylight can penetrate 350 mm or more deeper into the room. In addition, placing the wide solid walls at a height of 1500 mm, which has the most adverse effect on a lower illuminance requirement, should be avoided. The* *suggested placement of a tall solid wall is at least 900 mm away from the window edge for a higher working plane to make sure the daylight level in front of the wall reaches 300 lux*” (Lu et al., 2016, p.19).

3.2.4 Atrium

An atrium is an open space in the middle of a building to provide daylight for the whole building. A study done in an administrative building in a sub-tropical Hong Kong climate implemented this idea with an atrium. The atrium size in the lower part of the building is 11.5 m x 9.5 m x 40.7 m in height and 15 m x 15 m x 15 m in the high part of the building. The study found that interior spaces receive enough natural light from the sky glass in the top of the atrium. Daylight from the atrium ceiling distributes throughout all interior spaces (Chow et al., 2013). Similarly, Alraddadi (2004) found an improvement in daylight levels in indoor areas with a step terrace atrium in Riyadh city at 24' N and 46" 43'E latitude. The experiment took place between mid-February and April 2002, from 9 am to 3 pm. The atrium gable was slid towards a northerly orientation.

An atrium is commonly used in office buildings as it creates a charming atmosphere (Chow and Wong, 1999). In Saudi Arabia, an atrium is commonly used in hotels, schools and hospitals due to the hot climate and the need for interior daylight in interior spaces. An atrium is similar to a courtyard in vernacular architecture (Alraddadi, 2004). However, since contemporary architecture focuses on building height not width due to high population growth in urban areas, it is not a simple task to implement an atrium in contemporary architecture generally and in contemporary Saudi residential architecture especially as it requires a large amount of land. At the same time, it is important to provide daylight in all inhabited spaces (Mayhoub, 2011). Therefore, a light well, which is a smaller version of an atrium, has become more commonly used in contemporary residential buildings as will be discussed in the next point.

3.2.5 Light well

A light well is an opening in the middle of the building from the roof to the bottom of the building. It provides indirect daylight without providing a view of the exterior environment (Freewan et al., 2014). In Japan, due to the high rise buildings, most buildings have light wells, which they call “voids”. The void is located in the centre of the building floor plan. Corridors in the middle of the building surround the void. It has other functions in addition to providing daylight. For instance, since the gas water heaters in Japan are placed in the middle of corridors, the gas exhaust is discharged through the light well (Kotani et al., 2003b). Another study by Takai (1993) discussed the reasons for having a light well in the middle of Japanese high rise dwellings. First of all, due to the hot weather in Japan in the summer, a light well is needed to provide air flow in buildings. Secondly, as earthquakes are common in Japan, there is a need for a structural design that has the strength to remain stable against earthquakes. A light well in the centre of large plans is the best design solution. Thirdly, since the middle corridor is used in large plans for domestic buildings for occupants’ activities, it can provide a semi-outdoor feeling for occupants.

The above connection between light wells and ventilation is made since light wells in Japan are located in middle corridors. Therefore, ventilation is discussed as a major function. However, since some Japanese buildings and other countries locate light well windows towards the interior spaces of flats, a study of daylight levels is necessary. A study was undertaken by Kotani et al. (2003a) for light wells in four domestic buildings in different Japanese cities, Kobe, Osaka and Kaizuka. The study included a survey questionnaire for flat occupants regarding their satisfaction with heat, daylight and sound from the light well. Light well size differed in the four buildings. The biggest light well was 29X24 cm and the smallest was 8X8 cm. The results indicate that occupants are highly stratified in terms of heat and ventilation with different percentages from one building to another. However, the results significantly indicated that occupants are not satisfied with daylight from small light wells during the daytime.

In the Arab region, a study by Freewan et al. (2014) investigated daylight in a multi-storey residential building to figure out if light well windows could provide the necessary amount of daylight in Irbid, Jordan. This study took place between March and June under clear sky simulations (latitude 31.9° North; longitude 35.9 East). Jordon is considered a hot arid region where sunlight is available most of the year. The results indicated that a small light well of 1m X 1m or 2m X 2m cannot provide the required daylight. A bigger light well of 4m X 4m provided adequate daylight when it was adjacent to large windows of around 1m X 2m. The findings also indicated that lower floors in buildings with a small light well cannot get daylight. Additionally, the author found that the higher the building, the bigger the light well should be. The results showed that the light well is effective at certain times of day when the sun is high in the sky, for example 12 pm in June, since more light is able to reach the bottom of the light well (Freewan et al., 2014)

In a space with light well windows, it was found that, even if occupants are isolated from the exterior world, they are aware of the outer changes in conditions from the light conditions (Lam, 1992, Vischer, 1986, Vischer, 1989). Kristl and Krainer (1999) studied the effect of interior wall reflection on the amount of daylight from a light well. The study was carried out in Budapest city at 47.4979° N, 19.0402° E and with average temperatures of 21^{o} in summer and 1^{o} in winter. The study found that using a semi-individual light well as a source of daylight for a three-floor multi-residential building is a good way to provide natural light. The reason there is enough daylight is that the light well is designed as a slope that is wide at the top (4m X 2.4m) and narrow at the bottom (4m X 0.60m). Therefore, the top floors receive daylight due to the big opening in the light well and the lower floor receives daylight as mirror walls are designed in order to reflect more daylight into interior spaces.

On the other hand, Su et al. (2010) did a similar study under sunny sky conditions in sunny and overcast weather in Nottingham, at 35^{o}N and 1.25^{o}E, and found that upper floors receive enough daylight – more than 2% daylight factors. However, lower floors received less than 2% daylight factors, and the lower floor result was observed with the three types of materials the authors used, which were wood, matt paint and mirror. The authors found that the chosen dimensions for the light well, which was 100mm in width, 150mm in length and 800mm in height, was not large enough to produce sufficient daylight in the lower three floors in a six-floor building. They also found that a mirrored light well improved daylight up to 100% more that the matt material in lower floors. As a result, the authors assert that light well size should be increased by 25%. The authors suggest that reflective devices could be used in the upper part of the light well to convey additional daylight to the lower floors (Su et al., 2010).

In contemporary Saudi homes, a light well is considered mandatory in residential architecture, especially flats. According to Jeddah building regulations, the light well size in a two-floor residential building must be 90 cm x double the height of window wall (Dahlan and Mohamed, 2010). The size must increase by 30 cm for each additional floor up to 14 floors, then it stops increasing. A window design, either facing the light well or exterior space, should not be less than 8% of any room size and not less than 10% for the kitchen and bathroom size. However, window size should vary according to the space function, which is not considered in regulations (Dahlan and Mohamed, 2010). Chapter 5 will explore women's perceptions regarding these regulations, and how they help in providing adequate daylight or not.

3.2.6 Room zones and exterior obstructions

Natural light is divided into two parts: diffuse and direct sunlight. The amount of daylight which reaches different zones of an interior space from these two types of daylight varies according to the depth of the seating area. Therefore, a study of daylight in room zones is important in order to figure out if occupants are getting enough daylight in different zones (Cammarano et al., 2015). This method is also used by others, such as Kim and Kim (2010), Hensen et al. (2012) and Parise & Martirano (2013), who divided the sample room into parts to find out the daylight level in each part of the room. According to Parise and Martirano (2013), daylight decreased significantly in zones far from a window.

In addition to room zones, Cammarano et al. (2015) discussed another factor that affects daylight levels in interior spaces, which is exterior obstructions such as buildings. In their study of three rooms facing south, west and north at three different sites, Berlin, Germany (52.38°N), Turin, Italy (45.18°N) and Catania, Italy (37.58°N), the authors found that the higher the exterior obstruction the less daylight reach interior spaces even if windows were big. Similarly, according to Littlefair (1991, p.2), exterior obstructions effect the quality and quantity of daylight levels in interior spaces. The authors assert that living rooms need to be exposed to daylight more than other rooms because they are the most used spaces in the home.

The issue of exterior obstructions is also discussed by Li et al. (2006), who claim that, in high population areas like Hong Kong, daylight in interior spaces of residences is reduced due to exterior obstructions by high buildings reaching 10 to 30 floors. They go on to assert that high neighbouring buildings block daylight from reaching interior spaces especially on lower floors. They also add that the colour of exterior obstructions effects daylight transmitted to interior spaces as lighter colours help to reflect more daylight than darker ones.

Therefore, daylight in interior spaces is not about having big windows. It is about how the light is distributed, diffused and controlled to reach each part of a space. According to CIBSE (1999) placing a window high on a wall is preferred as it allows daylight to reach deep into a room and it is not obstructed by exterior factors such as trees.

3.2.7 Daylight in Saudi studies

The studies that have focused on daylight levels in Saudi contemporary architecture are few in number. Alshaibani (2000) is one example; he argues that the geometrical relationship between the interior space surface and window size is a major factor affecting the amount of clear sky daylight. The author studied the ratios between windows in different ways. For instance, he measured the relationship between window size, floor area, side walls area, window wall area, and total room surface area excluding the window wall. The investigation was done on 144 units using the light simulation program Lumen- Micro to vary geometrical design. He found that the geometrical relationship between windows and area could be calculated excluding window to window wall (Alshaibani, 2000).

In another paper, the same author found that lighting calculation equations used in the British system do not match other regions such as Saudi Arabia. The British equation measures light in a cloudy sky, and this does not work in an area with lots of direct sunshine. Therefore, a new equation should be used to calculate light in hot areas. (Alshaibani, 2009). However, the paper was limited to classrooms in one region of

Saudi Arabia, while climate is different from one region to another. Additionally, the paper did not provide results for the equation in different seasons of the year; it provided result for the summer only. There was not a description of the type of glass used in the classroom, and this may have had an effect on the light entering the interior space.

3.3 Daylight and wellbeing

3.3.1 Psychological and physical wellbeing and daylight

This section discusses the relationship between daylight and human wellbeing in interior spaces in terms of visual comfort, psychological and physical wellbeing and job productivity. The increase in population in contemporary urban areas has raised the demand for healthy buildings that provide daylight (Alawad et al., 2016, Al-Shareef, 1996, Sabry et al., 2012). In order to understand how much daylight people need to be exposed to, it is important firstly to know adequate daylight levels in each space.

Saudi studies have not, to date, quantified the required lux level that should be considered when designing domestic architecture, especially living spaces. According to the Saudi Standard Metrology and Quality Organization (2009), there are suggested levels for lux in work places. For instance, 100 lux is the target in rest spaces and corridors at work, 200 lux is recommended for waiting rooms and 300 lux for museums and class rooms. There are no regulations, however, for required lux levels in residential spaces (SASO, 2009). Therefore, the literature review in this chapter will discuss the required amount of lux as identified by international scholars.

The required amount of lux varies according to the space function as shown in Table 3-2 and Table 3-3 (Vergara-Salvat, 2011). According to CIBSE (Chartered Institute of Building Services Engineers in London) the necessary daylight for housing activities such as in the living room, dining room and bathrooms ranges between 100 and 300 lux (CIBSE, 2002).

Table 3-2 Required amount of lux in different public spaces

Space	**Required lux**
Office work that requires reading and writing	400 lux
Waiting room	200 lux
Corridors and stairs	100 lux

Table 3-3 Required amount of lux in different home rooms (BSI, 1992)

Space	**Required lux**
Bedroom	50 lux
Living room	75 lux
Kitchen	100 lux

In general, health is the absence of disease, but in relation to lighting it is considered to relate to the creation of satisfying conditions (Veitch, 2011). Daylight has a significant effect on occupants' wellbeing as it is associated with many health advantages (Aries et al., 2015). Therefore, architects must consider occupants' physical and psychological wellbeing in a space in addition to their functional needs (Freewan et al., 2008, Aries et al., 2015). For instance, daylight affects visual wellbeing as it can provide interior space with clear visual space without consuming energy (Aries et al., 2015). Also, the mood and behaviour of people is affected by daylight inside the space (Kim and Kim, 2010).

High rise buildings that are common in urban areas like Tehran have come about as a result of high demand for homes. However, this leads to architectural issues that affect occupants' wellbeing such as poor daylight penetrating from glass windows. In blocks of flats, windows are the only source of daylight since there are no exterior yards (Ahadi et al., 2016). Similarly, Edward (2003) studied building regulations in Hong Kong and reported that, due to the high population in urban areas such as Hong Kong, building codes set a certain gap between buildings to provide as much daylight as possible, yet, this gap leads to daylight being blocked from penetrating interior zones.

According to Batterjee (2010), daylight is mandatory for all members of a family inside homes for their wellbeing and health as psychological and physical wellbeing is highly related to daylight exposure. According to Jackson (2003), the healthiest building is one that provides its occupants with enough natural sources such as daylight, natural ventilation and greenery. He argues that new lifestyles and lack of daylight and access to nature in modern high rise buildings are the cause of many health issues. One of these issues is nerve dysfunction as a result of staying in a place with artificial light such as a fluorescent light. Similarly, According to Frontczak et al. (2012), daylight is a major factor that affects occupants' comfort at home. The authors did a study in Denmark and questioned occupants about the factors that affect their comfort. They found that daylight had the highest percentage effect in comparison to 10 other factors such as sound, view, temperature, nature, room size and others.

Many studies have found a strong relationship between indoor design and occupants' wellbeing (Bluyssen et al., 1995, Bonnefoy et al., 2004). According to Boyce (2003) and Brainard et al. (2001), loss of concentration and sleep disorder are caused by improper daylight in interior spaces. Hence, these physical and psychological issues increase in winter (Duffy and Wright, 2005). In support of this, a study conducted on 439 children (aged between 5 and 16 years old) from different countries examined the association between the time of sunset and physical activity. They found that longer daylight was associated with elevated levels of daily physical activity (Goodman et al., 2014).

Several studies showed a positive relationship between daylight and psychological function such as mood and cognitive functions even if individuals spent their time in an indoor areas (Watson, 2000, Kent et al., 2009). In a cohort study of 16,800 black and white individuals (aged 45 and above) from North and South Carolina, the effect of amounts of daylight exposure on cognitive function was examined. Cognitive function was measured using a validated six-item screener questionnaire and daylight exposure was assessed using data values prepared and provided by NASA's Marshall Space Flight Center. Findings showed a relationship between daylight exposure and cognitive function, where lower levels of daylight were associated with impaired cognitive status (Kent et al., 2009).

One cross-sectional study investigated the association between self-reported inadequate residential natural light and risk of depression. A total of 6,017 participants (aged 18 and above) from eight European cites (Vilnius, Lithuania; Geneva, Switzerland; Forli, Italy; Bonn, Germany; Ferreira do Alentejo, Portugal; Budapest, Hungary; Bratislava, Slovakia; and Angers, France) were included. The results confirmed that participants who reported inadequate daylight in their flats were 1.4 times as likely to be depressed compared to those who were satisfied with daylight amounts in their flats (Brown and Jacobs, 2011).

3.3.2 Daylight and wellbeing in administrative spaces

Gou et al. (2013) mention that artificial light with a dimmer control is preferable to natural light. They found that students in their research sample showed a reduction in positive mood in naturally lit classrooms in comparison to artificial light. They found the highest mood reduction in students next to windows because they experienced a high level of light. On the other hand, another study found that 80 % of students under florescent light suffered headaches and impaired visual comfort. This experiment was carried out in 90 classrooms in Cambridge, United Kingdom in 11 secondary schools from July to September 2006 (Winterbottom and Wilkins, 2009). Similarly, Edwards and Torcellini (2002) report that daylight improves productivity in students around the United States of America.

Other studies also supported the importance of daylight exposure in the workplace in enhancing mood and task performance (Mills et al., 2007). One case control pilot study investigated the effect of daylight exposure on the health of workers in offices. The study included 27 workers in offices which were windowless and 22 workers in offices with sufficient daylight. A windowless office was defined as a workplace with no window or a workplace far away from a window with no exposure to daylight. The workers' wellbeing was measured using a validated short-form questionnaire, which contained 36 items relating to physical and psychological aspects of health. Sleep quality was evaluated using the Pittsburgh Sleep Quality Index, which is composed of 19 self-rated questions and five questions for a bed partner. Findings showed that workers in windowless offices suffered from poor sleep quality and had physical problems compared to workers in working places with sufficient light who tended to be more physically active and have longer sleep duration (Boubekri et al., 2014). It was also found that, although daylight is essential in most interior zones, a combination of both daylight and artificial light can sometimes be advisable (Woolner et al., 2007).

Rooms in underground areas create many health issues such as depression. It is shown that daylight helps to reduce seasonal and non-seasonal depression (Nayyar and Cochrane, 1996, Rosenthal et al., 1984). Exposure to bright daylight can affect employees' health and mood positively. An experiment was done to test 25 staff at work who were exposed to daylight and artificial light. The experiment found that exposure to daylight enhanced staff performance and reduced their feelings of sleepiness (Borisuit et al., 2014). Similarly, Kim & Kim (2010) argue that visual comfort is a main factor in a healthy space. They recommend that this should be achieved by optimising the amount of daylight with less glare. They go on to assert that biological lighting needs might be very different from visual needs. Health issues related to lack of daylight exposure could be poor sleep, less work production and severe depression. As a result, enough daylight with less glare in interior spaces could prevent health issues (Kim and Kim, 2010).

Partonen and Lönnqvist (2000) surveyed 160 staff in southern Finland from 1 November 1996 to 28 February. The length of daylight was 8 h to 10 h at 60^{O} north. The authors reported that employees who had repeated exposure to bright daylight during office work in winter showed improvement in vitality and alleviated distress for employees with and without season-dependent symptoms. Hubalek et al. (2010) investigated the effect of daylight exposure on 23 full-time employees in Zurich, Switzerland, at 47.388° N, 8.548° E. The authors found that exposure to daylight during work hours had a great impact on mood and other psychological comforts. This shows that exposure to daylight plays a major role in improving people's satisfaction, mood, and enhancing positive emotions. Since mood and emotion are considered vital for people's wellbeing they are related to positive health in psychology (Dekort, 2014).

In London, a study was done in 6 offices which reported that the type of building affects the daylight levels inside, which of course affects employees. The authors found that the deeper the building the less daylight available in the deepest parts, such as in a room 15 metres from wall to wall. This type of building affects employees who work negatively as their productivity decreases due to their non-satisfaction with daylight levels. On the other hand, shallow buildings provide sufficient daylight levels to satisfy employees and enhance their productivity (Leaman and Bordass, 2000).

3.3.3 Daylight and vitamin D deficiency globally and in Saudi Arabia

According to Holick (2007a), vitamin D is essential for human health. It is gained by exposure to daylight (Tangpricha et al., 2002, Hyppönen et al., 2001, Mutti and Marks, 2011). Vitamin D is a fat-soluble vitamin, which plays an important role in health and has several functions in the human body (DeLuca, 2004). These functions include bone formation by regulating calcium and phosphate homeostasis (DeLuca, 2004) and improved immune system function (Delvin et al., 2014). Also, vitamin D levels have been shown to be associated with blood lipid levels (Kelishadi et al., 2014) and cardiovascular diseases (Gouni-Berthold et al., 2009). One of the most widespread health problems globally is vitamin D deficiency, which affects around 50% of the worldwide population (Holick, 2007b). Lifestyle and environmental factors such as reduced exposure to daylight are attributed to vitamin D deficiency. The ultraviolet light from the sun is necessary for the production of vitamin D in the skin (Rostand, 1997). For the body to get the necessary amount of vitamin D, there are certain times of the day when people should be exposed to daylight. In general, 30 minutes of exposure is considered adequate. According to Saudi weather, the best time during the summer is between 9:00 and 10:30 am and in winter it is between 10:00 and 2:00pm (Alshahrani et al., 2013).

In Boston, USA, 165 participants varying from hospital staff, attending physicians, and house staff physicians, students from medical school, and some visitors to the hospitals were included in a study on vitamin D levels. This took place "*during vitamin D awareness screening program at Boston University Medical Center during March and April, 1999 (end of winter) and September and October 1999 (end of summer)*" (Tangpricha et al., 2002, p.659). Vitamin D is mandatory for people of different ages, and the only source for this is direct sunlight or daylight exposure; however, contemporary lifestyles do not allow people to spend enough time outside as life is conducted indoors most of the time. This lifestyle results in vitamin D deficiency (Tangpricha et al., 2002).

Most studies on daylight and occupant wellbeing in interior spaces have been carried out in East Asian, North America and European cities. There is a lack of research on this issue in Saudi Arabia, where window design is critical due to the cultural need for privacy and the extremely hot weather in summer. Despite the high levels of daylight and sun availability in Saudi Arabia, there is significant deficiency of vitamin D amongst children and adults in Saudi Arabia (Al-Saleh et al., 2015, Alsuwaida et al., 2013). Several recent studies on medicine have found a high level of vitamin D deficiency among Saudi citizens of different ages; however, the highest level was found among females

(Alfawaz et al., 2014, Alsuwaida et al., 2013, Alzaheb and Al-Amer, 2017, Al-Zoughool et al., 2015, Tuffaha et al., 2015).

A recent study in Tabuk city, northern Saudi Arabia, examined vitamin D levels in 180 female students, who did not have any health issues, and found that 12.8% of the participants had a vitamin D insufficiency, and a further 67.8% had vitamin D deficiency. The study was carried out in May 2016 when the sun is bright in the country (Alzaheb and Al-Amer, 2017). Another study in Riyadh, the capital of Saudi Arabia, found that 465 Saudi women participants aged 19–40 years old had a vitamin D deficiency. In total, 79% of the participants had a severe vitamin D deficiency (Al-Mogbel, 2012). In Jeddah, a survey of 1172 healthy Saudi females found that 80% of them had a vitamin D deficiency. In this study, the authors claim that this level of deficiency is the reason for other health issues such as bone illnesses (Ardawi et al., 2011). Alzaheb and Al-Amer (2017) claim that females with fewer outdoor activities suffer a high level of vitamin D deficiency. Hence, Siddiqui and Kamfar (2007) claim that architectural planning for low income homes could be a reason for vitamin D deficiency among females in Jeddah, which will be discussed in detail in Chapter 6.

3.4 Conclusion

This chapter has reviewed the previous research on daylight in interior spaces. It has clarified the factors that affect the amount of interior daylight and the suggested design solutions. The most compelling design solutions relate to window orientation, colour and material reflectance, light shelves, atriums, light wells, room zoning and building orientation. This literature review on daylight has enabled me to expose a gap in knowledge in Saudi scholarship regarding daylight in architecture generally and in Saudi residences specicifically. Therfore, Chapter 7 of this thesis document will provide a detailed analysis of daylight and window design in contemporary Saudi residences.

The second part of this chapter has shown how poor exposure to daylight can affect human health. It has also explored how Saudi women are in danger of many health-related issues as a result of vitamin D deficiency since they are not exposed to enough daylight. However, it is important to highlight that most Saudi studies in this area have been carried out in the health field. Therefore, this literature review on daylight and wellbeing has enabled me to expose a gap in knowledge regarding the effect of residential design, especially design of windows, on women's exposure to daylight. Therefore, Chapter 6 of this thesis will investigate this issue from the Saudi women's perception.

To draw further conclusions on this issue, this research needs to investigate window design and daylight factors in contemporary residential buildings. It needs to investigate how daylight levels in contemporary flats effect women's exposure to daylight and, as a result, their wellbeing. This research will address this knowledge gap and study window design and daylight in contemporary flats in Jeddah and how they affect Saudi women.

Chapter 4

Chapter 4 The Research Approach & Methods

4.1 Introduction

The previous literature review chapter discussed the theoretical analysis of architecture in Saudi Arabia, women's lifestyles and architecture and culture in Saudi Arabia and daylight requirements in interior spaces as well as the impact on occupants' wellbeing.

This chapter will describe the methods that will be used in this study in order to achieve the research aim and answer the research questions. Although the concept of daylight has been studied in previous Western literature, this research will critically evaluate the situation in terms of social-cultural differences in Saudi Arabia. To achieve the aim of the study, four areas need to be investigated:

- Changes in home design generally and window design especially in Jeddah from vernacular to contemporary times in relation to cultural needs and changes
- Women's perceptions regarding window design and daylight in living spaces with regard to the cultural need for privacy
- Window design characteristics and daylight levels in participants' living rooms
- Reasons behind current window designs from professionals' perspectives

4.2 Using multiple methods

From the literature review, it was found that there is no research that discusses women's perceptions in relation to daylight in contemporary flats in Jeddah. Therefore, research is needed to collect background information from women in Jeddah. Figure 4-1 shows the areas that need to be covered in this study.

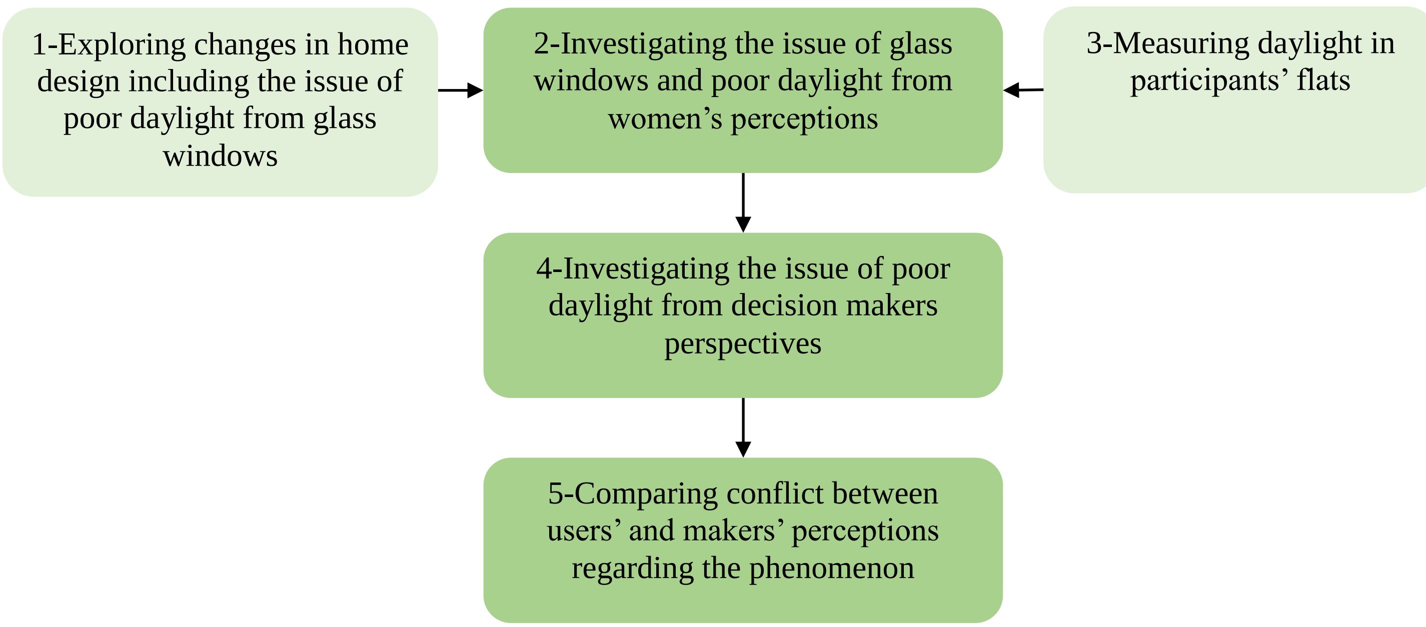


Figure 4-1 Data which need to be collected

To get all of this data, this study applies a qualitative and quantitative mixed method. Mixed methods research (MMR) is called "*the third methodological movement*" (Teddlie and Tashakkori, 2011, p.285). This methodological approach shows that the two common methods, which are qualitative and quantitative, are well-matched and can be very productively used in combination with one another (Brannen, 2005, Howe, 1988, Tashakkori and Teddlie, 1998). Johnson et al. (2007) have discussed 19 definitions for mixed methods eventually producing a composite definition:

"Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration" (Johnson et al., 2007, p.123).

Another definition for mixed methods is given by Hammersley (1996, p.167) "*what is being implied here is methodological eclecticism. Indeed, the combination of qualitative and quantitative methods is often proposed, on the ground that this promises to cancel out the respective weakness of each method"*.

In agreement with this definition, my study will apply a quantitative method in areas where qualitative verbal data could not provide clear and valid findings of accurate daylight measurements, in order to prove to decision makers how the detailed and precise data show that flat design needs to be developed in a way that takes into account the current situation for women in terms of weak daylight. The reason for using a quantitative approach arose from the realisation that professionals do not value arguments relying on women's opinions or experiences. Therefore, a stronger argument – in their eyes - could be achieved by valid measurements in Stage 3 as will be discussed later in this chapter. Also, since one of the aims of this study is to prove to policy makers that women's needs for daylight are ignored by decision makers, Stage 5 provides a valid statistical comparison between users' and decision makers' points of view. For this to be achieved, the research methods used in this research are divided into five stages as shown in Table 4-1.

Table 4-1 Mixed methods stages

	Approach	Method	Program or tool
Stage 1	Qualitative	Case studies on buildings	Photography AutoCAD Drawing
Stage 2	Qualitative	In-depth interviews with women	NVivo
Stage 3	Quantitative	Daylight measurements for female participants' living rooms	Diva for Rhino
Stage 4	Qualitative	In-depth interviews with professionals	NVivo
Stage 5	Quantitative	Comparison between Stage 2 and Stage 4 findings	SPSS

Although I planned to conduct a mixed methods study using qualitative and quantitative research methods, the qualitative method took up the major part of this study and it was carried out in three stages, while the quantitative method was used in just two stages of data collection. This methodological approach was chosen that could contribute to providing appropriate types of data to reveal different aspects of the social reality of women and daylight in homes as recommended by Moran-Ellis et al.

(2006). Utilising both qualitative and quantitative methods allowed an understanding of their social situation to be developed. Using qualitative in-depth interviews in two stages of data collection helped in terms of getting insight into women's experiences and professionals' perceptions regarding the situation; this revealed the complexity of circumstances at both the macro and micro levels (Kelle, 2001).

Table 4-2 describes the differences between qualitative and quantitative methods. It shows that qualitative methods can help in gaining the data needed as they are concerned with attitude and the meaning people give to certain issues or phenomena in their lives (Taylor et al., 2015, p.7).

Table 4-2 Differences between qualitative and quantitative methods (Groat and Wang, 2013, p.71)

Question	Qualitative	Quantitative
Nature of reality	Reality is subjective as seen by participants and researcher	Reality is objective; researcher is not part of it
Researcher and research	Researcher interacts with participants	Researcher is independent from participants
Process of research	Inductive exploratory and shaping factors	Deductive: cause and effect

Qualitative methods are significantly used in most research whether scientific or humanities-based such as geography (DeLyser et al., 2010), education (Bogdan and Biklen, 2006), business (Myers, 2013), health (Fatani, 2008, Harper and Thompson, 2011), psychology (Camic et al., 2003) and architecture (Groat and Wang, 2013). This method has been used to investigate individuals' or groups' perspectives and attitudes in relation to certain issues in order to understand the dimensions of place meaning and many other things. Qualitative analysis shows the similarity and differences in individuals' rich emotional relationships to specific places, which shows that the meaning of space develops from a perception of attitude and experiences whether positive and negative (Manzo, 2005).

"The phrase qualitative methodology refers to the broadcast sense to research that produces descriptive data-people's own written or spoken words and observable behaviour" (Taylor et al., 2015, p.7).

This shows that qualitative research is achieved by gaining data in a natural setting in terms of words rather than numbers; therefore, qualitative methods are mainly inductive (Kaplan and Maxwell, 2005, p.30, Taylor et al., 2015, p.4, Elliott and Timulak, 2005, p.147). This does not mean, however, that quantitative methods cannot be used in the same study where qualitative methods are used (Kaplan and Maxwell, 2005, p.30). Qualitative methods are more useful than quantitative in research focusing on issues that are not clearly divided into separate structures, or to explore the dynamics of an issue instead of static characteristics. This indicates that one of the advantages of the qualitative method relies on its accessibility in terms of understanding the hidden context of the research issue or phenomenon. It also helps in exploring the specific reasons or processes that have created this particular phenomenon over years (Maxwell, 2012, pp.87, 100).

To explore these issues, the researcher needs to collect data from written texts or rich conversationl, analysis of participant activities, and other artifacts of an individual's actions. Since qualitative data aim to understand a phenomenon from people's speech, these data can be analysed by returning to their inherent textual nature. If data are analysed using a quantitative statistical method, the aim of the qualitative method cannot be achieved (Maxwell, 2012, pp.23-30). This shows that qualitative methods have many advantages, as shown in Figure 4-2 which analyses the three advantages of qualitative research that are necessary for this study in order to investigate the problem.

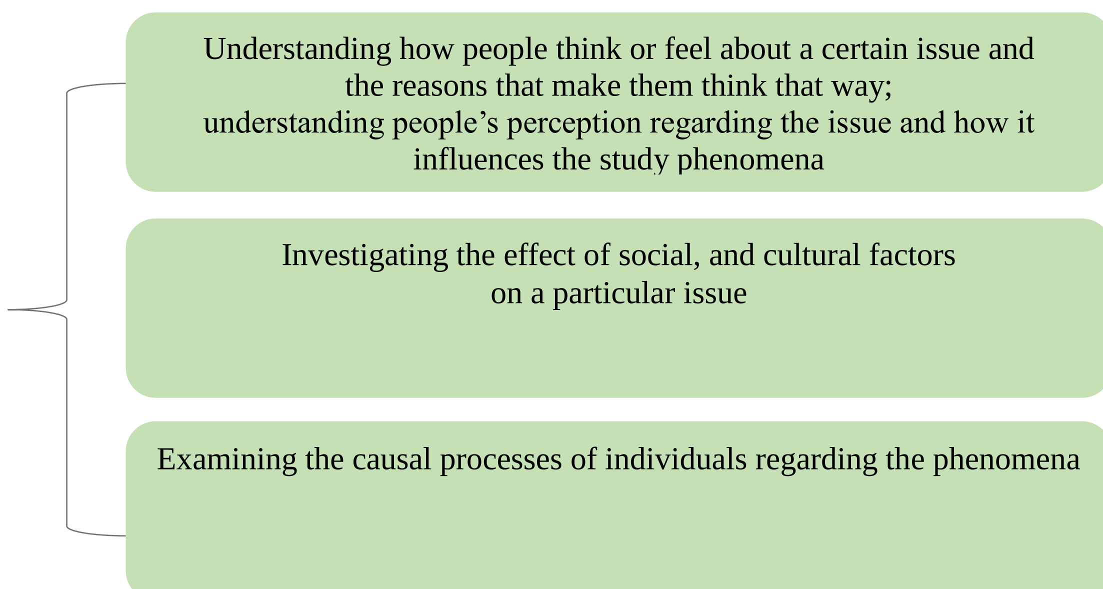


Figure 4-2 Advantages of qualitative research (Kaplan and Maxwell, 2005, p.31)

Hennink et al. (2011, p.5) discussed the qualitative approach by defining its cycle. Hennink et al. claim that a qualitative method starts with the foundation of the research, which is the design cycle. Then, it moves to the second stage, which is the ethnographic cycle obtained by data collection. Thirdly, it generates results from collected data which is considered the analytic cycle.

4.3 Interpretive approach

There are different types of approaches used in qualitative methods. Although these approaches differ significantly, they share some defining characteristics, features and objectives. Some of these approaches are broad and some are specific. Interpretive research is considered a specific approach (Cohen et al., 2013, Wolcott, 2002). "*Interpretive studies starts from our knowledge of reality, including the idea that the domain of human action is a social construction by human actors and that this applies equally to researchers*". (Walsham, 1993, p.56).

Since my study focuses on the specific phenomenon of women's perceptions of daily life as they are affected by poor daylight in contemporary flats in Jeddah, an interpretative approach was chosen to gain the necessary data for this research. IPA, Interpretative Phenomenological Analysis, is an approach used for qualitative research. IPA is specifically focused on psychological interest in terms of how an individual or group of people makes sense of their experiences of a specific phenomenon. In psychological research IPA is an idiographic focus, which means it offers insights into how each individual, in a given context, expresses his or her sense of a given phenomenon (Babones, 2016, p.101).

