# STUDY ON THE POTENTIAL OF LIGHT WELLS IN DEEP PLAN READYMADE GARMENTS FACTORY BUILDINGS IN DHAKA

**By**

**Razia Sultana**

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Department of Architecture

BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY

Dhaka, Bangladesh.

**Department of Architecture**
**Bangladesh University of Engineering and Technology**
**Dhaka-1000, Bangladesh.**

The thesis titled "STUDY ON THE POTENTIAL OF LIGHT WELLS IN DEEP PLAN READYMADE GARMENTS FACTORY BUILDINGS IN DHAKA" Submitted by Razia Sultana, Roll No-0413012012 P, Session- April 2013, has been accepted as satisfactory in partial fulfillment of the requirements for the Degree of MASTER OF ARCHITECTURE on this day 24 July, 2017.

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## Dedicated to my family

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## Abstract:

Ready-made garments (RMG) factories are playing a vital role in the economy of Bangladesh, supported by the labour of the workers who spent major part of day time in the RMG factory buildings and engaged in different types of works, such as cutting, sewing, ironing and packing. In general, because of poor visual environment of RMG factories, the workers often feel discomfort and health problems that impact on productivity.

The aim of this research is to develop architectural design strategies to incorporate light well in RMG factory buildings to improve luminous environment in context of Dhaka. To incorporate light well in the RMG buildings, effectively, simulation analysis was done to identify sensible location of light well in the building, define physical parameters of light well spaces and refine light well configurations. In this research DAYSIM, that use dynamic Climate-Based Daylight Modelling (CBDM) method was used to calculate Daylight Autonomy (DA), Maximum Daylight Autonomy ($DA_{max}$), Useful Daylight Illuminance (UDI) and annual illumination profile for the selected case RMG building. DAYSIM use RADIANCE (backward) raytracer combined with a daylight coefficient approach considering Perez all weather sky luminance models. ECOTECT was used as the modelling interface to launch DAYSIM program. The findings show that the square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of a six story RMG building, perform better to enhance visual quality into the interior space compared to other studied configurations, locations and proportions of light well. It is expected that the outcome of this research will help architects and designers to incorporate light well in RMG buildings to enhance the interior lighting quality of the RMG factories in the context of Dhaka, that will also improve the productivity of workspace.



**Keywords:**

Daylight, Dynamic Performance, Light well, RMG Building, Simulation analysis.

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## List of Abbreviations

| | |
|---|---|
| AGS | Architectural Graphic Standards |
| BGMEA | Bangladesh Garment Manufactures & Exporters Association |
| BKMEA | Bangladesh Knitwear Manufacturers & Exporters Association |
| BMD | Bangladesh Meteorological Department |
| BNBC | Bangladesh National Building Code |
| BUET | Bangladesh University of Engineering and Technology |
| CBDM | Climate-Based Daylight Modeling |
| CIE | International Commission on Illumination |
| DA | Daylight Autonomy |
| DDS | Dynamic Daylight Simulation |
| DF | Daylight Factor |
| EAC | Energy Audit Cell |
| GoB | Government of Bangladesh |
| GWR | Glazing-to-Wall Ratios |
| IFC | International Finance Corporation |
| ILO | International Labor Organization |
| IES | Illuminating Engineering Society |
| IESNA | Illuminating Engineering Society of North America |
| LED | Light Emitting Diodes |
| LWC | Light Well Configuration |

| | |
|---|---|
| MOD | Monthly Operational Data |
| NARM | National Association of Skylight Manufacturers |
| NGO | Non-Governmental Organizations |
| RMG | Ready Made Garments |
| UDI | Useful Daylight Illuminance |
| UV | Ultra Violet |
| UVR | Ultra Violet Ray |

# CHAPTER ONE: INTRODUCTION

Preamble

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# CHAPTER ONE: INTRODUCTION

## 1.1 Preamble

The Readymade garment (RMG) industry of Bangladesh started in the late 1970s and became a prominent player in the economy within a short period of time (Chowdhury et al., 2011; Hossain, 2011). The industry has a contribution in export earnings, foreign exchange earnings, employment creation, poverty alleviation and the empowerment of people, specially of woman. Approximate four million workers are directly and more than twelve million inhabitants are indirectly associated with the industry. The garment industry is one of the country's most significant manufacturer, earning about $5 billion annually and accounting for about two third of total exports. Bangladesh has near about more than 4,000 garment factories with up to 10 million livelihoods dependent on it directly or indirectly (Hasan et al., 2016); however, similar to many other developing countries, occupational health is still a neglected area in Bangladesh. Few industrial management is concerned to the work place environment and health of the workers. So, the industrial management provide little or no attention to the work place injuries, sickness and environment. The workers have also almost no concern about their health and safety.

Labour force is an important issue in industrial production as well as in garment industry of Bangladesh (Yunus et al., 2012). On the other hand, the economy of this sector mostly depends on the workers who spend most of the times (more than 90%) of their lives in an artificial indoor environment (home, transportation, work) (Hossain et al., 2014) due to the nature of the work (Chowdhury et al., 2011; Hossain, 2011). Proper illumination condition of work space of RMG factories, is a major requirement of a suitable working environment.

Visual comfort for different illumination intensities has influence on total physical comfort condition and any physical distress influences on the human performance and their work competence (Hossain, 2012). Excessive use of artificial light makes the spaces of RMG buildings enormous heated and glared; however, the daylighting condition of RMG buildings specially in Bangladesh is poor (Hossain et al., 2013).

When proper quality and quantity of lighting is provided; it adds a better working performance as well as productivity. Appropriate illuminated condition should be maintained not only for visual comfort but also to increase productivity. Proper daylighting can improve the quality of indoor spaces as well as can save the energy consumption in the readymade garments factory buildings (Hossain, 2012).

Daylight is one of the most important elements in individuals’ regular life. The regular life style of human being is sleeping at night and working during daytimes. Human brain roles and responds to the motivation of daylight. In work space, daylighting is very crucial for the wellbeing, efficiency and safety for the occupants. It can also improve the internal environment of buildings significantly (NARM, 2009).

Daylight is also one of the most important natural forces available for architects to enhance the visual quality of interior spaces. It is an abundant resource in the tropics (e.g. Dhaka, Bangladesh), essential both as a primary source of illumination as well as an ingredient of drama, excitement and dynamism in the architecture and aesthetics of spaces (Ahmed et. al., 2007). Daylight is often used for ambient lighting but may be used for critical visual tasks as well, in each case supplemented with electric light as needed (Joarder, 2009).

Most of the RMG factories in Bangladesh do not consider building depth, height, volume, equipment and number of story: factors that are important to make factory energy efficient (Chowdhury et al., 2011). RMG sector has a greater prospective than other sections in case of employment and foreign exchange earnings to decrease poverty and contribute to the nationwide economy (Ahamed, 2011). Edwards (2002) concluded in a study that the windowless factory workers experienced increased permeability of skin capillaries, decreased white cell activity, and increased catarrhal infections and colds compared to workers in factories with windows.

## 1.2 Problem Statement

In spite of the financial success of the RMG industry, since 2006, serious anxieties for poor working conditions and the lack of social compliance in the factories led to labour unrest and damage to institutions and properties. Working conditions in the RMG sector are below the ILO standards (Ahamed, 2011). Figure 1.1 shows some images of typical RMG interior space, where huge artificial lighting is used for working. Violation of health and safety regulations often happens in the RMG sector. As a result, workers specially swing operators, finishing helpers, and quality controllers suffer from constant fatigue, headaches, anaemia, cough and fever.

In most of the case, among the younger workers, chest, stomach, eye and ear pain, coughs and colds, diarrhoea, dysentery, urinary tract infections and reproductive health problems are common. Most of the factories do not meet minimum standards, as prescribed in building and construction legislation, i.e. Factory Rules 1979 (Ahamed, 2011; Zohir, 2008).

*Figure 1.1: Present working environment and artificial lighting in production space of RMG building.*

Readymade Garments (RMG) factories have been heavy criticized by International Labour Organization (ILO), World Health Organization (WHO) and other international organizations during 1970-2000, specially for poor indoor working conditions in production spaces (Hossain et al., 2012). After occurrence of disaster situation of readymade garments factories and about thousands of workers' death in (Bhuyan, 2013), Rana plaza building collapse (April, 2013) and Tazrin fashion factory fire incident (November 2012) different public organization e.g., Government of Bangladesh (GoB), Bangladesh Garment Manufactures & Exporters Association (BGMEA), Bangladesh Knitwear Manufacturers & Exporters Association (BKMEA), different Non-Governmental Organizations (NGOs), and ILO, came together to take initiative to improve the indoor environmental condition of RMG factories in Bangladesh. As a part of this initiative, other organizations, such as, Bangladesh University of Engineering and Technology (BUET), Dhaka; Accord on Fire and Building Safety, European Union; and Alliance for Bangladesh Worker Safety, United States, provided technical services in assessing the existing situation of the RMG factory buildings throughout Bangladesh (Joarder et al., 2015; Hossain, 2011).

Accompanied by the recent death incidents stated above, over the last few years, RMG factories in Bangladesh have been heavily criticized for its working conditions as well, some of these are described below.

### *1.2.1 Present Workers' Health Condition of RMG Factories*

Bangladesh as a labour-abundant country, started the development of industrialisation in the segment by focusing labour-intensive products such as clothing (Hossain et al., 2012). The economy of this segment depends on the production by the workers of garments factory buildings throughout the day. Proper illumination condition of RMG is a major requirement which indicate the quantity as well as quality of lighting suitable for the working spaces. For various illumination levels, visual comfort has a great impact on physical comfort condition of workers and this discomfort environment influence upon human behavior and their works (Hossain et al., 2013; 2012).

In RMG factory, workers need to do significant visual work which requires constant use of their eyes to do concentrated stitching work. For this reason, quality and distribution of light should be maintained properly in the workplace. In most of the cases, in RMG factories, work places were lighted by hanging artificial lights from at least 2 feet below the ceiling and closer to the workers table or machine (Prokaushali Sangsad Limited, 2007). In the production space particularly at sewing, cutting, dyeing and finishing areas, where illumination condition is much important, harmful human health impacts can be caused from poor environmental quality inside the buildings. Due to the poorly designed and maintained artificial lighting systems that result glare and flicker, factory workers may suffer discomfort and a range of health problems. Appropriate quantities of light are essential, but quality issues are just as important in providing a comfortable and safe working atmosphere (Zohir et al., 2007). When the lighting meets the needs, it adds better working performance and productivity (Joarder et al., 2015).