According to Babones (2016p, 453) Although qualitative research methods are often connected to interpretive approach, this approach is also used in analysing quantitative research methods. Generally, statistics are used in quantitative methodology to highlight unobservable data. In interpretive approach, results from quantitative methodology are analysed by integrating the statistical measurements into "*holistic process of discovery*". In this case, the researcher should think reflexively about the reasons that make the results that the research will obtain exists. This makes result from interpretive quantitative approach more understandable and have deeper meaning than conventional quantitative approach.

Qualitative interpretive approaches, by their nature, lead from one problem to another. As a result, the investigator will often find that methodological and ethical issues are inextricably interwoven in this approach (Cohen et al., 2013, p.69). In an interpretative approach, the author is required to make an in-depth investigation of a phenomenon of interest because it is necessary to discuss the subjective reasons behind social action. Therefore, interviewing people who are related to this phenomenon was deemed necessary (Denzin and Lincoln, 2011).

4.4 Interviews and observation

Data in qualitative studies are collected in different ways, yet, observations and interviews are considered to be one of the most common data collection methods for qualitative methods (Kaplan and Maxwell, 2005,p.39, Taylor et al., 2015, p.4). The interview is a common type of data collection (Cohen et al., 2013, p.409). There are different types of interviews in a qualitative study, for example structured interview, semi-structured interview, open ended, focus group interview and in-depth semi structured interview (Cohen et al., 2013, p.139, Hennink et al., 2010, p.108-110, Maxwell, 2012, p.29). The in-depth interviews involve individual one to one conversations, during which the researcher interviews each interviewee separately. This can be done at separate times and in different locations. The advantages of this type of interview are that the researcher can ask the participant about his or her personal information such as economic situation, lifestyle and culture or other factors that affect or guide the interviewee’s life. This may be not be possible in a group situation where interviewee are being asked questions in front of other people.

The other advantage of in-depth interviews is that the researcher has the chance to observe the interviewee’s reaction, body language and how they react to different questions (Hennink et al., 2010, pp.53-110, Kaplan and Maxwell, 2005, p.39). Since my study was with female participants at home and discussed each individual’s experiences in relation to her home, semi-structured in-depth interviews were used as a data collection method for this study.

4.4.1 Stage 1

In Chapter 5, the first qualitative method applied is case study for residential buildings in Jeddah. Case study method is used in my study in order to analyse the changes in residential design in Jeddah. Since the study focuses on window design, and daylight in living space, floor plans and façade designs were needed for this analysis to represent changes in residential building design from vernacular to contemporary. To achieve this, I went on a pilot trip for the first stage of data collection. Traveling to Jeddah and visiting all the residential districts in the city was the first mandatory part of the study in order to get a clear idea of the architectural situation in the city. Photographs of the exterior façades of buildings were taken for around 100 buildings in different residential districts see examples in appendix 3. Entering buildings was not possible since people live in them; therefore, dealing with real estate offices to have a chance to enter flats available for letting was necessary for this work. This was a great idea as it allowed the interior designs of flats to be assessed and compared and allowed, interior photos to be taken and flat floor plans to be drawn.

This stage helped to explore the architectural changes in the city from vernacular to contemporary. Three residential buildings were chosen to represent the changes in domestic design in Jeddah. One buildings' façade and floor plan were drawn to represent the common type of architectural design elements in these buildings.

4.4.2 Stage 2

After understanding the residential architectural changes in the city in general and in window design specifically, the second stage of data collection involved conducting semi-structured individual in-depth interviews with 23 Muslim Saudi females (aged 20–50 years) of different marital status, as will be discussed later in Chapter 5. All participants lived in contemporary flats in Jeddah city. The participants' financial situations meant they had between medium and above medium socio-economic status. They were selected using a snowballing technique, through social networks. The inclusion criteria for the study were that they should be female, because Saudi females — especially women who are not employed — tend to stay at home during the daytime. Also, female employment is still not accepted by some married Saudi men as discussed in chapter 2 (Elamin and Omair, 2010).

Jeddah city has the highest number of rental blocks of flats in Saudi Arabia (MOJ, 2015). The research focused on flats because they tend to be rented, so the inhabitants are not allowed to make changes to the flat design. Most people who live in a villa in Jeddah own the residence, so they have the freedom to design what they need. In addition, the building regulations for flats vary from those for houses. According to the Municipality of Jeddah, gaps between residential flat buildings should be two metres between the side and back of each building; however, the gap between villas should be four metres at the side of each villa (MOJ, 2015).

3.4.2.1 Sample size

Sample size has been discussed extensively by many researchers. According to Straus and Corbin (1998), sampling in both qualitative and quantitative research should focus on the aim of the findings rather than sample number, but, in this case, the study should not aim for generalisable stratified random sampling. In a qualitative study, the aim is not to secure confidence intervals for studied variables in a population. Rather qualitative research can involve interviewing either 8 or 100 people, and the aim is to interview deeply to ensure that all the important aspects and variations of the studied phenomenon are collected. Generalisability of a specific population is not one of the aims of qualitative research especially in in-depth interviews; therefore, a big sample is not recommended meaning the size of the sample is usually much lower than for quantitative research (Elliott and Timulak, 2005, Charmaz, 1990). Similarly, Crouch and Pearce (2012) mention that, since interviews for qualitative studies measure behaviour and people's perceptions of a phenomenon, qualitative interview methods do not expect or intend to include large numbers of participants. Deep or rich data from a small number of participants can be enough.

The IPA (Interpretative Phenomenological Analysis) suggests that a smaller size is preferable for a qualitative interview method as the aim is the quality of data rather than quantity. IPA implies that, when considering sample size, in addition to the research aim, the researcher has to consider level and context, time available and the resources of the researcher (Babones, 2016, p.101). Babones (2016, p.104) goes on to assert that the researcher can interview sample participants many times to gain more in-depth text instead of interviewing new participants to get more data; Babones claims that the depth is more important than the number.

In my study, the sample size was selected based on the methodological literature, which demonstrated that 20 to 30 respondents provided an adequate and appropriate number for in-depth interviews (Creswell, 1998, Mason, 2010). As qualitative analysis requires a smaller sample size compared to quantitative, in order to avoid data saturation, which occurs when the participants are no longer providing any additional perspectives or information, in my study, interviews stopped after 23 participants had been interviewed; at this time, enough data had been collected and I started to recognise that the answers were becoming repetitive.

Female interviewees were chosen according to the research question. This section aims to demonstrate women's perceptions regarding daylight and privacy in their living rooms during daytime. The interviews were face-to-face. However, in cases where this was difficult, I conducted interviews over the phone; conducting interviews by phone, Skype or email is considered to be a valid method (Brace, 2008). Participant comfort in answering the questions was important since it might affect the answers (Marshall, 1996). All participants lived in flats or had experienced living in more than one flat as shown in Table 4-3.

Table 4-3 Participants' abbreviations

Abbreviation	District name & floor level
L	A mother who had lived in 4 flats in Jeddah
N	A mother who had lived in 5 flats in Jeddah
y	A mother who had lived in 4 flats in Jeddah
So	A mother who had lived in 3 flats in Jeddah
A	A mother who had lived in 3 flats in Jeddah
E	A housewife who had lived in 3 flats in Jeddah
Du	A mother who had lived in 2 flats in Jeddah
F	A mother who had lived in 2 flats in Jeddah
Ash	A mother who had lived in 2 flats in Jeddah
D	A mother who had lived in 1 flat in Jeddah
H	A mother who had lived in 1 flat in Jeddah
Heb	A mother who had lived in 1 flat in Jeddah
J	A mother who had lived in 2 flats in Jeddah
M	A mother who had lived in 2 flats in Jeddah
Na	A mother who had lived in 2 flats in Jeddah

Sh	A mother who had lived in 1 flat in Jeddah
Su	A mother who had lived in 1 flat in Jeddah
Al	A mother who had lived in 1 flat in Jeddah
Han	A mother who had lived in 5 flats in Jeddah
O	A mother who had lived in 1 flat in Jeddah
Ra	A mother who had lived in 4 flats in Jeddah
R	A mother who had lived in 2 flats in Jeddah
Z	A mother who had lived in 1 flat in Jeddah

Interviews took place from May 2016 to August 2016 because this is the summer period in Jeddah. The summer period was chosen as this has the longest sunlight period compared to other seasons, and was thought to be the most appropriate time to discuss with females their perceptions of the daylight in their flats. The interviews took place in the females' current residences. Each interview lasted between 30 and 60 minutes, based on the participant's views on the subject. An explanatory introduction was given at the start of each interview.

3.4.2.2 Type of questions in interviews

As a qualitative study aims to understand the way others construe, perceive, and make sense of a particular situation or phenomenon, the researcher should ask questions that make him or her familiar with participants' everyday activities, habits, culture, daily routines, and attitudes (Kaplan and Maxwell, 2005, p.36). This is in agreement with Berg (2004, p.200) who advises that questions starting with "what", "why" and "how" help in understanding a situation from the user's perspective clearly. These types of question help the investigator to understand the factors, issues and problems that bother individuals in certain areas. It also helps in understanding how these problems affect an individual's life. These questions are divided into three parts. Firstly, the main question should help participants to respond to the research concerns from their experiences and perspectives. Then, the exploratory questions should help in getting deep, focused and detailed evidence. There should be follow-up questions that pursue certain issues introduced by the interviewees. Hence, the researcher should take into consideration the need to remain on topic to prevent losing time in non-related conversations.

Similarly, Denzin (1997) reports that the interview questions that allows researchers to understand people's daily life experiences is highly recommended and it should be carried out in clear everyday language. Therefore, the first part of my interview questions asked women about their daily activities: where they sit, how long they sit for, why, what activities they undertake in the living room, how these activities are affected by daylight. Then, it went deeply into the research phenomenon of poor daylight.

At the start of the interview, it is also important for the researcher to be familiar with the language or specific accent used by people who participate in the study.

Knowledge of the participants' language and the cultural background that guides their behaviour helps in identifying key concepts and values. It also helps the researcher to present findings in terms meaningful to the participants (Kaplan and Maxwell, 2005, p.36).

In my case, knowing the culture had implications for participants' answers; though interviews were conducted in the Arabic language it would not be an easy task for a non-Saudi researcher to conduct the interviews since Saudis use different typologies and accents for most of their expressions from one city to another. Also, being a female researcher made it possible to visit women inside their homes and carry out in-depth interviews. This would be impossible for a male researcher since the research required discussion of women's daily lives of inside their homes, and questions from a male researcher would not be sanctioned by most male guardians.

It was also an aim of the study for participants to be interviewed in their homes where possible in order to compare their answers with their home design. I also took photos of living rooms and windows as potentially valuable sources of qualitative data (Kaplan and Maxwell, 2005, p.40). This observation was important for me later in the data analysis in addition to the observations of women's reactions and body language during interviews.

3.4.2.3 Coding

Getting participants' permission to record the interviews allowed me to interact with participants to help them express and elaborate more on their answers, which would not have been possible if answers were immediately written down. It was very important to consider the different tones and expressions of participants during their speech. This was achieved when reviewing the recordings and making notes. Also, writing the transcript out helped in coding and finding different themes. After listening to the recordings in Arabic, I transcribed the answers into English immediately. Full transcripts were written after each interview in addition to my comments. The Nvivo programme was used to analyse data. Nvivo is software designed for qualitative data analysis as it can allow deep analyses for rich text-based data.

There are different techniques for qualitative data analysis such as coding, analytical diary or memo, displays such as tables or flowchart, and contextual or narrative analysis. The researcher can choose all of them in the same study or just select one or two. These types of analysis help the author to identify themes for collected data and explore similarities and differences in the data, and relationships among them (Kaplan and Maxwell, 2005, p.43).

As with most qualitative research, in this study the starting point for findings was common issues arising in the interviews. Others were discovered during data analysis and finally research objectives. Comparison between age groups and flat floor levels and districts was undertaken. Therefore, coding was applied according to similarities and differences. The unique findings arising from the coding are considered to be one of the primary data analysis stages for qualitative methods (Cohen et al., 2013, pp.216-229, Denzin, 1997, Kaplan and Maxwell, 2005, Hennink et al., 2010). Coding analysis begins at the level of the individual case and involves line-by-line analysis. Coding is partly about highlighting the main ideas to allow the researcher to continue with a more systematic and consistent focus (Babones, 2016, pp.105-106). In addition to coding, in this study, tables, memos and images for participants' flats were used to support findings and to provide clear images of each situation.

4.4.3 Stage 3

This stage was not planned as part of to take place later in the study, but when Stage 4 was undertaken immediately, it became apparent that that the professionals involved in this study do not value arguments based on women's opinions or experiences. Many professionals repeated the same sentences: "*Teach women first before asking them"* or "*They do not know what adequate daylight is as we know".* Therefore, a stronger argument – in their eyes - was needed from valid measurements of daylight in participants' living rooms, which was achieved in this stage using a quantitative method.

A reliable set of quantitative data analysed data was used to analyse the lux level during daytime. This helped to provide a clear understanding of the accurate amount of daylight that entered living spaces during different hours of the day. Researchers have applied two different methods for measuring daylight in interior spaces. Some researchers who have measured the light on-site or using a scale model (Ruck et al., 2000, Ahmed, 2000, Husin and Harith, 2012). However, there are advanced computer programs that are commonly used these days to do the same job.

Currently, researchers use a light calculation computer program such as DIVA-for-Rhino (Garcia Hansen et al., 2012, Hegazy et al., 2013, Hegazy and Attia, 2014, Mahmoud and Elghazi, 2016, Mohsenin and Hu, 2015, Yun et al., 2014). DIVA-for-Rhino is a plug-in that provides an optimisation for daylight and energy. It was initially developed at the Graduate School of Design at Harvard University. It provides different evaluations of environmental performance in buildings and urban landscapes, one of them being Climate-Based Daylighting Metrics, which was needed for this study .Therefore, in this research, the DIVA–for-Rhino computer program was used to obtain the data needed for this stage.

Window size in 15 participants' living rooms was analysed in detail as will be discussed in Chapter 7. Participants' with no windows in the living space or with small windows facing the light well were not included in this stage as it was clearly observed by the author how dull their living rooms were during the interviews. The Diva-for-Rhino calculations were carried out at four different times of the day: 10am, 12pm, 2pm and 4pm in relation to sun movement. Daylight lux levels were calculated for these hours for day 15 of the middle month for each season of the year. Thus, the calculation was done for 15th January, 15th April, 15th July and 15th October. Analysis was done for flats from the first to fifth floors with daylight of less than 100 lux in the entire living room and in 50% of the living room.

4.4.4 Stage 4

Getting accurate and valid measurements for daylight through Diva-for-Rhino provided additional evidence of the current situation of lack of daylight which supported females' claims in the second stage of data collection. Therefore, this was the right time to investigate the factors behind daylight levels in the living rooms of contemporary flats in Jeddah and women's perceptions of the situation from professionals' points of view as will be discussed in Chapter 7. This stage returned to the qualitative method of data collection through interviews with decision makers such as architects, professors in architecture and a municipality officer.

This study included 10 semi-structured in-depth interviews which were conducted with six architects, three professors of architecture and one municipality staff member, as shown in Table 4-4. A snowballing technique was used in addition to the researcher's social network to reach the interviewees. With regard to qualitative data, the aim was for quality rather than quantity, based on the question "*Who are the right people to be interviewed?*" (Onwuegbuzie and Leech, 2005). All participants worked in Jeddah. Architects who had designed a number of residential flat buildings in Jeddah were targeted. This was because building regulations for flats vary from those for houses. For instance, the gap between buildings was one of the major issues for discussion.

Interviews took place from December 2016 to January 2017. Each interview took around one hour, either in the architect's offices when meeting architects, or in the university where the professors worked. An explanatory introduction was given at the start of each interview. The interview questions were divided into three parts. The first part discussed the municipality building regulations that guide flat design in Jeddah. The second part investigated architecture as a job in reality and the factors that affect flat design in the job. The third and last part of the interview discussed in detail daylight in contemporary flats in Jeddah. All participants were very cooperative and were interested in the subject.

Table 4-4 **Professionals' abbreviation and experience**

Abbreviation	Architects
1. Y	Architect working in Jeddah for 20 years
2. B	Architect working in Jeddah for 30 years
3. H	Architect working in Jeddah for 35 years
4. N	Architect working in Jeddah for 30 years
5. s	Architect working in Jeddah for 30 years
6. O	Architect working in Jeddah for 20 years
Academics	
1. M	Professor in architecture working in Jeddah for 20 years
2. A	Professor in architecture working in Jeddah for 10 years
3. F	Professor in architecture working in Jeddah for 10 years
Municipality Staff and Landlord	
1. MA	Staff member working in municipality and stakeholder and architect for 31 years

As for the Stage 3 coding, the interviews were recorded, then the transcript was written up and analyses were carried out in the NVivo program for each participant. As with most qualitative research, findings started from issues mentioned in most interviews. Others were discovered during data analysis and, finally, from the research objectives. After that, a coding process began with coding divided into two tables. For instance, one table compared architects' answers and similarities and differences between their answers. The other table contained the same thing for academics. Then, it was clear from the coding that the architects' codes had many similarities, and the same for the academics as will be discussed in Chapter 7.

4.4.5 Stage 5

In Chapter 7, the final stage included a comparison between findings in Stage 2 and Stage 4. Major findings in Stage 2 and Stage 4 were converted from text paragraphs into points. This stage aimed to show a statistical discrepancy between users' and decision makers' points of view. The chi-square test in SPSS program was used to determine if there is a significant difference between users' and decision makers' point of views. SPSS is widely used in social sciences. It can perform complex data analyses with simple instructions (Foster, 2001, pp.1-5).

4.5 Pilot trip

The pilot study involves pre-study before a full final study. It also refers to the pre-testing of a research instrument such as a questionnaire or interview (Van Teijlingen and Hundley, 2001, p.182, Baker, 1994). In order to collect the major research data for my study, which required photography of buildings, drawings of floor plans, interviews and observations with participants in their homes, a pilot trip was mandatory for this study (Van Teijlingen and Hundley, 2001, p.182, Baker, 1994). The major purpose of conducting this pilot trip, which took place between May 2016 and January 2017, was to find a common design for contemporary flats in Jeddah and the reason for lack of daylight in living spaces, women's perceptions regarding their flat design, especially in terms of windows and daylight, and how decision makers see this issue.

In agreement with DeVaus (1993, p.54), the researcher should avoid risk by conducting a pilot test first. This risk was avoided in the first month of the pilot study when a pilot test for interviews with females and with decision makers was undertaken. It became apparent that interviewing decision makers was more difficult as they refused to talk about the issue since there was no statistical evidence for the argument that there were poor daylight levels in living rooms. Therefore, pilot interviews with decision makers were not undertaken until the data analysis for the first, second and third stages of data collection had been completed.

In the first stage of the pilot trip, photos of building façades in all Jeddah districts were required and unrented flats had to be visited in order for interior photos to be taken. In this stage, my father was my main supporter. Since women are not allowed to drive in Saudi Arabia yet, I usually rely on a driver or any male member of my family to drive the car. As a result, I do not know roads and districts well. Therefore, I asked my father to join me in this journey which took around one month. It was a difficult journey for many reasons. Firstly, traffic took up a lot of time going from district to district. Secondly, I needed to stop at each street from a specific corner and get out of the car to take photos, which was unusual for a woman in the Saudi context. I had to wait for cars to move and the street to be empty so I could take the photos comfortably. Thirdly, my father needed to ask permission from all building porters or real estate offices in the area to be able to go inside any empty flat and take photos. Finally, the most difficult thing was the weather; I did all the photography in summer in 40^{o} degree weather.

Coming from a Saudi background, it was apparent to me that the second stage of the study, which was interviews, would be more difficult. I knew how difficult it would be for me and for a participant to accept the idea of interviews and entering strangers' homes. In Saudi culture each women must have a legal male guardian as mentioned in Chapter 2. Women need to have his approval before making many decisions. For most families, the male guardian's approval is required even for small daily life activities such as going to a mall or visiting a friend. Since I am a Saudi female, I know that both the participants and I had to have permission from our guardians. I needed my father's permission to enter unfamiliar women's homes, and participants' needed their husbands' or fathers' permission to accept me into their homes. Additionally, I confirmed that all participants made sure that all males in their families were away from home while I did the interviews since this is part of the culture, as my father would not be with me during the interviews. This was the first issue relating to the interviews with women.

However, when I interviewed the architects my father had to be with me during the interviews especially with the architects since they were men. He allowed me to go alone when I interviewed academics since men are not allowed to enter women's universities in Saudi Arabia.

The first interviews, with the women, were not easy to set up as it was hard to ask women to participate in these interviews. To be able to get people to know me and my work, I did something new. I used my social media account to provide free architectural and interior design consultations for residences only. People were so happy with this service especially since it was free, and it is hard to get a free consultation these days. I had two aims for this free service. Firstly, I wanted to know if my research arguments were right. To achieve that, I asked followers what issues they suffered from in their homes and what they needed to achieve. This part was not included in the ethics and I did not include any of the data I got from this free service in my research. The second aim of this service was to make contact with people, so that I could ask them to participate in my research and be received in their homes to interview them. This experience was a very unique experience in my Ph.D study. It helped me not only in my study but it also opened new doors for me. I was named by the ambassador of Saudi Arabia in the United Kingdom as one of the excellent Saudi students in the UK in 2016 for my high marks during my study in the UK.

In agreement with AlKhateeb (2015, p.88) "*The pilot phase was conducted to test the validity of the designed questions. That phase had two main benefits: assessing the efficiency of the designed questions on one hand, and on the other hand it was a practice phase for the researcher, where interviewing skills and methods were explored.*"

When I began to study in the United Kingdom, I was planning to use a questionnaire as the main research method since this type of method is the most common In Saudi Arabia. However, I learned, while studying in the United Kingdom, to perform interviews since they were more suitable for the research aim. At the beginning, it seemed uncertain whether this was the right approach to take since it is not easy to interview people in Saudi culture. During this stage, I practiced my skills as an interviewer for the first time. After the interview stage, it became apparent that, without interviewing people and chatting with them, the reality of their situations would not have been obvious.

After contacting women and getting their permission for the interviews the real research journey began. There were many obstacles. For instance, some women were not committed to the interview time. On the way to the first interview, a message was sent by the participant saying that she could not make the interview, and she wanted to postpone it to the next week. The interview was rearranged for the following week. Another participant slept through and forgot the interview time. She was not answering calls just before the designated interview time when I was trying to pinpoint the whereabouts of her flat. After 30 minutes she called back and apologised. She was very polite and very welcoming with a lot of apologies for her mistake.

At this stage of the research there were difficulties encountered in relation to the heat. It was extremely hot in the summer in Saudi Arabia, when the interviews were taking place, in relation to finding the residences of the participants and in relation to organising female relations to accompany me for cultural reasons. This involved a lot of waiting time for female relations while the interviews were carried out and raised particular problems, like the participant oversleeping. It was hard to convince my sisters to wait for me with these delays. My father allowed me to carry out these interviews under the condition that two of my sisters came with me. One of them knows the roads well, so she helped me in explaining to the location to the driver. Since it is not polite to take my sisters with me into participants' homes, they had to stay in the car. According to my father's rules, a woman should not be alone with the driver in the car. Therefore, my other sister had to come and stay with her one for an hour in the car waiting for me.

Using Google maps for the location in Jeddah is not accurate. For most of the interviews, the correct district could be reached, but it was hard to find the participant's building. Therefore, I had to call participants to get clear instructions for the locations of their buildings, which was not easy. All the interviews were carried out in the morning and afternoon in order to be able to take photos of daylight in all the participants' living rooms. The happiness I felt after achieving each interview make made me forget what I had suffered before the interview. The second set of interviews was much easier since my father was with me, and he knows knew the locations very well without using GPS.

Also, architects' offices are usually in famous commercial buildings, so there was no need for road descriptions. The interviews with academics took place in famous universities. Professionals were also very committed to the timetable and very cooperative.

4.6 Ethical considerations

Ethics is a major consideration for scholars especially in qualitative studies since they involve human participants in their daily life environment (Miller et al., 2012, p.2, Richardson and McMullan, 2007, Orb et al., 2001, Cieurzo and Keitel, 1999, pp.63-75). As the protection of humans in any research is mandatory for ethics (Orb et al., 2001), one of the major ethical aims is to shield participants from exploitation, harm and coercion (Richardson and McMullan, 2007, Orb et al., 2001). Also, human privacy should be respected by a researcher as a human right. Ethics also aims to shield the researcher from harm or facing any difficult situation (Orb et al., 2001).

Allowing participants to freely discuss their perceptions regarding the study and issues they suffer and their requirements has three advantages. It provides knowledge of the research area and it gives their voices a platform to reach society and policy makers. In order to start the data collection, ethical approval was applied for and the university approved the study. This approval ensured that, as a researcher, I was aware of my responsibility toward research data and participants' rights. Anticipated ethical issues were addressed in the ethical approval including the safety of both the researcher and participants, and participants' knowledge of the nature of the research and their right to withdraw at any point in the study. According to UK ethics protocols, data has to be stored in a secure and safe place, so no one can see them except the researcher.

The only condition for this study was that, in the interview, all the names of participants who were interviewed were anonymised for this research. An initial is used to represent each participant instead of her or his name, as shown previously in this chapter in Table 4-3 and Table 4-4. These abbreviations will be used to represent each participant's answers or discussion in my study. This helped to give the participants the comfort to elaborate more in their answers.

At the start of the interviews, it was not clear if participants should be informed of the research aim. This point about whether or not to tell participants about the research aim has been studied by many authors. For instance, some authors support this idea (Oppenheim, 2000, Rubin and Rubin, 2011). Other authors argue that participants should not know the research aim because it might affect their answers (Edwards, 1993). Both opinions seem valid, but, for this study, it seemed ethically more suitable to provide a short introduction regarding the research aim. Therefore, participants signed a paper describing the scope of the study and the interview intentions before starting the interviews. Women had to have permission from their male guardians in order for photos of their homes to be taken. Providing women with this short introduction made them comfortable. They also gave permission for their voices to be recorded during the interviews.

4.7 Conclusion

This chapter has shown that all data for this study are primary data. This was necessary due to the differences in weather and culture from previous published research on similar issues. Since there was no data in the previous literature regarding daylight and women's perceptions of daylight in contemporary architecture in Jeddah, this chapter discussed the methods used to collect primary data for the study. In order to answer the research question and test the research hypothesis, this chapter has discussed how a mixed method was chosen for this study. A definition of each method has been explained in this chapter in addition to their similar and different characteristics. Advantages of a qualitative method were discussed to show why this method was chosen as the most common method for data collection.

This chapter has shown in detail the process of how each method was applied to collect primary data for the study. It explained the importance of ethics for this study and how approval was obtained. Obstacles and difficulties that faced me as an author have been discussed clearly in this chapter in the pilot trip section. The following chapter will be the first chapter to discuss the data finding in this study.

Chapter 5

Chapter 5 Transitions in Jeddah’s Residential Architecture

5.1 Introduction

Since this research studies daylight in Jeddah’s flats, the first section will discuss the transition in residential design in Jeddah from vernacular architecture to contemporary architecture. Blocks of flats are the most common architectural type in Jeddah city. In total, 719,305 blocks of flats are occupied, which is the highest density of flats in Saudi Arabia (Statistics, 2016). They are inhabited by families from various financial backgrounds. Therefore, the purpose of this chapter is to compare different residential designs and cultural changes in Jeddah in terms of façade design, flat floor plan, type of family in the home and privacy and social interaction. The chapter will focus on window design since it is the major source of daylight in interior spaces, which is the main topic of this study. This will be achieved by selecting a building that represents a common type of flat design in each period after making a survey of around 100 buildings in all the residential districts in Jeddah.

My literature review in Chapter 2 clarified the importance of cultural need for privacy in vernacular architecture and classified architecture in Saudi Arabia as vernacular and contemporary. This chapter will provide an overview of residential design in Jeddah and how apartments and windows are designed in relation to privacy. It will discuss the changes in home design from vernacular to contemporary in Jeddah.

5.2 Case study of a vernacular home in Jeddah

Vernacular architecture was the dominant type of architecture in Saudi Arabia from 1932 to 1950 (Saleh, 2002). It was characterised by many distinctive factors, which can be summarised in two main groups: the environmental aspects and the physical aspects. The former includes principles of climate control, use of local resources, and smart use of available assets such as daylight or the significant temperature variation between day and night, and the search for passive systems to allow internal comfort indoors (Abu-Ghazzeh, 1994, Abu-Ghazzeh, 1997, Abu-zaid, 2013, Al-Jawahrah, 2002, Alsaleh, 2008). The latter includes a system of shapes, materials and use of space that are deeply connected to the local culture and religion (Abu-zaid, 2013, Al Surf et al., 2012, AlKhateeb et al., 2014, Bahammam, 1998). Although vernacular Saudi architecture shares common features across the country, there are significant variations from region to region as discussed in Chapter 2.

Understanding the architectural identity of each region requires an examination of a combination of factors. Some authors have focused on major sustainable architecture in different regions. For instance, the Roshan window, which is a common element in vernacular architecture in Jeddah, has been studied by many Saudi authors such as Hariri (1991), Al-Jawahrah (2002), Al-Murahhem (2008), Abu-zaid (2013), Adas (2013) and Kamal (2014). Façade design in different Saudi regions is affected by many factors, for instance, climate, culture and available materials as discussed in depth in the literature review. However, many authors argue that building identity no longer exists in contemporary Saudi architecture, as it does not take account of cultural needs (Al-Ibrabim, 1995, Kahn, 2013).

In vernacular homes in Jeddah, four to seven families used to fit in one residence from the grandfather and grandmother to the grandchildren as shown in Figure 5-1. The extended family, not just the nuclear family, used to live in one home. The father allows all of his married sons to live with their families in the same home. The building had four floors and one or two entrances. It contained up to 23 rooms. There could be more or less according to the family's financial situation and number of members in the family. All the blue squares in Figure 5-1 represent bedrooms. Each nuclear family had one private bedroom and one bathroom. The home also contained a roof, which was occasionally used as a bedroom, mainly in the summer. The extended family shared a kitchen as well as the reception, living and dining areas. The reception room had to be the biggest room in the home since receiving guests is a major part of the Saudi culture. In addition to extended family members, relatives who come from different cities for a short vacation were welcome to stay in the same home.

The most common distinctive element in vernacular architecture in Jeddah is Roshan. It comes in different colours, either brown, blue or green. This window covers the façade from top to bottom, or it might cover one floor only. It is made of wood since aluminium and glass did not exist at this time (1932-1950) in the city. The window has many functions; not only does it provide daylight, but it also allows those inside to have visual contact with the exterior. This type of window provided women with privacy from street pedestrians who could otherwise see inside. However, Chapter 6 will provide unexpected information about Roshan from female users' points of view.

Figure 5-1 (Left) Floor plans for vernacular architecture in Jeddah, (Source: Old Jeddah Municipality, 1984); (Bottom right) vernacular façade in Jeddah, (source: author)

Bedrooms and reception rooms

Living space

Roshan

Since Roshan is originally made of wood, its colour is brown in most buildings. However, during the pilot trip for this study, it became apparent that Roshan has different colours such as brown, blue and green as shown in Figure 5-2. I questioned the guide on the educational tour regarding this point since entering a vernacular building in old Jeddah is not allowed without the permission of the municipality and the presence of a guide, who has full information about the history of the area. As the official tour guide had spent time with elderly people who lived in this area and some of them were carpenters who built most of the Roshan in the area, it is known that the blue colour was used for people who work at sea as Jeddah is a coastal city. The green colour came into existence after King Abdul Aziz added the Hejaz area to the Kingdom of Saudi Arabia. The Saudi flag is green. Therefore, some people coloured their Roshan green to express their attachment to the nation. Finally, brown remained the dominant colour in most buildings.

In addition to the colour of Roshan, its pattern varies from one building to another, according to the names written outside each home and to its room numbers and location. Additionally, the more patterns and details in the Roshan, the richer the family. People with low incomes have small and simple patterns and designs of Roshan as shown in Figure 5-3. On the other hand, homes for rich people show hugely detailed Roshan that covers the whole façade. Roshan in these buildings has a very detailed design as shown in Figure 5-2.

Figure 5-2 Roshan with different colours and patterns

Figure 5-3 Small and simple design

5.3 Case study: contemporary architecture in Jeddah

In 1950, a form of contemporary architecture appeared in Jeddah (Saleh, 2002). It became popular by 1970 due to oil boom as discussed in detail in chapter 2. It replaced Roshan with glass windows, which lack privacy. Women cannot sit next to the glass window and look out onto the street. Alhumaidi (1996) defines privacy in domestic architecture as protection from being seen by one's neighbours. Contemporary architecture in Saudi Arabia, with the concept of looking outward, creates a lack of privacy for occupants. This allows neighbours to see one another from their windows.

Contemporary domestic buildings in Jeddah can be analysed into two categories. The first category started in 1950 and the second started in 2005 due to changes or updates in building regulation (MOJ, 2015). In the first categories, simple façade design started to appear in contemporary architecture as shown in Figure 5-4 and Figure 5-5 . Windows have no pattern or decoration, and they are also smaller in size than the traditional Roshan. In addition to windows, balconies were a common element in most contemporary residences. Figure 5-4 and Figure 5-5 show how balconies are covered totally, which shows that they are not used as balconies as will be discussed critically in Chapter 6 and 8.

Figure 5-4 Contemporary building's façade in Jeddah (category 1 sample 1)

Figure 5-5 Contemporary building's façade in Jeddah (category 1 sample 2)

In addition to windows, after documenting interior flat planning, I realised that building an entire house for an extended family does not match with contemporary lifestyle in Jeddah. In some cases, extended families live in one building as will be discussed later in chapter 5. Unlike the vernacular architecture, in the contemporary architecture, parents live in one flat in a building and each son lives in a separate flat in the building after marrying. This allows more privacy for the nuclear family since they do not share rooms with other members of the family. A nuclear family is the name given to a modern family that has its separate place away from the rest of the world extended family (Ozbay, 1999).

In the first categories, the building contains two flats per floor. Each flat has around five rooms, a living space, kitchen, and two or three bathrooms as shown in Figure 5-6. Since windows can no longer be used by female inhabitants to enjoy looking at the street, reception rooms face the façade since guests visit people at night, so windows have no function at this time.

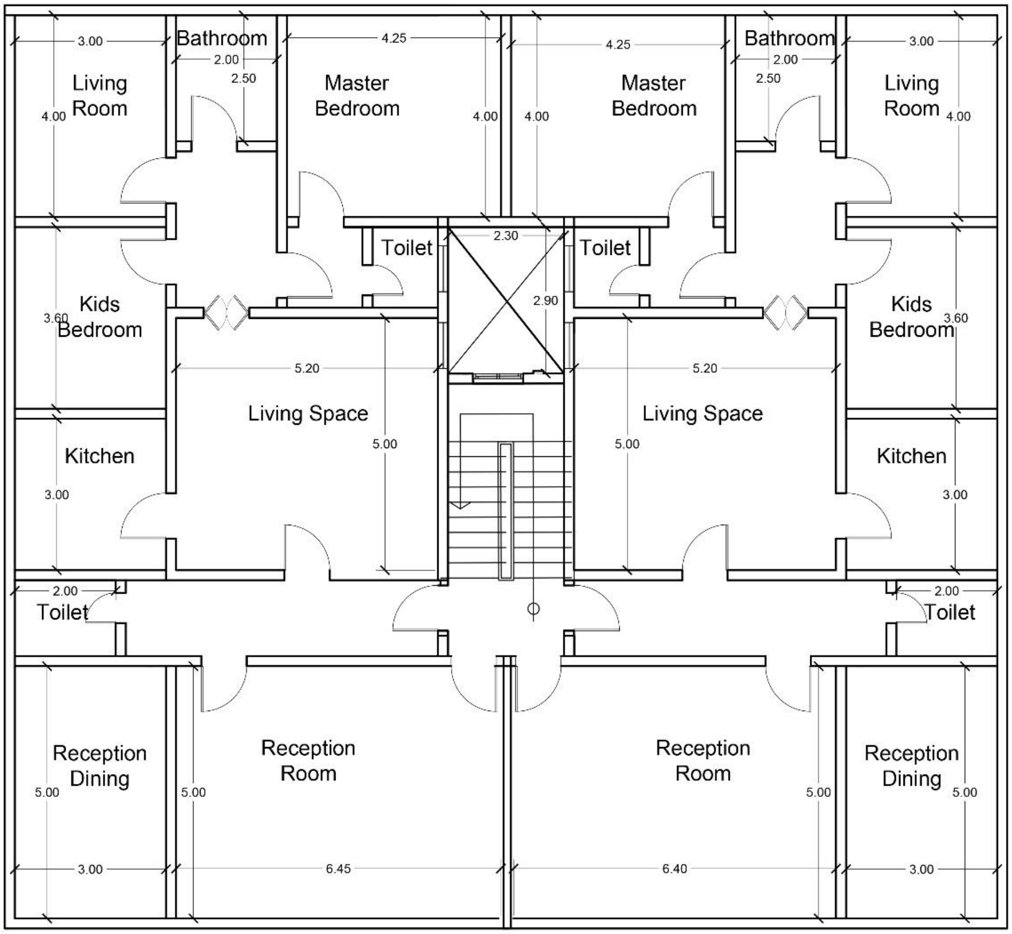


Figure 5-6 Floor plan of Contemporary block of flats (category 1)

The second category, which started in 2005 due to the update in building regulation, contains similar characteristics to the first one. However, Islamic patterns and arches started to appear again on a big scale on façades as shown in Figure 5-8. Other than façade pattern, changes were mainly in terms of flat sizes and number of rooms as shown in Figure 5-7. Buildings began to have six floors instead of three floors. Floors from the first to the fourth floor started to have four flats instead of two. Rooms in the flat were reduced from five to three on these floors, which made room sizes smaller than in modern flats. Flats contain three rooms, kitchen, living space, and one bathroom or one toilet. It is also found that some buildings have five rooms per flat by reducing room sizes more.

In the case of three rooms per flat, this contradicts the need for privacy and hospitality as discussed in Chapter 2 which indicated that privacy between females and males in reception rooms is required and privacy between genders within family members is required in sleeping areas. In the case of families with children of both genders, only one bedroom is available for them during this period. This point will be highlighted when discussing women's perceptions in Chapter 5.

It is worth noting that in the case of roof flats on fifth and sixth floors, which started to be built after 2005 (MOJ, 2015), each flat is only allowed to take up 50% of the block's ground floor footprint, and the rest has to be an open roof. This leads to occupants using the rest of the space as a roof garden. Other than the roof, replacing the ground floor with parking and the building's entrance instead of having flats on the ground floor represents a major change in the architecture from 2005 as shown in Figure 5-8. This method was inspired by one Le Corbusier's five points (pilotis) modern architecture, which was introduced in 1930 (Leuthäuser, 1990).

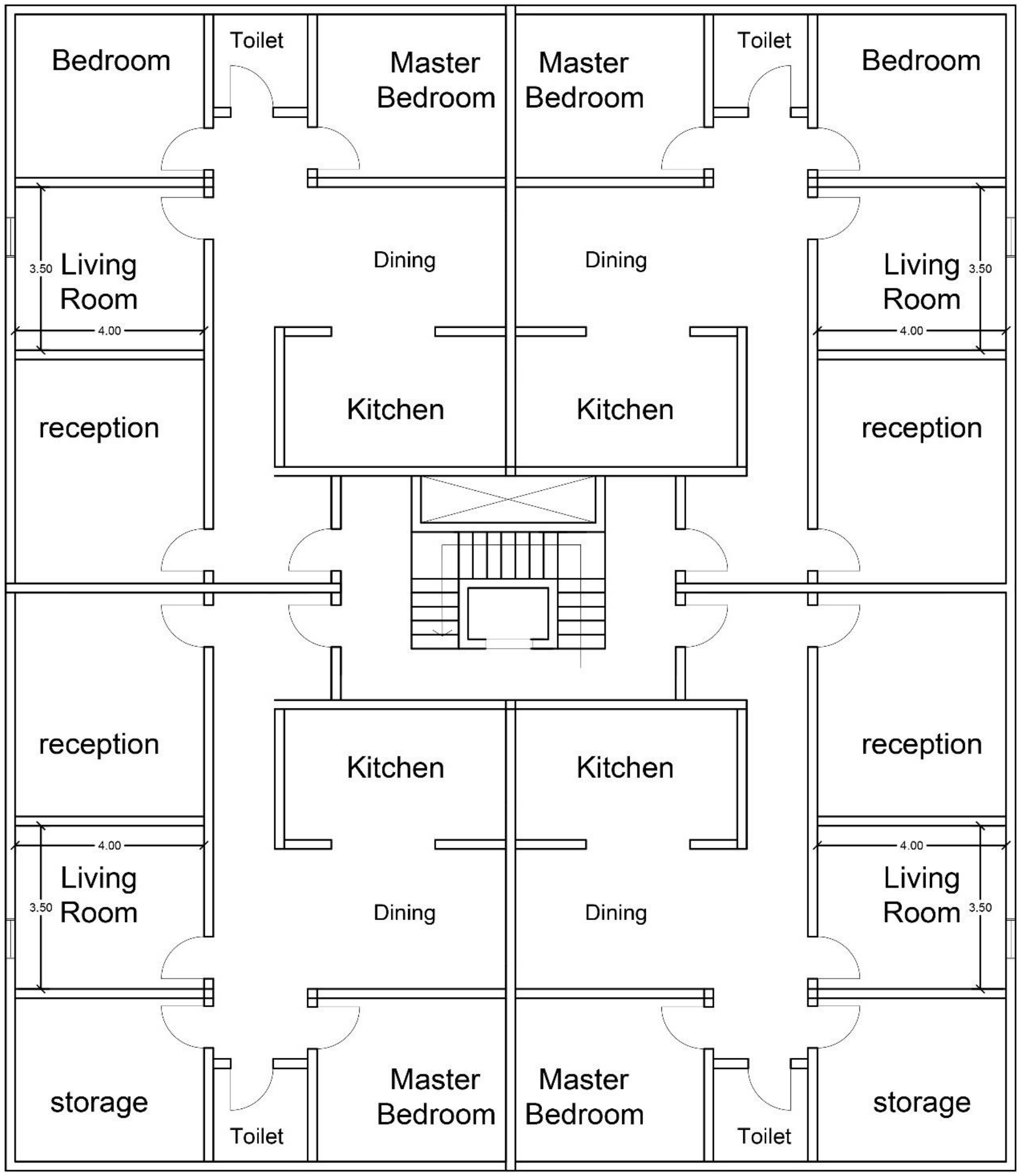


Figure 5-7 Floor plan for Contemporary block of flats (category 2)

Figure 5-8 Façade for Contemporary block of flats (category 2)

Table 5-1 Comparison between types of home architecture in Jeddah

	Vernacular Architecture	Contemporary Architecture	
		Category 1	Category 2
Type of members per home	Extended Family Grandfather to grandchildren	Nuclear Family Parents and children	Nuclear Family Parents and children
Type of Privacy	1-Privacy between genders in extended family members 2-Privacy between guests and family members 3-Privacy between inhabitants and street pedestrians	1-Privacy between adult genders in nuclear family 2-Privacy between guests and family members	3-Privacy between inhabitants and street pedestrians
Number of floors	4-7 *According to financial level	Half of a floor	Quarter of a floor
Number of rooms	10-23	5-6	3-5
Façade Design	Islamic pattern	Simple geometrical lines	Islamic pattern
Window Design	Roshan	Square or rectangular	Square or rectangular
Window Material	Wood	Glass	Glass

Table 5-1 shows architectural design characteristics in Jeddah's homes from vernacular to contemporary. It shows clear variation in architectural designs in terms of window shape, material, member of family, and the type of privacy needed.

5.4 Conclusion

Within the framework that is discussed regarding vernacular and contemporary architecture, the perception of privacy has changed, which has created a series of positive and negative circumstances. Positively, each nuclear family has privacy from the extended family in contemporary homes. However, privacy between the residents and street pedestrians is lacking due to the use of glass windows. This is a result of the development of new materials and design ideas in the contemporary architecture.

This chapter has shown that the notion of privacy has changed dramatically in homes in Jeddah in the period from 1932 to 2016. Privacy between the interior and exterior is neglected, though it is mandatory in Islam. Having glass window does not mean occupants do not need or require privacy, as will be discussed in the next chapter detailing the in-depth interviews with home occupants, especially women. Additionally, Chapter 7 will discuss the type of glass that is used in each participant's flat and how it affects daylight levels and privacy. However, the reason for the disappearance of daylight and privacy through the use of glass window will be discussed in Chapter 8 with reference to the in-depth interviews with home designers in Jeddah.

Chapter 6

Chapter 6 Women's Perceptions of Daylight and Flat Design in Relation to their Wellbeing

6.1 Introduction

The previous chapter summarised the changes in residential architecture in Jeddah. Since a lot of attention is given by scholars to vernacular architecture in Saudi Arabia, generally and in Jeddah specifically, this study has not focused much on vernacular architecture except in terms of women's perceptions regarding Roshan in relation to daylight levels and privacy. Therefore, this chapter will focus mainly on women's perceptions, satisfaction and wellbeing regarding daylight in contemporary flats. It will explore the reasons for poor daylight in flats from female participants' points of view. It will explore in-depth how poor daylight affects them in their daily lives.

This stage was undertaken in the first year of study in order to provide a clear framework for the subject since there is little attention paid to it in the literature. The data that was collected at this stage backs up the claim and helps to define the new stages of methodology for this study. Women were interviewed as they spend a lot of time during the day at home, and represent a part of the population not commonly considered in the statistics or included in the design guidelines offered by the government. The second reason for choosing women was that men go to the mosque five times a day as part of religious customs. Walking from home or work to the mosque and returning allows men to be exposed to direct sunlight on the street. Women do not walk on the street to go to car parks: most cars have to stop at the building gate for the women to get into the car. This lifestyle does not allow women to be exposed to daylight. Also, most of the school or university courtyards are covered with a ceiling for privacy. Windows are either covered with curtains or tinted glass for privacy in schools and universities for women.

Also, the hot summer climate (30–50 degrees Celsius) in Middle Eastern countries is a major restrictor of outdoor activity; furthermore, there is a lack of appropriate facilities, such as parks (Benjamin and Donnelly, 2013). Consequently, females are seldom exposed to sunlight outdoors. In addition to this, women have more responsibilities in the home which keep them indoors more; and this is a common feature in many societies not just Saudi Arabia. For instance, according to the U.S. Department of Labour statistics, women spend 85% of their average day on household work, compared to 65% for men (Statistics, 2017a).

During the interviews it was apparent that daylight is really missing in flats and especially in living rooms – the major room used in the daytime. Also, the passion on women's faces was apparent when they expressed their need for daylight. After analysing the data collection, it was obvious that the research hypothesis about lack of women's exposure to daylight proved to be true. When home layout design generally and daylight specifically were mentioned, participants responded with fluency and enthusiasm. The way they discussed daylight expressed their interest in the topic and the fact that, after suffering from a certain problem, they had finally found someone who shared the same thinking. Some women wanted to provide me with a clear idea of the situation so they started to compare their flats with their parents' villas and how they used to be happy with daylight in the villas. The participants further mentioned the lack of interest concerning this issue among the men in the family and its effect on their relationships. The interviewed women claimed that their homes should be designed by somebody able to understand the nature and details of their needs and daily use. They suggested that only women are in a position to appreciate in a comprehensive manner such needs, as opposed to men, who have a completely different perception of the use of interior spaces in the observed flats.

Interviews included a discussion about women's lifestyles and daily activities. In order to gain a better understanding of the importance of living rooms as the most used spaces, participants were asked about their early morning activities, followed by their tasks throughout the day. Then, the women were asked what they did in each hour. As not every participant was able to explain their day-to-day routine clearly, I helped them with key words for better communication, including examples, to facilitate the interview process. This helped in understanding the types of activities women perform in the living room. Also, it helped me to figure out the time spent on each activity. At the same time, activities that tend to require more physical labour, such as cooking and cleaning, were also talked about in the discussion. This confirmed the importance of the living room for all women. At this stage in each interview, it became apparent that participants were answering questions in this section in a biased manner, as they perceived the questions regarding their private sphere to be intrusive. Some women interviewed proved reluctant to share this part of their lives, which they considered intimate, and, as such, should be kept separate from strangers.

Some women discussed some issues as a result of a lack of daylight in the home, which are subsequently discussed according to the eight points listed below.

- Living space *salah* and light well window
- Daylight and building regulations
- Privacy and glass windows
- Privacy and Roshan
- Daylight and wellbeing
- Women's satisfaction with contemporary flats
- Women's rights in choosing a home
- Comparison between villas and contemporary flats

6.2 living space *salah* and light well window

The in-depth interviews with Saudi women showed that living space (*salah*) or the living room is the most used space for all females for their daily activities. Though the kitchen is used at different times of the day, the majority of participants' time was described as being spent in the living space. Since females stay at home, they need to live in homes that fulfil all their psychological and physiological needs.

A living space with a small window facing a light well as a main source of light does not provide adequate quality light and, thus, is clear evidence of the lack of information on inhabitants' needs in architectural design. According to the results from interviews with participants, it was apparent that most flats in Jeddah city have *salah* as shown in Table 6-1 and Table 6-2.

Table 6-1 Number of flats that had *salah* in the flat's major layout

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
1. Living room	0	2	3	1	6
2. Living space (*salah*)	4	2	6	5	17

Salah is an open living space located at the flat's entrance and, as such, it is the first space encountered when entering the flat as shown in Figure 6-1. The majority of participants who had a *salah* with a window facing the light well claimed that the light well is not a source of daylight as shown in Table 6-2. However, this finding is different from a previous study that considered a light well to be an additional daylight source for multi-residential flats and, potentially, a good solution for providing natural light without glare or extensive heat (Kristl and Krainer, 1999). This could be because the size of the light well in this study was smaller in each case than the ones studied in different countries. In participants' building, the light well varied from 1.5mX2m up to 2.50mX3m. However, in Kristl and Krainer's study the dimensions were 4mX4m and in a different climate, in Budapest in Hungary at 47.4° N, 19.0° E.

Table 6-2 Daylight levels in *salah*

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
No daylight	1	4	7	4	16
Enough daylight	1	0	2	1	4 (not facing light well)
No window	2	0	0	1	3

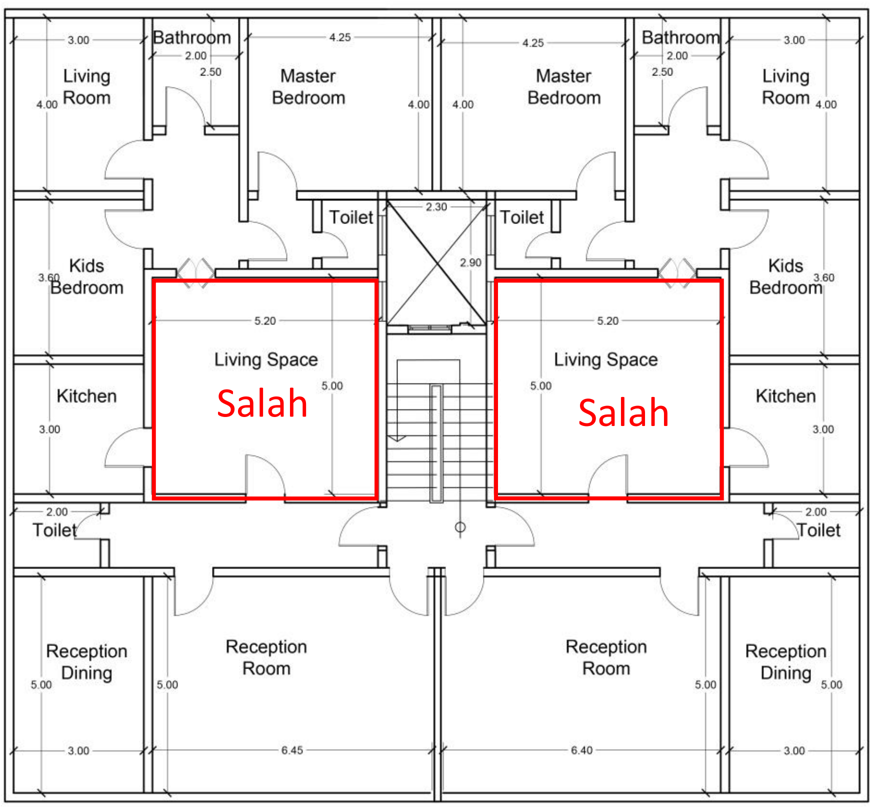


Figure 6-1 Location of *salah* in flat

On the other hand, the findings in this study agree with Stevens (2013, p.194) that a light well is a poor source of daylight for lower floors. From this study, it has also been found that the light well does not even provide daylight for the upper floor. The majority of participants from the first to third floors complained that they do not use the *salah* or the open living space with the window facing the light well due to a lack of light quality (e.g. morning light looks like sunset, or constant twilight). This issue was raised in most interviews, prevalent with participants living in flats as shown in Figure 6-2 for two flats on the ground and the third floors. One of the participants was surprised to hear that previous research proved that, even if a light well does not provide enough daylight, at least it makes you aware of daylight (Lam, 1992, Vischer, 1989). She asked with a shocked face pointing at the window "*Do you see any daylight*"' (D, 2016, pers. comm., 2 July). This interview took place in the summer from 12 to 2 pm, when the sun is very bright in the city.

Figure 6-2 Light well windows in the living space. Left: third floor. Right: first floor

The light well is a design element inspired by Western architecture which allows for a higher density footprint and can be applied to a building with more than two floors (Kristl and Krainer, 1999). The vernacular Saudi architectural courtyard was the traditional element that provided daylight and ventilation to buildings and is very similar to the concept of a light well. This shows that when architects practiced vernacular architecture in designing courtyards, they studied climatic and cultural needs, thus providing privacy too. On the other hand, a light well is a Western variation of the courtyard found in contemporary design that is implemented in Arab countries but is not suitable for Arab culture in general or Saudi culture specifically.

Kultermann (1999) claims that most contemporary buildings in Arab countries show Western design elements. According to Asfour (1998), one of the major issues in contemporary Arab architecture lies in the fact that these design elements are details and forms copied from Western buildings and pasted into Arab contexts with great disregard for the differences between contextual aspects and cultural values underpinning those elements. The light well is one of those elements referenced by the previous claims by Kuhlmann (2014) and Asfour (1998).

Three issues stem from light wells, mainly that they do not provide daylight, they transfer bad smells and noise and they do not allow people to know the time of day, since they do not allow direct daylight inside the rooms. For windows facing light wells, privacy does not relate only to visual aspects but also acoustic ones; this is one of the issues that was introduced by the participants as a reason for not using this space. This issue was also raised by Hashim and Rahim (2010) who, after interviewing people in their homes, found that sound privacy was lacking in Malayan homes. They noted that this issue arose because of closely adjoining and small homes.

The use and efficiency of the light well in providing daylight depends on its architecture: the narrower and longer it is, the less the illuminance it provides. Freewan et al. (2014) also showed that the design of the light well opening could be a factor in the daylighting performance of the light well. Providing occupants with a light well window shows not just a lack of understanding of cultural needs, but also does not take into account daylight which is a major element in architecture (Edgar and Lahham, 2008, Goell, 2007).

A lack of daylight in a space will make users rely mainly on artificial light. This was observed by some participants who mentioned that they have to keep an eye on the clock to know the time of day or they can know it from the prayer sounds that come from nearby mosques. Some researchers claim that excessive heat from exterior wall windows increases energy consumption through the extensive use of air conditioning (Gul and Patidar, 2015, Kreith and Goswami, 2016). Similarly, I posit that having a living space with windows facing a light well is a major factor for energy consumption as occupants have to turn on artificial lights from the time they wake up. This will lead to larger levels of energy consumption as artificial light consumes a considerable amount of energy in a building (Batterjee, 2010, Ghisi and Tinker, 2005) that can be as high as 25-40 percent (Krarti, 2000). Increasing access to daylight would necessarily and significantly decrease energy consumption (Crisp et al., 1988).

Since most females do not use a living space with a window facing a light well, I interviewed females who substituted another room in their flat to be their living room as shown in Table 6-3. Surprisingly, female participants complained about how the lack of daylight did not end here. A new reason was raised about exterior wall windows that reduce daylight levels inside the rooms as will be discussed in the coming point.

Table 6-3 Number of women who use *salah* or other rooms as a living room

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
Living in bedroom	**0**	**1**	**3**	**0**	**4**
Living in guest reception	0	1	0	0	1
Living in *salah*	4		4	5	13
Living room	0	2	2	1	5

6.3 Daylight and Building regulations

Saudi building regulations require that all habitable areas should have access to natural light (MOJ, 2015, p.10) as discussed previously in Chapter 3; however, the amount of light required in living areas has not been clearly set out in the regulations. In spite of this, I interviewed three participants with living spaces that had no windows at all; this could be either because building codes had not been followed at the time of construction or for other reasons, which will be investigated in Chapter 8. This suggests that there is not enough detail in the regulations about the nature of the requirements to ensure access to natural light.

Flats in Jeddah have small windows, which offsets the perception that a normal living should have enough daylight. Based on the idea that Saudi females would want large living spaces that are well-lit, these results demonstrate that flats offer poor quality of light in interior spaces. The living spaces in these flats convey a claustrophobic feeling, generating an atmosphere that resembles a '*jail'*, in the words of one participant, for it isolates the inhabitants from the outside world (S, 2016, pers. comm., 9 July). One of the participants who lives in such a flat stated: "*We are living in the sun land; we have a lot of sun. However, women have severe psychological and physical issues due to not seeing or being exposed to daylight"* (J, 2016, pers. comm., 12 July).

Siddiqui and Kamfar (2007) made a link between low-income areas and the proximity of buildings to one another. However, this point is debatable because building regulations do not vary from one neighbourhood to another, but only between different types of building. Therefore, even middle-income families and those with a higher than middle income can suffer from the same issue if they live in flats. According to the municipality, the gap between buildings should be no less than two metres at the sides and backs of apartment buildings (MOJ, 2015, p.14). This rule must be followed in all neighbourhoods, regardless of property value or income level. The issue of building proximity is still significant in districts populated by rich families in high-rise buildings as shown in Figure 6-3.

Figure 6-3 Flats in a rich district in Jeddah

6.4 Privacy and glass windows

The issue of small gaps between buildings does not end with daylight. It also creates an issue related to privacy. Figure 6-4 illustrates the cause and effect of poor daylight and of the effect on women consistently.

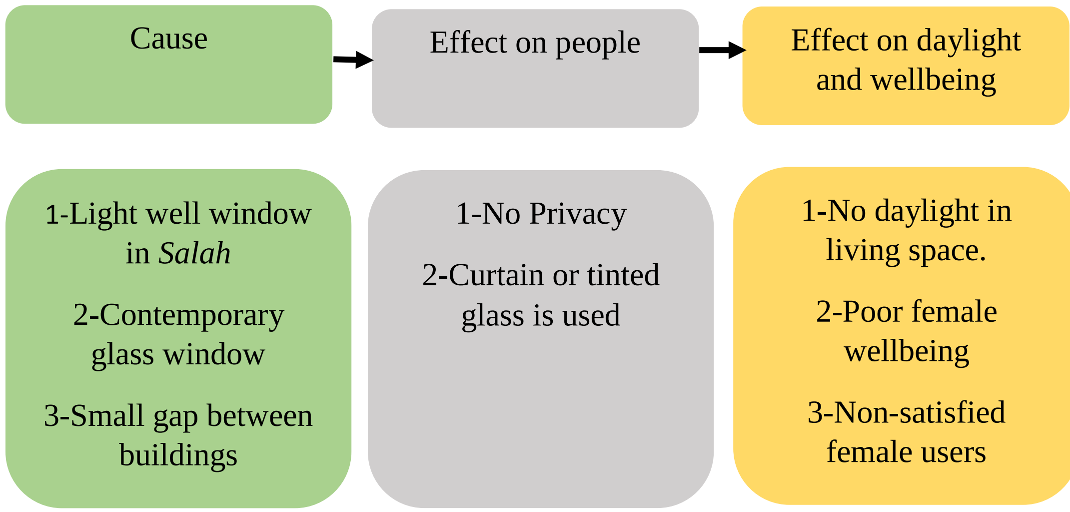


Figure 6-4 Consistent cause and effect in the study

Privacy controls major parts of home design in Saudi Arabia (Abu-Gaueh, 1995, Al-Jamea, 2014, Al-Jawahrah, 2002, AlKhateeb, 2015, Mofti and Balto, 2013). The design of Saudi residences is usually a reflection of the principles of privacy, modesty and hospitality (Othman et al., 2015). In most Muslim houses, the conservation of privacy is a vital factor and this is reflected in the screening from view to maintain visual privacy for the protection of the female members of the family (Mortada, 2003). In the Saudi context, a window is designed in relation to privacy rather than access to light and visibility. This raises the argument that exterior wall windows are controlled by religious and social factors rather than environmental needs. For instance, most windows are small in flats in Jeddah. Some windows are covered with either wooden boards or dark-coloured reflective paper for privacy. These small windows are unable to provide sufficient daylight in the interior space and do not acknowledge privacy as a factor among Saudi Arabians, especially among females, as proven by quantitative data in Chapter 7.

Privacy is defined differently in different parts of the world but there is a uniqueness to the interpretation of privacy in Saudi culture ((AlHumaidi, 1996). Rather than being an issue of physical access, privacy in Saudi culture is protection from neighbours' eyes. Thus, the issue of privacy is a design challenge in flats in Jeddah, which must balance healthy environments physically with secluded environments culturally, is something that is addressed through the findings of this research and explains the presence of curtains.

Saudi women requiring privacy in the presence of an external window have to open one side of the window and make sure it is covered with a curtain as shown in Figure 6-5. This solution does not make home occupants' feel comfortable since dust enters when opening the window. This is, however, the only solution. None of the participants were satisfied with curtain or tinted glass, but they did not have the right to change it. As mentioned by participants, tinted glass are put up by conservative landlords who want to create privacy in interior spaces. However, women claim that this is not the right solution because it blocks daylight totally. Therefore, the design of windows should not only consider upholding privacy or protecting users against the harsh impacts of weather such as dust but should also uphold the idea that daylight needs to be penetrative throughout the whole living room. According to Al-Hemaidi (2001), (Hariri, 1991) the major issue in contemporary home designs is that the roles of some architectural elements such as windows are diminishing and their traditional usefulness is vanishing.

Figure 6-5 Window covered with black paper for privacy

The reason for blocking glass with certain materials is related to the small gap between buildings whereby people could be seen by neighbours. The findings of this section raise a question about why municipality rules set two metres to be the minimum gap between buildings. Since two metres is the minimum, it is actually the only distance found between buildings as all landlords wish to maximise land use. Conversely, females find this small gap insufficient in terms of privacy. After interviewing participants, it was found that the municipalities who set building codes, architects who design the space and people who use the space think in different ways as will be discussed later in Chapter 8.

There is, however, no clear study about why there exist differences between the users and designers of the living space and how this difference can be solved. This tension between users and planners needs to be addressed. For instance, Dahlan and Mohamed (2010) argue that a two metre gap between buildings in municipality regulations is more than enough as it provides extensive sun and heat inside a home. They go on to assert that the two metres was set as a building code to provide daylight, but that light also caused high heat through solar gain within the interior spaces.

In opposition to the above position, the 20 participants who had small or medium-sized windows from first to third floor claimed during the interviews that their flats lack daylight due to various reasons, one of which is the small gap between buildings. Oppositely, the three participants who lived on the top floors, with large windows and bigger gap between buildings, confirmed their satisfaction with the amount of daylight in their living spaces. Therefore, the findings of this study disagree with Dahlan and Mohamed (2010) and suggest that the gap between buildings should be increased to enhance daylight and provide privacy, or a new design solution should be considered to solve this issue.

Finally, although there are many issues found with the design of exterior wall windows that create a lack of daylight in terms of window size, glass type and location, all participants from the first to third floors had one window in the living room. Only three participants had two medium-sized windows because they used one of the corner bedrooms or reception rooms to be their living room. However, they were not satisfied with the daylight because they shared the same issue as all the other women in that the window was facing neighbours with a very narrow gap not exceeding four metres in total. One participant mentioned:

"I *always find this as a major issue not just for daylight but also the view. I think 50 m is the minimum distance that should be between buildings. I hope that a person who holds a main position that her voice could be heard to add this 50-m rule*" (E, 2016, pers. comm., 5 June).

The claim of this woman is similar to those of the others. This clearly suggests that female voices are not heard. Additionally, participants claim that the issue relates to the type of window, which is either frosted or covered with black paper for privacy. On the other hand, transparent glass is an issue in itself because it must be covered with a curtain all the time for privacy. Therefore, I argue that window size is not such a critical issue for the lack of daylight as glass type and gap between buildings.

6.4.1 Balcony

The other option for daylight is a balcony. Idris (2001) studied the design issues in contemporary blocks of flats for university professors in Riyadh. He found that balconies are not used in university staff's flats. Although the examined flats had two balconies, all the occupants shared the same response that they do not sit on them because they are narrow, small and lack privacy. They use them for storage. Similarly, some participants in this study had a balcony in previous flats; however, the majority did not use them because they were not private. For instance, one participant had covered the balcony with a wall and added it to the room. Other women used it for storage or for drying clothes. Two participants mentioned that the balconies in their flats were covered totally with frosted glass for privacy. Then, the interior wall of the balcony is a solid wall with a small frosted glass window. This prevents daylight from reaching the room.

6.5 Privacy and Roshan

To discuss privacy and daylight, I questioned all participants about Roshan, either if they lived in home with Roshan or not. The question related to whether participants preferred a vernacular window in Jeddah over a contemporary glass window. The finding was a surprising answer that disagrees with most of the previous papers that support Roshan. The majority of the data in this study contradicts the position that Roshan provides enough daylight with ventilation and privacy (Abu-Ghazzeh, 1994, Adas, 2013, Al-Jawahrah, 2002, Al-Murahhem, 2008, Hariri, 1991, Salloum, 2013).

There are also some points of agreement with previous findings. As a cultural element, the Roshan is not valued and is considered *"old-fashioned"* (Al Murahhem 2008). In this study, 11 participants discussed the aesthetic part of Roshan as shown in Table 6-4, its pattern and how it reflects Islamic design. One participant mentioned that she would implement it in the interior decoration but not the exterior. In Islamic architecture, light is used to create interior decorative patterns (Al Surf et al., 2012). This point is also found in Roshan with its pattern design. Only 3 participants mentioned that it provides daylight and ventilation, as shown in Table 6-4 with the rest of the group having little knowledge of Roshan.

According to Samuels (2010), Roshan is no longer employed due to its cost and manufacturing time. While this is true, there is another additional important reason: Roshan is not required today culturally by females in Jeddah. Only two out of 23 women mentioned that they enjoyed looking out at the street from Roshan. The majority of females, whether they lived in a home with Roshan or not, rejected the idea of having Roshan in their flats, as shown in Table 6-5. Women who lived in a flat with Roshan claimed that it does not provide enough daylight. The light enters from the small holes and gives a dim light. They would sleep in the afternoon while the Roshan was open, but they would close it for another reason, namely privacy. This is in agreement with a recent study by Alawad (2017), who examined one room on the west side of Jeddah with different window types. It was one room tested twice, once with Roshan and then with a glass window. This study found that glass windows allow more daylight to penetrate, but bring humidity and heat if open. It also found that although Roshan allows less daylight to penetrate, it prevents hot air and humidity.

Out of 6 women who lived in a flat with Roshan, two women claimed that they could be observed by pedestrians especially since they were on the ground and first floors. This finding disagrees with that of Salloum (2013) who discussed Roshan's small opening as functioning to provide daylight and privacy. The rest of the women either preferred a modern glass window or found Roshan difficult to clean and dust, as shown in Table 6-6. There were two participants who disagreed with the idea of Roshan and privacy.

One participant mentioned: *"I went to a hotel with Roshan. I did not feel comfortable at all. It is like jail. It blocks you from the exterior. I would not repeat this experience. I prefer a glass window" "* (SH, 2016, pers. comm., 13 August). From the analysis of this section, it shows that Roshan is not a recommended type of window anymore for Saudi women. It also shows a finding that is opposite to that of other papers. Roshan does not provide enough daylight in an interior space and only provides privacy if it is on a high floor. This shows that the idea of Roshan is not recommended by most females.

Table 6-4 Women's answers about Roshan

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
What you know about Roshan					
Beautiful	2	0	4	5	11
Provides daylight & ventilation	1	2	0	0	3

Table 6-5 Number of women who wanted to have Roshan in their flats

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
Want to have Roshan at home					
yes	0	2	0	0	2
no	4	2	9	6	21

Table 6-6 Issues of Roshan mentioned by participants

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
Roshan issues					
Weak daylight	**2**	**2**	**3**	**0**	**7**
Brings dust	**0**	**0**	**5**	**0**	**5**
Needs extensive cleaning	**1**	**2**	**0**	**0**	**3**
Not private	**1**	**0**	**1**	**0**	**2**

After the surprising finding about women's perceptions regarding Roshan, decided that it would be useful to go back to Jeddah and observe the situation in person. In July 2017, I spent time in the old city of Jeddah where most of the vernacular homes have Roshan. On a sunny morning, I was sitting in the street, walking around homes waiting for someone to open their Roshan window to see if they could be observed or not, as participants complained that Roshan does not offer privacy. In spite of spending a long time in the daytime, few people opened their windows especially on the ground and first floors. I questioned some pedestrians who lived in the area, they mentioned the visual privacy issue. This made it clear that Roshan does not provide visual privacy in lower floors as pedestrians can see who is inside the home as shown in Figure 6-6, which was taken of an open Roshan on the ground floor.

It was apparent that when people stand inside their homes they can be seen very clearly, but if they sit on low seating they will not be seen. This shows that not all types of Roshan can provide privacy as is the case for the Roshan in Figure 6-6. It has a simple pattern. On the other hand, as mentioned in the vernacular architecture section in Chapter 5, the richer the families the more detailed Roshan they can have. More details in the Roshan pattern take more effort and therefore cost more money. This also clarifies that homes with a simply patterned Roshan cannot get daylight as the Roshan cannot be opened due to privacy issues especially on the lower floors.

Figure 6-6 Roshan opening and privacy

6.6 Daylight and wellbeing

Daylight has a great impact on the wellbeing of both genders (Parmar, 2016). However, due to cultural and religious demands for privacy in some countries, studies have investigated the lack of daylight exposure and its effect on adult female health, as a result of issues such as vitamin D deficiency. Christie and Mason (2011) undertook semi-structured interviews with 17 university students in Prince Sultan University and found that the majority are not exposed to daylight outside their homes as their bodies are entirely covered with *Abays*. This type of clothing, which comprises long black material covering the whole body, does not allow the body to absorb daylight (Alsuwaida et al., 2013, Naeem et al., 2011). Similarly, a study done in Jordon examined volunteers from both genders in terms of body absorption of vitamin D from the sun and showed that women who wear *Hijab,* clothing similar to *Abaya,* have significant vitamin D deficiency in comparison to those who do not wear *Hijab* or to men (Mishal, 2001).

The second reason is that homes do not allow females exposure to daylight in a private setting, except for those who live in houses with high walled gardens. However, even those who live in such houses reported insufficient exposure to daylight due to the heat (Christie and Mason, 2011). According to Siddiqui and Kamfar (2007), a considerable number of female students in the western region of Saudi Arabia have vitamin D deficiency. They go on to assert that these students, who do not gain exposure to sunlight, are within the low income demographic. The authors suggest, in conclusion, that living in low income neighbourhoods with homes close together could be the reason for the lack of daylight in residences (Siddiqui and Kamfar, 2007). However, this study's findings, that there is no formal differentiation between low income and high income building regulations, contest this assertion. Rather, this study found that lack of exposure to daylight within buildings is also a common issue in middle and upper middle income families.