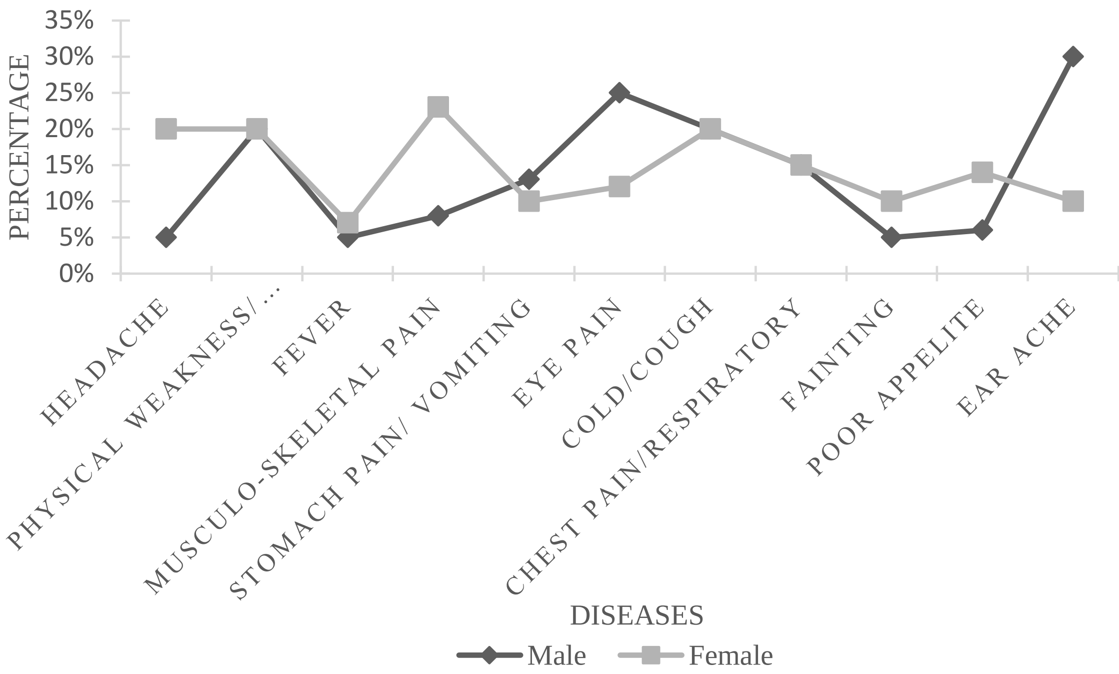



*Figure 1.2: Health issues in terms of duration and the workers with eye problem (Zohir et al., 2007).*

While considering the human factor in luminous environment, visual comfort often comes first and it can be described by the concepts of glare and contrast. Glare is usually caused by high luminance or excessive luminance difference in the visual field. Visual performance can be improved with increasing luminance. Poor illumination condition has harmful impacts on workers' health resulting in a high incidence of illness (Zohir et al., 2007). The most frequent incidences are headache (98%), respiratory problem (36%), vomiting (28%), fatigue (28%) and fainting (18%). (Hossain et al., 2014). Among the illness and diseases, eye pain and headache were notable issues in the record of 2003 considering average duration of suffering (Zohir et al., 2007). Across job categories, sewing operators, finishing helpers and quality controllers were found to suffer most from the eye troubles (Figure 1.2). On an average, a worker took two days leave in a month due to their health condition (Zohir et al., 2007).

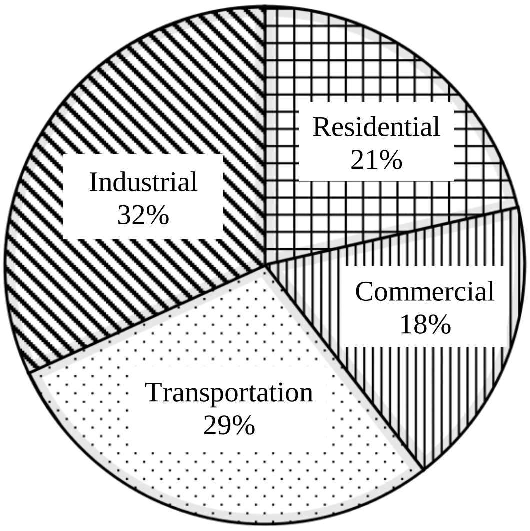
As the RMG workers do more critical jobs which need adequate lighting, inappropriate lighting condition may cause vision problems including eye pain. Most of the activities in RMG factories are labor intensive, demands operating environment with adequate lighting for efficiency. Proper illumination condition should be maintained not only for the visual comfort but also for helping production targets (Hossain et al., 2013). The poor luminous environment in production areas is one of the alarming issues for the workers. Among the environmental compliance factors, illumination condition includes the quality as well as quantity of the lighting which must be ensured by the owners of the factory (Hossain et al., 2013; 2012).

### *1.2.2 Energy Consumption*

Most of the RMG factories in Bangladesh use artificial lighting during day hours which increase indoor temperature as well as building cooling load and increase energy consumption. There have lots of possibility to use daylighting to improve working environment and decrease use of energy (Chowdhury et al., 2011).

One of the most cost effective ways to reduce energy consumption in non-residential buildings is to supplement electric light, which contributes about one-third (Figure 1.3) of the commercial building energy use, with daylight (Erlendsson, 2014). About 20-35% of the total energy is consumed by artificial lighting (Figure 1.4). Daylighting can be effective to reduce the energy consumption and excessive cooling load caused by artificial lighting in RMG sectors.

If architects or designers do not consider the luminous environment while locating and selecting the types of artificial lights and daylight penetration in the building envelop, it will increase the overall national electrical energy demand (Zhou et al., 2009). Many building owners and architects have reported energy savings received from daylighting. Utility costs for a building can be decreased when daylighting is properly designed to replace electrical lighting.



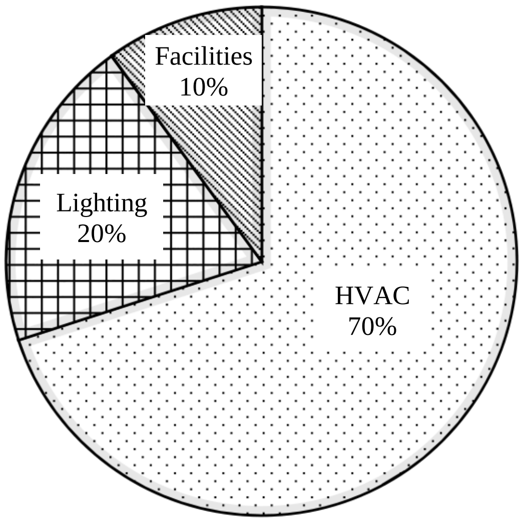




*Figure 1.3*: *Total energy consumption by sector, 2007 (*Zhou et. al., 2009*)*

*Figure 1.4*: *Energy consumption for Industrial buildings (*Zhou et. al., 2009*)*

## 1.3 Light well for RMG buildings

In deep planned multi-storeyed buildings, daylight can be brought inside the building by incorporating void spaces, such as light well, atrium or courtyard. The usual purpose of these elements are to: improve the quality of life of the occupants dwelling or working in the building or home (Quora, 2016); provide light to adjacent spaces, which depends upon the width to height ratio of the voids and the reflectance of the opaque surfaces within the void (Sfgate, 2017). These voids offer a semi-covered or private space to enjoy the outdoors. Daylight entering the space provides an area to grow a garden or a variety of other full-sun plants (Quora, 2016).

A light well is usually a large and multistoried, open space used bringing daylight into the interior of large buildings where sidelight alone cannot penetrate enough daylight to improve the indoor space (Figure 1.5). The light well may be surrounded on one, two, three, or four sides by rooms or spaces (Erlendsson, 2014). Light wells are vertical spaces provided within the volume of a large building to illuminate spaces without direct light access, with covered (*Kristl et al., 1999*) or opened (Farea et al., 2012) at the top. The light well allows the exploitation of daylighting by bringing natural light into areas on the inside of buildings, thus allowing daylighting access to "dead" areas of the buildings (Ahmed et al., 2014). Light wells (sometimes referred as deep courtyard) also act as vertical air passageway that is commonly used in high rise buildings, especially in deep planed (more than 20m wide) buildings, to admit daylight and to induce natural ventilation.

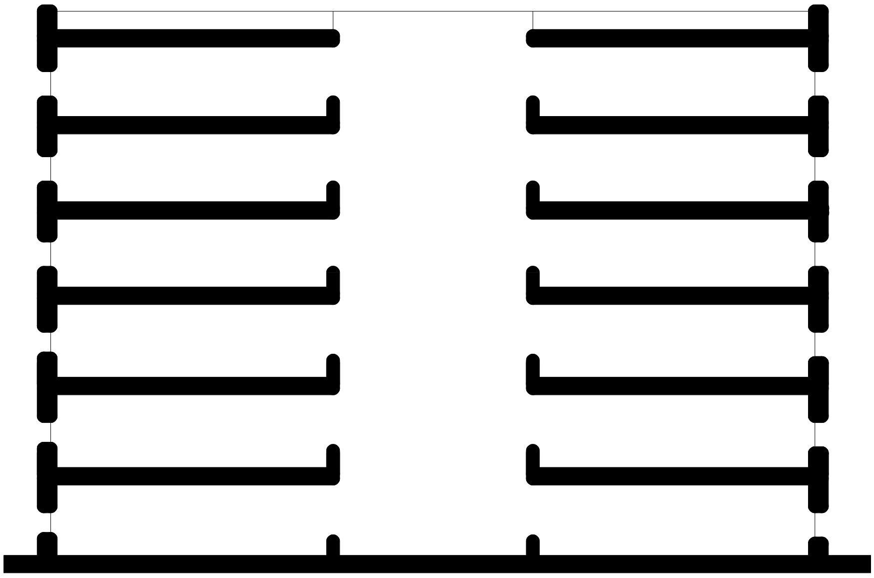


*Figure 1.5: Influences of light well in the adjacent rooms or spaces (Mabb, 2001).*

Light well space if appropriately connected with the outdoor environment will not only enhance the air flow (open roof) and cool down the building structure but also change the wind environment around the building especially at the pedestrian level (Farea et al., 2012). Even if the light well cannot directly connect the occupants with the outside world, it can give them an idea about the changes of the outer conditions, caused by daylight dynamics, which regulates individual's internal body clocks (Kristl et al., 1999).

As a design element light well can be used to incorporate daylighting into the interior deep areas of RMG buildings effectively. Economic value of floor area is an important factor for industrial and commercial buildings. As an industrial building, the value of floor area for RMG building is high and owner urge to utilize maximum floor area for production purpose. Light well takes less space than other types of voids (e.g. atrium and courtyard). Considering the commercial value of RMG floors, research could be started to explore the potential of light well, and parametric changes can be applied and analysed gradually on the location, shape, and proportion of light well to improve the luminous environment of RMG buildings.

## 1.4 Aim and objectives

The aim of this research is to develop architectural design strategies to incorporate light wells in deep plan RMG factory buildings to improve indoor luminous environment in the context of Dhaka. To achieve this aim following three objectives have been developed.

**Objective 1:** To rationalize the benefits of light wells in deep plan RMG buildings.

**Objective 2:** To identify the best possible parametric configurations of light wells to improve the indoor luminous environment of deep plan RMG factory buildings.

**Objective 3:** To find out effective ratios of light well to building volume to increase useful daylight for deep plan RMG factory buildings in context of Dhaka.

## 1.5 Overview of research methodology

In Chapter 3, a thorough picture of the research methodology that is used for this research has been discussed. This section affords a brief outline of the research methodology for the thesis. A flow diagram of the research process is shown in Figure 1.6, which incorporates the main research methods: literature review, case study and simulation analysis.

In this research, at first literature study was done to provide knowledge and information on the RMG factory building’s present illumination level, national and international illumination standards for RMG buildings to understand the appropriate luminous environment of RMG buildings. Benefits and different configurations of light well and effective ratios of light wells and building heights were also identified from literature study.

A RMG building was selected from the BGMEA registered member list for physical investigation based on specific criteria (Section 3.2.3). Window details, material, sill height, lintel height, shading device, work plane height, aisle width, exterior interior photographs, detail observations and related information were collected for this RMG building. This RMG building was selected as case study, for simulation analysis.