In addition to adults, daylight is an important factor in improving the health of children. Mothers with young babies on all floors, except the roof, mentioned that they cared about daylight and the physical health of their children. One participant explained that, in her previous house, there was not enough lighting and access to natural light to enable her daughter's bones to grow well. Therefore, she had to move into a new flat where a balcony was available for her daughter to be able to be exposed to daylight. Other participants mentioned that they suffer from bone issues as a result of vitamin D deficiency, and doctors had advised them to get exposure to daylight; however, they cannot since they spend all their time in a flat with weak daylight. The majority of females care about daylight for their psychological wellbeing. Ten of them said they feel depressed when spending the morning in the living room because they do not really feel it is the morning. Their feelings varied from bored to depressed.

6.7 Females' satisfaction with contemporary flats

Most of the answers for the 74% female participants show that they are not satisfied with their flats with regard to daylight issues as shown in Figure 6-7. They are 17 participants out of 23 most of them live in flats from first to third floor. According to Gamboa (2008), contemporary homes for middle or low income families do not fulfil occupants' needs in general. Similarly, Salama (2006) showed that the inhabitants of flats have needs in terms of their culture and environment and these must be considered in any type of home, even affordable homes.

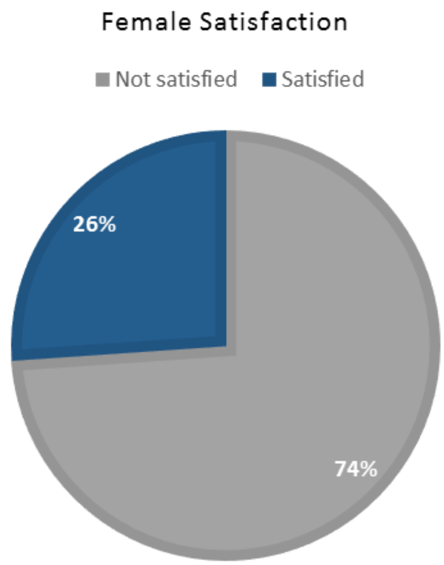


Figure 6-7 Diagram to show Females' satisfaction with daylight levels in living rooms

However, it is not just in affordable homes that these issues persist but also in middle class rental homes as only 26% of participants showed satisfaction according to their answers as shown in Figure 6-7. Three of them lived in roof flats with big windows and big flats compared to family members. One participant lived in a flat with enough daylight since there was no building close to it. Although the living space window was still very small in relation to previous accommodation she had lived in with no window in the living space, she felt very satisfied. One factor for her satisfaction was that the seats in the living space were next to the window as shown in Figure 6-8 which allows daylight to reach all the seats. Additionally, the window is facing west, which allows enough daylight in the afternoon. Therefore, in Chapter 7 which follows, variable daylight calculations (i.e. the whole living space and for the seating area only) should be taken into consideration for this living room in order to determine if there are variations in daylight levels that equate to satisfaction levels.

Figure 6-8 Small window facing road in third floor flat

Most participants shared two main reasons for non-satisfaction, which were lack of daylight and small rooms. Bahammam (1998) explains that Saudi houses are divided into two sections – the family section and the guest section. This is intended to provide a maximum level of privacy. He also confirms that Saudi houses are the biggest compared to many other countries. The majority of participants aged 30–50 claimed that the reception area is big but it is rarely used. They want the living space to be the biggest part of the flat as it is the most used part. My study shows a shift in spatial use in the past decades which differs with the findings of Bahammam. In 1998, contemporary architecture and lifestyle had existed for 20 years but many changes started to take place during the 20 years which followed up to the current study in terms of the economy, technology, and other factors. For instance, the majority of participants discussed their current daily activities as if they had little function. My findings show this when comparing the answers of females of different ages. Participants aged 20-40 expressed that they meet relatives at malls or cafés. They do not meet at home anymore as they used to in the past when there were not many malls and cafés in the city.

In comparison to participants from the first to the third floor, participants in the roof flats expressed their satisfaction with the daylight levels. They mentioned that they do not like to leave home. One of the participants who lives on the top floor mentioned: *"I feel so happy during the morning when I see sunlight. It provides me with psychological comfort during the day"* (M 2016, pers. comm., 28 June). They enjoy the morning in the living space and feel relaxed as shown in Figure 6-9. While the top floor location exposes the resident to the gaze of neighbours, this did not seem to be a factor for this individual. Another participant living on the top floor asked her husband to design a big window facing the roof as shown in Figure 6-10 as she was concerned about being seen by neighbours. She relies on this window to provide daylight as it is transparent and facing the northern sky with diffused light. The side window facing the east is frosted and covered with a curtain due to the sharp morning daylight.

Figure 6-9 Roof flat

Figure 6-10 Roof flat with window facing the roof

6.8 Females' rights in choosing a home

According to Ward (2011, p.4) "*While buildings shape human behaviour, human decisions shape building*s".

This suggests that home users' decisions should be considered when designing a home. Interview findings showed that the majority of participants complained that no one cares about their decisions, not even their husbands. Since their husbands are the ones who pay the rent, they think that they have the right to choose a flat that suits their budget not the wives' needs. Six participants did not have any input in choosing their flats since they were married and it was the husband's decision as shown in Table 6-7. This shows that men control flat choice in Saudi culture since, according to the religion and culture, the man is responsible for providing his family with what they need. This is part of his religious duty (Aleid, 2006).

Table 6-7 Participants' marital status

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
1. Married women	3	2	7	4	`16
2. Widowed	1				1
3. Divorced		2			2
4. Single			2	2	4

If a husband does not rent a flat, it means he lives in a flat in his family building for free as shown in Table 6-8. Therefore, they do not have the right to change anything at home in terms of major design. This is because the father can let the flat later when his sons' financial situation gets better and he can own a home according to the wish expressed by most participants. This is true especially for those who live in their parents' buildings since they do not pay rent. This means that users cannot change room divisions or windows and doors. Therefore, this shows that window location is an important element that should be considered by architects when locating windows and dividing rooms in a flat. For instance, the bedroom is for sleeping, and the guest area is used at night. These two rooms should be located in an area from which daylight can be blocked while the living area window should be facing an open space like a street. Reasons for these issues existing will be explained in Chapter 8 from professionals' points of view.

Table 6-8 The number of women according to flat payment type

	Age 50-59 4 Women	Age 40-49 4 Women	Age 30-39 9 Women	Age 20-29 6 Women	Total 23
Rented	3	1	3	5	12
Owned	1	1	3		5
Family building		2	3	1	6

6.9 Comparison between villas and contemporary flats

In Saudi culture and according to the Saudi way of thinking, people do not spend all their money except if they buy a house. They believe that owning land can keep them safe for the rest of their lives. However, the idea of owning a flat has not become accepted yet. This is also confirmed by Opoku and Abdul-Muhmin (2010) whose study in Saudi Arabia found that 323 people preferred to own a house and only 56 accepted the idea of owning a flat. In contrast, 108 preferred to rent a flat while only 56 accepted the idea of renting a villa.

On the other hand, the majority of interviewed women dreamed about living in a villa or roof flat. A villa is considered the perfect home for most Saudis as it is surrounded with high walls that hide the ground floor windows from observation (North and Tripp, 2009). They also find villas to offer a great source of daylight from their big windows and garden. The high fence or garden trees in a villa provide privacy as one participant mentioned.

"*I lived in 4 different flats, but I was not satisfied with any of them either in terms of daylight or flat plan. I could not achieve what I needed unless I lived in my villa. Now I have very big windows in most rooms. I really enjoy drinking my morning coffee next to the window even if there is no view. The sky is enough*." (N, 2016, pers. comm., 10 July).

Most participants from the first to third floors mentioned that they see sun in their parents' villas or roof flats. Villas and roof flats are considered to be expensive residences, so people can live in them when they get old having saved money. Young people without high incomes cannot have such residences. Females who have exposure to daylight in their flats were the females who live in roof flats. These participants find roof flats better than villas since they do not want big residences. Figure 6-11, Figure 6-12 and Figure 6-13 show window design and daylight variation between standard floor flats, roof flats, and villas, providing a clear illustration of the females’ claims. Other than roof flats and villas, a small number of females go to beaches or cafés at weekends to enjoy the sun. However, four participants who had flats in other Arabian countries or who studied abroad in the UK or America had been exposed to and enjoyed daylight in their flats.

Figure 6-11 Left: Living room in roof flat. Right: Living room in a house

Figure 6-12 Living room on a first floor

Figure 6-13 Differences in window size between roof flat and other flats in the same building

In addition, the reason for the small number of interviews with females aged 50 is that the financial situation of women's husbands gets better at this age, so they buy or build their own villas or roof houses. I contacted around 50 women in Jeddah to ask if their mothers or sisters at age 50 lived in a flat; the majority lived in villas. Three out of four women in the age 50 group had either moved to their own villas or, in one case, had moved to a roof flat. One participant, aged 30, with a high family income lived in two roof flats and she had great control of the flat design. In contrast, another participant in the same age group lived on the roof floor, but she rented the flat. Although she was very satisfied with the flat, she might move from it because of its high rent.

6.10 Conclusion

In relation to Chapter 5, which shows that the notion of privacy has changed from extended families to nuclear families, and privacy between the interior and exterior is neglected, this chapter shows that privacy between interior and exterior spaces is still mandatory. However, it is not obtained by the use of suitable designs. It is found that if privacy is obtained in window design by the use of tinted glass or curtains, then daylight is missing. Similarly, if daylight is achieved in the space, privacy is missing. However, due to a significant social need for privacy, it is found that daylight is poor in most flats, which affects women's daylight exposure negatively. This study shows that the individual, cultural and social needs of participants regarding the design of rental flats are not considered.

The study found that light well windows should not be located in living spaces at all as they do not provide adequate daylight and create issues with acoustic exposure. A living space with a small window facing the light well was not recommended by any of the participants. Most participants use one of the bedrooms or reception rooms as a living room. Although, they do prefer the living room not to be in a deep part of the flat, like the bedroom zone, they find it much better than an open *salah* with a light well window. All participants find the light well window has no function. It does not provide sufficient daylight at all. This was also observed by me when visiting the flats during the morning and afternoon. This supports that a light well window should not be located in the living space. It should be in the toilet or kitchen, as has been found in the women's interview section.

This lack of daylight leads to psychological and physical illness for some women as they spend a long time in these spaces. Also, it is found that the majority of participants do not recommend Roshan windows as a solution to the current situation. They recommend a solution that provides them with enough daylight and privacy in a contemporary design. The research exposes that building codes regarding window design and daylight need more study as the current code requiring a two metre gap between buildings creates an issue instead of solving a situation. Even though there is a special department in the Saudi Council of Engineers held by women, this department does not seem to be addressing the needs of women in their daily lives.

It is also found that no attention is given to women's needs either by male guardians or decision makers, which will be investigated deeply in Chapter 8 to find out the factors that guide flat design generally and window design specifically. However, before starting with the investigation in Chapter8, it is necessary to give details of valid daylight measurements for participants' living rooms in order to be able to argue with architects and decision makers. Therefore, the next chapter, Chapter 7, will provide valid daylight measurements for participants' living rooms in relation to glass type, window size, exterior obstructions, window orientation and floor level.

Chapter 7

Chapter 7 Daylight Simulation in Participants' Flats

7.1 Introduction

Spending time in participants' flats and observing that daylight was weak in most of them, as found in the previous chapter, was not enough to gain valid daylight measurements. Also, it is difficult to provide photos that show exactly the daylight levels and, therefore, the main concern of this chapter is in finding a reliable set of quantitative data for the daylight lux levels during daytime, which was considered crucial for the progress of this investigation. This chapter also aims to provide a clear understanding of the accurate amount of daylight that enters living spaces during the different hours of the day in participants' flats. This will support female participants' claims regarding privacy and weak daylight levels. It will also form valid evidence for the next part of the investigation with decision makers.

Daylight luminance level is measured in different units, such as daylight factor, foot candle and lux (Alshaibani, 2009, Hayman, 2003, Hegazy et al., 2013, Su et al., 2010). For instance, 2% DF (daylight factor) is equal to 100 lux (Phillips, 2004, p.5). In this research, lux unit is used as the measure for daylight in interviewees' flats. Lux is a unit of illuminance and luminous emittance, measuring luminous flux per unit area. It is equal to one lumen per square metre. In photometry, lux is used as a measure of intensity, as perceived by the human eye, of light that hits or passes through a surface: Illuminance = Light Falling on a Surface.

It is important to discuss the required lux unit before measuring it in participants' living rooms. The required amount of lux differs according to space function. For instance, 100 lux is considered suitable for corridors and changing rooms. Daylight lux should be very high, reaching 5000 lux in spaces that require detailed work like factories (Tregenza, 1998, p.9). Many researchers have studied lux levels in commercial spaces such as offices and claim that 100 lux to 500 lux is appropriate for offices because people need high daylight levels when using a computer or doing other such tasks. However, this can vary according to climate and window orientation (Boyce and Raynham, 2009, Mardaljevic, 2016, Nabil and Mardaljevic, 2005, Schuler, 1995).

Nabil and Mardaljevic (2005) used a computer simulation tool to study daylight in office buildings for 14 different locations, including Miami, Hong Kong and Cairo, as climate data can be freely accessed online. Interior reflection was set at 0.7, 0.8 and 0.2 for walls and floors, respectively. The examined space had a 6mm clear double glazed window facing south. The authors found that 500 lux is best for office space. Another study surveyed employee satisfaction of daylight levels in a computer hardware and software distribution company. Each office in this company had a minimum of two computers and the study findings showed that employees felt satisfied with a low lux level of not more than 100 lux and that they found 500 lux to be too intense, which is in contradiction with the standard regulation for 300-500 lux (Schuler, 1995).

In 1983, a study was conducted in Surrey with 101 occupants of different ages and social classes and found that daylight in interior residential spaces was weak, only reaching 70 lux or less in some rooms. The authors claimed that daylight was inadequately low in most surveyed homes and went on to assert that this low daylight level was the reason for home accidents amongst occupants (Simpson and Tarrant, 1983). Although this is an old study, the authors believe low daylight does not provide visual clarity. However, Liu et al. (2015) investigated the effect of daylight level on the perception of living space atmosphere. They found that cosiness and liveliness are the feelings most required for living room atmosphere.

Similarly, According to Phillips (2004, p.65) in *Daylighting: Natural Light in Architecture*, a home living space with 100 lux is considered to have a suitable amount of daylight in UK for people to relax in. According to averaging across the working plane, 100 lux is adequate at floor level in corridors and stairs, 150 lux at floor level in lounges and 150 lux at table height (typically 0.8m) in dining halls, study areas, kitchens and utility rooms (Boyce and Raynham, 2009). Similarly, Afroz et al. (2014) consider 150 lux is the required amount of daylight for a living space in south-facing residential buildings in Dhaka city in all seasons, at 20º 34N to 26º 33N and 88º 01 E to 92º41 E. Also, Nedhal et al. (2016) considered 100-200 lux sufficient for living spaces in Malaysia with a temperature of 23-34°C from April to July at 1°–7° N, 100°– 120° E. They went on to assert that, in cases where lux is more than 200, it creates glare and heat gain. In Egypt, 300 lux is considered the target luminance in the Egyptian code of Energy Efficiency in Residential Buildings (EERB) (Hegazy et al., 2013).

7.2 Description of the experiment

The following experiment was conducted for 15 living rooms: four living rooms in each of the first, second and third floor flats and three living rooms on the fifth roof floor. The experiments for living rooms from the first to third floors were carried out separately to those for the fifth roof floor living rooms. Separate analysis was done for roof living rooms on the fifth floor as floor plan, window design and daylight differed totally from the rest of the building's floors. Participants' living rooms with different window sizes, numbers, glass types, window ratio to floor area and window orientation are analysed in Table 7-1, Table 7-2 and Table 7-3. Also, window to floor area was measured as the following:

Floor area (F) = LXW

Window area (W) = LXW

Window area ÷ floor area = ( )X100 = Window to floor area (WFA)

Interviewees' living rooms with no windows and windows facing the light well were excluded from this experiment. The reason for this is that there was no daylight in the living space according to their answers and my observation. The following three tables show the characteristics of the 12 flats for participants' from the first floor to the third floor.

Table 7-1 Window characteristics of participants' living rooms on the first floor

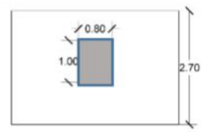
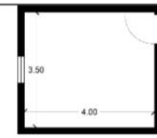
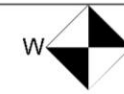
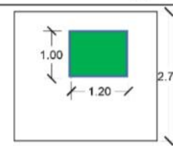
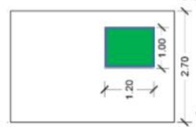
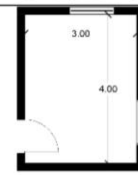
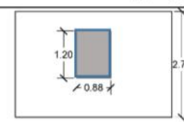
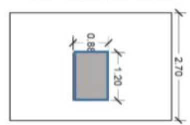
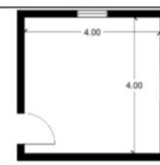
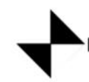
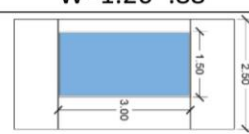
Participants' abbreviations	Room number	Elevation transparent glass frosted tinted	Floor plan	Window orientation	WFR
F	Room 1	 W=1*.80	 F=3.50*4		F = 16m^2 W = 0.8m^2 WFR = 5.7%
D	Room 2	 W=1*1.20  W=1.20*1	 F=3 *4	 	F = 12m^2 W = 2.4m^2 WFR = 20%
H	Room 3	 W=1.20*.88  W=1.20*.88	 F=4*4	 	F = 16m^2 W = 2.11m^2 WFR = 13.18%
SU	Room 4	 W=1.50*3	 F=6.20*5		F = 31m^2 W = 4.5m^2 WFR = 14.51%

Table 7-2 Window characteristics of participants' living rooms on the second floor

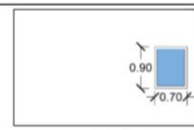
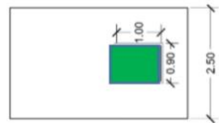
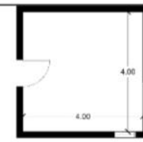
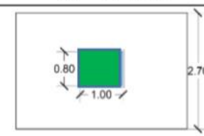
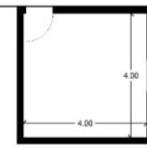
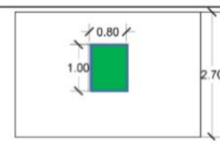
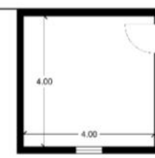
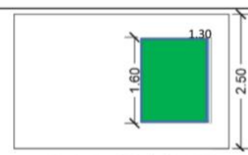
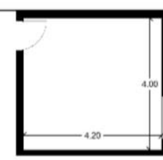
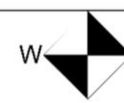
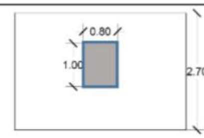
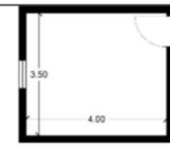
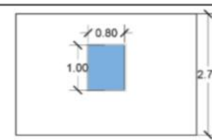
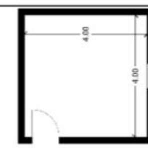
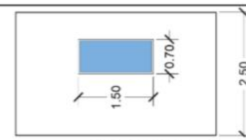
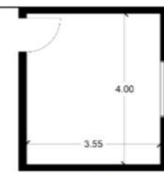
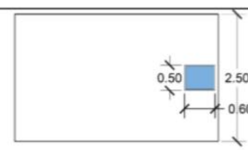
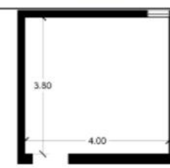
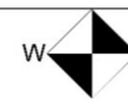
Participants' abbreviations	Room number	Elevation transparent glass frosted tinted	Floor plan	Window orientation	WFR
E	Room 5	 W=.90*.70  W=1*.90	 F=4*4	 	F = 16m^2 W = 1.53m^2 WFR = 9.5%
DU	Room 6	 W=1*.80	 F=4*4		F = 16m^2 W = 0.8m^2 WFR = 5%
O	Room 7	 W=1*.80	 F=4*4		F = 16m^2 W = 0.8m^2 WFR = 5%
Z	Room 8	 W=1.60*2.50	 F=4.20*4		F = 16.8m^2 W = 2.08m^2 WFR = 12.38%

Table 7-3 Window characteristics of participants' living rooms on the third floor

Participants' abbreviations	Room number	Elevation: transparent glass (blue), frosted (green), tinted (grey)	Floor plan	Window orientation	WFR
Ash	Room 9	 W=1*.80	 F=3.50*4		F = 16m² W = 0.8m² WFR = 5.7%
A	Room 10	 W=1*.80	 F=4*4		F = 16m² W = 0.8m² WFR = 5%
Heb	Room 11	 W=1.50*.70	 F=3.55*4		F = 14.2 m² W = 1.05 m² WFR = 7.39%
R	Room 12	 W=.50*.60	 F=3.80*4		F = 15.4m² W = 0.3m² WFR = 1.94%

Building regulations in different countries have certain requirements for building glazing areas. For instance, in 2014, the Dubai Green Building Regulation was introduced requiring a minimum of 50% of the glazed area to be on the north ordination; however, if a window is located towards the south or west orientation, then consideration of the surrounding environment is required. Additionally, if the glazing exceeds 60% of the building, certain shading elements are required (DEWA, 2017). On the other hand, after analysing the window characteristics in participants' living rooms in Jeddah, as shown in Table 7-1, Table 7-2 and Table 7-3, it was found that the only common characteristic was that all the windows were single pane sliding windows, which were placed on the interior surface of the wall. Table 7-1, Table 7-2 and Table 7-3, show the significant variation in window size, window orientation and glass type. Glass types were transparent, tinted or frosted. Also, no attention was given to window orientation, as windows faced in different directions. The ratio for window to floor area was very low in participants' living rooms. This shows that there is no detailed study of window design in Jeddah's flats. There was a clear lack of daylight in all the tested living rooms for different reasons, except in the flats of those who lived on the roof floor. This substantiates the original claim by providing a quantitative set of data using DIVA-for-Rhino to calculate the accurate lux level in all participants' (tested) living rooms.

7.3 Simulation study

In order to test the daylight lux level in each living room with an exterior wall window, a series of simulation studies were carried out. Although it would be more appropriate to conduct these simulations in real space, participants were not keen on this idea as the lux metre measuring device would have had to remain in their homes for a day. Therefore, a computer simulation with DIVA-for-Rhino was used to investigate daylight in 15 rooms. A number of data were collected to describe rooms and climate conditions, since this was an exploratory study:

- Jeddah's latitude of 21.300 N and longitude 39.100 E was inserted in the DIVA plug-in to set the climate.
- In the absence of references in Saudi studies and Saudi building regulations regarding the target lux or daylight factors (see page 78), 100 lux was chosen as the target luminance. This level is taken from the standard for British regulations as discussed before in this chapter (Phillips (2004, p.65). However, due to climate variation between the UK and Saudi Arabia, daylight might need to be 200 to 300 lux in interior spaces in Saudi Arabia.
- Clear-sky was used as Saudi Arabia has clear-sky.
- Jeddah's weather reaches 20°C in winter and 39°C in summer, as shown in Table 7-4.
- Ceiling reflection was set at 50% and floor and wall reflection at 20% for all rooms since dark coloured furniture covered both floors and walls, there was

dark paint on some walls and dark coloured curtains or big paintings on walls, as shown in Figure 7-1. According to Meek and Van Den Wymelenberg (2014, p.19), interior furniture in terms of size and colour affects the amount of daylight in an interior space. The brighter the colour, the more light is diffused. However, most furniture was in dark colours, like red or brown. Even the walls were painted with dark colours or covered with dark coloured curtains or paintings. Therefore, furniture reflection was selected to be 20%. No artificial light reflection was used in the calculation.

- Glass transmittance was set on tinted glass for living rooms with tinted glass windows and frosted for frosted windows and transparent for the transparent ones.
- Windows were oriented correctly in the simulation.
- The daylight calculation was set on lux for each metre in the room above 1 metre from the floor.

Table 7-4 Average weather in Jeddah (Source: WWIS, 2016)

Month	Mean Daily Minimum Temperature (°C)	Mean Daily Maximum Temperature (°C)	Mean Total Rainfall (mm)	Mean Number of Rain Days
Jan	18.2	28.9	11.1	2.2
Feb	17.9	29.4	3.2	0.7

Mar	19.3	31.6	2.5	1.0
Apr	22.0	34.8	2.4	0.8
May	24.0	37.1	0.2	0.3
Jun	24.8	38.2	0.0	0.1
Jul	26.4	39.4	0.2	0.0
Aug	27.3	38.7	0.5	0.6
Sep	26.3	37.6	0.1	0.1
Oct	24.0	36.6	1.0	0.5
Nov	22.1	33.3	23.0	2.3
Dec	19.9	30.6	11.4	1.8

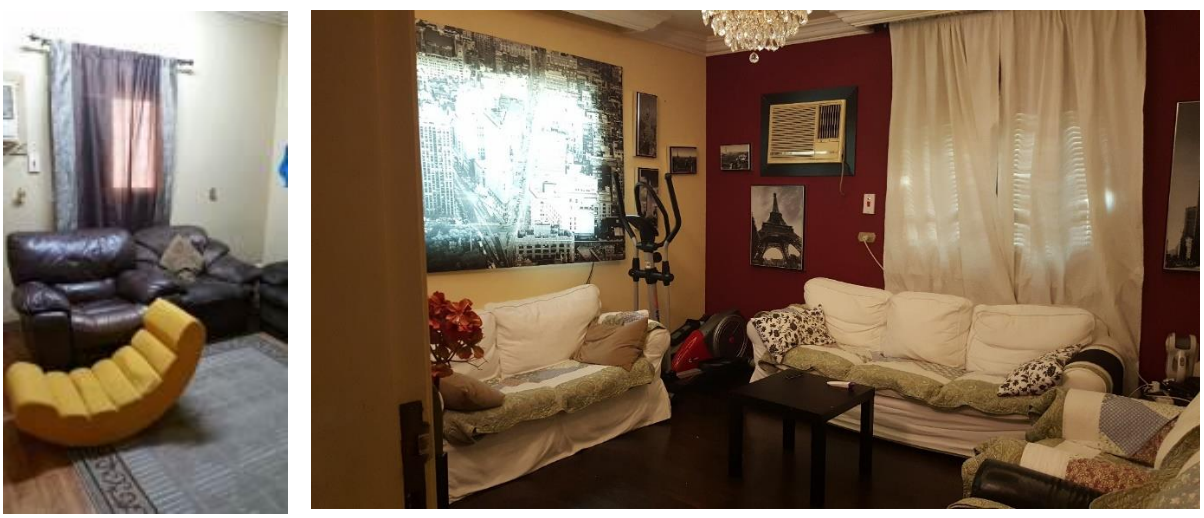


Figure 7-1 Dark colours in living rooms

For the Rhino program, which is a 3D computer graphics and computer-aided design program, each participant's building was drawn with specific identification of its living room. Additionally, before running the simulation on DIVA, neighbouring buildings were also drawn in the right width and height and a two-metre gap between buildings was also set, as shown in Figure 7-2.

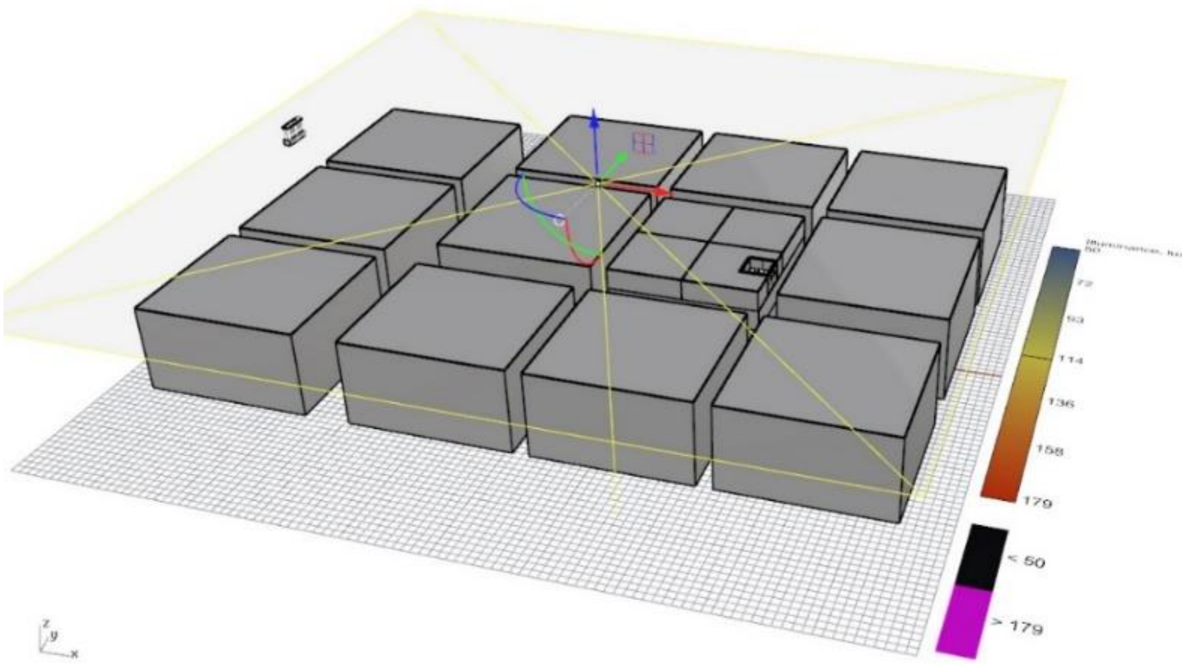


Figure 7-2 Neighbourhood in simulation study

The simulation study findings for four of the 15 rooms are discussed in the following six points:

- Daylight level and glass type
- Window orientation
- Daylight and exterior obstruction
- Daylight level in room zones

- Window to floor ratio
- Daylight levels in roof flats

7.4 Daylight level and glass type

The findings revealed that daylight is less than 100 lux in most of the 12 living rooms in all seasons and at four different times of the day, as shown Table 7-5, Table 7-6 and Table 7-7. On the first floor, Table 7-5 shows that the majority of living rooms have weak daylight, except for two living rooms, which are rooms 2 and 4, where daylight is between 108 and 196 lux in April and July at 10am and 12pm. Room 2 continues to have daylight levels of more than 100 lux at 14pm from January to July and at 16pm in April and July. These two flats are on the first floor. Also, it was found that having two medium-size frosted glass windows for room 2 can provide as much daylight as one big transparent window for room 4, as shown in Table 7-5; however, shutters are closed all day in room 4 due to privacy, which means that inhabitants have not been able to enjoy daylight since a new building was recently constructed next to them, as shown in Figure 7-3.

Table 7-5 Number of living rooms on the first floor that have daylight of less than 100 lux

	10 am	12pm	14 pm	16 pm
15 January	4	4	3	4
15 April	2	2	3	3
15 July	2	2	3	3
15 October	4	4	4	4

Figure 7-3 Living room number 4 for participants (SU)

Additionally, on the second floor, Table 7-6 shows that the same issue of weak daylight continues, except in two living rooms with frosted glass, which are rooms 5 and

6. Daylight lux in room 5 is between 116 and 147 at 12pm in April and July, respectively. Daylight lux in room 6 varies between 114 and 131 lux in all seasons at 14pm. In the same room, daylight ranges between 101 and 119 in April and July, respectively, at 16pm. In this scenario, it could be argued that frosted glass is better, as it matches the culture's need for privacy.

Table 7-6 Number of living rooms on the second floor that have daylight of less than 100 lux

	10 am	12pm	14 pm	16 pm
15 January	4	4	3	4
15 April	4	3	3	3
15 July	4	3	3	3
15 October	4	4	2	4

Weak daylight lux levels continue on the third floor, as shown in Table 7-7, except for two living rooms, which are rooms 11 and 12. Although both rooms have transparent glass windows, in room 11, the window is placed in a high part of the wall to insure privacy. In room 12, the window is small and is facing the main road, so there is no need for privacy from neighbours. In this room, daylight lux ranges from 100-200 lux at 12 and 14pm in January, 14pm and 16pm in April and July and 12pm, 14pm and 16pm in October. However, in room 11, daylight is more than 100 lux at 10am in all seasons, except January. According to Gordon (2003), one of the daylight design rules is that windows which are located high up provide daylight in the deep part of the space. Similarly, Meek and Van Den Wymelenberg (2014, p.31) claim that upper wall glazing provides enough daylight – twice the amount compared to middle wall windows and, in this scenario, daylight reaches the deep part of the space. In my study, daylight is weak during the daytime in room 11 with an upper window, except at 10am. Additionally, this positioning of the windows makes the user feel that there is no window in the space and that the room is blocked with walls, as participant Heb described during the interviews.

Table 7-7 Number of living rooms on the third floor that have daylight of less than 100 lux

	10 am	12pm	14 pm	16 pm
15 January	4	3	3	4
15 April	3	4	3	3
15 July	3	4	3	3
15 October	3	3	3	3

Study of daylight and glass type shows that glass type has a significant effect on daylight levels in living rooms. It is found that tinted glass provides the lowest level of daylight, even if windows are big or if the room has more than one window. This type of glass is used by landlords or male guardians to provide privacy. If the glass is transparent, they cover it with reflective papers that convert glass from transparent to tinted, as discussed in Chapter 5. It is understood that this is an issue in some flats, which shows that transparent glass must not be used because it will be converted to tinted glass, either by the landlord or the home's inhabitants.

Hashim and Rahim (2010) argue that tinted glass is preferable in Muslim cultures, such as Malayan society for the two groups Gombak and Kajang in the district of Hulu Langat in Selangor, Malaysia. A questionnaire with 401 random people selected from these groups who live in two floor terrace homes and in-depth interviews with selected participants according to their answers showed that cultural requirements such as privacy must be considered in home design. Therefore, the authors suggested that tinted glass can provide inhabitants with privacy. On the other hand, I found that, although tinted glass provides privacy, it also blocks daylight from entering the interior space. Since one of the main reasons for windows is providing daylight, tinted glass is, therefore, not a suitable solution as it creates another issue by blocking out daylight.

As discussed before, participant SU, with a large transparent window, mentioned that she now closes the shutters throughout the day since a new building was constructed next to them, although the main reason that her family rented the flat initially was for its big window which provides ample daylight. As a result, the advantage that made them rent the flat no longer exists. She is one example of someone who uses open and closed shutters, while the others, with tinted glass, blocked out the daylight completely. Hegazy et al. (2013) did a similar study in Cairo, at 30.04 N and 31.23 E, and found that daylight was weak through different glass windows combining shaded or tinted glass with different ratios on the ground and first floors. Daylight did not reach

300 lux in any of the examined cases. They went on to assert that this issue continues even on the upper floors, such as the third floor, with the same glass type. This study was limited to a southerly orientation. My study examines tinted glass in easterly and northerly orientations and transparent glass with a southerly or westerly orientation has the same issue. This strengthens my claim that transparent glass should not be used in Saudi culture as it results in windows having no function since window design and its glass material are responsible for the amount of daylight in the indoor area (Evans, 1981, McMullan, 2012, Baker and Steemers, 2002, Szokolay, 2008).

Afroz et al. (2014) found that lower floor residences with south facing single plane glazing under an overcast sky receive less daylight than upper floors in a Dhaka climate in all seasons, at 20º 34N to 26º 33N and 88º 01 E to 92º41 E. However, my study shows that floor level does not create an issue if window size is studied and the glass type provides both privacy and daylight. Therefore, floor level does not create an issue in blocking daylight as much as glass type.

7.5 Window orientation

According to Littlefair (1991, p.1) and Parise and Martirano (2013), window orientation is important for providing sufficient daylight. A window facing south helps to provide the maximum amount of daylight in all seasons in the United Kingdom, while a northerly orientated window can provide daylight in the morning in summer only (Thomas, 2013, p.131). Similarly, Tregenza (1998, p.5) reports that, in order to get enough daylight in the United Kingdom, a window should be within 90° of facing south and avoid having exterior obstructions that are more than 25° above the building horizon. Hegazy and Attia (2014) studied daylight in hot Cairo weather in four locations and found that eastern and northern façades provide the highest level of daylight in comparison to western and southern ones. Similarly, Alshaibani (2015) studied daylight in an administrative building in the eastern province in Saudi Arabia and found that locating windows in the north and south prevented heat and direct solar radiation from entering the interior space.