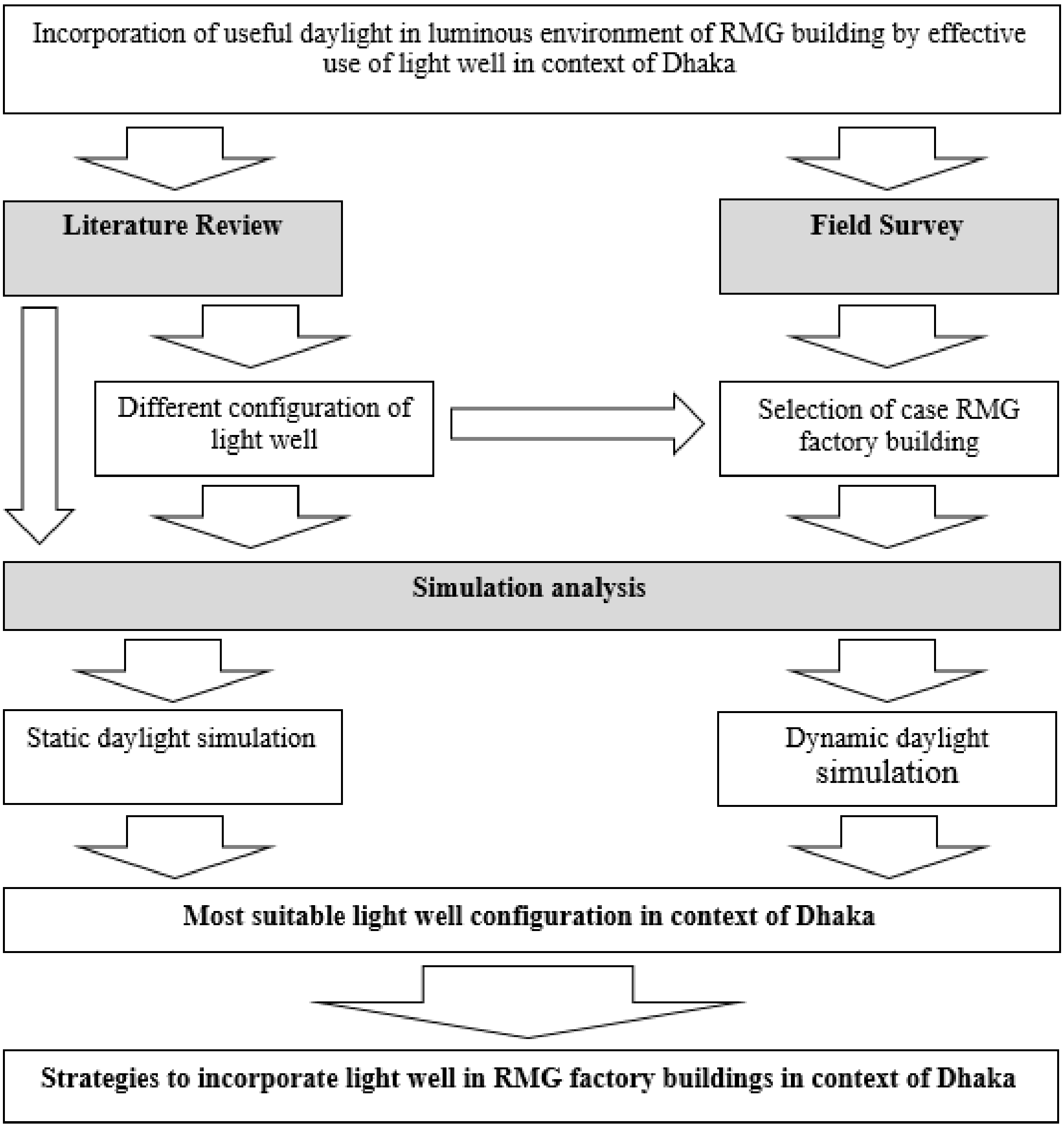



*Figure 1.6: Flow diagram of the research process.*

Daylight simulation process was done in two phases. At first phase, Static and annual dynamic annual Climate-Based Daylight Modeling (CBDM) analysis were conducted with different light well configurations, identified from literature, to find out the most effective one for the case RMG factory building to maximize useful daylight.

Further simulation analysis was done with the most suitable light well configuration (identified from first phase) to refine the design parameters, e.g. shape of the light well and ratio of building height and light wells to incorporate useful daylight in luminous environment of RMG factory building under the climatic context of Dhaka.

Finally the experience of the simulation exercise, data from parametric simulation study, case studies and findings from literature reviews were compiled to recommend architectural design strategies to incorporate light wells in deep plan RMG factory buildings to improve luminous environment in the context of Dhaka.

## 1.6 Scope and limitation

The research work concentrates on strategies for daylight penetration in RMG buildings in Dhaka city. Though, in the tropics, with the daylight unwanted heat may enter into the building and excessive daylight may cause glare, this study is limited to evaluate the amount of daylight penetration into RMG building only. Recommendations and design guidelines of this study are made regarding simple modification of existing building design by incorporation of light well that can be applied easily in context of Dhaka.

Daylight penetration not only improve the visual performance in RMG building but is also related to aesthetics, energy consumption (electric lighting, mechanical heating and cooling), heat loss and gain, sound transmission, glare control, ventilation, economics, safety, security and subjective concerns of view and privacy.

In the short time available, the consequence of daylight penetration on energy savings, ventilation, view, heat, comfort and efficiency of workers were however beyond the scope of this thesis. Considering the time and resources limitation, the present work focuses mainly on performance of light well to meet the required illumination level of RMG building in context of Dhaka.

## 1.7 Structure of the research

This thesis is structured into five chapters. This Section delivers an overview of each of the following chapters, which is presented graphically in Figure 1.7.

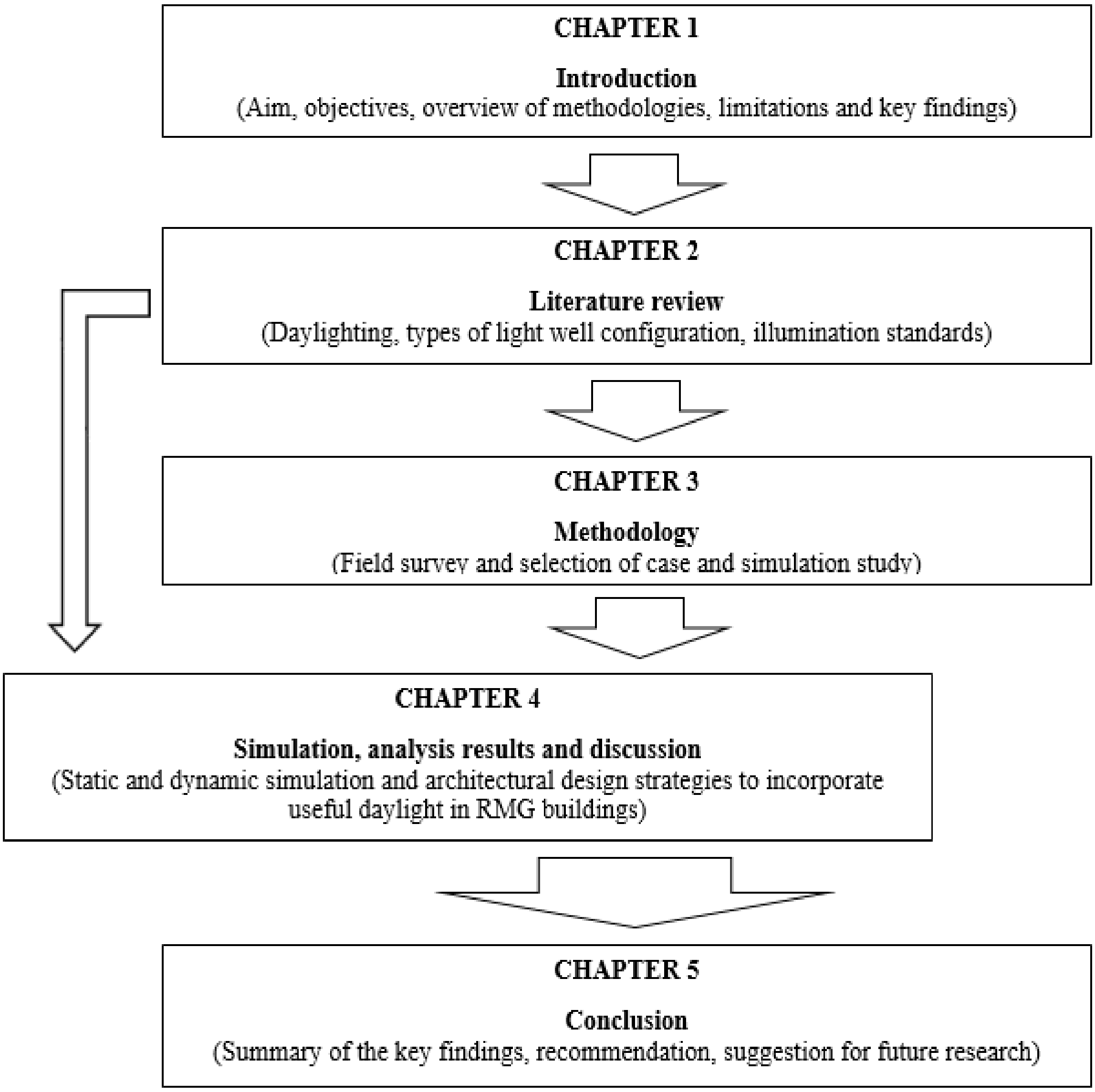



*Figure 1.7: Organisation of the chapters and structure of the thesis.*

**Chapter 1** constitutes an introduction of the thesis. This chapter also describes issues that might be necessary for understanding this research, problem statement with the aim, objectives, brief methodology and limitations.

**Chapter 2** describes the outcome of the literature review, based on conventional research and published sources, to provide a basic knowledge for this research, which helped to focus on the concerns on which later the simulation is accompanied.

**Chapter 3** provides the detail steps of the methodology for simulation study for this study. This chapter also provides the criteria of the selection of the case RMG building for simulation study.

**Chapter 4** affords the detail description and output of the simulation analysis. This chapter divided into three main parts. In the first part static and dynamic CBDM simulation are conducted to find out the most suitable light well for RMG buildings; the second part describes the parametric study to propose the parametric configuration of the suitable light well configuration; and the third part discusses the architectural design strategies for incorporation of useful daylight illumination in RMG building.

**Chapter 5** concludes the findings of the whole research, at first fulfill the aims and objectives which describe in this chapter, and then suggest architectural design strategies for the indoor luminous environment of RMG buildings. The work ends by identifying research areas that need further investigation subsequent to this study.

## 1.8 Key findings

The research started to overcome some constraints mentioned at Section 1.2.With the gradual development of the research from the literature review and incorporation of research findings at each stage made objectives, methodology and limitations of the research more defined, refined and detailed. Table 1.1 presents a summary of the key findings of the research in relation to the objectives, methodologies and concerned chapter.

*Table 1.1: Summary of the key findings of the research in relation to the objectives, methodologies and concerned chapters.*

| Objective | Methods | Chapter | Key findings |
|---|---|---|---|
| **Objective 1:** To rationalize the benefits of light wells in deep plan RMG buildings. | Literature review | Chapter 2 | Light well increase daylight penetration in the core space, can also help to maintain thermal comfort, natural ventilation and save energy. It also acts as a buffer space sheltering from wind, rain and other outdoor environmental factors. Incorporation of light well in deep plan RMG building can meet the visual and psychological needs of RMG workers as well as increase productivity. |
| **Objective 2:** To identify the best possible parametric configurations of light wells to improve the indoor luminous environment of deep plan RMG factory buildings. | Simulation analysis | Chapter 4 | Square shaped north oriented semi-enclosed light well for six storied RMG building was found most suitable configuration of light well for useful daylight illumination among other studied light well configurations. |
| **Objective 3:** To find out effective ratios of light well to building volume to increase useful daylight for deep plan RMG factory buildings in context of Dhaka. | Simulation analysis | Chapter 4 | Square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of a six story RMG building was found as most suitable parametric configuration of light well for useful daylight illumination among other studies light well configurations in this research. |

# CHAPTER TWO: LITERATURE REVIEW

Preamble

Illumination standards for RMG building

Illumination levels of Bangladeshi RMGs

Light well as a strategy of daylighting for RMG factories

Potential of light well

Different aspects of light well configuration

Light well configuration standard

Finding from the literature review

Summary

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Preamble

Chapter one introduces the background study of the research. This Chapter deliberates the outcomes of the literature review to define the basic information essential to develop a suitable luminous environment for workers of RMG factories by incorporating light well, as a strategy of daylighting. This Chapter consists of five parts. First part discusses the comparison between international and national standards for illumination level of existing RMG buildings measured by previous researchers. The second part presents light well as a potential source of daylighting to meet the illumination requirement of RMG building. The third part highlights the different light well configurations, types, shapes, ratio of building height and light well. The forth part presents the parametric standards for light well, which help to support decisions during simulation analysis. At last, key findings of this chapter have been described. The next chapter (Chapter 3) discusses the methodology for field studies and simulation studies with respect to the outcome of this chapter.

## 2.2 Illumination Standards

This section presents different international and Bangladeshi local illumination standards for different interior work spaces of RMG factory buildings.

### *2.2.1 International standards*

Although the International Building Code (IBC, 2012) states all habitable spaces to have natural or artificial light, in some jurisdictions, natural light is required for all space (even bathrooms and kitchens). Codes set minimum sizes for the light wells and yards of multistoried buildings in order to assure the minimum amount of natural light and ventilation into the building spaces that they serve (Ahmed et al., 2014).

According to Illuminating Engineering Society (IES, 1968) code, illumination level needed for fairly sever task and small details such as, drawing, sewing is 600 lux, where, 900 lux is recommended for severe, prolonged task, very small detail e.g. fine assembly and hand tailoring (Table 2.1).

*Table 2.1: Recommended illumination and limiting glare index based on IES code, 1968 (Koenigsberger et al., 1997)*

| Visual task | Illumination (lux) | Glare index |
|---|---|---|
| Casual seeing | 100 | 28 |
| Rough task with large detail | 200 | 25-28 |
| Ordinary task, medium task | 400 | 25 |
| Fairly sever task small detail (drawing, sewing) | 600 | 19-22 |
| Severe, prolonged task, very small detail (fine assembly, hand tailoring) | 900 | 16-22 |
| Very severe, prolonged task, very small detail (e.g. gem cutting hosiery mending gauging very small parts) | 1300-2000 | 13-16 |
| Exceptionally severe task, with minute detail (e.g. watch and instrument making) | 2000-3000 | 10 |

National Association of Roof light Manufactures (NARM, 2014) recommends 50 to 100 lux for general work spaces e.g. corridors, bulk store, where simple visual task are performed. For performing visual task of high contrast and large size for example loading bays and plant rooms, 150 to 200 lux is recommended. 300 to 500 lux is recommended for moderately difficult visual tasks in general offices, retail shops. 750 lux to 1000 lux is recommended for difficult visual task. On the other hand, for extremely difficult visual task, 1500 lux to 2000 lux is recommended (Table 2.2).

*Table 2.2: Examples of activities/interiors appropriate for each maintained illuminance (NARM, 2014).*

| Characteristics of activity/interior | Representative activities/interior | Standards maintained illuminance (lux) |
|---|---|---|
| Interiors used occasionally, with visual tasks confined to movement, limited perception of detail. | Corridors, bulk stores. | 50-100 |
| Continuously occupied interiors, visual tasks not requiring perception or detail. | Loading bays, plant rooms. | 150-200 |
| Moderately difficult visual tasks, colour judgement may be required. | Packing, general offices, engine assembly, retail shops. | 300-500 |
| Difficult visual tasks, accurate colour judgement required. | Drawing offices, chain stores, general inspection, electronic assembly, supermarkets. | 750-1000 |
| Extremely difficult visual tasks | Precision assembly, fabric inspection. | 1500-2000 |

### *2.2.2 Local standards*

Bangladesh National Building Code (BNBC, 2006) was published as an introductory gazette on 16 November, 2006, to maintain and guide construction activities inside Bangladesh. Table 2.3 shows the recommended illumination level for clothing factory of Bangladesh which illustrated that 450 lux is recommended for matching up, 300 to 700 is recommended for cutting and sewing activities and for inspection and hand tailoring, 450 to 1500 lux is recommended and 300 lux is recommended for pressing or ironing (BNBC, 2006).

*Table 2.3: Local codes for clothing factory (BNBC, 2006, Table: 8.1.10).*

| **Area or activity** | | **Illuminance (lux)** |
|---|---|---|
| **Matching up** | | 450 |
| **Cutting and sewing** | Light | 300 |
| | Medium | 450 |
| | dark | 700 |
| **Inspection** | Light | 450 |
| | Medium | 1000 |
| | dark | 1500 |
| **Hand tailoring** | Light | 450 |
| | Medium | 1000 |
| | dark | 1500 |
| **Pressing/ironing** | | 300 |

### *2.2.3 Design illumination level for Bangladeshi RMG*

For critical work for example clothing (cutting and sewing, inspection, hand tailoring and pressing) in RMG factory needs sufficient lighting than other general works. The designers and architects should design the flow of working activities in such a way that more critical work which needs high lighting level for comfortable work, be placed near the openings with sufficient daylight. The lighting condition with daylighting is most encouraging for the workers. For designing work space with healthy and safety, should follow different international and local standards. Table 2.4 shows the different international and national standards for illumination level of clothing factory.

*Table 2.4: Comparison between national and international illumination standards for clothing (Hossain, 2012)*

| Standards | International standards (IESNA) | International standards (IES code) | National standards (BNBC, 2006) |
|---|---|---|---|
| **Minimum illumination level at work plane (lux)** | 300 | 600 | 300 |
| **Minimum illumination level at work plane (lux)** | 1000 | 900 | 1500 |

The preferable illumination level is considered as 100 lux to 2000 lux for visual performance. Ilumination level 100 lux is considered as insufficient for performing tasks (Applefeld et al., 2011). At production space (sewing and cutting) work plane, the preferred illumination level is 800 lux (Hossain et al., 2013). But 300 lux is considered as effective for task light source with or without artificial light. Over 2000 lux is considered as discomfort and make glare which is undesirable for any work (Applefeld et al., 2011).

## 2.3 Illumination level of Bangladeshi RMGs

Hossain et al. (2013), measured illumination condition of RMG building during field survey, where average illumination condition with only daylight and with both daylight and artificial light, illumination range for less defects, comfortable illumination range in terms of brightness of three RMG production space was shown. From the surveyed data, it was found that near the window the illumination level with only daylighting vary from 166 lux to 287 lux for three RMG cases where at the centre the illumination range was almost “0”. Near the window the average illumination level with both daylighting and artificial lighting was found from 873 lux to 1088 lux for three case spaces where at the centre of the production space the illumination level with both daylighting and artificial lighting was found from 532 lux to 792 lux. Among the surveyed production spaces, for both daylighting and artificial lighting minimum and maximum illumination levels were found as 380 lux and 1490 lux respectively (Table 2.5). From the surveyed case space, it was found, most of the RMG factory do not maintain daylight strategy for required illumination level. In this M. Arch research the minimum illumination level was assumed as 300 lux.

*Table 2.5: Measured illumination level at work plane of production space for three RMGs (Hossain, 2011)*

| Production space | Location or zone | Average illumination level with only daylight (lux) | Average illumination level with both daylight and artificial light (lux) |
|---|---|---|---|
| **RMG Production space Case-1 Range (380-900 lux)** | Near the window (partly daylight) | 166 | 873 |
| | Centre of the half of the space (most artificial lighting) | 3 | 588 |
| | Further from the window (completely artificial lighting) | 0 | 532 |
| **RMG Production space Case-2 Range (480-860 lux)** | Near the window (partly daylight) | 258 | 953 |
| | Centre of the half of the space (most artificial lighting) | 9 | 672 |
| | Further from the window (completely artificial lighting) | 1 | 581 |
| **RMG Production space Case-3 Range (390 -1490 lux)** | Near the window (partly daylight) | 287 | 1088 |
| | Centre of the half of the space (most artificial lighting) | 6 | 792 |
| | Further from the window (completely artificial lighting) | 0 | 697 |

## 2.4 Light well as a strategy of daylighting for RMG factories

Daylight access means the availability of daylight into the interior space of building for utilization of public amenities as well as interior illumination. In the building, daylight access is pre-condition to use of daylight. The main classes of daylighting strategies are side-lighting, top lighting and light well /Atria (DeKay, 1992).

The use of daylight could give a significant contribution to the sustainable performance of an indoor environment and also reduce the use of artificial lighting as well as save the energy. User satisfaction of building depends largely on lighting comfort. Efficient daylight is conductive not only for good health and productivity in the workplace but also reducing the running costs (Erlendsson, 2014).

### *2.4.1 Source of daylighting*

Though the sun is the main source of daylight, from different pathways it may enter in work space. The bright overcast sky is brighter than the clear blue sky. In absence of artificial light, the available daylight is both direct sunlight and diffused light from the sky. The direct component, light coming directly from the sun, is composed of directional, parallel rays. Its intensity may be as high as 100,000 lux, depending on the time of day, year and the angle of incidence. Defuse skylight, reflected from clouds, dust, etc., is composed of weaker rays coming from all directions and is traditionally the major source for daylighting. Its intensity varies from 1000 to 30,000 lux, depending on the degree of overcast and solar altitude. Sunlight reflected from the ground constitute only 10-15% of the total daylighting reaching a window, but light ground surfaces increase this amount (Kim et al., 2009).

A light well, could be a major source of daylight for multistory deep plan (more than 20m wide) RMG factory buildings. Light well also offer other environmental benefits in terms of supporting natural ventilation and maintain the energy consumption (Farea et al., 2012; Kristl et al., 1999).

## 2.5 Potential of light well

Daylight is desired because it accomplishes two very basic human needs such as to be able to see both a task and the space well, and to experience some psychological stimulation. Long-term working under artificial lighting is thought to be harmful to health; working with daylight is thought to result in less stress and discomfort. Daylight strategies depend on the availability of natural light, which is determined by the latitude of the building site and the conditions of immediate surroundings of the building, e.g., the presence of obstructions. Daylighting strategies are also affected by climate. Daylight is the sum of sunlight and skylight (IEA, 2000).

The light well concept is to allow the accessibility of daylighting into the centre of the buildings which enhance more even distribution of daylight. The use of daylight could give a significant contribution to the sustainable performance of an indoor environment (Kim et al., 2009). The light well of a building is beneficial not only for increasing daylight penetration in the core space of the building but also it can help to maintain natural ventilation, thermal comfort, a buffer space to reduce energy losses and consumption. Though the measurable energy savings, quality of lighting, and environmental benefits of daylighting in buildings are undisputed, there are other equally exciting reasons associated with daylighting (Erlendsson, 2014).

When designing a light well in a building, the regional climate as well as the functional characteristics of the building should be considered besides its physical dimensions and properties to produce the optimum daylighting performance (Ahmed et al., 2014). The amount of light penetration through the light well, depends on the availability of outside lighting which changes with climatic conditions, time of the day, and season of the year. On sunny days, daylight remains the maximum, but in rainy days, it is very dark and less light is available (Iqbal, 2015).

### *2.5.1 Environmental benefits of light wells*

In architecture, daylighting plays a vital role of sustainable environmental approach. Light well acts as a major source of daylight for deep plan buildings and also offer other environmental benefits such as, solar gain in winter, reduce energy losses and natural ventilation (Erlendsson, 2014). Artificial lighting is known to be the major element that contributes a great deal in increasing heating loads and light well would be huge bonus in this aspect especially in deep plan industrial buildings. By using plant-filled light well, air could be filtered and particulates removed when it enters the hollow space. Light well also act as a buffer zone sheltering the space from wind, rain and other outdoor environmental factors while retaining the outdoor effects such as fresh air, natural light and sunshine (Jaberansari et al., 2016).

The level of natural light in the interior space is a combination of the sky component (direct and diffuse), the externally reflected component (ERC) and the internally reflected component (IRC) (Figure 2.1). This light penetrates into the buildings and eventually into the work surface. Before the light gets to the eyes, it has to pass through the atmosphere, be transmitted through the glazing and reflect off surfaces both externally and internally (Mabb, 2001).