In my study, after analysing daylight and glazing type, it was found that daylight reached 100 lux in only six rooms out of 12 in most daytime hours, especially the afternoon. Additionally, four rooms out of the six had at least one window oriented to the west, rooms 5, 6, 2 and 12. However, rooms 4 and 11 were located towards the east and north, respectively.

None of the participants who lived in living rooms where daylight reaches 100 lux at different times of the day from different orientations complained about glare or intensive heat; however, they did complain that they needed more daylight such as in Figure 7-4. It is possible that female participants were acclimatised to a 100 lux daylight because they spent a big proportion of their time indoors. Indeed, the findings relating to this point show that it cannot be claimed that other orientations do not provide daylight, as there are other factors to consider, which could be the reason for weak daylight levels, such as exterior obstructions, which will be discussed in the next section.

Figure 7-4 Living room number 6 for participant (DU)

7.6 Daylight and exterior obstructions

Distance between buildings has a major negative impact on daylight according to different studies, such as that by Littlefair (1991, p.3), Thomas (2013, p.131) and Afroz et al. (2014). In the study by Afroz et al. (2014), as discussed in point 6.4, the authors studied the effect of road width on obstructing daylight from entering the space on lower floors. They found that obstructing windows with another building close by has a significant impact on daylight penetrating into the interior space. They asserted that the wider the distance, the more daylight can penetrate inside a room. Li et al. (2006) studied a similar case, but in a Hong Kong high rise building in a high density area, at 22.39 N and 114.10 E. The authors found that closeness between buildings creates a major obstruction to daylight entering the interior space (Li et al., 2006).

My study findings show that exterior obstructions have a significant effect on daylight levels just as type of glass and orientation do. As mentioned in the previous section, westerly and easterly orientations provide a high level of daylight; however, it is observed that exterior obstructions can reduce or block this daylight, as was found for rooms 1, 9 and 10 with transparent glazing and room 8 with a big area of frosted glass. In these four rooms, daylight did not reach 100 lux at any time of the day in any season. These rooms are facing east, west and north, but no daylight is penetrating inside the rooms as the distance between these rooms and the neighbouring building is just four metres. To confirm this finding, rooms 1 and 10 were examined again, but with a distance of 10 metres between buildings. Daylight increased in this scenario rapidly from 40 lux to 110 lux in July. This shows that having an exterior obstruction blocks daylight from reaching interior space.

The above finding was compared with room 12 with a very small window, as shown in Figure 7-5. The window is facing the main road with around an eight-metre distance between buildings and facing west. Daylight ranged between 100 and 200 lux at 12pm, 14pm and 16pm in most seasons. The reason why this living room had this amount of daylight was not just that the window is transparent and facing west, but also because, in this scenario, the distance between buildings is wide at eight metres. This shows that, in addition to type of glass and window orientation, the issues of exterior obstruction is important when looking at providing enough daylight. Although, a westerly orientation is not recommended as the sun is so intense in the afternoon, this issue was, however, solved with a small window that provides enough daylight without excessive heat. Therefore, the gap between buildings plays an important role in daylight levels, as, in rooms 2 and 5, one of the windows had no building to block daylight. This could be one of the additional reasons for the daylight levels in these rooms in addition to frosted glass. Therefore, the factors that were found to help in increasing daylight in living spaces were frosted glass and bigger gaps before exterior obstructions.

Figure 7-5 Living room number 12

7.7 Daylight levels in room zones

Although some living rooms had enough daylight, as discussed in the previous findings, the female users of these rooms indicated that they were not satisfied with the amount of daylight in their living rooms. According to Ibrahim and Hayman (2005), Afroz et al. (2014), Kim and Kim (2010) and Sherif et al. (2010) daylight levels should be studied in each zone of the room to make sure that all parts of the room have daylight, as shown in Figure 7-6. The above studies claim that daylight decreases in the deep parts of the room and they go on to assert that the depth of the room must be studied when designing window size. Stevens (2013, p.187) and Meek and Van Den Wymelenberg (2014, p.32) report that narrow vertical windows allow daylight to reach the deep part of a room more easily than horizontal ones. This is because vertical windows provide circular contour lines where horizontal windows provide an elliptical shape (Stevens, 2013, p.187).

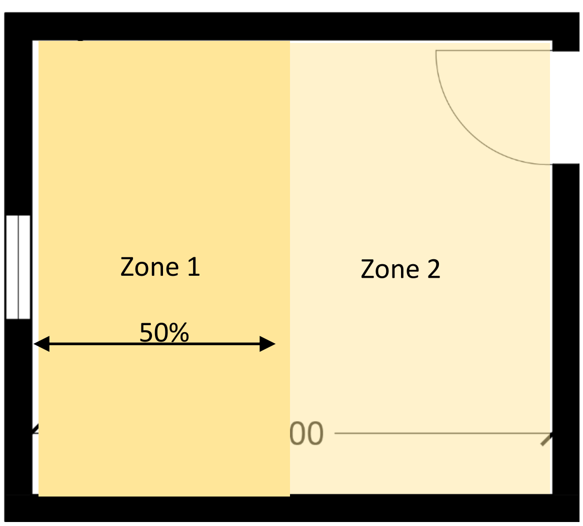


Figure 7-6 Daylight levels in different zones

In this study, room zones were divided into two parts with each zone being two metres. Since daylight in most flats did not consistently reach 100 lux, zone analysis was done with the first zone defined as 50% of the room area starting from the window wall to the middle of the room at floor level, as shown in Figure 7-6, since this is the seating area. The rest of the space is usually for a T.V. and shelves so nobody will sit in the rest of the space. The findings revealed that, even if daylight reaches 100 lux in some rooms, this does not, however, mean that 100 lux is available in the whole room. It was found that daylight in 12 out of 12 rooms from the first to the third floor did not reach the whole of the first 50% of the living rooms near the window at any time of the day, as shown in Table 7-8 except for one room, which is room 2.

Table 7-8 Number of living rooms that do not have daylight in 50% of the living room

	1 floor	2 floor	3 floor	Total 12
15 January	4	4	4	12
15 April	3	4	4	11
15 July	3	4	4	11
15 October	4	4	4	12

Daylight at 100 lux is only available in the first 1 metre close to the window. . This finding supports the women's claims in Chapter 6 that they do not feel that there is sufficient daylight in their living rooms. However, it was found that only one room was excluded from this issue in April and July, namely room 2. Daylight was more than 100 lux in 50% of the room at 12pm in April and at 10am, 12pm and 14 pm in July. This room has two frosted glass windows. One of its windows facing main road as mentioned before

7.8 Window to floor ratio

Window to floor ratio (WFR) is a rule that guides architects to design windows with certain sizes in relation to floor size in order to provide enough daylight in interior spaces. The most common rule is to design a window that is 25% of the floor area (Caroline, 2013). British building codes show that window to floor area should not be less than 25% (BCWHBC, 2013). According to Public Works and Government Services of Canada, 25% is considered suitable as it can provide a sense of daylight in interior space in office buildings in cloudy regions (PBWGSC, 1990). On the other hand, in Japan, 14.2% is recommended for the window ratio to room floor area in homes, while it can vary from 10% to 14.2% in other buildings according to their function (Koga and Nakamura, 1998, p.280). The reason that there is a different percentage from the United Kingdom to Japan is related to climate variation. In the hot climate of Japan, a window that is 14.2% of the floor area can provide enough daylight in an interior space (Tregenza, 1998, p.7).

Nedhal et al. (2016) studied daylight in residential building in Malaysia at 4.2° N, 101.9° E with hot weather averaging 32^{o}C in summer. The building is oriented to the southeast. Authors found that 100-200 lux is sufficient in living spaces. According to Nedhal et al., in order to achieve this, the window to floor ratio should be 10% or less. The authors go on to assert that this percentage provides daylight without creating an over lit space. They found that if window to floor ration is 25%, it can create over lit space. Additionally, some participants in the study were satisfied with daylight when the WFR was just 5%. It is important to highlight that in this study glass type is transparent, rooms are in high floors and there are no close exterior obstructions.

Therefore, window to floor ratio is analysed in this study to identify the common ratio in Jeddah flats, as shown previously in Table 7-1, Table 7-2 and Table 7-3. The analysis shows that the common ratio for most living rooms ranges from 5% to 13%, which is a low ratio. Five flats out of 12 had 5% WFR. This shows that ratio is not considered when designing windows in rental flats. On the other hand, only room 2 in Table 7-1 had 20% WFR. This percentage was a result of two windows in one room. However, this woman complained that she is not satisfied with daylight in her flat due to privacy concerns. Her husband does not allow her to open the curtains and this shows that glass type and privacy should be considered alongside WFR. Additionally, the participant for room 4 had 14.51% WFR but felt she had to close the shutters all day since a new building had been built next to them. Conversely, there was an unexpected result for room 11 for participant RU, who was fully satisfied with the daylight that reached more than 100 lux in the afternoon. In this room the WFR was just 1.9%. This finding is in agreement with Nedhal et al. (2016), who found that 5% WFR can be considered sufficient when daylight lux reaches the necessary percentage in the space.

My findings show that daylight lux can reach 100% or more even if the WFR is low. However, other factors such as glass type and distance between buildings may be significant in such a case.

7.9 Daylight levels in roof flats

A separate diagram is given for the three flats on the fifth floor since they all have adequate daylight at 10am and 12pm in all seasons, as shown in Table 7-9. Flats on the fifth roof floor have adequate daylight, not just because they are on a high floor, but, from the interviews with the women, I realised that the occupants are the owners of these flats, except in the case of room 13. Therefore, the women had a choice as regards window size and glass type, as mentioned by them during the interviews in Chapter 5.

It was observed that all the windows were big size transparent or frosted glass windows covering most of the wall, as shown in Table 7-9. Daylight lux in these three rooms is above 100 lux in all seasons, as shown in Table 7-10. For instance, room 15 has daylight lux between 100 and 187 at 10am and 12pm in all seasons as it is facing east. Room 14 with two big transparent windows, as shown in Figure 7-8, has daylight ranging from 150-400 lux at 10am, 12pm and 2pm. However, lux levels did not reach 100 lux at 4pm in any season in this room.

Table 7-9 Window characteristics for roof living rooms

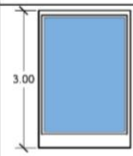
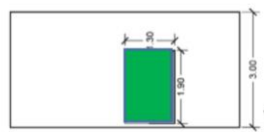
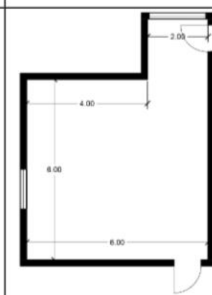
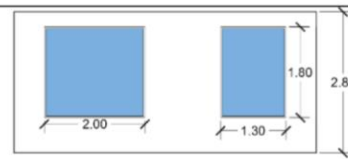
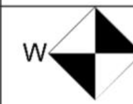
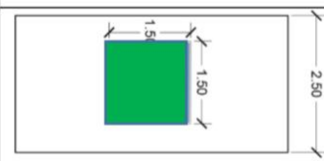
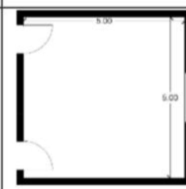
Participants' abbreviations	Room number	Elevation	Floor plan	Window orientation	WFR
Y	Room 13	 W=2.70*2  W=1.30*1.90	 F=6*6		F = 40m^2 W = 7.87m^2 WFR = 19.45%
M	Room 14	 W=2*1.80 \ !=1.20*1.80	 F=6*4		F = 24m^2 W = 5.94m^2 WFR = 24.75%
NA	Room 15	 W=1.50*1.50	 F=5*5		F = 25m^2 W = 2.25m^2 WFR = 9%

Table 7-10 Number of living rooms on the fifth roof floor that have daylight of less than 100 lux

	10am	12pm	14pm	16pm
15 January	0	0	1	2
15 April	0	0	1	2
15 July	0	0	1	2
15 October	0	0	1	2

The majority of rooms have daylight at 100 lux and above at 10 am and 12 pm. The same is true for all rooms at 14 pm except for room 15. At 16 pm none of the rooms reached 100 lux except for room 14. The surprising finding was for room 13 where the daylight ranged from 300-3000 lux. This supports my findings during the interviews that the daylight in this flat was more than enough, as I could not conduct the interview with the two windows open because the daylight was so intense, as shown in Figure 7-7. The north oriented window of 5.4m^2 only could be open, while the west oriented window of 2.47m^2 had to be covered by a curtain as the daylight was too intense. The highest lux level for this room is at 12pm and 14pm. This finding led me to carry out another analysis of room 13 by measuring daylight from the north oriented window of 5.4m^2. It was found that daylight lux is 65 lux in January and October and 80 lux in April and July. This is why daylight is less than 100 lux at 16 pm in this room. In this room shading devices, which are discussed in Chapter 3 were needed to solve the issue of sharp daylight in order to keep the two windows open. However, I realised that shading devices are not taken into account in residential architecture, in this residence for participant Y or in any of the flats in Jeddah during the first and second stage of data collection in Chapters 4 and 5.

Although, WFR does not reach 25% for all the roof flats, daylight, however, reaches 100 lux and more. All participants in these rooms were very satisfied with the daylight levels. Additionally, by comparing the findings for WFR, it was found that the WFR in rooms 13, 14 and 15 are 19.45% and 24.75%, 9% respectively. This shows that room 13 has a higher WFR percentage than room 14, and lux is much higher in room 13, yet this is not just because room 13 is higher than room 14. This could be because of the distance between buildings, as, in room 14, there was a neighbouring building in front of the windows, whereas, in room 13, there was not and, therefore, daylight entered the room from both windows without any obstruction. This shows exterior obstruction is one of the major factors affecting daylight. Therefore, it is highly recommended that gaps between buildings should increase for other floors with small windows.

Figure 7-7 Living room number 13 for participant (Y).

Figure 7-8 Living room number 14 for participant (M)

7.10 Conclusion

According to the findings from the daylight analysis, it has been shown that daylight is less than 100 lux in most living rooms from the first to third floors. It is also clear that more than 50% of living room space in all living rooms on the first, second and third floors have daylight of less than 100 lux. The previous literature has discussed that daylight inside rooms is affected by many factors, such as glass type, window size, window to floor ratio, exterior obstruction and window orientation (Afroz et al., 2014, Gordon, 2003, Hashim and Rahim, 2010, Hegazy et al., 2013, Hegazy and Attia, 2014, Kim and Kim, 2010, Koga and Nakamura, 1998, Li et al., 2006, Littlefair, 1991, Meek and Van Den Wymelenberg, 2014, Nedhal et al., 2016, Parise and Martirano, 2013, Stevens, 2013). My study adds that the most significant issues affecting daylight levels are glass type and gap between buildings. It was found that transparent and frosted glass provide daylight, while tinted glass blocks daylight. Hence, due to cultural reasons, frosted glass is preferable since it provides privacy.

Secondly, windows that are facing the street provide enough daylight, even if they are small, but they have to be transparent or frosted. Additionally, the findings revealed that all living rooms on the first, second and third floors show weak daylight during the day except flats that are facing the street and not obstructed by a small gap between neighbouring buildings. Windows that are obstructed by neighbouring buildings which are four meters apart from each other block daylight even if the glass is frosted or has an easterly or northerly orientation. Therefore, the greater the distance between buildings, the better the daylight levels inside them.

Previous research claims that corner windows are a great source of daylight because they provide light from two directions (Afroz et al., 2014). However, this solution would only be appropriate if the glass is frosted due to cultural requirements. As found in the study, participant D with corner windows had enough daylight because both windows were of medium size and frosted. All flats, with sufficient daylight levels had either frosted or transparent glass, while all the flats with tinted windows showed very weak daylight levels, even if there were two corner windows in a small room. This shows that a study of culture is mandatory when designing windows in Saudi Arabia. The window as a device has other functions, such as providing occupants with a view in addition to daylight (Cheung and Chung, 2008, Galasiu and Veitch, 2006, Roche et al., 2000). This advantage of a window is missing in frosted and tinted glass and not considered in this study due to the cultural need for privacy.

On the other hand, all living rooms on the fifth roof floor had a high level of daylight. This was due to many reasons. Firstly, the flats were owned by the inhabitants, so they had designed big windows in an open living space. The windows took up a huge part of the living space walls. There was also more than one window. Since these occupants were on a high floor, even if they had a close neighbouring building, daylight remained high due to the height and the big window size. Only one of the flats on the roof floor was limited to one big window, but daylight was still more than 100 lux in the morning and afternoon.

The aim of this chapter was to appraise women's claims by contrasting their response with valid and scientifically approved measurements of daylight levels in their living rooms rather than investigating how specific window design affects daylight levels. Findings in this chapter do not provide definite evidence that daylight lux is low because windows are oriented in a certain way, at a certain distance from neighbouring buildings, that WFR is of a certain ratio or glass is of a certain type. However, it analysed the design factors that lead to a reduction in daylight levels in the examined living rooms, which provided me with evidence for the women's claims to enable me to investigate the reasons for certain window designs from the perspectives of decision makers in the next chapter.

Chapter 8

Chapter 8 Discrepancy between users and decision makers

8.1 Introduction

This chapter returns to the contextual issues in order to evaluate them in the light of what has been discovered and shown in Chapters 5, 6 and 7. In Chapter 6, a detailed discussion of interviews with 23 women was carried out. It analysed women's missing needs in the design of contemporary flats' living rooms generally and for daylight levels specifically. To confirm that their claims are correct, a second stage of data analysis was required. Floor plans of the participants' flats were drawn in AutoCAD program and daylight calculations were done in Diva-for-Rhino program. The Diva analysis confirmed that contemporary flats in Jeddah lack daylight in living rooms by offering a quantitative dimension to the qualitative findings obtained so far. The interviews confirmed that the level of daylight is not adequate in the domestic spaces observed. Positioning the openings of the living rooms so they face the light wells results in a poor level of daylight. Since women's needs are not fully understood and considered, as found in Chapter 6, this part explores the dynamics that underpin the design considerations that architects include in the design process.

Therefore, the purpose of this chapter is to discuss the contextual issues from the perspective of decision makers including architects, municipality officer and professors in architecture in Jeddah. This done through the analysis of interviews with these professionals in order to investigate the reasons that have led to the current issues of dim daylight and lack of privacy in contemporary flats. This chapter will explore the factors that influence window design in Jeddah, as well as considering possible strategies to address the poor daylight quality in the observed apartments, with special attention to the level of privacy dictated by the local cultural aspects. These factors will be explored from the professionals' points of view.

Seven points will be here considered:

- Transition in window design
- Flat design and inhabitants' needs
- Arab architects and different cultural needs
- Site visit
- Window Orientation
- Commercial aspects regarding window design
- Window design and investors

These seven points form the structure for the discussion which follows.

8.2 Transition in window design

"Culture largely affects window designs in Jeddah. You will find that living space or places where people gather within the flat will have their windows designed in such a way that they let in little daylight or it is not exposed to the world." (Architect H, 2017, pers. comm., 2 January)

Vernacular architecture in Jeddah is culturally determined as are the window designs. Most windows designs do not have regard for daylight levels as found in chapter 6 where some participants mentioned that Roshan does not provide adequate daylight. Instead, they reflect traditional lifestyles and, invariably, climatic conditions around Jeddah. This finding is consistent with studies which observed that culture is a big influence, not only on window designs, but material choice and location of the window, such as Al-Jawahrah (2002), and Alsaleh (2008) and, accordingly, these windows are designed so as to adapt to climate and Jeddah lifestyles. My findings suggest that cultural orientation has dictated that most sections of the windows of flats in Jeddah are hidden to conform to privacy concerns.

The local interpretation of cultural values of privacy remains one of the biggest influencers on the design of windows in contemporary homes (Al-Jamea, 2014, Al-Jawahrah, 2002, Batterjee, 2010, Sobh and Belk, 2011b) as mentioned in Chapters 2 and 6. The decision to have small windows, using Islamic patterns or hiding the lower part of windows, is largely influenced by the cultural need for privacy, as discussed in Chapter 6, where some husbands or brothers cover windows with wood or black paper to provide privacy. To understand the extent to which culture influences window design, the question "How does culture affect window design in Jeddah?" was asked to decision makers. It revealed that culture plays a significant role in determining window designs. For instance, interviewed architects' answers suggested that most clients do not want transparent glass as it does not provide privacy. Therefore, they prefer tinted glass.

My findings reveal that, while most contemporary flats in Jeddah share a similar design, they all appear to reflect the cultural opinions in Jeddah and Saudi Arabia in general. Most window designs in Jeddah restrict onlookers from seeing the central interior, either with the type of glass or type of curtain used. Furthermore, these designs restrict exposure of rooms to the exterior world and confine these rooms for family use. Living spaces where people gather within the flat will have their windows designed in such a way that they do not let in a lot of daylight or expose the inside view to the exterior world. According to this finding, culturally, living space is considered to be a place or a room within the home that should be secured from public view. One of the ways of ensuring this is to design windows that will ensure that people from the outside do not witness events inside. The response to this consideration is that these windows will be placed or designed in a manner that means allow little daylight into these rooms.

Modernisation and urbanisation have had an influence on window designs in Jeddah flats, but this creates conflict with the cultural need for privacy. Most windows have aspects of traditional architecture and there are renewed attempts to preserve and maintain buildings whose windows have geometric patterns inspired by Roshan, as shown in design is inspired by Roshan. Figure 8-1 and Figure 8-2 . Geometric patterns are combined, interlaced and arranged to become one of the most distinguishing features of windows around Jeddah. In most cases, these windows obscure daylight from some rooms as the pattern is so detailed. However, according to architect B, these geometrical patterns are part of the building regulations set the municipality to provide privacy, where the design is inspired by Roshan.

Figure 8-1 Sample 1 for geometrical patterns on the exterior side of windows

Figure 8-2 Sample 2 for geometrical patterns on the exterior side of windows

Finally, It is important to highlight the blocks of flats do not have fire exits as there is no code in the building regulations that discusses fire exit for domestic buildings. However, this is important as Al-Homoud and Khan (2004) noted that building regulations must consider safety for occupants. They state that building regulations in Saudi Arabia need to include fire exits for residential blocks of flats. Therefore, until this regulation is added window will remain as exterior openings where people could use to escape from fire as what happened in one of the girls' school in Jeddah in 2011 (Alzahrani, 2011, p.5). However, these solid geometrical patters made it difficult for all students and teachers to escape easily resulting in some injured and dead teachers (Alzahrani, 2011, p.5).

8.3 Flat design and inhabitant's need

According to Bahmmam (2011), blocks of flats have many disadvantages for Saudis, for instance, neighbours' noise, sharing one entrance in the building and one staircase or lift. The idea of sharing a common space between different families means that flats are not dream homes for Saudis. However, people with middle or low incomes have no choice but to rent this type of residence. But, even if they own a flat, they will still plan to own a house at some point as discussed previously in Chapter 6. In addition to Bahammam's findings, Chapter 6 of this thesis showed that inhabitant dissatisfaction is not about sharing a common area only, as no one mentioned this issue during the interviews. They mainly discussed the interior planning of a flat as being a major issue for them, such as room divisions and window design in relation to daylight and privacy.

The concept of inhabitants' needs is very important when it comes to designing flats in Jeddah. The most important aspect is whether architects consider inhabitants satisfaction with daylight in their living spaces or not, which is the question under discussion. Architectural design should take into consideration the overall satisfaction of inhabitants and home occupancy when designing flats. Architect H did not see the concept of inhabitants' needs in the design and the construction of flats as an issue in Jeddah. On the other hand, Professor M mentioned that existing issues regarding inhabitants' needs could be found in published researches and these researches can help in enhancing flat design to satisfy users. However, these researches are not easily accessible to architects compared to academics. This shows a weak connection between different sectors in the same field. On the other hand, all of the architects who participated in this study felt that the only way to understand if their design did not fulfil the inhabitants' needs was if they dealt with the same client for future projects and discussed the issues they had. Other ways of finding out, such as having to do follow-up work as part of the completion of the initial project needs extra staff in the office, which would cost the office owner.

The concept of inhabitants' needs should be paramount for a flat or any other building. According to the above answers of the interviewed architects, home design shows a clear tension between the decision makers and users. For architects and municipality officer, investment comes before users' needs, as my results show that window design is not regulated, while daylight is mandatory in residences for humans.

The analysis further shows that the absence of detailed building regulations does not stop at window design, but it also continues to be an important factor that affects design and occupant satisfaction in a flat. Therefore, municipality should provide rules to ensure inhabitants' satisfaction. Enforcement of this service could be monitored via the municipality website, to identify inhabitants' complaints and room for improvement. My findings support other studies which state that the main reason for providing building standards is to ensure human comfort (Indraganti and Rao, 2010, Klein et al., 2012).

8.3.1 Women in the design process

Considering different gender needs in home design is a crucial point in Western research. According to Borden et al. (2002, pp.1-2), the study of gender, and especially women, in relation to architecture is very important. They claim that architecture is a cultural artefact, since architecture is shaped according to human needs. Unlike public space, when it comes to home design, a study of women is mandatory as home is considered to be the housewife's domain and women play a major role in each part of the home, whether the kitchen, children's room or any other place at home (Borden et al., 2002, Leslie and Reimer, 2003).

Other than AlKhateeb (2015) and AlKodmany (1999) who have studied women's privacy in Dammam and Damascus respectively as discussed in the literature review in Chapter 2, this consideration is still absent in Arab studies in terms of contemporary design. Most published studies of vernacular Arab architecture argue that women's privacy is a major element (Adas, 2013, AlHumaidi, 1996, Al-Murahhem, 2008). In contemporary architecture, my interviews with architects show that users' needs generally and women's needs specifically are totally neglected in their designs, as none of the architects used the words users, inhabitants or women's needs in their answers. They simply repeated landlords' needs as their major concern.

The question, "Are women's needs in terms of daylight, flat floor plan or privacy considered or just the landlords' request? Why?" was asked to ascertain the extent to which women's needs are factors when considering privacy, daylight and architecture. I found that most architects considered the landlords' wishes more than the home's inhabitants, either men or women. Architects argue that their job is to design homes according to the landlord’s request. Women’s needs or daylight are not issues they can take into consideration if a landlord does not ask them to. Interviewed architects also claimed that it is not their job to tell their landlord ‘clients’ what they are supposed to have in their homes according to what they have learnt at university as this can make them lose clients.

On the other hand, all three professors focused on users’ needs generally, and females specifically, in their discussion. Hence my claim, after interviewing the female participants, that their voices are not heard and their needs are not taken into consideration as discussed in Chapter 6. In response, Professor M noted that no single investor considers the needs of women in the process of designing flats in Saudi Arabia. They only aim to design flats with a greater number of rooms since they are the most recommended by landlords in Saudi Arabia because they provide privacy, segregation and high rent. According to Professor F, the reason for this issue could be the unavailability of female architects working in the field. She goes on to assert that women understand each other; therefore, the need for female architects is mandatory. It is important to mention that this point is also raised by female participants.

To explore this subject further, searching the municipality website for architecture offices in Jeddah is a valid source of information, as all architecture offices have to be displayed there. This source shows that most offices are run by male architects. When I visited architecture offices, all the staff were men. A few design offices are owned by Saudi women, but they focus mainly on interior design. This issue is not exclusive to Saudi Arabia. In other countries, for instance, in a different context, in the UK, one study showed that women remain considerably under-represented in the architectural profession since women architects account for less than 20% of the profession (Fulcher, 2010).

Flat design in Jeddah is dictated by male architects and owners, and exemplifies men's negligence of women's needs such as the need for both daylight and privacy. This leads to women's dissatisfaction in their homes. My findings support the claim that women are being discriminated against, with men dominating all sectors of the building industry. There is a need for more women to work in architecture and building to help to ensure that women's needs are considered in home design. Women architects would be likely to consider Saudi women's cultural needs in design, for instance, they could design a window or a balcony that has a function instead of designing redundant balconies as are currently found in buildings.

8.3.2 Privacy

In Saudi home design, Islam requires the privacy of women, as discussed previously in Chapter 2, in that women must be protected from being seen by any man who is not a *Mahram* (Wahid and Khozaei, 2008). Accordingly, the perspective of men with regard to culture and religion is that privacy remains a major characteristic of Muslim culture in Saudi Arabia.

I found that the ignorance about daylight does not end with architects, landlords or municipality officer, but it also extends to male guardians in the family. Interviewed women claim that curtains have to be closed at all times in some flats as the male guardian does not allow his family to be seen. There are some women who keep the curtains open all day and their male guardian does not refuse this as they live in roof flats, as mentioned before in Chapter 6, which is a special case. I also found that there is a little cultural variation as there are some open minded men who do not care about privacy. However, this was limited to one woman in my study.

On the same issue, municipality officer MA argued that building regulations do not take into account different gender needs, but only commercial considerations and social factors. Commercial considerations relate to the landlord's right to have a building that is designed in a way that allows him or her to invest the land. In terms of social factors, I found that the municipality officer did not really consider social factors as he discussed how having a home is enough for a person whether a man or woman to have privacy. A home with a separate door is a private place. I realised that the municipal officer changed the subject when discussing windows that face neighbours' windows. He finds that using curtains is enough to solve privacy and he ignores daylight. This shows a clear discrepancy between decision makers and users.

On the other hand, one of the interviewed academics, professor A, stated that there is a need to take into consideration men's perspectives about religion and culture in terms of influencing decisions on aspects of daylight. I realised from the above response that men are not only concerned with culture and religion, but they look at architectural design in terms of privacy rather than daylight. Previous studies that have attempted to link culture and daylight in architectural designs confirm the results of the analysis. For example, Al Darwish (2014) states that modern life in Saudi Arabia, specifically for women, has been influenced by the cultural and religious perspectives of men. Men see such designs as allowing neighbours to see one another from their windows. Within the framework of my data, men are not really against architectural designs that allow increases in daylight in general terms. However, from a religious point of view men do not accept the idea of strangers being able to look into their homes.

8.3.3 Gender privacy and room divisions

"*Variation in gender is quite evident in Jeddah town when it comes to the building industry*." (Professor F, 2017, pers. comm., 4 January)

Discussing the factors that control flat building regulations in Jeddah from decision makers' points of view is essential as it helps in identifying if different gender needs are considered in the regulations. Architect S responded by noting that there are indeed regulations that have been put in place to govern the building industry as a whole, without specifically mentioning gender. Architects O and B agreed with S, noting that their work was to provide buildings based on given specifications with little consideration of gender. Furthermore, architect Y noted that most rules and regulation are set by men, since there are many more men compared to women on the panels overseeing such regulations.

Architects repeated many times that, with regard to window design and room division, they have to apply landlords' requirements as discussed previously such as providing more rooms to increase the rent and design windows which are not costly. Professor M noted that architects flout rules in the name of owners' needs. She observed that architects should strive to give their best and work in tandem with regulations governing building and constructions.

One of the architects I interviewed complained that visual privacy takes up a huge part of residential design, which echoes Day (2000) who emphasises home size in relation to visual privacy. Visual privacy should entail a well-designed interior which caters to the needs of everyone living in a flat. The aspect of culture and room division in Jeddah is mandatory. According to Sobh and Belk (2011b) gender segregation was common in the vernacular architecture of different countries. For instance, women used to have a certain part of the home where they could sit during the day, such as the *harem* in Morocco, *haramlak* in Turkey, *zanana* in Persia and India, and *nadani* in East Africa. The authors go on to assert that although these spaces no longer exist in Muslim contemporary architecture, gender segregation is still considered significant in some Muslim countries, such as Qatar. In Qatar, home design needs to have separate receptions, one for women and one for men, because both genders cannot sit together in one room if they are not relatives *Mahrams*. Conversely, for some Arab countries, such as Egypt, gender segregation either in public or private space, such as at home, is not considered an Islamic rule but is a convention which is observed in the Gulf countries for cultural reasons (Sobh and Belk, 2011b). Similarly, according to building regulations in Saudi Arabia, houses must include two entrances, one for males and one for females (MOJ, 2015, p.4). These gates are located by different zones. For instance, the men's entrance allows men to enter to their reception area without passing through the women's zone.

To understand the extent to which culture and room division is a factor that affect daylight and architecture, participants were asked many indirect questions to find whether men's beliefs have control in this area. The reason for asking these questions was to ascertain how culture and room divisions were factors that determine religion and culture from the perspective of men in Jeddah and how their perspectives influence overall culture, daylight and architectural designs. Architect A states that room division is a factor for men and their cultural beliefs. Clients, especially men, are conscious of the total number of rooms, as that affects their privacy. They see this as a social factor that is inherent in design and, thus, room divisions help to preserve the culture of privacy and hospitality. On the other hand, Professor M argues that window design is a factor that cuts across culture and room division. The more good window designs you have, the better you minimise room divisions.

The responses above show that male architects and men in general take gender segregation into consideration as far as privacy is concerned. They confirm previous studies from scholars such as AlKhateeb (2015) who noted that flat zone divisions remain important for women due to privacy. Men do not take women's needs into consideration and their decisions on room divisions are based on cultural concepts of privacy and hospitality. Municipal officer MA argued that, as far as he is concerned, there is no problem with just considering men’s perceptions regarding privacy and home division in home design since it is the man’s duty to provide his family with a home.

According to the responses mentioned above, culture, daylight and architecture are issues that women see differently to men. I found that although women’s opinions varied with regard to culture and room divisions, women claimed that if the living room is placed by the main façade this helps in providing privacy instead of placing it to the side or back of the flat where neighbours’ windows are facing them directly. From the façade side, there is bigger distance between buildings which helps in providing privacy from windows. This view contradicts that of Daneshpour (2011), who noted that room divisions are mainly a factor for privacy, but cannot be said to be a factor for daylight. Indeed, my findings confirm the fact that room divisions are often designed in some flats to–conform with requests made by landlords. Studies that have discussed home design in different region of Saudi Arabia show that privacy and hospitality are the essential factors, especially in residential buildings (AlKhateeb, 2015, Bahammam, 1998).

8.4 Arab architects and different cultural needs

A study done in Cuenca in Ecuador by Klaufus (2006) shows that having non-local architects designing buildings in urban areas leads to cultural needs and identity being overlooked. These types of architects are known as migrant architects. Migrant architects are people who have migrated to another region and introduced design elements that did not previously exist in the area to which they moved. However, adopted styles are not achieved by cutting and pasting designs from migrant architects' places of origin. They should be adapted to the material, climate, culture and environment of the area they have moved to by combining a mixture of traditional construction and new building techniques. The blending technique leads to an architectural metamorphosis (Klaufus, 2006).

Regarding Arab architects and different cultural needs, there is consensus that the current problems of daylight in rooms can be partly blamed on the influence of Western culture, since most of the flats present architectural characteristics that differ from traditional architecture in the region, which do not meet the cultural needs of Arab architecture (AlHumaidi, 1996, Al-Jawahrah, 2002, Al-Wafi, 2006). When the question "Are these regulations taken from other countries or not? Why?" was posed to the professors, professor M argued that she didn't believe that was the case, simply because such building designs do not exist in major cities in Western countries. She went on to assert that if building regulations are taken from Western countries, but are not implemented in reality, this means there is clear negligence by local architects who are financially motivated.

When interviewing professionals, it was also clear that most of the architects in the city are from Egypt and within Jeddah, but the analysis considered them all in the same way as they are all Arabs. Hence, the finding disagrees with the arguments. Interviews with architects and academics showed that Western architects designed commercial projects and reflected Western architecture in these. This argument could be true for a villa design, but not for flats because using Western architects can be expensive. People with a good income will for sure build a villa as discussed in Chapters 2 and 6. People in the Saudi culture do not believe in owning a flat for many reasons. For instance, a flat's size is small compared with a villa; it does not represent wealth and it is not an independent home since the building is shared with other families in different flats (Bahammam, 2015, Bahammam, 2006, Bahmmam, 2002).