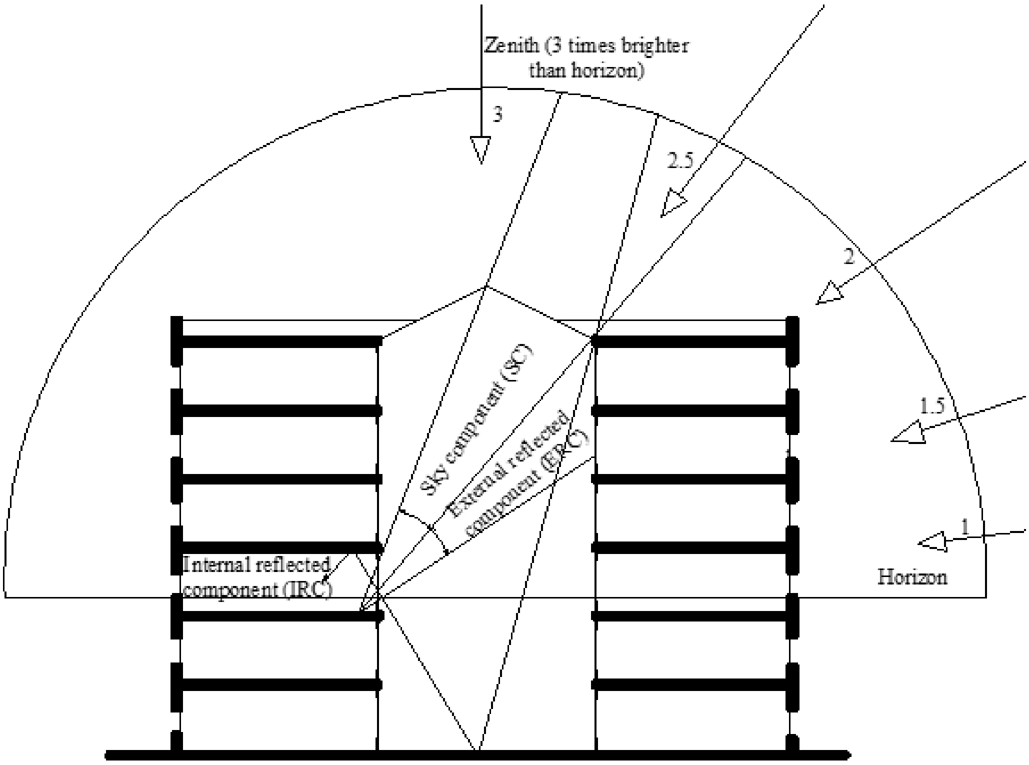



*Figure 2.1: The component of daylight at a point in a room (Baker, 2002; after Joarder, 2007).*

Sunlight penetration into the light well is different from normal buildings due to the vertical view through the glazing. As the sun's elevation rises, the light penetrates further into the light well but less into the adjoining spaces. As the solar elevation decreases the light penetrates further into the adjoining spaces on the upper levels but penetrates less in the well and the adjoining spaces on the lower levels (Figure 2.2) (Mabb, 2001).

Deep spaces in building, making possible free organization of functions spatially in commercial sectors, need proper daylighting not only because of potential energy savings in the buildings but also because of  higher standards for living and working environments (Kristl, 2000).

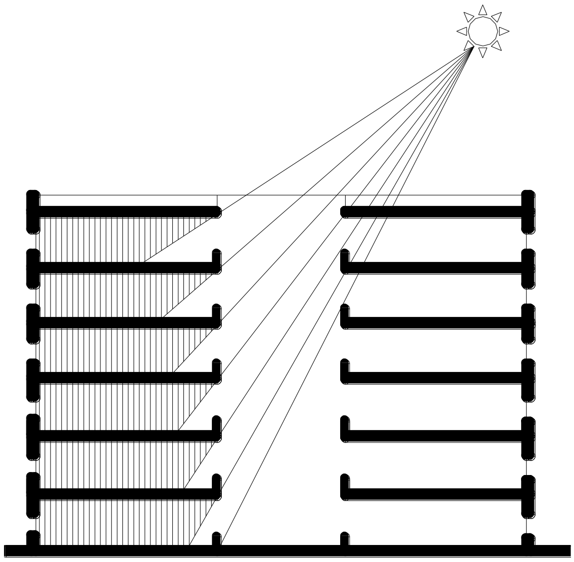


*Figure 2.2: Conceptual distribution of daylight through light well (Mabb, 2001).*

Deep spaces in building, making possible free organization of functions spatially in commercial sectors, need proper daylighting not only because of potential energy savings in the buildings but also because of higher standards for living and working environments (Kristl, 2000).

### *2.5.2 Industrial benefits of light wells*

Generally, daylighting has been comprehensively used for lighting purpose of industrial spaces. Earlier to the 1940s, incandescent light was the only everyday choice for factories and warehouses (McCowan et al., 2005).

In order to explore possible biological impact of the luminous environment reported health issues can be considered. Most of activities in the RMG factory are labour intensive, demands operating environment with adequate lighting for efficiency. Therefore it is necessary to maintain an excellent work environment for maximizing productivity (Hossain, 2013).

### *2.5.3 Physiological and psychological benefits of workers*

In Roman period, courtyard was used as central open area of the house. Now-a-days, light well is used as the central area of a building (due to the compactness of space) and the space is often covered or sheltered in commercial or public buildings (Fahmawee, 2013).

Daylighting is not only advantages of building with light well, it also improve the internal space on psychological aspect and reduce the use of artificial light (Fahmawee, 2013). In RMG the artificial lighting is not comfortable for working. Another case, natural lighting into the work spaces often act as medicine. Daylighting is the only source which provides vitamin-D and prevents grave disease, such as, cancer, diabetes, weight loss and help to absorb calcium (Joarder, 2009d). It is important to penetrate daylighting into the RMG building psychologically and physiologically, because it affords a very pleasant and hygienic atmosphere. Effective incorporation of light wells in deep plan RMG buildings can be a way to accommodate daylight to meet the visual, physiological and psychological needs of the workers (Kristl, 2000).

## 2.6 Different aspects of light well configuration

In determining the performance of daylighting, reflectivity, window area to aspect ratio, orientation of building, and the aspect ratio of the light well itself are essential aspects which affect the daylight conditions in the adjoining space of light well. There were three aspects that are considered affecting the illuminance of the rooms surrounding the light well: orientation of light well, area of light well, and reflectance of surrounding walls. Generally there have seen that increasing the reflectance of the surrounding walls, had a major effect in increasing the illuminance of the building (Ahmed et al., 2014).

### *2.6.1 Different types of light wells*

Light wells are popular among other options because it meets daylighting necessities, for energy saving and urban benefits of compact designed building. Light well can be one of the green design criteria with enough daylighting (Hung, 2003; Kristl et al., 1999).

Light well configurations can be defined by its number of sides that are enclosed by building mass, that determine the building form and shape (Yunus et al,. 2010). The configuration of the light well is determined based on the purpose of the interior space and the use of the building (Ahmed et al., 2014). The light well form is the crucial factor in the initial phase when deciding the daylight performance attribution. Internal, semi enclosed and attached types (Figure 2.3 to 2.7) are generally used as basic typological configuration of light well (Farea et al., 2012) and could be incorporated in RMG buildings without conflicting the RMG functions or workflow. These three types of light well configurations are described below.

**a. Internal light well**

Internal light well is located inside the buildings and surrounded on all sides by rooms or spaces (Figure 2.3). Internal light well usually came without any horizontal inlet such as corridor or void, instead they only depend on the indoor space which connected through the wall windows (Farea et al., 2012). Internal light well is the most common form of light well and used normally in deep plan buildings to allow natural light into the centre (Jaberansari, 2016).

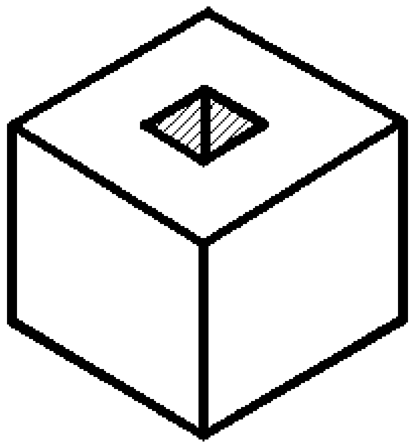


*Figure 2.3: Internal light well surrounded on all sides by rooms or spaces (Farea et al., 2012)*

**b. Semi-enclosed light well**

Semi-enclosed light well is a recessed cavity that is surrounded by rooms on two or three sides but open on at least one side (Figure 2.4 and 2.5). These types of light wells are also common especially in deeper plans. The benefit of the semi enclosed light well is that it provides significant amount of lights from side openings (Farea et al., 2012). Semi-enclosed light well are of two types.

a) Semi-enclosed light well surrounded by rooms on three sides.

b) Semi-enclosed light well surrounded by rooms on two sides.

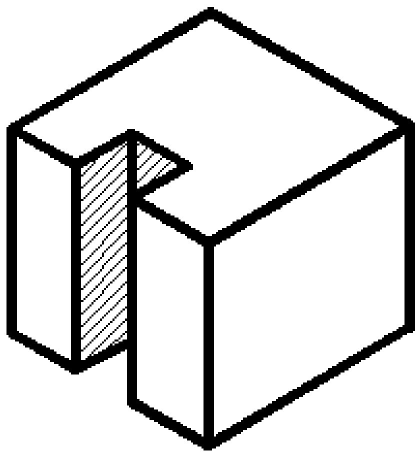


*Figure 2.4: Semi-enclosed light well surrounded by rooms on three sides (Farea et al., 2012)*

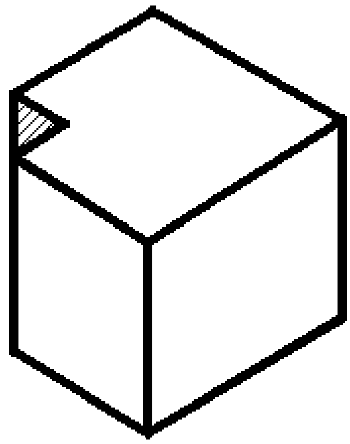


*Figure 2.5: Semi-enclosed light well surrounded by rooms on two sides (Farea et al., 2012)*

**c. Attached light well**

Attached light well remains attached at the perimeter of the building (Figure 2.6 and 2.7). Therefore one or two sides of the light well is enclosed by perimeter wall or a corridor (Farea et al., 2012). Single sided vertical voids have been used usually in temperate climate often with a glazed facade in order to have more solar heat gains in winter time as well as great views during rest of the year, while internal vertical voids seem to be used mostly in hot and humid climate (Jaberansari, 2016). Attached light well are of two types.

a) Attached light well enclosed by one perimeter wall

b) Attached light well enclosed by two perimeter wall

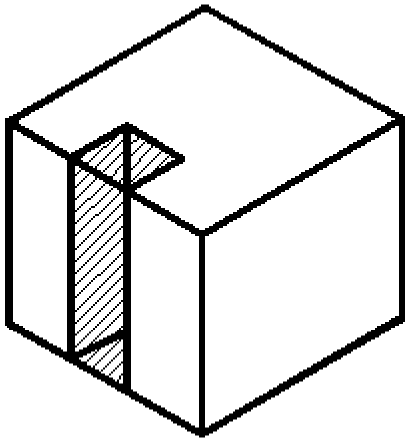


*Figure 2.6: Attached light well enclosed by one perimeter wall (Farea et al., 2012)*

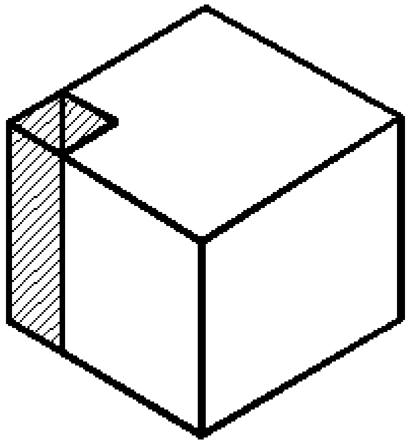


*Figure 2.7: Attached light well enclosed by two perimeter wall (Farea et al., 2012)*

### *2.6.2 Different shapes of light well*

According to Erlendsson (2014), the illumination condition of indoor space also depends on the shape of the light well. With changing the shape of a light well, the reflectivity of light within the light well is affected (Erlendsson, 2014). There are three basic shapes (i.e. square, circular and triangular) (Figure 2.8). The area of the light well walls also depends on the shape.

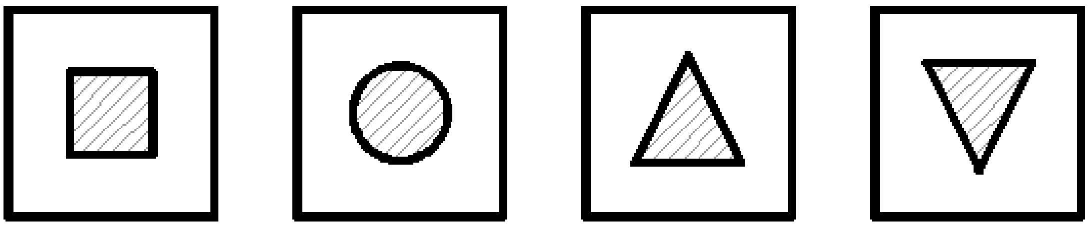


*Figure 2.8: The schematic plans considering three basic shaped light well configurations assigned for this study (Erlendsson, 2014).*

### *2.6.3 Ratio of building height and light wells*

How much effective light would be provided to adjacent area of light well, mostly depends on the ratio of width to height of light well and the reflectance of the opaque surfaces within the light well. The geometry and surface properties of the light wells govern the total light defeat. Light wells can decrease the amount of light incoming a space from as little as 10% to as much as 85% (A. G. S., 2000).

The most common shape of shallower, rectangular light well seemed brighter with abundant sunlight penetration on the light well floor (Yunus et al., 2010). The light well building design is now assess as one of the most popular and environmentally interesting spaces in architecture. Incorporation of light well in a building can be used to simulate the outdoors and to enter natural light and solar heat into the indoor space.

The proportion is an important factor to categorize a light well in a building. A low height light well building is brighter than a high height light well based building (Figure 2.9). Even a shallow light well with circular shape will be brighter than a deeper light well with rectangular shape (Figure 2.10). It is seen that when the cube shaped light well is doubled then it reduce the daylight factor at the light well floor from 34% to 29% (Yunus et al., 2010).

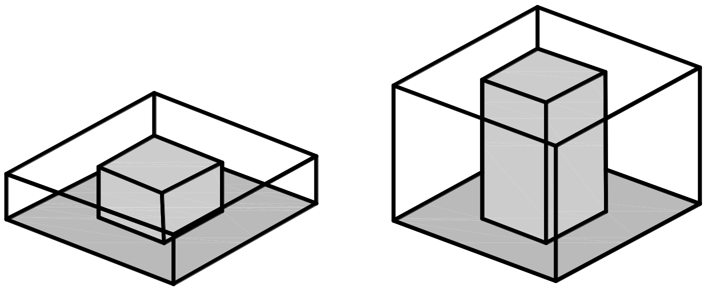


*Figure 2.9: A low light well base is brighter than a high light well which has a same plan (Yunus et al., 2010).*

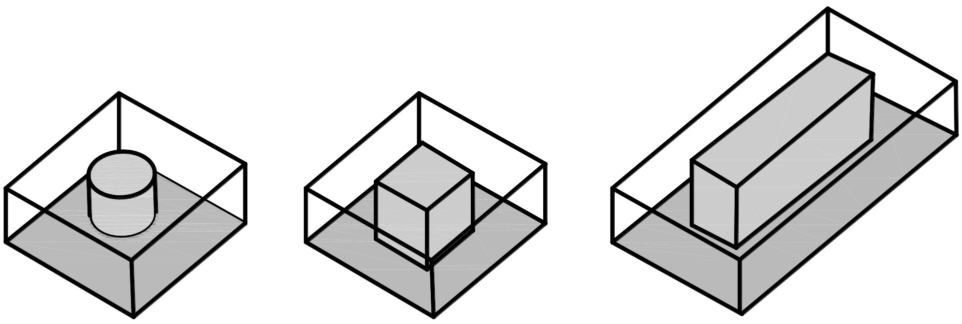


*Figure 2.10: A circular light well base is higher than a square one, which in turn is lighter than a rectangular one, assuming all three has a same roof aperture area (Yunus et al., 2010).*

The proportions of the light well and the reflective capacity of the enclosing wall surfaces are critical, and those light wells which are wide in relation to their height, will perform better than taller, narrower spaces in ensuring that daylight reaches the lower levels (Phillips, 2004).

## 2.7 Light well configuration standards

Studying previous research and published resources, standards of light well configurations are discussed in this section.

### *2.7.1 Orientation of light wells*

An essential characteristic of light well design is orientation to the sun and its consequence on building use and occupant comfort. In 1993, Kainlauri studied four university buildings with light well of different orientations: North-South, East-West, South-East and South-West exposures. Depending on the orientation, the light well obtains direct sunlight in massively different quantities from different directions during the day and the season. In the time of noon in a light well opening to a southerly direction happens at a certain time, varying only by an hour because of daylight saving time. Depending on the sun angle and direction, the walls and the floors of the light well are exposed to direct sun radiation for varying amounts of time and intensity. On cloudy days, dark and bright times will alternate, sometimes vary fast, and on overcast days, sky light provides a steadier and uniform daylighting condition. The wide range of sometimes fast changes in the amount of solar radiation results in one of the most serious control problems for HVAC systems, which can only be alleviated by use of various external or internal louvers, filters, and shades, combined with a suitable selection of glare-reducing glass. The orientation of the light well should be carefully selected with regard to the anticipated use of the building and its varying daily and seasonal purposes (Kainlauri, 1993).

### *2.7.2 Light well glazing*

The application of glazed materials at the light well would make the temperature of the light well higher than the ambient throughout the year. For winter time, it is so beneficial that the heating load can be reduced but, it may be problematic in the summer time, overheating may be happened. By increasing the glazing areas in the internal surface of the light well, air temperature in light well would be slightly increased in winter whilst that in adjacent building would be increased in summer. Undesired situations could be diminished by varying the transparent area according to the heat gain received by the light well internal surface. Shading device and putting glazed area at lower levels can be considered for this purpose (Hung, 2003).

Generally, the structure reduces the transmission by 10%, while single glazing reduces it by a further 10%. The proportion of glazing between the light well and its adjoining spaces effects the light penetration further into the well and the spaces (Mabb, 2001). Contemporary glazed light well provide exciting views. Even landscaped light well without glazed facade provide a sense of connection to the outside world (Tabeshi et al., 2015). Triple glazing has lower heat loss but reduces daylight transmittance meaning windows need to be bigger for same effect (Table 2.6) (Robertson, 1999).

*Table 2.6: Visible light transmission/solar heat gain coefficient (%) (Robertson, 1999)*

| Glazing system (6mm glass) | Clear | Blue-green | Grey | Reflective |
|---|---|---|---|---|
| **Single** | 89/81 | 75/62 | 43/56 | 20/29 |
| **Double** | 78/70 | 67/50 | 40/44 | 18/21 |
| **Double, hard low-e, argon** | 73/65 | 62/45 | 37/39 | 17/20 |
| **Double, soft low-e, argon** | 70/37 | 59/29 | 35/24 | 16/15 |
| **Triple, hard low-e, argon** | 64/56 | 55/38 | 32/36 | 15/17 |
| **Triple, soft low-e, argon** | 55/31 | 52/29 | 3026 | 14/13 |

Light well glazing often permits the inhabitants to view the sky and therefore having a connection to the external environment. The type, shape and position of the glazing can vary the daylight penetration in the light well dramatically. Frames, shading and external obstructions also affect the amount and the direction of the daylight

(Sharples, 1999). Admitting as much diffuse skylight, while minimizing the direct solar gain is the design requirement for most light well glazing (Mabb, 2001).

### *2.7.3 U-Value of light well glazing*

The annual cooling energy ratio decreased with decreasing the Solar Heat Gain Coefficient Ratio (SHGCR) and with increasing the U-value ratio (UR) (Tabeshi et al., 2015).

When roof lights across a roof of light well are the same, they must have a U-value of 2.2W/m$^2$K or better to achieve the average U-value requirement (Table 2.7). If the roof lights differ on a single roof, it would be acceptable for some roof lights to have insulation values as poor as 3.3W/m$^2$K, but the average (on an area weighted basis) must still be 2.2W/m$^2$K. So if some roof lights are poorly insulated, other areas have to be better, to keep the average insulation values constant. This flexibility is not relevant where all roof lights are the same. The requirement of 2.2 W/m$^2$K applies to the average insulation value of the entire roof light after allowing for the effect of any glazing bars, kerbs or other thermal bridges. This requirement will never be achieved by double skin plastic roof lights, but will usually be achieved by the use of triple skin roof light assemblies (NARM, 2009).

*Table 2.7: U-Value standards (NARM, 2009).*

| Element | Area-weighted average (w/m$^2$.k) | For any individual element (w/m$^2$.k) |
|---|---|---|
| **wall** | 0.35 | 0.70 |
| **Floor** | 0.25 | 0.70 |
| **Roof** | 0.25 | 0.35 |
| **Windows, roof lights, curtain walling** | 2.2 | 3.3 |

### *2.7.4 Light well glaze area (% ratio of floor area)*

Increasing the access to the sky within a light well, by making the light well wider at its top than at its base, was found to have dramatic effect on the daylight autonomy on all floor plans within the building. Doing the opposite, i.e. making the light well narrower at its top than at its base resulted in much lower levels of daylight. A light well with a variation of forward leaning and backward leaning light well walls therefore had very uneven distribution of daylight depending on the slope of the light well wall (Erlendsson, 2014).

Daylight was found to converge at glazing-to-wall ratios (GWR) set to 65% – 75%, and gradually decrease with higher GWR, due to a reduction in reflected light within the light well (Erlendsson, 2014). Varying the ratio of glazed to opaque material within the light well, by increasing the reflective surfaces in the upper part of the light well, resulted in better daylighting at lower floors. Combining these solutions with glazing with higher light transmittance also resulted in noticeable increase of daylighting (Erlendsson, 2014).

### *2.7.5 Visual comfort*

For deep planned building, light well is an effective way to provide visual comfort as well as to save energy, in where the void space can bring daylight into the interior space spatially in the central space rather than solid slab by slab building design (Ahmed et al., 2014; Kristl, 2000). Generally, good visibility is defined by an adequate quantity of light for the expected visual task, uniform distribution of illuminance and luminance, sufficient directionality to model three-dimensional objects and surfaces (direction of incident light from the side or from above), the absence of glare, and sufficient spectral content to render colors accurately when required. Poor visibility and visual discomfort may result if the eye is forced to adapt too quickly to a wide range of light levels. Daylight can have health effects on skin, eyes, hormone secretions, and mood (IEA, 2000).

Daylight, essentially needed to aid in the visual comfort of the occupants of a building. Contact with the outside world regulates the body's clock, benefits the metabolism and balances the hormone levels. The creation of healthier, brighter and more enjoyable working conditions can improve productivity by reducing fatigue. Too much direct light can cause uncomfortable glare. Reducing the transmission of the window through the use of advanced glazing or controlling elements can reduce glare conditions. Glare is the discomfort caused when the eye has extremely different light levels in the field of view at the same time. Glare can be caused directly, indirectly or by reflection. Direct glare can be caused from the view of a light bulb or the sun (Mabb, 2001).

## 2.8 Findings from literature review

a) The preferred illumination level at production space (sewing and cutting) work plane is 800 lux (Hossain and Ahmed, 2013). The illumination level 300 lux are considered as effective for task light source with or without artificial light for other spaces. Over 2000 lux is considered as discomfort and make glare which is undesirable for any work (Applefeld et al., 2011).

b) As the sun's elevation rises, the light penetrates further into the light well but less into the adjoining spaces. As the solar elevation decreases the light penetrates further into the adjoining spaces on the upper levels but penetrates less in the well and the adjoining spaces on the lower levels (Mabb, 2001).

c) The light well of a building is beneficial not only for increase daylight penetration in the core space of the building but also it can help to maintain natural ventilation, thermal comfort, a buffer space to reduce energy losses and consumption.

d) Internal, semi enclosed and attached shapes are generally used as basic typological configuration of light well (Farea et al., 2012) and could be incorporated in RMG buildings without conflicting the RMG functions or workflow.

e) According to Erlendsson (2014) the illumination condition of indoor space also depends on the shape of the light well. There are three basic shapes (i.e. square, circular and triangular).

f) A low height light well building is brighter than a higher height light well based building (Figure 2.9). Even a shallow light well with circular shape will be brighter than a deeper light well with rectangular shape (Figure 2.10) (Yunus et al., 2010).

g) When all the roof lights across a roof of light well are the same, they must have a U-value of 2.2W/m$^2$K or better to achieve the average U-value requirement.

h) Daylight autonomy was found to converge at glazing-to-wall ratios (GWR) set to 65% – 75%, and gradually decrease with higher GWR, due to a reduction in reflected light within the light well.