Professor M claims that rich families prefer Western architects to design their houses as they find Western architects more creative. This supports the previous findings, in Chapter 6, that little attention is given to flat design as the owners will not live in them. Foreign architects who design blocks of flats are from neighbouring countries, such as Egypt, as Egyptian architects have dominated this job in the city since contemporary design began. The six architects and three professors who were interviewed were Egyptians, since they were dominant in all architectural offices and universities. Professors A and M stated that architecture professionals are to be blamed for the poor flat design that does not look at individual needs from women's perspectives. They also blame them for the poor quality flats appearing in our towns.

The above claim clarifies that flat design has been adopted from other Arab countries which share some similarities in culture and climate but not all. I visited many architecture offices in a famous commercial building that has been home to many such offices for more than 20 years and found that the offices were registered under Saudi architects' names. Nevertheless, most of the staff who worked in them, and managed the offices were Egyptian along with some Indian AutoCAD drafters. Also, when the interviews were planned and appointments were arranged, the Saudi owners contacted me directly on their personal mobiles, but, on arriving at the offices, none of them were available. The reception staff mentioned that they did not often come to their offices. Therefore, one of the Egyptian architects, who was considered to be the manager of the architectural departments, was appointed by the owner to do the interview since he was aware of the overall work. This experience I found during data collection strengthened my claim that having architects from different cultural background is considered a reason for the design of homes that do not fulfill individual needs in another country.

Small architectural details show how people can perceive Arab culture differently from different Arab countries, taking balconies as an example. For instance, Professor F believed that a balcony is an important feature of construction. However, people have lived in apartments with balconies for years in Jeddah, but they have not used them. In fact, people tend to close their balconies completely. The consequence of this attitude is evident in the outer façades of most buildings in Jeddah as shown in Figure 8-3 and Figure 8-4. Interviewed women use their balconies for storage, since they do not sit on them, as discussed in Chapter 6. This is an example of implementing a design element from another country without considering the small variations between cultures. Privacy for women is paramount and must be considered in the construction of a building in Saudi Arabia.

Figure 8-3 Covered balcony with black tinted glass in Jeddah

Figure 8-4 Covered balconies in Jeddah

Figure 8-5 shows the frequency of women's and professionals' responses to the question of whether a balcony is used by women in Saudi culture. The results show a statistical difference between women's and professionals' responses (P=0.00002), where the majority of women agreed that they would not use a balcony even if they were wearing *hijab* due to associations with cultural disrespect relating to this behaviour in Saudi Arabia. On the other hand, most professionals claimed that the balcony is used by inhabitants, yet they did not attribute significant attention to its use. The presence of balconies is chiefly dictated by the clients' requirements.

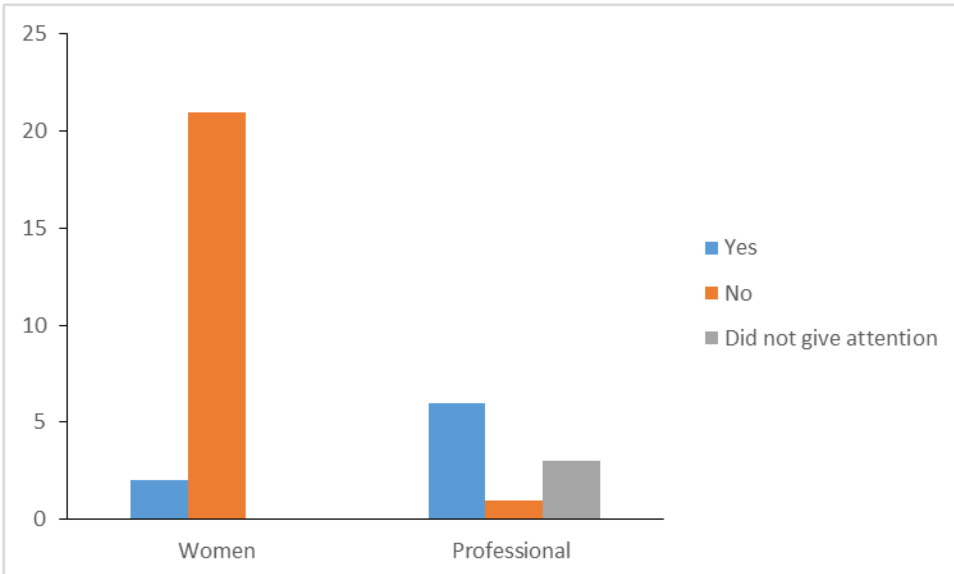


Figure 8-5 Showing differences between women's and professionals' opinions of whether balconies are used by women in Saudi culture

Although Islam is the common religion in Arab countries, according to Al-Jamea (2014), Saudi culture needs the highest level of privacy according to its cultural beliefs. In Saudi Arabia, women cover their faces as required by the religious leaders (Binbaz, 2017). Therefore, they cannot sit on open balconies. According to Zamani-Farahani and Musa (2012, p.1), Islamic nations should not be viewed as *"homogenous".* They go on to assert that, even if Islam has certain rules regarding daily life, Muslims do not share the same cultures. Muslims in different Arab countries vary in their culture as their governmental rules are different.

However, professor M disagreed with this position regarding the balcony, pointing out that the problem in Jeddah flats is window design and not the balcony. She further emphasised that the designs are poorly developed, without consideration for the occupants' safety and general health. She asserted that it is the poor professionalism in the architecture which should be changed. Elsewhere, my findings support the position voiced by professor M, as she agreed that the design should be improved to reflect the actual cultural backgrounds of people. Al-Jamea (2014) agrees that designs should be improved to reflect people's actual cultural backgrounds. One of the female participants mentioned that she had lived in a flat with a balcony that has a high wall that obscures her when she stands. This allowed her to sit on the balcony during the morning time to be exposed to daylight. However, other flats did not offer the same opportunities. Clearly, flats with a balcony potentially have more daylight than the ones without a balcony.

8.5 Site visits

Site visits offer a different perspective as they help in comparing metrics for architects to factor in the aspect of culture and, at the same time, establish the necessary illumination or lighting for optimal visual as well as task performance that suits the cultural orientations within Jeddah. A site visit is often a mandatory stage in the design process. Visiting the location involves more than just looking at it. It requires experiencing the space, taking photos and drawing hand sketches that will guide the next stages of design for the project. Site visits happen more than once during a project; the architect might need to repeat his or her visit to a location many times during the first stage or at further stages of the design process. Site visits can include discussing suggestions with neighbours, common issues and recommendations (Palazzo and Steiner, 2012, pp.50-124). The authors of the American Institute of Architects' *Architecture Student's Handbook of Professional Practice* note that the number of site visits differs according to the type of project. Small projects obviously require fewer site visits than huge projects that need site visits at all stages (Architects, 2016, pp.406-407). A recent study in Saudi Arabia found that not just architects, but also contractors do not visit sites as often as they should for many reasons, such as financial problems, poor site management or delayed payments, which leads to poor quality residences (Mahamid, 2016).

Findings from my interviews with professionals show that architects have to visit project sites to understand how neighbouring buildings are designed in relation to height, window size and other factors that they may deem essential during the design of the house. However, there is a significant difference between architects' and professors' perceptions of site visits. None of the interviewed architects considered site visits in their design process, whereas, on the other hand, all the interviewed professors considered them to be mandatory. Architects B, H, N, S, O and Y argued that they only put their client's vision on paper and, for residential flats, a site visit before construction is not necessary. Architect B claimed that his work is only to express his client's wishes on paper in a measurable manner unless they have to work with the contractor on the excavation. In this case, they have to go to the site, but during the building process, not the design stage. Similar sentiments were echoed by architect H who emphasised that a site visit is not part of the job of an architect; rather, it is the function of the construction engineer.

Responses from Y and H showed a difference of opinion about site visits as mandatory and the extent to which site visiting relates to social, architectural designs and daylight and is a professional mandate that falls to the constructors. Although the some response by architects demonstrates that site visits are considered to be valuable, but in reality architects leave this job to the contractor. This finding is in agreement with previous works in which it is noted that, in as much as the architecture should consider site visit, site visit is an essential part of contractors' job (Mahamid, 2016).

On the other hand, interviewed academics gave different answers from architects. Academics believed that site visits should be a prerequisite for architects. They suggested that the similarities in window position for side and back walls for most buildings must arise because architects do not take enough account of the individual circumstances and positioning for each building. In contradicting the position of architects, professor M argued that similarities between flats can only be explained by the fact that architects do not visit an area before they embark on the design of buildings. Academics would like to participate in that, but, due to government rules, staff in the public sector, other than doctors, are not allowed to work commercially while working in the public sector.

Within the framework of previous studies and my findings, it is noted from academic responses that site visits help to give a greater understanding of how engineering theory is put into actual practice. Skipping this stage can affect designers in the later design stages as far as observations of privacy and daylighting are concerned. Findings further show that architects tend to neglect site visits at the primary design stage, especially for flats. Yet, the site visit should be an important stage in the building design of flats for all architecture offices (Architects, 2016, pp.406-407, Palazzo and Steiner, 2012, pp.50-124, Thomas et al., 2015, pp.305-307).

8.5.1 Window location in relation to neighbours

"*Windows should not face neighbours' windows*" (Professor M, 2016, pers. comm., 29 December)

Although some flats have medium-sized windows and are oriented in the most efficient way, the function of windows in terms of daylight and privacy are not taken into account enough. Having a window facing the neighbours' leads occupants to close their curtains at all times, which results in dim spaces. Previous research claims that window size, orientation or exterior obstruction are the factors effecting daylight levels in the interior space (Afroz et al., 2014, Littlefair, 1991, Lu et al., 2016). As Saudi culture requires the highest level of privacy, privacy is, thus, another major factor affecting lack of daylight in the interior (Al-Jamea, 2014). Therefore, cultural factors such as privacy are considered mandatory in window design in a country such as Saudi Arabia, as discussed previously in Chapter 2.

I compared the findings in the assessment of daylight in Chapter 6 to those derived from the women's interviews in Chapter 5. The comparison shows that some flats on the first or second floors have some capacity to provide sufficient daylight, as found in Chapter 6. However, women who live in these flats complain that they do not have enough daylight in the living room due to privacy. Their windows' orientation could provide daylight, but are immediately facing their neighbours' windows. After discussing this point, I suggest architects should consider neighbours' windows before deciding on the location of windows in their projects, so they can avoid locating windows so that they face each other. As discussed before, this will only be achieved if a site visit is undertaken by the architects.

8.5.2 Gap between buildings

Daylight should be taken seriously in flats as in offices and other buildings. Professor M noted that, in some cases, privacy is lacking in small buildings, such as homes, which are sited near tall buildings, such as offices. A gap between buildings should be provided to a precise distance, for privacy. Similarly, Professor A mentioned that the relationship between privacy and distance between buildings is not taken into account in the regulations. Having small windows or using a curtain during daytime is not the right solution for privacy as it reduces interior daylight.

Academics suggested that, for a four-floor building, the gap between buildings should be more than six metres, while architects want it to be less to add more space to the building area. Architect B observed that, in some cases, landlords pay a lot of money for land and, in return, they deserve to use each metre in it for investment instead of losing it in the surrounding gap. This architect complained that privacy rules regarding gaps give more space than is actually needed for privacy.

Some interviewed architects (H, O and B) reiterated that, in most cases, building regulations are too stringent and do not conform to the cultural needs of the people, who are the clients. They cited an example of the roof of a villa which was redesigned to have an additional gap two metres from the sides and back in addition to the main building gap. Only one architect, architect Y, claimed that this gap was insufficient, thus creating privacy issues. People are being isolated by the narrow gaps between buildings because they lead people to close their curtains in most cases.

Figure 8-6 shows the nature of interviewed women's and interviewed professionals' responses to the question "Does the standard 2 metre gap between buildings provide an appropriate level of privacy?" The results show that there is a statistical difference between women's and professionals' responses (P=0.001); the majority of women agreed that this small gap does not provide privacy. On the other hand, from the professionals' perspectives, architects considered this gap not to create an issue of privacy, while academics supported the women's points of view.

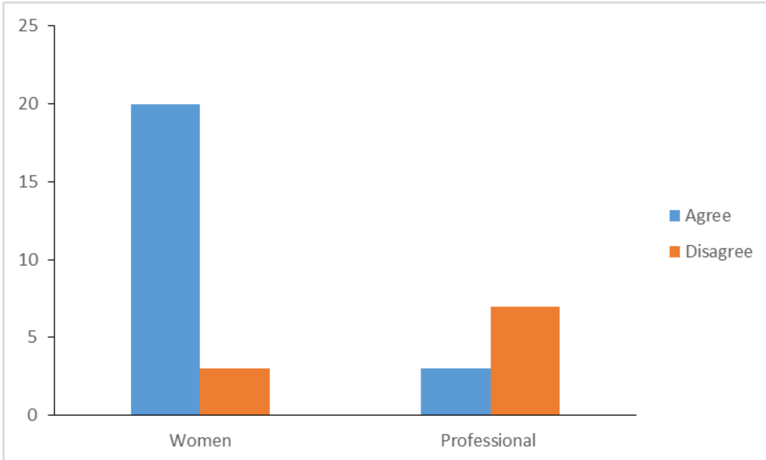


Figure 8-6 Showing the differences between women's and professionals' opinions about whether a minimum 2 metre gap between buildings does not provides privacy

Other than privacy, small gaps between buildings increases the issue of exterior obstructions in crowded urban areas which affect daylight in interior spaces. For instance, in Hong Kong, three studies were undertaken of a multiple floor residential block with a different context. The three studies found that buildings which face extensive exterior obstructions due to small gaps between buildings suffer low daylight levels. They found that the daylight level was low during the daytime inside the flats reaches 0.3 or 0.1 daylight factors in low floors due to the close proximity to the neighbouring buildings as 2 daylight factor equals 100 lux (see page 176) (Li and Lam, 2001, Li et al., 1999, Li et al., 2006). In my study, this issue was clearly recognised during interviews with the women, in that most windows are facing their neighbours' buildings, which does not allow daylight to penetrate well into the houses, in addition to having an impact on the privacy issue, as discussed previously in Chapter 6. Also, participating academics agreed that the closeness of buildings and poor design by architects are the main reasons for a lack of daylight entering homes.

Figure 8-7 shows the differences of interviewed women's and interviewed professionals' responses to the question of whether a 2 metre gap between buildings blocks daylight. The result shows that there is a statistical difference between women's and professionals' responses (P=0.005); the majority of women agree that this small gap blocks daylight. On the other hand, architects find this gap to be more than enough since the landlord has the right to use each metre of his land, while academics support the women's point of view.

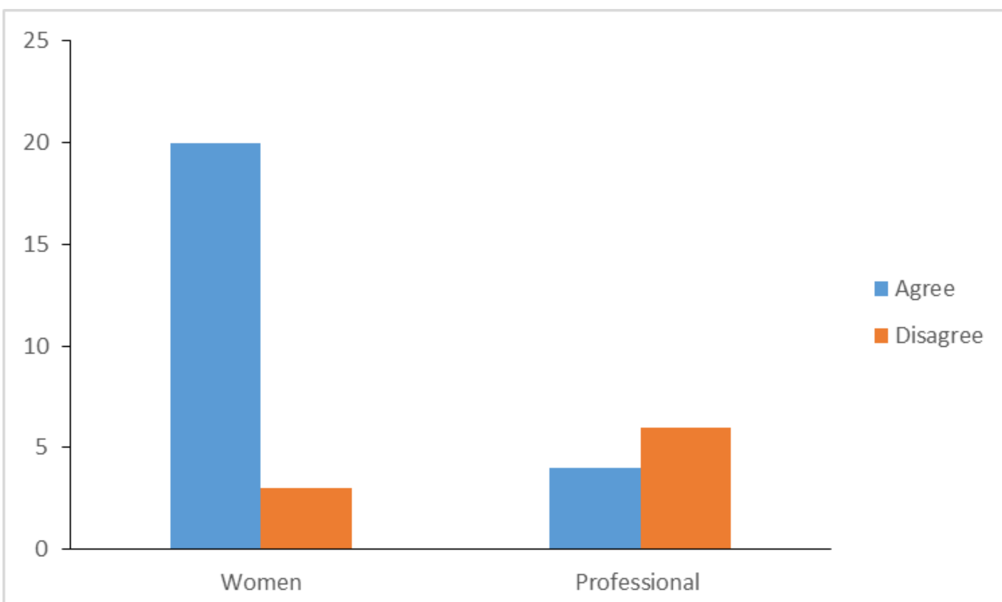


Figure 8-7 Showing differences between women's and professionals' opinions about whether the minimum 2 metre gap between buildings blocks daylight

8.5.2.1 Architectural solution

According to architect Y (2017, pers. comm., 1 January), *"We should find the best alternative approach which will meet our client's needs".* On the other hand, all interviewed academics supported my argument that a solution for gap between buildings should be found to provide daylight for inhabitants. For instance, professor A argued that, in order to solve the problem of small gaps between buildings, an additional setback for part of the building would be a great solution for daylight issues as shown in Figure 8-8. Introducing new regulations to ensure that a certain part of the building provides more daylight to interior spaces would be a solution to the current situation in Jeddah. She suggested that this idea should be studied to find out whether it could solve the issue in Jeddah's flats as it does in other parts of the world. It should be considered by the municipality to be included in the new building regulation update. Agreeing with this point, professor M noted that there is a need for an urgent solution from the municipality since there is still a lack of daylight in most flats. The respondent further called for the monitoring body to develop ways of enforcing the standards.

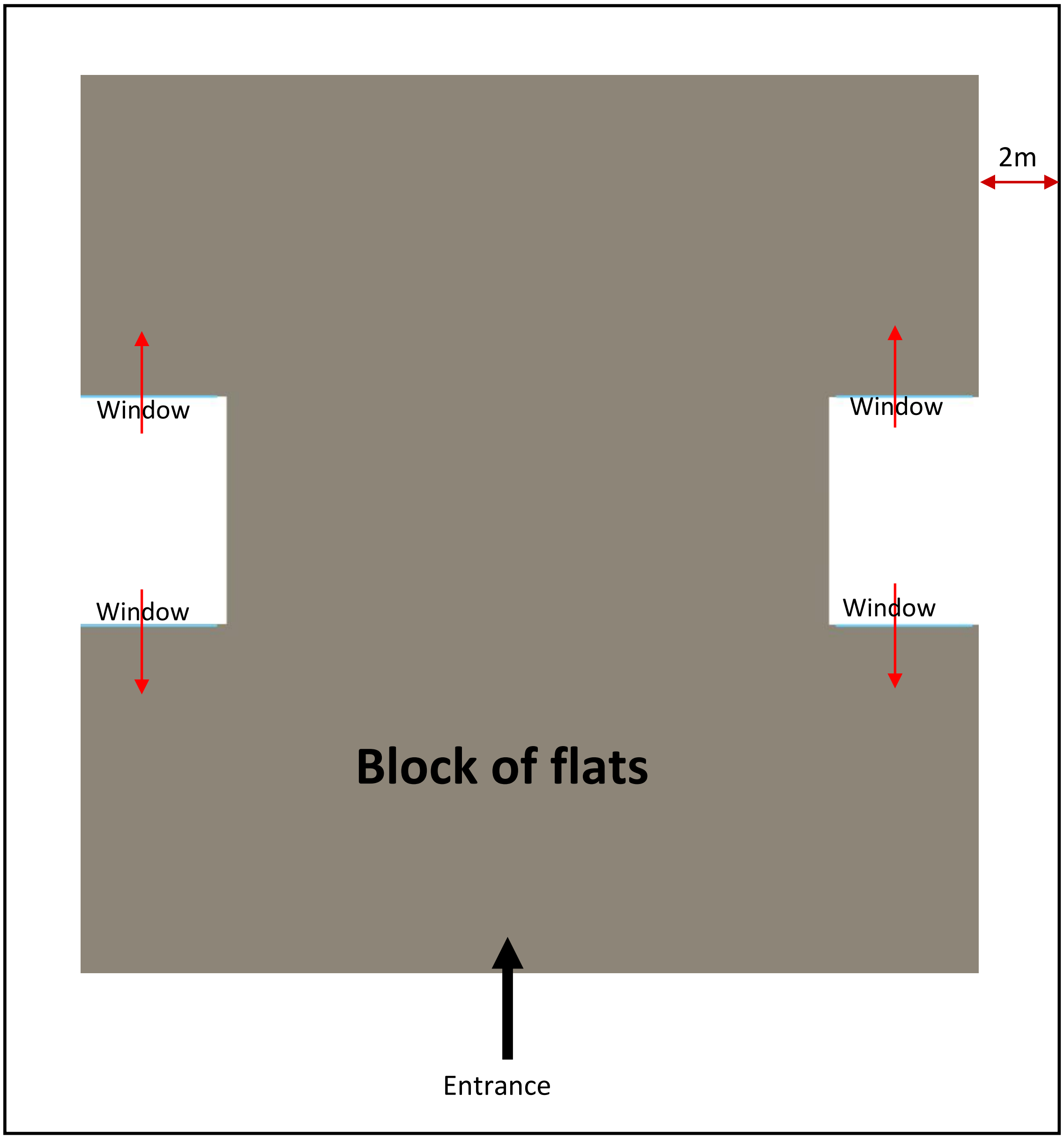


Figure 8-8 Illustration for the idea of an additional setback

8.6 Window orientation

This point is discussed in chapter 7, but it is significant to note that, from the finding of professors' interviews in this study, window orientation in relation to sun movements emerges as a potential solution for addressing limited daylight in Saudi buildings. Professors claim that studying the relationship between window position and sun movement has a major impact in allowing daylight to penetrate inside the living space. The findings from Chapter 6 show clear ignorance of this point where windows have been placed with no attention to sun's movements as each window is oriented differently. On the other hand, interviewed architects blame landlords for this issue. They claim that considering the sun's movements and window orientation can prevent them from arranging the room division according to landlords' needs. As the architects mentioned, if landlords do not care about daylight as much as they do about room division, architects cannot force them to do so. If architects consider a window orientation and sun's movements, this can affect or reduce room sizes or locations, and this will affect architects' professionalism in the clients' eyes.

The finding above regarding the importance of window orientation agrees with arguments given by the professors I interviewed. These professors noted that architects in Jeddah have failed to ensure enough daylight in most of the city's flats. The finding concludes that academics blame Western design ideas for the lack of a local identity in the built environment. They further blame increased technology, which has overtaken the traditional methods and ways of handling matters, including the development of AutoCAD used in design instead of physical visits to the sites.

Another point raised by academics was that no attention is given to window orientation since AutoCAD drafters are now able to design plans for blocks of flats. One of the architects I interviewed agreed that employing AutoCAD drafters in architectural design is a business decision: office owners do not want to pay the high salary for architects. The above claim related to hiring AutoCAD drafters to take architects' jobs prompted criticisms of cut and paste flat designs.

Another architect, architect B, believed that, in most cases, he designed the project according to different landlords' requests rather than the cut and paste concept being propagated, though. He mentioned that he designs homes with special requests such as to meet elderly or handicapped needs for ramps and lifts or those who care about decorating their homes with expensive materials to create a creatively designed home different to others. However, I disagree with this architect as later, during the interview, he said that most of his clients live in these homes, they are not for rent.

Visiting around 100 buildings in the first stage of data collection in all of Jeddah's residential districts showed that most buildings in the different Jeddah regions are the same, not because of the lack of professional architects, but rather because of a process whereby buildings are designed in a formulaic manner such as cut and paste designs. This shows that architects prefer to concentrate on certain aspects of their professions such as the commercial side of the building industry. This aspect of design relates to selling properties. This aspect is defined by the 'cut and paste' approach whereby AutoCAD drafters or architects take ready residential floor plans from previous projects and adapt them to the new context as shown in Figure 8-9 and Figure 8-10, the two most common flat designs in the city.

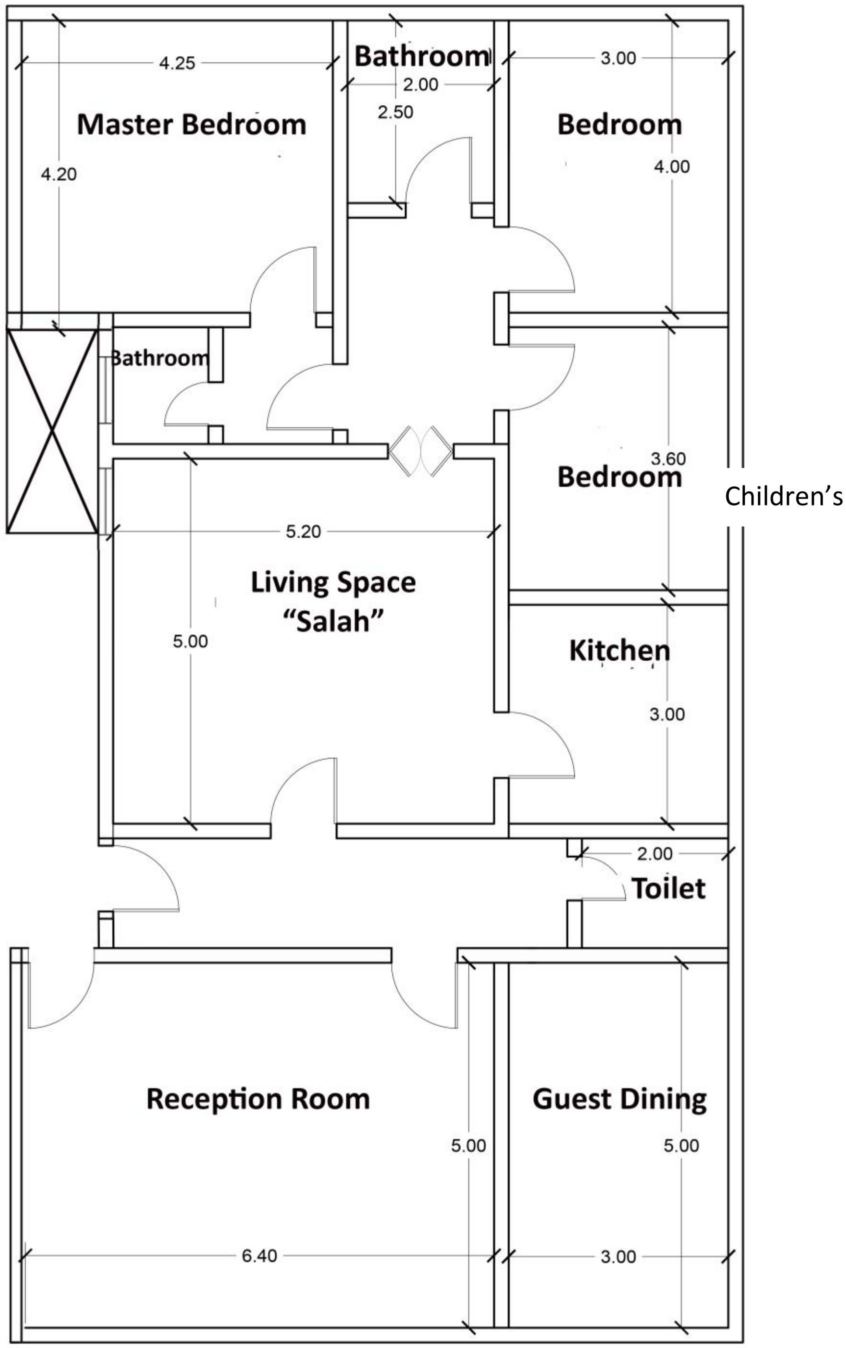


Figure 8-9 Sample 1 of common flat floor plan in Jeddah

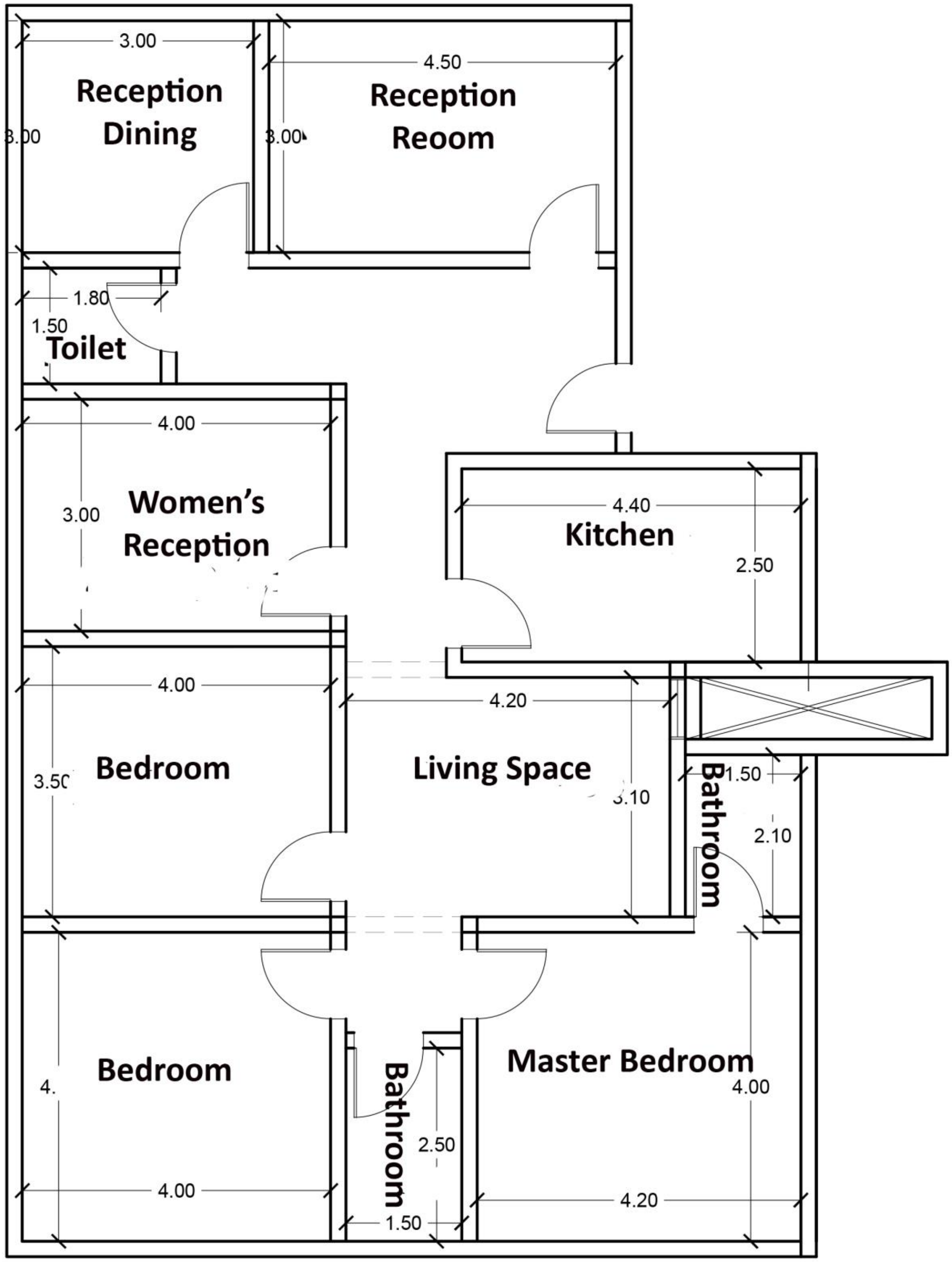


Figure 8-10 Sample 2 of common flat floor plan in Jeddah

The concern regarding copy and paste architecture design has been discussed by some authors (Asfour, 1998, Kultermann, 1999). These authors discussed the idea of cutting Western architecture designs from their original contexts and pasting these design into contemporary Arab architecture without considering cultural variation. Kultermann (1999) goes on to assert that these Western designs should be edited and revised before importing them to other countries especially if these countries have totally different cultures. The author continues to assert that the method of cut and paste is the major rule of having architecture with no cultural identity or needs. The above studies discussed the idea of cut and paste on a wider platform. However, in my study I found that this idea is still an issue within one culture. I found that cut and paste design without editing previous plan had a lot of disadvantages for users as discussed previously in Chapter 6 with women.

Additionally, interview with architects show that all architects who participated in this study understand the disadvantages of *Salah*, but they have to design it to be able to add more rooms in a flat and accommodate freedom for business. This is the easiest solution they can find. This supports the findings about cut and paste flat design, and it does not support architects who blame AutoCAD drafters for this issue. Professor A argued that many architects are not giving proper directions to the AutoCAD drafters, resulting in work duplication when it comes to flats. This should not happen and AutoCAD drafters should be given proper direction when it comes to architectural design. However, I claim that architects care more about business in that they want to secure as many projects as they can to enhance the office profit instead of finding new solutions that satisfy both landlords' and occupants' needs.

8.7 Commercial aspects regarding window design

Interviews with decision makers provided me with an understanding of the extent to which my findings provided answers to reasons of daylight deficiency in Jeddah's flats. My data analysis was intended to explain the extent of daylight in Jeddah's flats and the extent to which these buildings have been impacted by culture, Islamic beliefs and architectural designs. A concern arising from existing studies is whether architectural designs in Jeddah meet the minimum required standards of daylight needed for homes (Alawad, 2017, Alawad et al., 2016, Dahlan and Mohamed, 2010). Conclusively, Jeddah's flats have little guidance regarding specific daylight in their designs in regulation and in follow up after the building construction process. The municipality officer interviewed noted that window design and glass type are not essential points, especially when they are following up or monitoring the building processes of a new building.

While my study finds that Jeddah's flats have not really followed guidance regarding specific daylight illumination levels in their designs, many questions were asked to decision makers to find the extent to which daylight in Jeddah's flats has been considered. All participant architects stated that they understand daylighting as being linked to the energy demand of any flat in Jeddah. This idea of considering energy as a major factor is considered more important than the health benefits to women.

My findings indicate that commercial factors determine daylight in Jeddah's flats. Building owners disagree with installing extensive glazing that allows daylight to enter a building and reduce heat as double glazing costs more. This response agrees with studies such as that by Besheer and El-Hamidi (2012) who observed that intensive heat from large, single pane, clear windows in contemporary homes in the Tabuk region, at 28° 23' North, 36° 35' East, affect the temperature inside houses. This leads to high energy consumption due to the extensive use of air conditioning systems. Furthermore, it was found from the data output that flat owners and inhabitants in Jeddah see daylight as something that would increase inside temperatures. My findings showed that, while daylight is an issue that may be taken into account in architecture, the heat dictates how these flats will be designed as regards their windows, façade and balconies. Therefore, in most cases, they are made to face away from the sun as a source of daylight.

Daylight in Jeddah's flats is not about opening the entire building or flat to daylight, it is about filtering it to a level that inhabitants will comfortably withstand. Daylight remains a concern in most of Jeddah's flats. My findings support that, in as much as the level of daylight is considered important among designers and flat owners, the extent to which this is incorporated into the designs depends on the need of privacy, and mainly the financial budget of landlord. It also indicates that most of the flat owners, architects and professionals must account daylight as a very important consideration.

Architect S mentioned that he had designed several flats that had a room or two with windows to allow daylight. However, such an approach does not always provide adequate daylight, perhaps because inhabitants cover up their windows. They cover their windows due to belief, privacy or a nearby wall or building that the flats' inhabitants want to be hidden from. However, data output from professionals indicates that renters and commercial buyers are ready to pay extra for flats with sufficient daylight even though most flat owners would be more concerned with privacy than exposing their flats to daylight.

Figure 8-11 shows the differences of interviewed women's and interviewed professionals' responses to the question: "Is the daylight level or measurements adequately considered in the designing of windows in living rooms?" The results show that there is a statistical difference between women's and professional's responses (P=0.019); the majority of interviewed women in my study agree that no consideration is given to daylight levels when designing windows compared to considerations about privacy. On the other hand, architects felt that, from their experience, they do not need to make any calculations on daylight and window design. They felt that they can design windows that provide daylight from experience, while academics support the women's point of view.

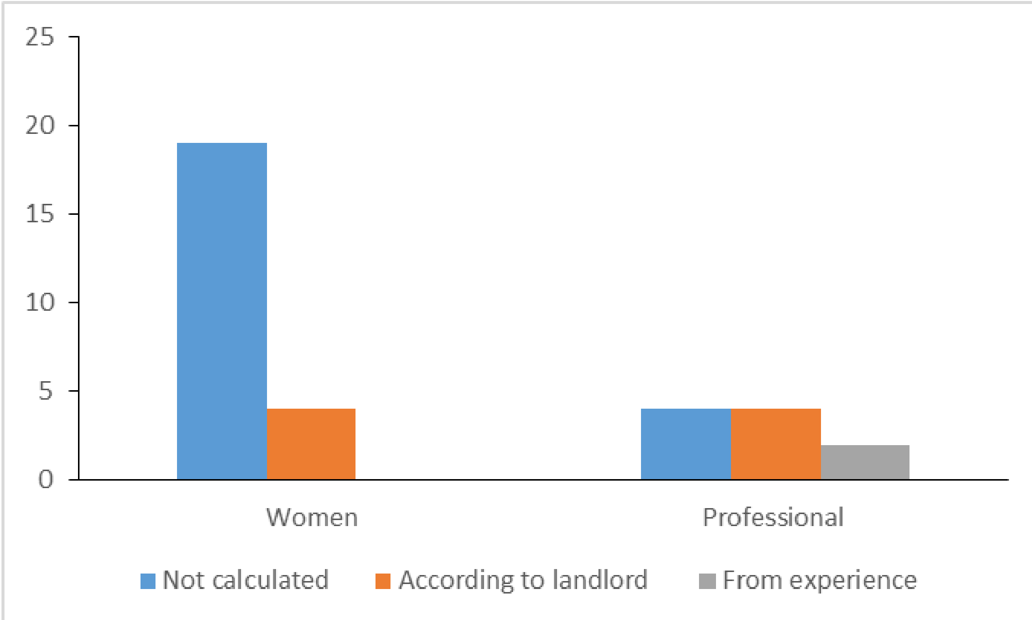


Figure 8-11 Showing differences between women's and professionals' opinions on whether daylight levels or measurements are considered when designing living room windows

8.8 Window design and investors

Flat owners do not care much about window design. They want simply to reduce the costs of residential investment buildings, resulting in the poor quality window design and poor environmental conditions inside the apartments. According to Mahamid (2016), delay in payment by landlords to contractors is considered one of the major factors for poor quality residential design. This is a major contributor to lack of daylight in the living rooms in flats. I found that landlords can change the window design, size or glass type during the building process through consultation with the contractor, who cares only about budget. According to architect Y, in Jeddah the average window size is 80x80 cm for the kitchen and bathrooms and 1.20 x 1.50 metres for rooms with exterior windows. However, Chapter 7 shows that window sizes vary from one flat to another and this dimension is not common in the city.

I found from the interviews with architects that some landlords reduce the window size because aluminium is expensive and they want to save on the budget for interior or exterior decorative materials. This happens most often in rental flats, as opposed to owner-occupier properties. Aesthetically pleasing buildings attract higher rents more easily than those with big windows. This could be a reason for the absence of details in building regulations, as in this case, the municipality should follow up with an inspection of the building after construction to avoid changing of the architectural drawings by the contractor.

Interviewed academics argued that giving landlords and contractors the right to change any part of the architectural drawing negatively impacts daylight. Interviews with architects suggest that landlords just build for investment. Therefore, strict rules should be imposed on them. This finding supports Mahamid (2016) whose survey with 120 contractors in Saudi Arabia showed Saudi residential design is problematic due to many factors. For instance, contractors do not undertake site visits; contractors or landlords frequently change designs; unqualified labour is used; delaying in payments by landlords to contractors and mistakes in design result in poor residential design.

8.8.1 Freedom in building regulations

Building regulations are designed to control the space from which users benefit instead of allowing design of an aesthetic building with issues in its function. Therefore, building regulations must be considered by architects in the first stages of design as it provides detailed guidance for building design (Imrie and Street, 2011, pp.138-140). However, leaving major design elements such as window design unregulated, as is currently the case in Jeddah's building regulations, is the reason for business freedom as shown in Figure 8-12. For instance, windows have no specific size or material requirements. Also, window design is not a major element to be considered by the municipality when following up on building construction (MOJ, 2015). This level of freedom allows architects' discussions on clients' requirements to be more important for them than anything else, even the views of home users.

The rules and regulations governing building and the construction industry in Jeddah are not exhaustive as discussed in Chapters 2 and 6, and they afford flat developers considerable freedom. This facilitates the dominance of men's beliefs and freedom in business. For instance, some buildings with four flats per floor have five very small rooms while buildings with two flats per floor have the same number of rooms, but bigger, as discussed in Chapter 5. The reason for this is that the rent is higher. Also, designing living spaces with just a small window facing the light well is also a result of this freedom. Freedom in building regulations leads to landlords' freedom and landlords' financial benefits take precedence over occupants' needs.

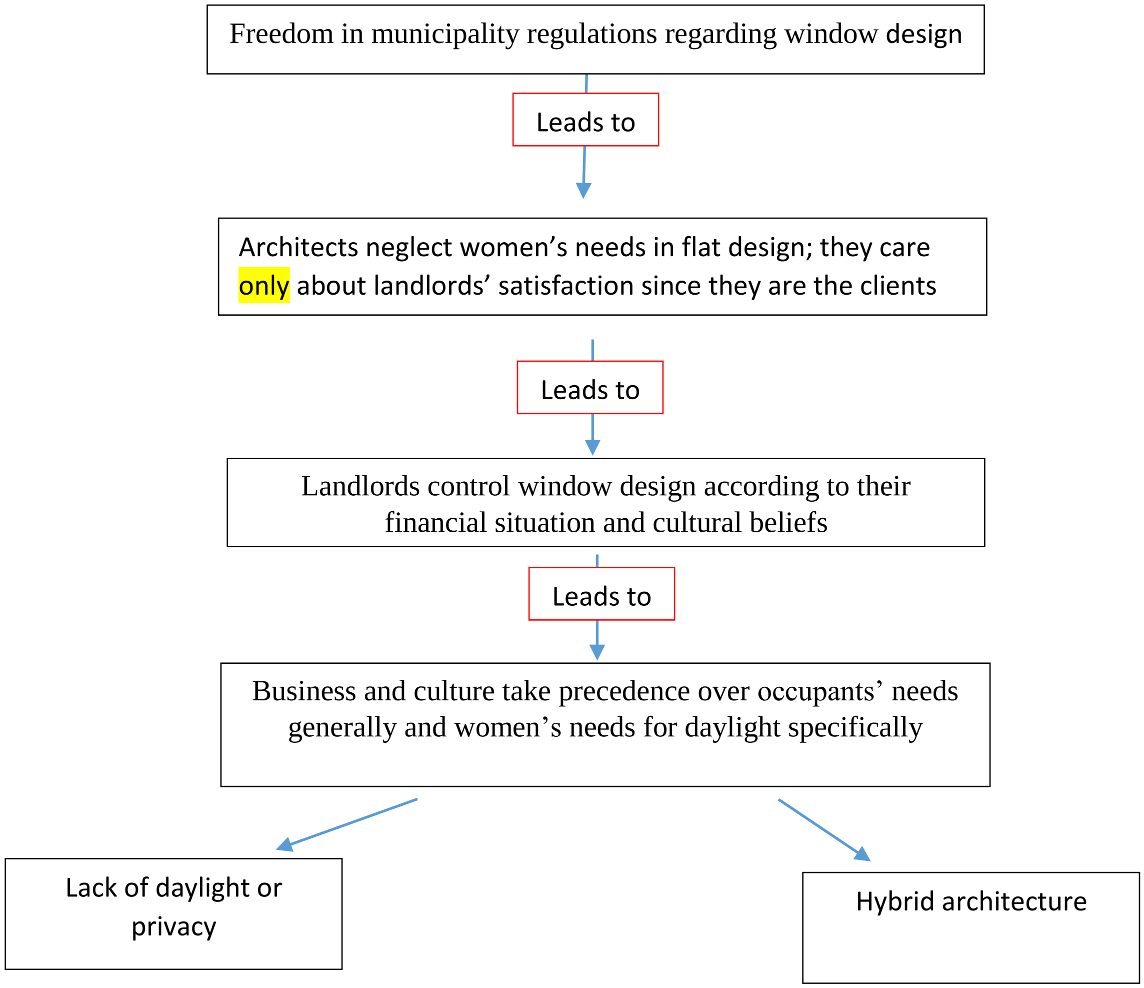


Figure 8-12 Diagram showing the freedom issue from its main starting point to its end

Saudi building regulations are not precise in monitoring each part of building design during building process. For instance, the size of the light well and light well windows are not always the same as it is in building regulation , which is 90 cm x double the height of window wall. This means if the height of the window wall is 3 m, the light well should be 90cm x 6m. Also, window size should not be less than 8% WFR (Dahlan and Mohamed, 2010, 293). This conflict between building regulations and construction practices in building regulations makes economics to be the dominant factor affecting design rules. This provides a platform for landlords to use the lack of codes for their financial benefit. For instance, I found that the living space, *Salah*, should not be allowed by the building regulations especially if the window takes its light from a light well. This part of a flat is considered to be a dead space for small families who could use one of the bedrooms as a living room. However, families with six members have no choice but to use this space for their living area, as discussed in Chapter 5. Therefore, they have to live in a space with no exposure to daylight.

Figure 8-13 shows the frequency of women's and professionals' responses to the question of whether there are criteria that guide living room location in relation to daylight. Table 8-1 shows Chi-square result that there is a statistical difference between women's and professionals' responses (P=0.0002); the majority of women agree that locating the living space in the *salah* is a major issue. On the other hand, architects find this is the best way to provide extra rooms according to the landlord's request.

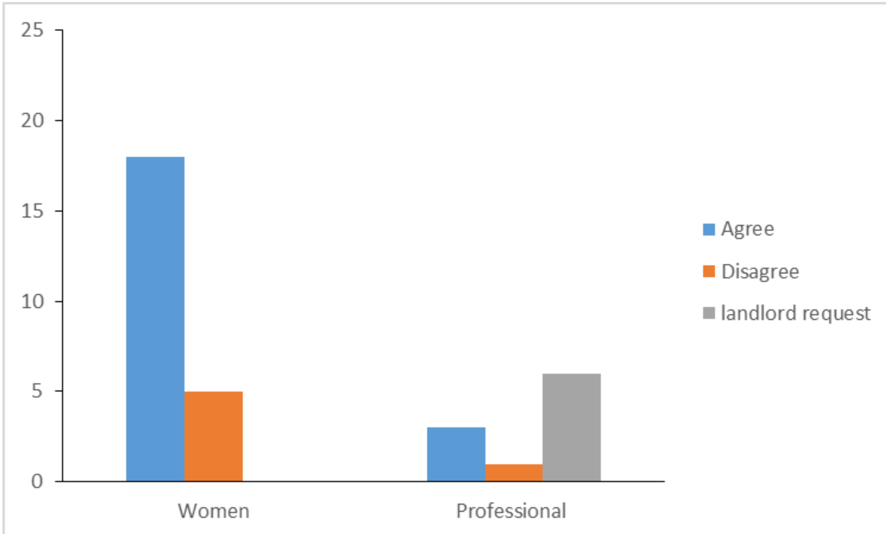


Figure 8-13 Showing differences between women's and professionals' opinions about whether there are no criteria that guide living room location in relation to daylight

Table 8-1 Chi-square table show the p= 0.0002

Crosstab

			study_participants .00	study_participants 1.00	Total
living_room_location	.00	Count	18	3	21
		% within study_participants	78.3%	30.0%	63.6%
	1.00	Count	5	1	6
		% within study_participants	21.7%	10.0%	18.2%
	2.00	Count	0	6	6
		% within study_participants	0.0%	60.0%	18.2%
Total		Count	23	10	33
		% within study_participants	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.879[a]	2	.000
Likelihood Ratio	17.853	2	.000
Linear-by-Linear Association	12.952	1	.000
N of Valid Cases	33		

0.000216

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.82.

As Taleb and Sharples (2011) noted, Saudi homes are considered bigger than many homes in the rest of the world. They go on to assert that the reason for this is the lavish life people want to live. Similarly, Saudi homes are considered big, as guidelines show that personal space per person at home should be 74.4m. However, in the market, it shows that it is actually 91.5m (Bahmmam, 2011). Although Bahmmam and Taleb and Sharps discuss villa design, their studies show that Saudis prefer big spaces at home, but when it comes to flats, my study shows that investment comes first.

From the above findings, it is clear that, for architects, the economic factor takes precedence over users' needs such as the number of units per flat and not the need of users as discussed before. According to the response from the municipality officer MA, there still exist some missing building regulations, especially in terms of monitoring and deciding on the size of the rooms. The respondent further added that the building regulations should not be used by architects to flout the building ethics in the design process.

8.9 Conclusion

The objective of this chapter was to critically analyse data from respondents on societal aspects, daylight and architecture. After discussing findings from the interviews with decision makers on seven independent issues, my results indicate that culture, daylight and architecture are intertwined. Based on case studies and data from decision makers, I conclude that two of the factors that affect building design and daylight levels within buildings is privacy and the commercial approach by landlords. Most architects I interviewed agreed that privacy dictates customers' wishes to an extent that, at some point, building regulations may be compromised so as to meet specific demands from customers.

I found that Arab culture emphasises the concept of privacy and this element is applied in architectural design, but it is considered from a male point of view in residential design. Privacy is the major factor that controls flat design, either in the interior design of room divisions or interior and exterior privacy in terms of window design. There is considerable segregation between genders from a male perspective, which leads to an increased number of rooms. It has also been found that increased numbers of rooms is a factor driving the design of investments.

The findings show that major architectural elements or design stages are not taken into consideration by architects. For instance, site visits are not considered a part of an architect's job in residential design. Architects restrict their work to drawing architectural plans and submitting them to the client for such residential projects. Since some landlords deal with separate contracts, this gives the architects freedom from responsibility to visit the site. Also, some work that could usefully be achieved at the office without a site visit is not undertaken with responsibility by certain architects. For instance, window orientation in relation to sun movements is not an important factor that the interviewed architects take into consideration when locating rooms and windows. As has been found in this chapter, considering such factors could stop the interviewed architects from fulfilling landlords' requirements. Therefore, landlords' requests come before inhabitants' needs in architecture jobs. This shows that architects deal with residential projects as if they were commercial projects.

This chapter shows a clear discrepancy between the architects' and professors' points of view, and between users and architects, as architects consider landlords' needs more than inhabitants' needs in design. Interviewed academics blamed architects for the poor quality flat design in relation to inhabitants' needs, and suggested that whilst architecture is a business it should also be a field which takes into account human users. Additionally, there is poor monitoring as a result of the absence of detailed building regulations by the municipality regarding especially windows, which leads contractors and landlords to make changes to architectural drawings according to their budgets. The major factor that leads to the current situation is undetailed building regulations regarding window design, which is considered to be freedom in regulation. This factor is an open door that allows all other factors to exist.

This research revealed several instances where architects agreed that their work was confined to accepting and expressing clients' wishes. This chapter concludes that daylight in most flats within Jeddah does not meet basic standards since commercial factors play a key role in the architectural designs that each flat adopts. Window designs are focused more on privacy and budget rather than daylight in blocks of flats.

Chapter 9

Chapter 9 Conclusion

9.1 Originality and a possible shift in shared awareness

From the perspective of the rights and wellbeing of Saudi people, this study is very important. To my knowledge, it is the first study that explores Saudi Arabian women's experiences of daylight in domestic spaces especially flats. As I am a Saudi woman with a similar cultural background and religious beliefs to many of the participants, an awareness of culturally sensitive issues for women was central to this study.

When this study began, the domestic situation of women in Saudi Arabia was the focus. At that time (3 years ago) the common assumption was that women were not satisfied with daylight levels in their flats. This study was, thus set up to be the first Saudi investigation of the phenomenon of poor daylight and window design in contemporary flats from the perspective of Saudi women in Jeddah. Through my work, I found that women are not actually happy with their living spaces due to poor daylight, which is a result of poorly designed windows that take into account cultural needs for privacy and landlords' financial budgets rather than considering daylight penetration in living rooms.

Interviewing women inside their homes for research purposes is not a commonly accepted technique in Saudi Arabia as people do not allow strangers to enter their homes. However, participants were happy and enthusiastic in their interviews that this research was focused on one of the major issues in their lives that they could not express to anyone in government. Interviews also highlighted the variation between genders when visiting architects in their offices as the offices were staffed only by men. Hence, a male guardian, who is my father, was present at all times during the interviews with architects. From this experience it was apparent that that the interview method is welcomed by Saudis, and it provides significant findings that cannot be simply gained through a questionnaire.

9.2 Addressing the initial statements of this study

By examining window design in the living rooms of contemporary flats in Jeddah, the aim of this study was to understand the extent to which the window, considered as an interface between the inside and outside, provides adequate daylight for women in living spaces and how it affects their daily lives. This thesis explored Saudi culture to show the importance of privacy in Saudi Arabia. It determined to what extent privacy plays a major role in window design and, as a result, blocks daylight from entering interior spaces in contemporary flats.

This study also investigated how gender-related issues are affected by the religious and social aspects of women's lives. It examined how the lack of availability of daylight diminished the quality of life in contemporary flats; and how Saudi women's perceptions of the situation affected their ability to manage their everyday lives. It also investigated the discrepancy between women's perceptions of the situation as users and the opinions of those who provide the domestic space. This includes regulators (e.g. municipality officers) who approve and sign drawings if they follow building regulations, and architects who design the interior spaces where women spend the majority of their lives. This investigation was important in this study as it evaluated the contextual issues in order to compare them to findings on women's perceptions and daylight analysis with Nvivo and SPSS softwares.

A further aim of this study was to provide policymakers with an insight into the situation from female users' perspectives. Since women's voices are not heard yet on this issue, this study is a platform for them. This will show policymakers how important it is to amend and create new building regulations that will meet users' needs, especially those of women, to improve the quality of window design and daylight in flats, which is needed for a better life for Saudi women.

The work achieved in this thesis was able to answer the research questions by showing that daylight deficiency is underpinned by a number of design factors, which are financial and cultural and societal concerns in the Kingdom of Saudi Arabia. These factors were explored in terms of four distinct aspects. Firstly, the speculative approach of landlords with regard to their properties rented out to tenants has a major impact on window design. It was found that, if inhabitants own the home, they can design it according to their needs. However, if they rent the home, they do not have the right to make any minor changes without the landlord's permission. This shows that commercial aspects of designing windows that do not provide enough daylight replace human needs for exposure to daylight inside in rental flats. Secondly, no design factors for windows such as window to floor area, glass type or window orientation are taken into consideration when designing rental flats' windows (see pages, 183 and 243).

Thirdly, this study identified that the gap between buildings can be considered one of the major issues for the current phenomenon of poor daylight (see pages, 195-197 and 237-240). Fourthly, it was also found that there is a clear discrepancy between architects and users, especially women, regarding the design of windows and flat layout. Finally, all these four factors, which will be summarised in this chapter, contribute to the overall detrimental effect on Saudi women caused by limited access to daylight prompted by a range of cultural and religious factors.

9.3 Landlords' commercial approach

Chapters 6, 7 and 8 showed that a landlord's financial situation plays a major role in window design, which results in poor daylight penetrating interior spaces. The lack of financial support affects window design in terms of daylight and privacy negatively. Looking at the financial situation or financial budget from the decision maker's point of view, it was found that landlords modify the architectural specifications of the window in the building process chiefly focusing on the budget (see page, 252 and fig. 8-12 on page, 254,). This approach is supported by the contractors' experience in the local construction industry. The fact that landlords are able to suggest changes and alter approved schemes during the construction process can be related to the vagueness that characterises the local building regulations. Chapter 8 provided a detailed account of this situation, where architects mentioned that it is not their responsibility when a residence is built that is different to their drawings as long as the municipality does not follow up on detailed designs such as windows during the building process.

9.4 Window design codes

In comparison to other countries, which have certain rules about window design to consider space users' luminance and thermal comfort such as Dubai (DEWA, 2017) and the United Kingdom (BCWHBC, 2013), this study shows that there are no fixed regulations to guide window design in living spaces. This was demonstrated by the fact that each flat had windows of different sizes, orientations or glass type. This was found after analysing window design in 15 living rooms whether they were living rooms with windows or other rooms in the flat used to replace a living space with a light well window (see tables 6-1, 6-2, 6-3 and 6-9 in pages, 180-182 and 203). Chapter 7 shows that tinted glass blocks daylight even if window size and orientation are designed in a way that allows enough daylight to penetrate the interior space. This study shows that tinted glass is a major issue in home design.

As a result of building regulations that lack specifications, male guardian dominance over home design is indicated where transparent glass has been changed to tinted glass in order to provide privacy with no concern for the daylight from the male's point of view. According to female participants, they suffer because their voices are not heard, and since they live under a male guardian's control, they do not have the right to change the situation. Since the majority of participants do not have a separate income since they do not have jobs, they rely entirely on their male guardian. They rely on their husband or father to pay the rent as this is part of the religious duties of men in Islam. This shows that the lack of income for some female participants is a result of a culture and tradition that either encourages or forces them to stay at home and fulfil domestic duties as discussed in chapter 2.

9.5 Gaps between buildings

Although small gaps between buildings are not because of an absence in detailed building regulations but rather a result of the current building regulations, this study found that a major issue in contemporary homes is the small distance between buildings. This issue is common in the most crowded urban areas such as Hong Kong and Dhaka (Li and Lam, 2001, Li et al., 1999, Li et al., 2006, Afroz et al., 2014). This issue is thought to be one of the major reasons for poor daylight in interior spaces (see pages, 195-197 and 237-240). Daylight does not reach the deeper parts of a room at any floor level due to exterior obstructions such as neighbours' buildings. However, when this issue (small gaps between buildings) is combined with another cultural need such as privacy, it can have two disadvantages. Firstly, the small gap between buildings blocks daylight from penetrating into interior zones, and secondly it does not provide privacy as neighbours' windows are facing each other. The privacy issue makes women close their curtains all day or makes male guardians or landlords cover transparent glass with dark reflective papers that offer privacy to protect females from being seen by neighbours (see pages 146-147).

The only solution discussed regarding this issue was raised by one of the female professors in architecture, the dean of an architectural college. She discussed this issue from users' and professionals' points of view. She claimed that a site visit to a given location should be mandatory. It would allow architects to design windows with consideration to the other buildings around them. Placing non-facing windows between neighbours' windows would allow women to keep their curtains open. Her argument is in agreement with the authors of the American Institute of Architects' *Architecture Student's Handbook of Professional Practice* that a site visit should be mandatory for an architecture job *(The Architecture Student's Handbook of Professional Practice,* 2016 p.406).

9.6 Discrepancy between users and makers

Chapter 8 illustrated the discrepancy between the views of decision makers and female users of flats. It also discussed the discrepancy between the views of architects and professors of architecture regarding women's needs in the observed flats. Professors showed attention to women's needs for daylight and privacy. On the other hand, architects claimed that landlords pay a lot of money to own land and to build. Therefore, they have the right to invest in each metre and design the building in a way that helps them to achieve high rents (see page 237-238).

Interviews with professionals show that building regulations that lack specification are considered one of the major reasons that architects and landlords neglect women's needs for daylight and privacy and focus on landlords' financial situations more. Building regulations are designed to control the space from which users benefit instead of designing an aesthetic building which has issues in terms of its function. Therefore, building regulations must be considered in the first stages of design (Imrie and Street, 2011). In this study, it was found that building regulations should require detailed descriptions of window design in their future updates. Detailed descriptions of the number of windows and window size, orientation and glass type should be required by the codes. In addition, building regulations must involve follow up on domestic sites during the building process and after the building is finished. This help to make sure that building is built exactly as it is in the architectural drawing that is stamped by the municipality. Building regulation could invite occupants' comments and complaints on the municipality website in order to understand occupants' needs and consider them in later regulations. This would make occupants, especially women, feel that they have the right to express concerns about their daily issues related to domestic architecture.

9.7 Women's perceptions of windows: daylight and privacy in flats

Chapter 5 showed that the level of privacy at home that characterised vernacular architecture in Jeddah started to disappear as the notion of privacy changed when nuclear families started to require private homes instead of living with extended family members in one home. This study clarified that the changes in architecture from vernacular to modern in the Kingdom of Saudi Arabia were due to many factors, including economic growth which led to the influence of Western architecture as discussed in Chapter 2 (see page 49-50).

Previous studies show that culture and climate were considered carefully in vernacular architecture in different Saudi regions where windows were designed in a way so as to provide daylight, ventilation and privacy (AlHumaidi, 1996, Al-Jawahrah, 2002, Alsaleh, 2008, Batterjee, 2010, Kamal, 2014). The differences between these studies and my study is that the former investigated climate and culture through studying building design, whilst my study focused on the architectural characteristics of contemporary window design, privacy and daylight levels through qualitative and quantitative approaches related to female users' points of views.

The findings from this study from qualitative methods showed disagreement with the findings in the previous literature. It was found that women who had experienced living in homes with Roshan disagreed with the published advantages (see page 156-158). However, these female participants mentioned this point of view since, at the time of interview, they lived in contemporary homes. It was not possible to interview women who had only experienced Roshan as they are either dead or they have moved to contemporary homes. In accordance with this study's findings, a recent study by Alawad (2017), found that glass window provides more daylight than Roshan (see page 157).

Since this study included interviews with home occupants and did daylight simulations to discuss daylight and privacy, the findings agree with some authors who applied similar methods, but in different countries with different context. For instance, Hanna (1990) found that courtyards with a southern orientation in traditional homes in Iraq do not provide enough daylight. Also, they do not provide privacy between family members and visitors. This backed up evidence from earlier literature in same area. Hanna's findings were based on site thermal measurements, questionnaires and interviews with home users and thermal simulation insights. The interview method was also used by AlKodmany (1999) who interviewed women in Damascus homes and found that they keep their curtains closed at all times due to privacy. Also, AlKhateeb (2015) used the interview methods to investigate the concept of privacy in house planning in the eastern region of Saudi Arabia. She found that this method allowed her to understand the situation from the users' stories during the interviews. Although, these studies offered considerable findings that examined users' perceptions, some of them could be considered dated. However, it was found that little attention has been given to the interview method in this area of study in Arab countries recently, which indicated that it would be a good approach to get to the bottom of users' perspectives and provide unique findings which could not be obtained through other methods. It seemed necessary to examine the issue from the perspective of those who suffered from it.

The majority of women who participated in this study agreed that daylight levels in their flats were weak or there was no daylight at all in cases with light well windows. Additionally, two female professors of architecture who participated in this study discussed this issue from a professional point of view and from users' points of view which totally agreed with the responses of female participants. This study shows that professors of architecture are in agreement with most of the issues discussed by women participants regarding window design, poor daylight, and poor design of flat layouts.

Finally, women complained that living spaces were not located in the right place in flats. However, there is not much variety in flats as most of them share similar designs in Jeddah. They also discussed the effect of poor daylight exposure on their physical and psychological wellbeing and that of their children.

9.8 Agreement and disagreement with others

Since this study investigated daylight levels and its effect on women's daily lives, the study had to discuss culture, religion and decision makers in this context. Therefore, a comparison with previous literature focused on these issues.

In 2014, Aljamea studied the factors affecting residential design in Saudi Arabia. She concluded that privacy is a major factor that should be considered by architects in Saudi Arabia. My study agrees with that of Aljamea as it was found that privacy is one of the major reasons why women cannot enjoy daylight in their residences due to the small gaps between buildings.

In 2017, Alawad studied daylight levels in interior spaces from Roshan and glass windows of the same size and in the same sample room in Jeddah. She found that glass windows allow more daylight to penetrate than Roshan. My study is in agreement with her as the participants in this study mentioned that they used to sleep in the afternoon next to the Roshan as Roshan does not allow much daylight to enter.

In 2010, Dahlan and Mohammed studied building regulations in Jeddah city. They claimed that small gaps between buildings are a major issue as they result in extensive sun radiation inside buildings. They complained that the minimum gap between buildings should be less than two meters to reduce sharp sun and heat penetrating in interior space (see page 54). However, my study disagrees with them since it shows that the gap between buildings needs to be bigger than two meters to allow adequate amounts of daylight into interior spaces as the study found that daylight is very low in interior zones.

Also, in 2010, Hashim and Rahim did a survey questionnaire involving 401 Malay heads of the households in Selangor, who live in medium cost two-storey residences. Homes were selected from two different home sizes from the two areas, namely Gombak and Kajang. These areas were located in Hulu Langat, with the smallest (14’ x 55’) in Gombak and the bigger units (18’ x 70’) in Kajang. Then, in-depth Interviews were carried out with 12 selected subjects. The authors suggested that tinted glass is one of the preferred glazing types in Muslim cultures such as Malaya. They went on to assert that cultural requirements such as privacy must be considered in home design. Therefore, it was observed that tinted glass can provide inhabitants with privacy. However, in my study, it was found that tinted glass blocks daylight from entering the interior space. Since one of the main reasons for windows is providing daylight, tinted glass is, therefore, not a suitable solution as it creates another issue by blocking out daylight.

Su et al. (2010) studied light wells and daylight under sunny sky conditions in sunny and overcast weather in Nottingham, at 35^{o}N and 1.25^{o}E and found that upper floors receive enough light, more than 2% daylight factors. However, lower floors received less than 2% daylight factors, and the lower floor results were observed in the three types of materials, which were wood, matt paint and mirror. Therefore, the authors found that the chosen dimensions for the light well, 100mm width, 150mm length and 800mm height, were not enough to produce sufficient daylight in the lower three floors in a six-floor building. They also found that a mirror light well improved daylight up to 100% more than the matt material in lower floors from ground to second floor. As a result, the authors asserted that light well sizes should be increased by 25%. The authors suggested that reflective devices could be used in the upper part of the light well to convey additional daylight to the lower floors. On the other hand, in my study in Jeddah city, were interviews took place in summer under 39.4^{o} hot weather and sharp sunlight, light well windows showed poor daylight penetration in interior spaces. This was observed by me during site visits to buildings and according to the findings from the interviews with female participants. Although, light wells in my study have different sizes and windows have different sizes, but in general, the light well windows could not penetrate enough daylight in all floors even in summer.

9.9 Contribution to knowledge

This work contributes to the knowledge on daylight in interior spaces in domestic environments by identifying Saudi women's perceptions of poor daylight levels in living rooms of contemporary flats in Jeddah. It identifies and qualifies the negative impact that contemporary window design has on daylight levels in living rooms and how, as a result, this impacts on women's daily lives in terms of social, physical or psychological wellbeing.

The study contributes to knowledge in recognising that problems with physical and psychological wellbeing, as a result of poor daylight exposure, should be discussed from many perspectives not simply the health perspective. It is important to discuss this matter from an architectural perspective. This is particularly the case in certain cultures and climates such as Saudi Arabia where women stay inside buildings most of the time due to heat and privacy. This study contributes to the current studies about daylight and domestic environments by clarifying the meaning of privacy from women's perspectives and how their perceptions are not taken into consideration since women are under male authority and since commercial factors take precedence over users' needs.

Moreover, it identifies the clear discrepancy between female users' points of view about poor daylight and decision makers' responses to the situation since they focus more on financial considerations. This study also contributes to knowledge in the sense that using multiple methods for investigation helps to strengthen the research findings as two different methods can provide similar findings or support each other to help increase the validity or reliability of the results. This is shown in Chapter 7 where daylight simulation confirmed that daylight levels were weak in most participants' flats. These findings support the women's claims discussed in Chapter 5. Also, the similarity in the findings from both statistical SPSS and qualitative Nvivo for the comparison between users' and decision makers' opinions in Chapter 8 strengthens the findings and increases the truth of the results.

9.10 Policy and health implications

According to Finch (1984, p.86), the researcher must connect with participants emotionally and intellectually. Therefore, this study has been used to advocate on behalf of Saudi women since this position is not in conflict with that of an objective researcher. This support does not create any conflict with Saudi development plans. Indeed, it could assist these plans to enhance citizens' lives as this study shows the negative affect of non-detailed building regulations regarding window design and the effect on women's wellbeing. This study will influence policy makers in the future as they update building regulations in Saudi Arabia related to window design and daylight in contemporary flats.

This research will assist municipalities and other authorities that control building regulations by clarifying the psychological and physical effects on women due to poor daylight exposure, which could also affect others such as children or the elderly of both genders. However, due to the limitations of this study only women were considered. This study may influence policy makers to improve building regulations and provide strict rules that insure penetration of adequate daylight inside flats generally and living rooms specifically, which will improve females' wellbeing.

Indeed, as the literature search shows, no study similar to this has been undertaken, and therefore, it is envisaged that this study may be instrumental in drawing health experts into a debate with building planners and architects about their practical responsibilities in building design.

9.11 Strengths and weaknesses

Seliger and Shohamy (1989, p.144) state that the bigger the sample size the higher the internal validity of the study. A small sample size is subject to biases that can be created due to an over-representation of some subject characteristics. Although a small sample size can affect the objectivity of the study findings, in this study, the differences in female participants' characteristics were carefully considered so that they did not affect the findings and avoided bias. This was achieved by ensuring that participants were from the same cultural background, had the same religious beliefs and shared similar family characteristics in terms of male authority controlling their lives. Participants shared similar financial situations and similar flat designs.

Additionally, the small sample size is considered acceptable in a qualitative study since qualitative methods do not always aim to find a statistically significant variable or definite true findings as much as they try to support a contextual exploration of the phenomenon, which is the case of my study. The responses from 23 female participants and 10 decision makers helped in studying the phenomenon of poor daylight in living rooms in contemporary flats. Hence, this small sample size for both female users and decision makers provided some significant results in SPSS.

It is important to highlight that interviewing female participants with different histories, living in multiple flats or living in vernacular and contemporary homes is considered as a strength as this enhanced the depth and value of data. Women who had lived in multiple flats before the one they were interviewed in discussed how the issue of poor daylight is dominant in the city and flats share similar designs. They also commented that it was almost impossible to find a better flat with better daylight levels. Also women who had lived in vernacular homes shared similar answers regarding Roshan as those who had not lived in such homes, by not recommending Roshan as the solution to the issue. The sample of women who had lived in flats with Roshan in the past was very small. It did not prove possible to find more women who had lived in flats with Roshan due to time limitations. Vernacular homes were searched to see if women could be found who would agree to be interviewed, but such homes were lived in by single men predominantly.

The skillset of the professionals interviewed appeared quite similar. For instance, most professionals had worked in the city for 20-30 years. The majority were Egyptian since such architects are the common in the country. The majority had designed more than 40 blocks of flats in Jeddah. They were all from the same religion, same culture, and similar architectural training. This information was taken from the interviews and this similarity in professional background clearly appeared in their response to interviews' questions. Also, the majority of flats observed had the same issue of missing daylight which suggests a similar approach to flat design. However, it is necessary to highlight that their culture differs from that of the female participants; it was not possible to find Saudi architects who had worked in this area and who agreed to participate in this study. Also, Saudi architects own the offices, but the Egyptian architects are the ones who do the job as became apparent in this study.

In quantitative and qualitative studies, validity refers to whether the used instrument in the study can measure what it is supposed to measure and if it can provide a truly valid answer (Kirk and Miller, 1986). All used instruments in this study were incorporated. Using interviews as a method for collecting data yielded more profound data than a questionnaire might have done as people will not express their stories or hidden issues on a questionnaire. As a researcher conducting the interviews face to face, it became apparent to me that none of the participants falsified any response because they were participating in a study. Once only a participant asked if she should give a specific answer regarding Roshan. The importance of her expressing her own opinion without worrying about the research result was explained to her.

Using Diva-for-Rhino to measure daylight provided accurate results for many reasons. Firstly, previous researchers who used Diva found that it provides accurate results for measurements for daylight (Garcia Hansen et al., 2012, Hegazy et al., 2013, Hegazy and Attia, 2014, Mahmoud and Elghazi, 2016, Mohsenin and Hu, 2015, Yun et al., 2014). Secondly, the computational analysis by Diva corroborated the women's accounts. For instance, a living room with more intense daylight in the afternoon had a high lux level in the afternoon in the simulation by Diva and a low lux level in the morning, which shows a similarity between reality and the instrument's findings (see page 196 the discussion for room 12).