## 2.9 Summery

This Chapter has accomplished the first objective by illustrating the importance of light well as one of the strategies of daylighting focusing on environmental, industrial, psychological and physiological benefits for workers. Affording to the scope of this thesis, aspects of light well configurations, national and international standards for illumination levels for RMG buildings have been discussed in this chapter based on previous studies and research. The information presented in this chapter will help to identify issues based on which methodology for simulation study has been developed in next Chapter 3.

# CHAPTER THREE: METHODOLOGY

Preamble

Methodology

Summary

# CHAPTER THREE: METHODOLOGY

## 3.1 Preamble

The Second Chapter discusses the outcomes of the literature review to define the basic information helped to justify the methodology for simulation. This Chapter includes the detail steps of the methodology for simulation analysis. By using lighting simulation tool (i.e. DAYSIM), the amount of daylight and its quality can be identified. From the point of view of useful daylight inclusion, the performances of the different available light well configurations have been assessed in this Chapter.

The outcomes of the Chapter 2 justify assessing the performance of three basic types of light well configurations and three different shapes of experimental exercise**.** This Chapter consists of the method of simulation tool selection, selection of case RMG building, and different parameters for the case RMG building that have potential for daylighting analysis. The next chapter will compare the annual simulation results of different light well configurations in terms of some daylight metrics (DA, $DA_{max}$ and UDI), based on the recommended methodology which have been developed in this Chapter.

## 3.2 Methodology

In this research, simulation study was fixed to identify the design parameters and light well configurations which can improve the quality of indoor luminous environment of RMG buildings. At first, field investigation and physical survey were done to fix the case RMG building and the micro climatic data of the building was studied in detail. Then simulation tools ware selected for measuring the performance of available light well configurations. Later, a comprehensive and innovative building analysis software ECOTECT V5.20 which is a highly visual, architectural and analysis tool (Crawley et al, 2005) was used as the modelling interface to develop the 3D-case RMG building based on the field survey data and also required to launce DAYSIM program, a dynamic annual Climate-Based Daylight Modelling (CBDM) simulation tool. After selection of the core sensor points and work plane height, measuring criteria was developed for the evaluation of performance metrics of studied light well configuration. The flow diagram of the methodology is shown in figure 3.1.

a. Studying the micro climate of the geographical location of RMG building for simulation.

b. Selection of simulation tools and simulation parameter for measuring performance of available light well configuration.

c. Field survey and selection of RMG building.

d. Creation of 3-D model based on selected RMG building.

e. Import the 3d model and climate data of the building site into the simulation program for both static and dynamic daylight simulation.

f. Selection of core points on work plane height and simulation parameters.

g. Identifying the metrics (DA, $DA_{max}$, and UDI) for daylight simulation performance

h. Transform the simulation result into performance measure.

i. Compare performance measure for different available light well configuration of RMG building.

**Effective light well configuration (based on types and locations of light wells) of RMG building.**

j. Experimental parametric study of the suitable light well configuration (repetition of process h and i).

**Effective light well configuration (based on shapes of light wells) of RMG building.**

k. Experimental parametric study of the suitable light well configuration (repetition of process h and i).

**Best possible parametric configuration of the suitable light well.**

*Figure 3.1: Diagram of the simulation process. (after, Joarder 2011).*

### *3.2.1 Microclimate of Dhaka city*

The city of Dhaka lies between 90º20'E - 90º30'E and between latitudes 23º40'N - 23º55'N. Modification of urban climate level varies from city to city, spatially it depends on the size and site of a city, land use pattern, structure and density of buildings, industry, traffic and other actions. The climatic appearances of Dhaka city vary from other cities for its location and physical growth. Even, these appearances may vary within the same city in different locations. This is happen because of density of built environment, building types, height and orientations, proximity between buildings, surface quality of the area ( hard or soft), building materials, electrical and mechanical appliance and other related issues. The climatic condition of Dhaka is tropical and significantly influenced by Himalayan Mountain, Tibet plateau in the north and the Bay of Bengal located in the south. It has a distinctive monsoonal season, with an annual average temperature of 25.7°C and monthly means varying between18.4°C in January and 28.4°C in April. Dhaka city has mainly three distinctive seasons - the hot dry (March-May), the hot humid (June-November) and the cool dry season (December-February) (Appendix C5, C6) (*data from 1961-2016, Bangladesh Meteorological Department (BMD), Dhaka, 2016*).

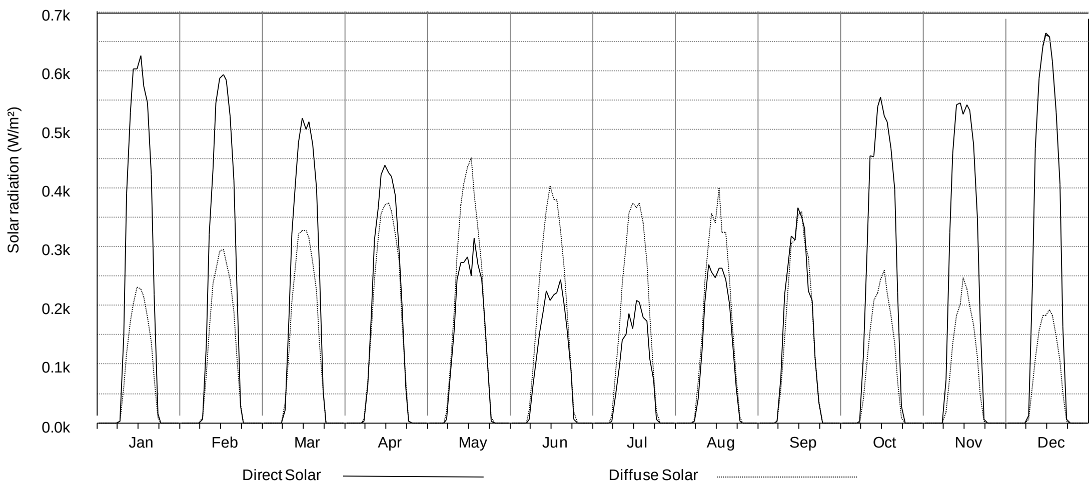



*Figure 3.2: Hourly solar radiation averaged by month for TRYs, Dhaka (source: U.S. Department of Energy, 2008, after Joarder, 2007).*

Usually the summer is long and wet and the cool dry season is short. January is the coldest month with average temperature vary from 16.2ºC to 19.8ºC and April is the hottest month with average temperature vary from 25.9ºC to 30.7ºC (data from 1961-2016, BMD, Dhaka, 2016). Although overheating is the major problem of Dhaka city, it is due to some associated factors. For example, it is observed that from March to May remain high air temperature associated with high solar radiation (Joarder, 2007) (Figure 3.2).

From June to October there is high humidity with high air temperature. From March to May can potentially moderate the overheated situation, minimizing the impact of solar radiation, while from June to October can contribute to minimize the over-heating condition, maximizing wind flow. This is the overall climatic condition of Dhaka city related with basically thermal environment (Table 3.1) (Joarder et al, 2013, Joarder, 2007).

The luminous environment of the city is related to the duration of sunshine hours and sky condition. These two major climatic features define the quality and quantity of daylight which are discussed below.

*Table 3.1: Climate data of Dhaka (Data source: BMD, 2016; Appendix C1, C2, C3, C4, C6, C7, C8 and C9).* .

| **Climatic period** | **Hot-dry** | **Warm -humid** | **Warm -humid** | **Cool-dry** |
|---|---|---|---|---|
| Month | Mar-may | Jun-Sep | Oct-Nov | Dec-Feb |
| Climatic Factors | | (Monsoon) | (Post-Monsoon) | (Winter) |
| Air temperature (ºc) | | | | |
| a .Maximum | 39.0°C | 36.1°C | 36.0°C | 34.0°C |
| b. Minimum | 18.2°C | 22.8°C | 17.6°C | 10.0°C |
| c. Average | 26.8°C | 28.6°C | 25.8°C | 20.1°C |
| RH (%) | 68.33 | 79.00 | 73.50 | 67.67 |
| Rainfall (mm) | 107.33 | 231.50 | 50.50 | 5.33 |
| Sunshine hours | 6.8 | 4.4 | 6.2 | 5.3 |
| Cloud cover (octa) | 4 | 6.3 | 3 | 1.3 |
| Wind speed | 3.0 | 2.4 | 2.25 | 2.4 |
| Wind direction | S | S, E | W, NE | W |

### a. Sunshine hours and sun path diagram

Latitude and weather pattern influence daylight accessibility in any location. In winter, Dhaka remains sunshine more than eight hours per day. But during monsoon period (warm-humid season), due to cloud cover, this comes down to four hours per day. But after June and July this again increases progressively (Joarder et al, 2013; Joarder, 2007).

During the months of July to November, the climatic condition remains cloudy. Thus, in this period, the diffused elements of daylight are significantly high and the variation in sunshine is wide in that times. Figure 3.3 shows the sun path diagram of Dhaka. Bangladesh.

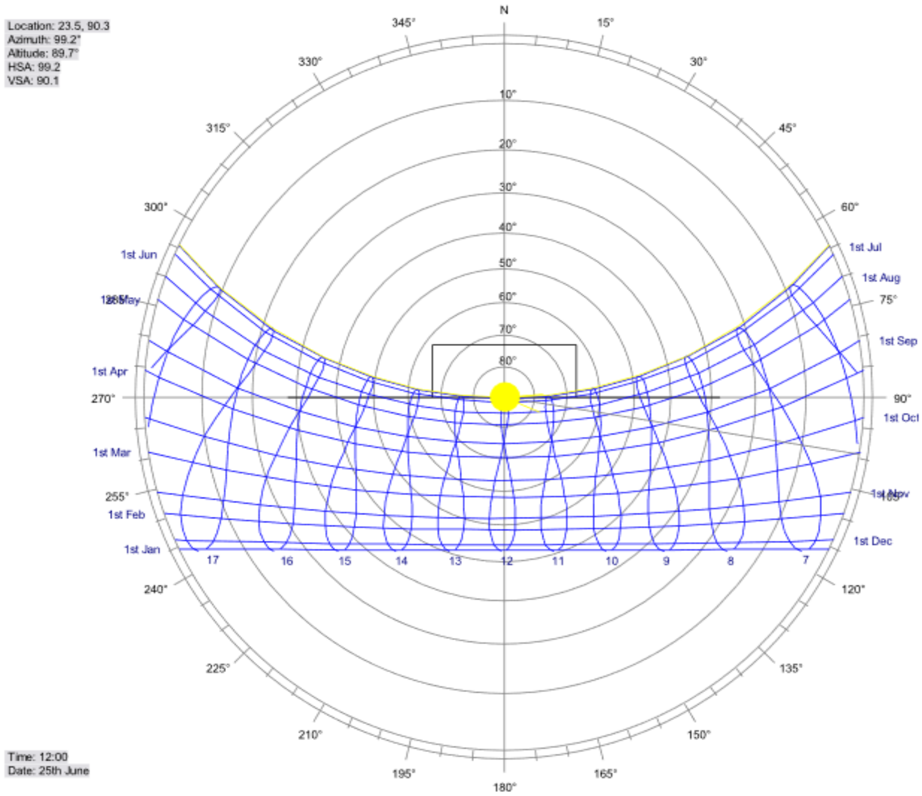



*Figure 3.3: The sun path diagram of Dhaka, Bangladesh (Source: SUNTOOL - Solar Position Calculator, 1998, after Joarder, 2007).*

**b. Sky condition**

Direct sunlight is intense and varies considerably as the sun’s position changes throughout the day (up to 1,00,000 lux). Daylight from a clear sky can be 10 to 25% of the intensity of direct sunlight (10000-25000 lux). Daylight under partly cloudy conditions can vary largely; daylight under full overcast environments can be 5 to 10% of sunny environments (5000-10000 lux).