However, the tested living rooms had different window sizes, room sizes and windows were oriented in different ways. This variation was a result of testing interviewed women's living rooms. It was realised that stronger findings could be achieved if all tested rooms shared similar characteristics, yet, it was considered that looking at different window characteristics in Jeddah flats was a strength of this study. This variation in window characteristics showed that no specific characteristics are considered when designing windows for living rooms.

In order to apply the research findings to a wider population, the characteristics should be similar to those of the wider population. Participants in this study were female from four different age groups ranging from 20-50. They were all Saudis who were Muslim and middle and upper-middle class.

Findings on types of flat and windows examined in this study can be applied to a wider area across Saudi Arabia as it was found that these types of flats that were studied share common characteristics in the city. In Stage 1 of the data collection, three buildings were chosen to represent common designs for blocks of flats from different periods. This selection was made after visiting more than 100 buildings in all the residential districts in Jeddah and designs were found to be the same.

Applying a study to real environments can be considered a strength as it increases its reliability. This study examined a phenomenon in a real environment and discussed it with people who suffered from the problems identified in the same context in which this phenomenon exists. The data simulations by Diva were done in similar environments to the real living rooms in term of design, material, reflection and climate of the city. These research findings could be applied to different Muslim societies to find out if Muslim women face similar issues in different societies.

9.12 Research limitations and further studies

Due to the limitations of time, resources and sensitivity of the topic, firstly, the research focused on Jeddah city although its findings are arguably more broadly applicable to a range of contexts and settings. However, Jeddah was chosen instead of any other city as blocks of flats are common types of residences in Jeddah as discussed previously. Secondly, due to cultural sensitivity, it was only possible to conduct interviews inside homes with females. However, this limitation could be considered a strength rather than a limitation However this limitation could be considered a strength rather than a limitation, since, as I have shown, relevant recant data from Muslim/Arab studies have not focused on interview data, particularly from women. This contrasts with aspects of relevant western research, which find this perspective crucial. It would be valuable to explore this divergence in more detail.

The sample size in both groups was limited to 23 female users and 10 professionals in architecture. However, this limitation was acceptable as it answered the research questions and provided significant findings. Findings in this study were limited to participants' verbal discussions, the author's observations and Diva-for-Rhino software results. Daylight measurements were limited to 15 flats only. For daylight measurements, studying the ratio of the window in a room was limited to window to floor ratio. Finally, this study was limited to looking at daylight from windows in contemporary flats.

Therefore, the study could be taken forward in future research to cover the research limitations. Further research is needed to investigate this subject from the perspective of Saudi males to find the differences between male and female perceptions regarding the situation. It also needs to be widened out to a bigger sample of home users such as elderly people, children and handicapped people as well as more professionals in architecture. Daylight from windows should also be studied in different types of residence such as villas in Jeddah and in other cities in Saudi Arabia to find if this issue is a problem in other types of residence or if it is exclusive to flats.

Other measurements for windows relating to different interior space elements are needed such as window to room walls ratio, and window to window wall ratio. Finally, as this study focused on daylight and window design, further consideration should be given to other factors that affect home occupants' satisfaction such as thermal comfort, views from windows and other interior planning for homes.

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Figure 5-1: Old Jeddah Municipality. 1984. Annual report, Old Jeddah Municipality, Jeddah.

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Appendices

Appendices

Appendix 1 Semi-structured interview Questions with female participants

Activity	Location of doing the activity in the living room	Time How long each activity takes place	How does window affect each activity	**Do you feel comfortable with natural light during this activity**
1. Watching T.v				
2. Talking in the phone				
3. Eating				
4. Sitting or relaxing				
5. Receiving guests				
6. Chatting with family members				
7. cooking				
8. others				

1. How old are you?

   15-25

   26-36

   36 and above

2. What is your major of study?
3. In which district and city do you live?
4. Do you live in flat or villa?
5. Do you rent or own the home?
6. In which floor is your living room?
7. How does daylight affect your mood in the morning?
8. Does daylight create an issue between family members? For example some might like it others or prefer to close the curtain.
9. Do you prefer to have the living room in another room of the home? and Why?
10. What time does the whole family sit in the living room?
11. What is the major element that bother you in the living space?
12. What is the major element that bother you in the window?
13. What do you think about roshan and a window that provide you with daylight, privacy and ventilation?
14. Would you implement Roshan?
15. If you want to get exposed to the sun what do you do?

Other questions were asked again, but in direct way:

- Are you satisfied with window design in your home?

- Does your living room window provide enough natural light?
- Do you close the window curtain? Why?
- When you stay at home in the morning how long do you spend in the living room?
- Do you feel comfortable when spending your time in the living room in relation to natural light?
- Do you turn on artificial light during the morning or afternoon? Why?

Appendix 2 Semi-structured interview Questions with Professionals

Building Regulations;

1. May you provide me with general information about your expertise?
2. What are the factors that control flat building regulation in Jeddah city?
3. Who set these building regulation?
4. Do you participate in creating building regulations; why?
5. How do building regulations affect architect's design processes?
6. Are these regulations taken from other countries or not? Why?
7. To what extent these regulations suits Saudi culture?
8. How often does residential building regulation update?
9. When were the last 2 updates?
10. What are they?
11. Why is the minimum gap between buildings is just 2 metres at the sides and back of apartment buildings while it is 4 metres between villas?
12. How does this gap affect daylight level?
13. Is there a possibility to increase it? How?
14. How do building regulation care about occupants' health? For example, daylight exposure?
15. What are the factors that control window design regulation in Jeddah city?

Architects Job

16. When designing windows for rental flats buildings what guides you? What do you want to achieve?
17. How does culture affect window design in Jeddah?
18. Do cultural changes affect window design? Less need for privacy?
19. Do you think having building regulations that are based on non-Saudi or non-Muslim regulations is the reason for missing privacy daylight in Jeddah's flats? How?
20. Can you provide me with designs to support your answers or clarify them?

Daylight in Flats

21. How does stakeholder financial budget affect window design in Jeddah?
22. Why are windows small and frosted or tinted? Is this the only option for privacy & low budget?
23. Are women's needs in terms of daylight, flat floor plan or privacy considered or just stakeholder request? Why?
24. How can you know what women's needs are in flat design?
25. Do you know that Jeddah's flats lack daylight most of the year?
26. Do you know that babies needs to get exposed to daylight to grow well? How can this be achieved in a flat with weak daylight?
27. What is the place for women to get exposed to daylight with privacy if they live in rented flats?
28. How do you find daylight level in modern and postmodern flats in Jeddah?

29. How do you calculate or insure that daylight is enough in flat rooms especially Living spaces?
30. Do you use daylight calculation programs to do so?
    a. How do you know women needs in terms of daylight and flat planning before designing the building?
    b. How do you know if occupants are satisfied with daylight level or not?
    c. Is there a follow up survey to know that?
    d. How can window design develop to provide occupants with enough natural light and privacy?
    e. How does building orientation or street width play a role on natural light?
    f. Why is Roshan not implemented in modern and post-modern architecture in Jeddah?
    g. What do you think about implementing Roshan in Modern flats in Jeddah?
    h. What do you think about people who say that Roshan does not provide enough daylight or privacy in ground floor?

Appendix 3 Images for Blocks of Flats in Jeddah

Vernacular Residencies

Contemporary Blocks of Flats

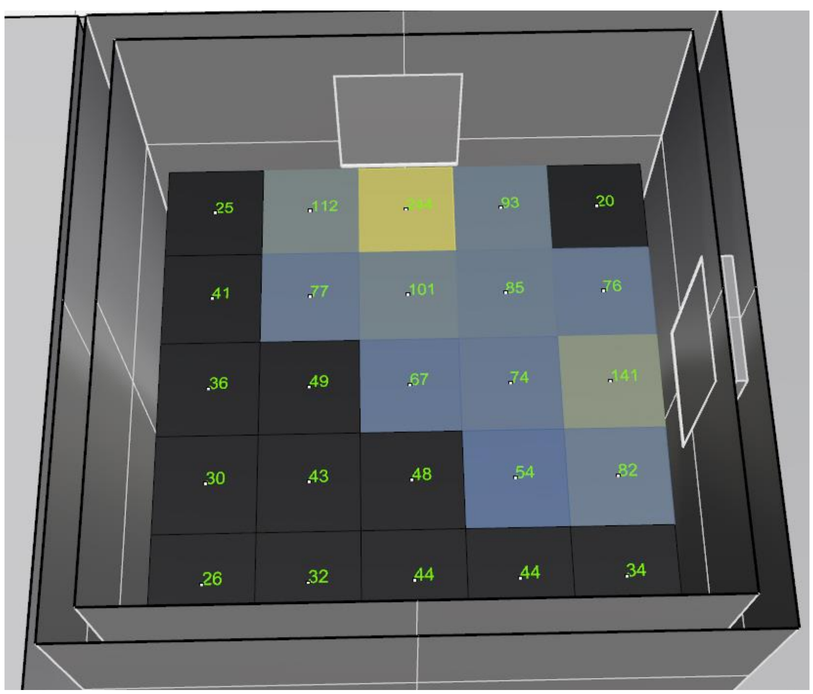
Appendix 4 Examples of Daylight and Lux in Diva

Room 5 Participant E	10 am	12 pm	14 pm	16 pm
15-January	20 lux	47 lux	82 lux	23 lux
15-April	83 lux	116 lux	147 lux	54 lux
15-July	24 lux	45 lux	81 lux	27 lux
October	17 lux	50 lux	22 lux	20 lux

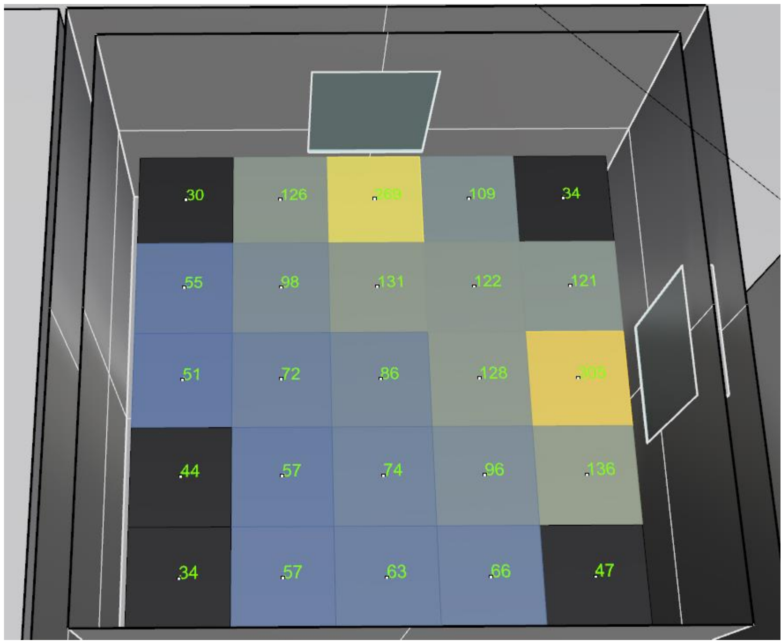
Room 11 Participant HEB	10 am	12 pm	14 pm	16 pm
15-January	90 lux	143 lux	150 lux	100 lux
15-April	31 lux	40 lux	42 lux	30 lux
15-July	10 lux	30 lux	36 lux	10 lux
October	10 lux	14 lux	19 lux	9 lux

Lux units for Room 2 in the first floor for participant D

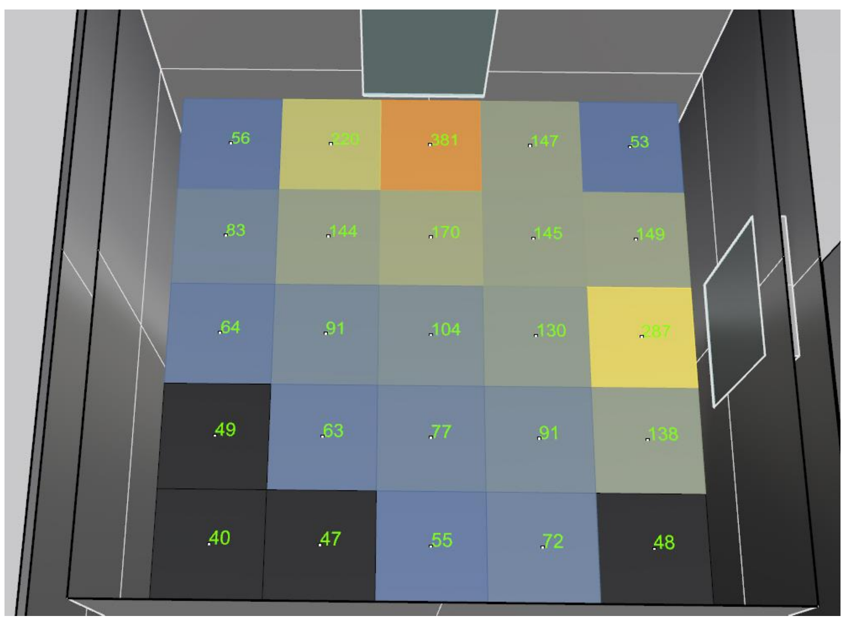
Room 2 Participant D	10 am	12 pm	14 pm	16 pm
15-January	65 lux	95 lux	100 lux	21 lux
15-April	108 lux	143 lux	163 lux	112 lux
15-July	144 lux	179 lux	196 lux	127 lux
October	81 lux	94 lux	88 lux	53 lux



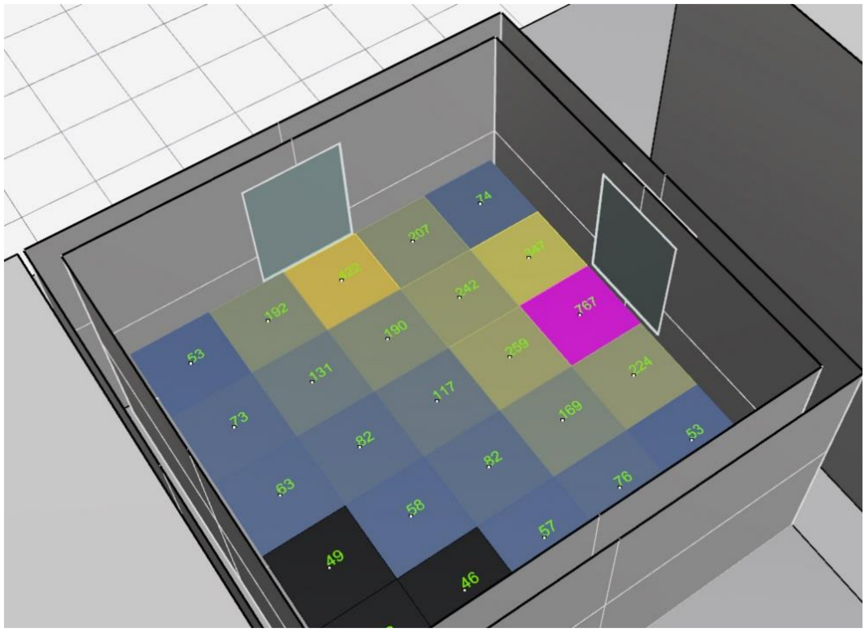
10 am January



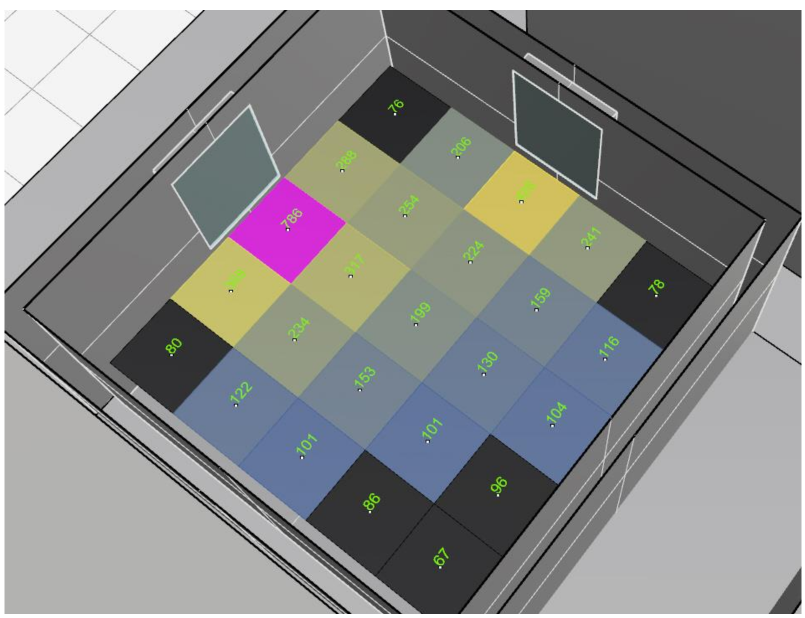
12 pm January



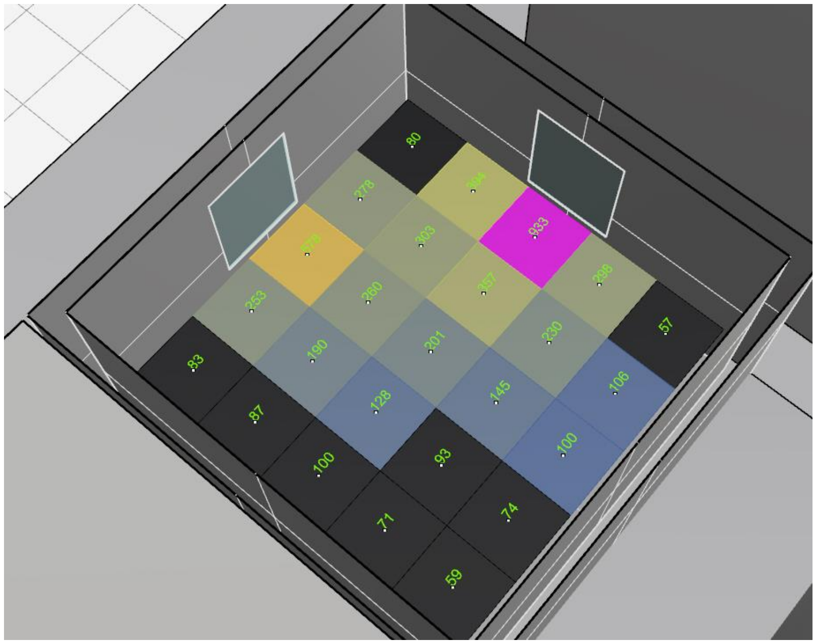
10 am April



14 pm April



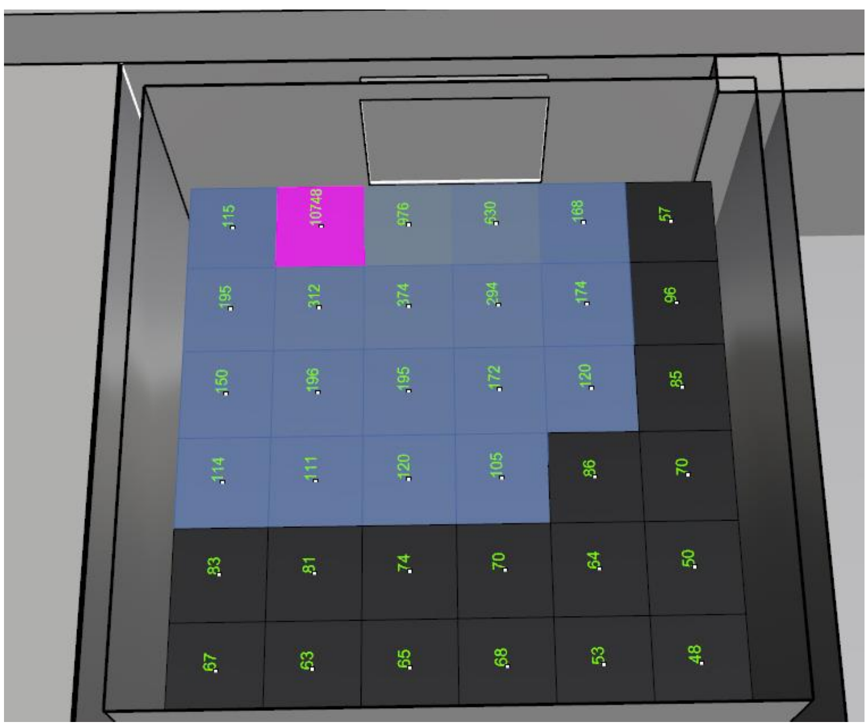
12 pm July


80
278
303
933
253
260
357
298
57
83
190
201
230
87
128
145
106
100
93
100
71
74
59

14 pm July

Lux units for Room 15 in the fifth floor for participant N

Room 15 Participant N	10 am	12 pm	14 pm	16 pm
15-January	486 lux	104 lux	82 lux	48 lux
15-April	1298 lux	135 lux	94 lux	57 lux
15-July	1376 lux	183 lux	98 lux	58 lux
15-October	187 lux	111 lux	77 lux	48 lux



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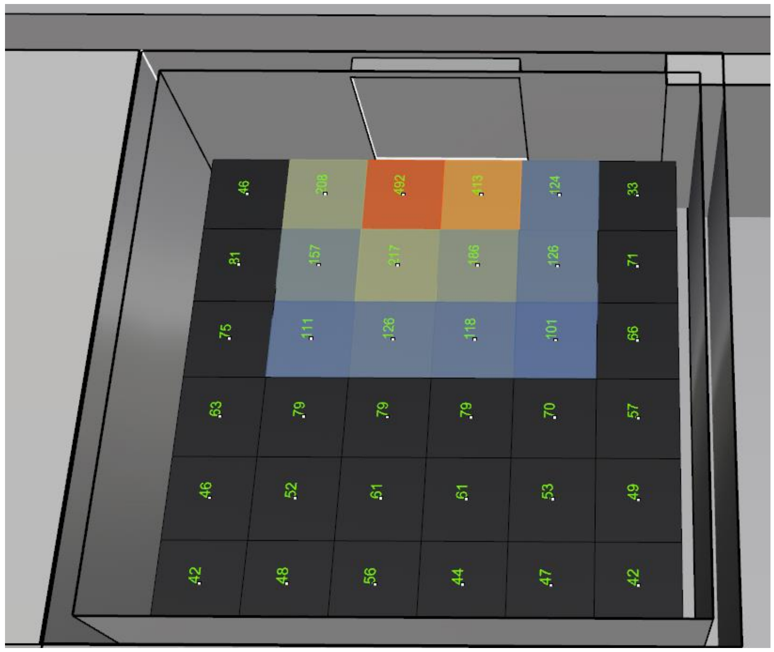

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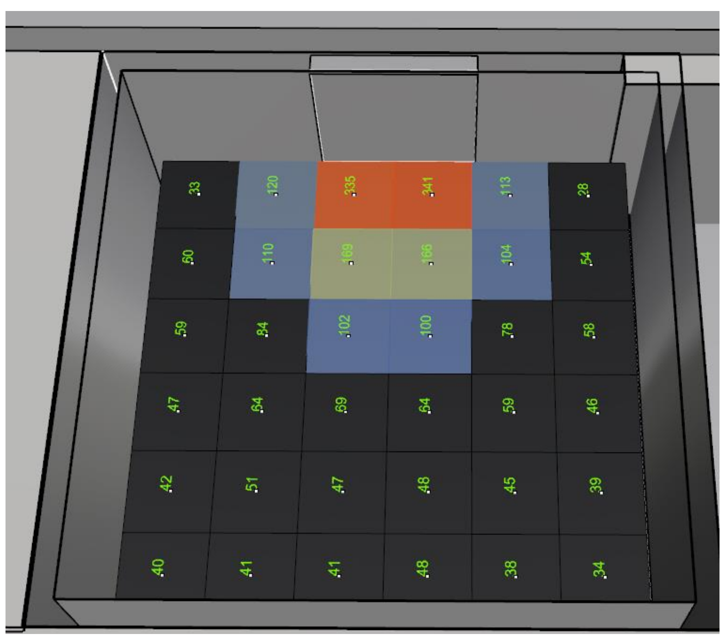
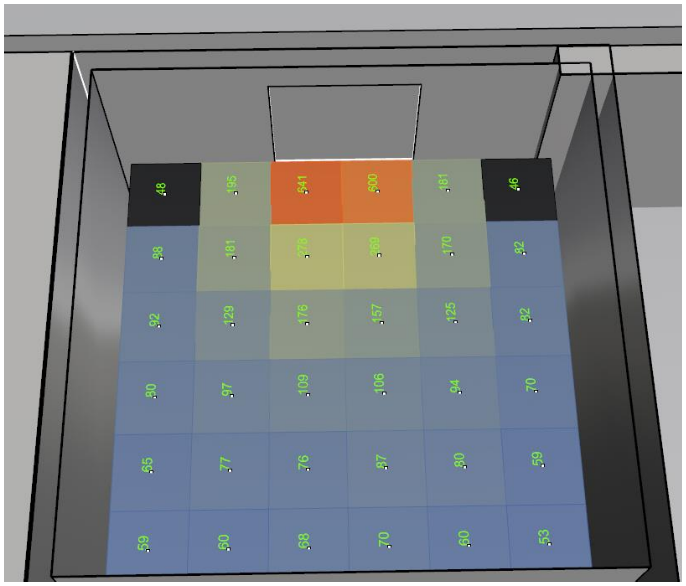


14 pm January



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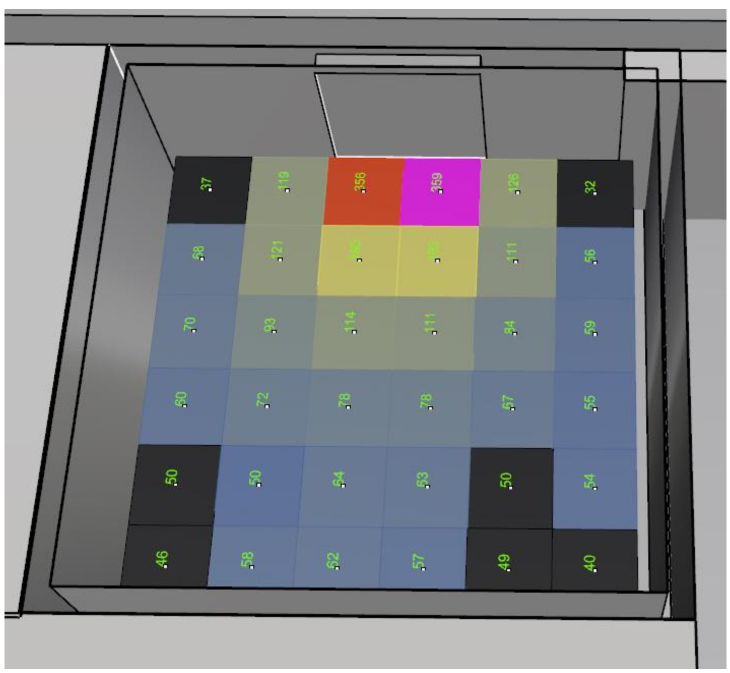

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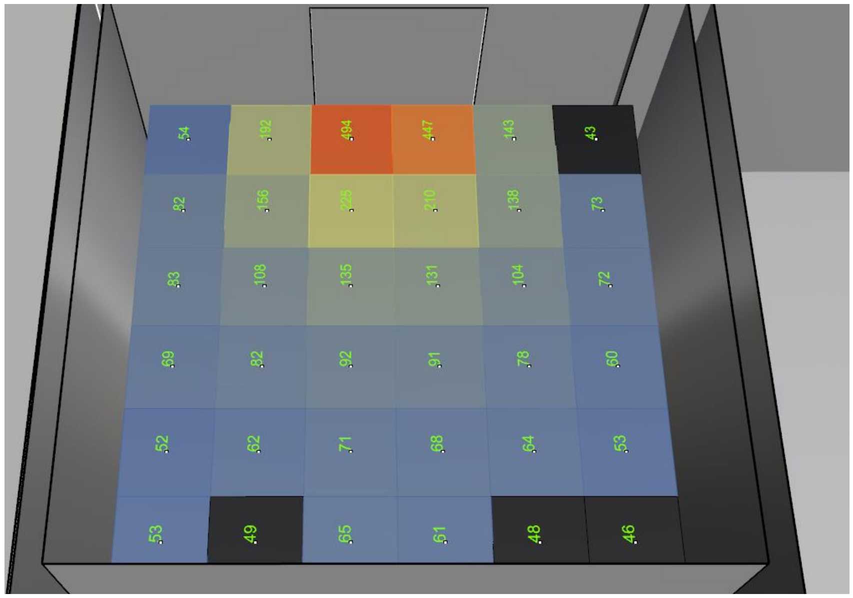

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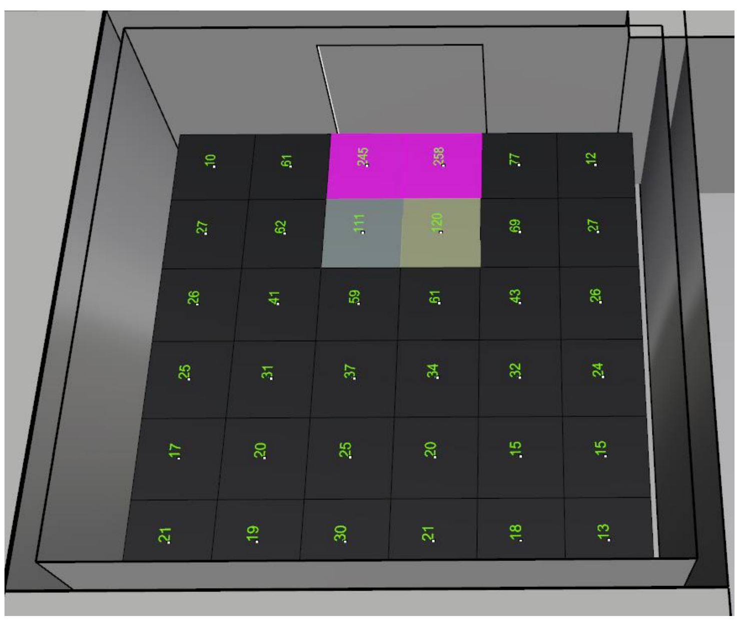

16 pm October

Appendix 5 Abstracts for my conference participation papers

PRIVACY AND HOME DESIGN IN JEDDAH BETWEEN VERNACULAR AND MODERN ARCHITECTURE

ALAA SHATWAN, SILVIO CARTA
Alaa Shatwan, School of Creative Arts, University of Hertfordshire, United Kingdom
Alaa Shatwan, College of Art and Design, King AbdulAziz University, Saudi Arabia
Silvio Carta, School of Creative Arts, University of Hertfordshire, United Kingdom

Abstract
This article examines the evolution of the spatial characteristics of privacy that occurred in the transition from vernacular to modern and postmodern residential architecture in Jeddah. The first part of this study establishes a historical framework that contextualises the tension between the vernacular and modern architecture in Saudi Arabia generally, and in Jeddah specifically. The second part analyses a series of case studies of residential buildings in Jeddah. Qualitative analyses are conducted by means of technical drawings and photographic techniques to provide a clear description of the current situation. This work provides evidence to substantiate the notion of privacy that has changed dramatically. Therefore, the re-introduction of vernacular architectural elements that have been lost after the introduction of the modern and postmodern architecture in Jeddah is important. Privacy between habitants and street pedestrians through window is missed, and more attention is given to privacy between extended family members.

Keywords: Window design; vernacular architecture; modern architecture; privacy.

FACTORS BEHIND LACK OF DAYLIGHT AND PRIVACY IN CONTEMPORARY FLATS

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2-Alaa Shatwan, College of Art and Design, King Abdulaziz University, Saudi Arabia

Abstract

Contemporary architecture in urban cities in Saudi Arabia no longer has the same identity that it had in vernacular architecture (Abu-Ghazzeh, 1997, Boon, 1982, Konash, 1980). Cultural privacy was one of the major factors that guided residential vernacular architecture in the country. As Islam is the major religion in the country, privacy is required to protect women from being observed by men outside the home. Vernacular windows are designed in ways that provide both daylight and privacy. On the other hand, contemporary architecture in the area reflects Western designs (Al-Naim, 2014). Glass windows in contemporary architecture lack privacy, which is still mandatory in the culture. This issue has become a common phenomenon in the area, which has led people to cover the windows for privacy. However, this solution blocks daylight in the interior space. Therefore, this paper discusses reasons that have led to the current issues of dim daylight and privacy in contemporary flats. It aims to find the conflict between users and makers whereby architects do not consider women's needs in rental flat design. Semi-structured in-depth interviews with ten professionals working in the field of architecture have been done to investigate the phenomenon. This paper provides insights on factors that created this issue in rental flats in the city of Jeddah. The findings strongly indicate that commercial considerations have precedence over occupants' needs in the design of contemporary flats in Jeddah. The finding strongly revealed that little attention is given to daylight and window design in Jeddah's building regulation. This leads to freedom in architecture design to fulfil stakeholders' requests.

Keywords*: contemporary architecture; window; Building regulation; culture*

CONSIDERATIONS ON WOMEN'S NEEDS FOR DAYLIGHT IN CONTEMPORARY RESIDENTIAL ARCHITECTURE

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Abstract

Humans share common needs and rights; however, there are special needs which vary according to gender. Women in Saudi Arabia spend long periods of time at home and are responsible for domestic duties. This creates particular needs for women which for men are easily fulfilled in the outside world, such as exposure to daylight. Furthermore, privacy has been studied as a major concern for Muslims and Arabs in their homes, and a number of studies have discussed window design and privacy culture in the vernacular architecture of different Muslim countries. Yet little attention is given to the point of how privacy effects daylight level in contemporary homes, where glass windows are the major source daylight and ventilation. This contributes to figuring out factors affecting daylight level according to each case variation. There are also some recent studied about similar cases in Arab countries. However, climate and culture vary from country to another and from city to another. Most previous findings cannot fit in Saudi buildings since window design is effected by culture factors such as privacy. Therefore, this study aims to find out if women mandatory right of daylight is sufficiently considered inside homes by studying daylight level during daytime in Jeddah city. This work seeks to find out if women are able to get their right of daylight while staying at home. This research studies daylight lux level in twelve modern flats in Jeddah. Diva for Rhinoceros is the tool to figure out the accurate daylight in different daytime of different seasons. Finding reported that the amount of daylight that enter all examined living rooms are less than the required level. The paper concludes that there is major lack of daylight in most examined flats due to different factors such as glass type, exterior obstruction, and window size.

Keywords

Daylight, Contemporary flats, window design, Glass type, Gender studies

Females' Satisfaction of Daylight in Jeddah's Contemporary Flats

Alaa Shatwan

ABSTRACT

In residential buildings located in Saudi Arabia, access to sufficient interior daylight is generally considered to be sufficient with that daylight made available through building window design (Dahlan and Mohamed, 2010). While several studies analyse light conditions as a general parameter for urban dwellers (Boubekri, 2008, Edwards and Torcellini, 2002, Gou et al., 2013, Kim and Kim, 2010), there is a lack of attention to the specific case of females spending considerable time inside homes. Moreover, the window is a socio-cultural element in Saudi Arabia and embodies a complex combination of religious, cultural, and environmental questions. This study examines females' satisfaction with daylight levels in their living spaces in middle-class residential flats in Jeddah. Twenty-three females between the ages of 20–50 who live in contemporary flats in Jeddah were interviewed. This study aims to examine female residential users engagement with daylight in their living space by addressing the general attitude of daylight sufficiency.The study provides insight into females' satisfaction of daylight provided in their daily lives through qualitative evidence. Findings strongly revealed that most flats in Jeddah city have *salah* with a small window facing a light well. Consequently, instead of using the *salah,* some females moved to other rooms that had an exterior window. However, these windows were either covered by curtains or tinted glass to provide privacy as required by Islamic culture. The lack of daylight in their domestic spaces made female residents dependent on artificial

light. Currently, there is no clear Saudi Arabic building code regarding the provision of daylight in contemporary flats. This study seeks to provide evidence about females' dissatisfaction with the amount of daylight within their flats, and to make a significant contribution to the gap in knowledge regarding females and daylight in Saudi Arabic culture while balancing the cultural need for a high level of privacy.