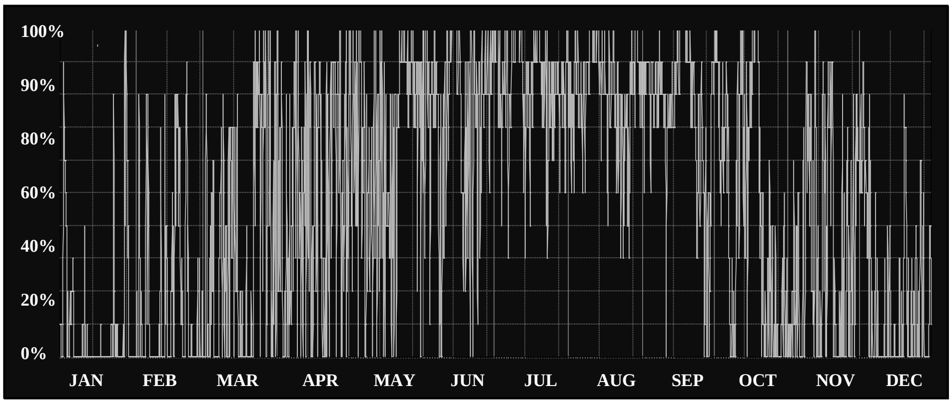



*Figure 3.4: Cloud cover for Test Reference Years, Dhaka. (Source: U.S. Department of Energy, 2008)*

In context of Dhaka city, the sky remains clear and overcast in different parts in different seasons (Figure 3.4). During summer (Hot dry), the sky remains both clear (sunny with sun) and overcast. During the winter (December-February) the sky remains mostly clear. While during the rest of the year, both clear and overcast conditions are observed (Joarder 2009a: 2009c). Table 3.2 shows the sky condition of Dhaka city with respect to cloud cover for Test Referance Year (TRY).

Figure 3.5 shows the relationship of monthly average cloud cover and monthly average sunshine hours in Dhaka (Source: Bangladesh Meteorological Department, Dhaka, 2016) (Appendix C1 and C2).

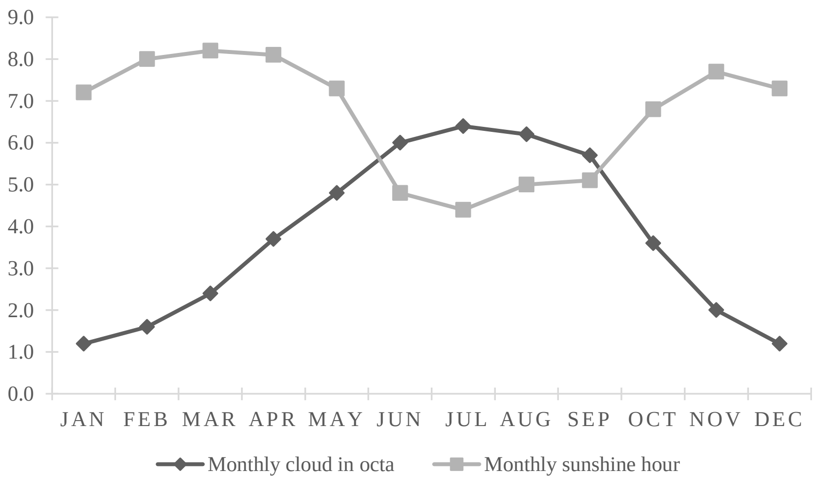



*Figure 3.5: Monthly average cloud cover and monthly average sunshine hours in Dhaka (Data source: BMD, 2016).*

*Table 3.2: Sky condition with respect to cloud cover over a year. (Source: Climatic Division, Bangladesh metrological department, Dhaka, 2005).*

| **Type of sky** | **Pre-Monsoon (March-May)** | **Monsoon (Jun-Sept)** | **Post-Monsoon (Oct-Nov)** | **Cool Dry (Dec-Feb)** | **Total (day)** |
|---|---|---|---|---|---|
| **Clear sky** | 62 | 38 | 39 | 77 | 215 |
| **Overcast sky** | 30 | 84 | 22 | 14 | 150 |
| **Total sky** | 92 | 122 | 61 | 90 | 365 |

As the city of Dhaka consider composite climate, where both clear sky, overcast and partly overcast skies observed round the year (Figure 3.6), and designer face difficulties (Ahmed, 1987). The two conditions are quiet contrasting to each other. In such circumstance, the overcast sky which presents more critical condition, so, designer should fulfil good lighting measures under overcast conditions for daylighting (Joarder, 2007).

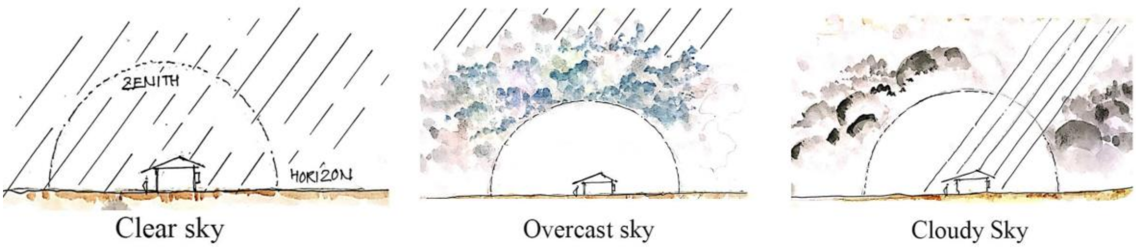



*Figure 3.6: Sky condition of Dhaka city (Source: Hossain, 2011)*

### c. Design skies

In temperate climate, most of the researchers agree that design for daylight should be considered for a 'design sky'; not the poorest condition possible, as this would be unrealistic, but for a situation when illumination is exceeded for about 85%-90% of the daylight hours. By statistical evaluation of long-term illumination records a 'design sky' illumination value can be established for a particular location. Suggested values for 'design sky' in the different latitudes are given in Table 3.3. In lower latitudes the sky being much brighter than in the higher latitudes. Published data on outdoor design sky illumination specifies a value of approximately 10,000-12,000 lux for Dhaka latitudes. This figure represents the outdoor illumination that is bettered 85% of total daylit hours in this location (Joarder, 2007).

Considering warm-humid climate, Dhaka shows that for reduced eight hour time frame, an average of about 16,500 lux can be considered as outdoor design sky illuminace (Khan, 2005; cited from Joarder, 2007). In this research, the outdoor illumination value assumed as 16,500 lux and static daylight simulations are based on this value.

*Table 3.3: Illumination from a design sky on a horizontal unobstructed surface on different latitude and solar altitude (Evans, 1980, after Joarder, 2007).*

| | |
|---|---|
| Suggested values for overcast sky | |
| **Latitude 50°-60°** | 5,000 lux (lumen/m$^2$) |
| **Latitude 40°-50°** | 5,000-6,000 lux (lumen/m$^2$) |
| **Latitude 30°-40°** | 5,000-8,000 lux (lumen/m$^2$) |
| **Latitude 20°-30°** | 8,000-10,000 lux (lumen/m$^2$) |
| **Latitude 10°-20°** | 10,000-15,000 lux (lumen/m$^2$) |
| Suggested values for overcast sky | |
| **All latitude** | 5,000 lux (lumen/m$^2$) |
| **Solar altitude 15°** | 14,000 lux (lumen/m$^2$) |
| **Solar altitude 30°** | 36,000 lux (lumen/m$^2$) |
| **Solar altitude 45°** | 58,000 lux (lumen/m$^2$) |
| **Solar altitude 60°** | 75,000 lux (lumen/m$^2$) |
| **Solar altitude 75°** | 83,000 lux (lumen/m$^2$) |
| **Solar altitude 90°** | 94,000 lux (lumen/m$^2$) to 110,000 lux (lumen/m) |

### d. Air Temperature

The air temperature of Dhaka city (1961-2016) based on meteorological data have shown in Figure 3.7, which shows the Monthly Mean Maximum and Minimum air temperature profile.

The monthly maximum average temperature in pre-monsoon season (highest temperature at 37.8°C in April) was higher than other season (Figure). Alternatively, January shows the coldest month in Dhaka city (1961-2016). In 2016, 24$^{th}$ April (39.0°C) was the hottest day and 27the January (10.0°C) was the coldest day (BMD, 2016).

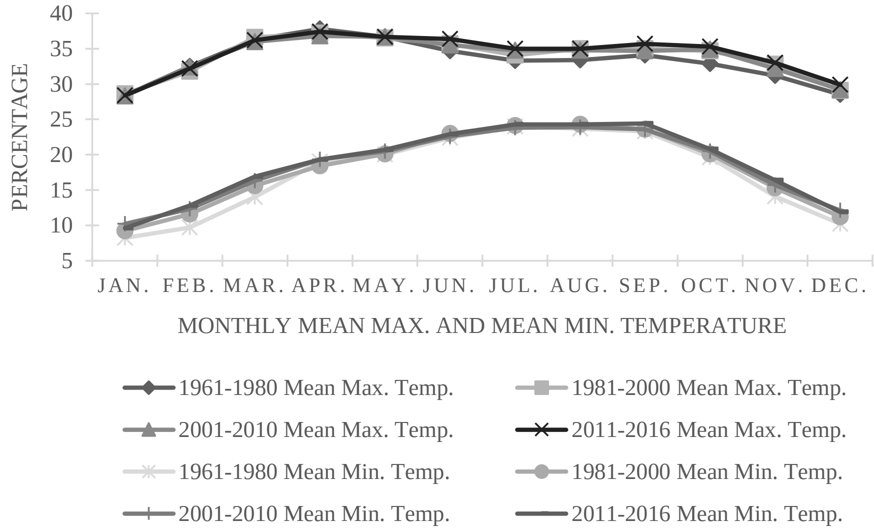



*Figure 3.7: Monthly Mean Maximum and Minimum air temperature profile for the year 1961-1980, 1981-2000, 2001-2010 and 2011-2016 (Data source: BMD, 2016).*

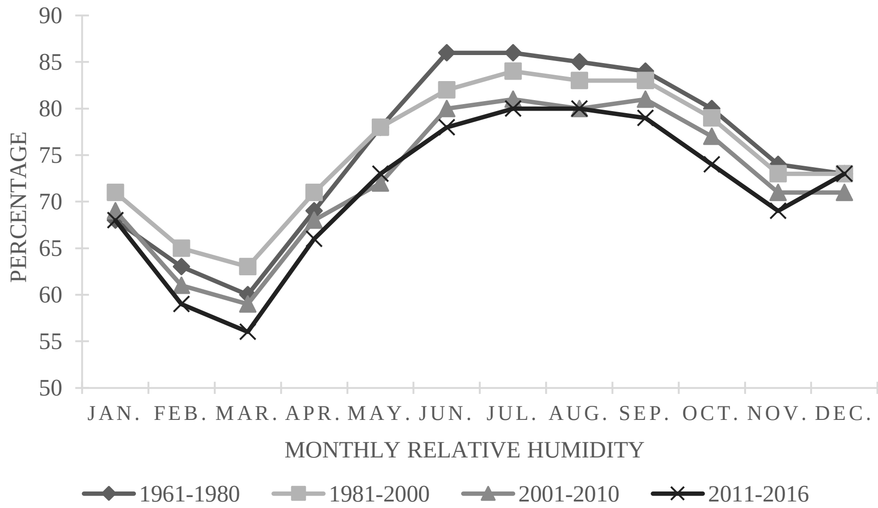



*Figure 3.8: Monthly Relative Humidity profile for the year 1961-1980, 1981-2000, 2001-2010 and 2011-2016 (Data source: BMD, 2016).*

**d. Relative Humidity:**

The relative humidity depends on two factors, the air temperature and the presence of moisture in air. When air temperature increases, the relative humidity decreases as the capacity of air to hold moisture increases, given that the moisture content of the air stays unchanged and if the temperature decreases the opposite occurs. Therefore relative humidity has an inversely relationship with the air temperature, the relative humidity increases when the moisture content of the air increases and the relative humidity decreases when the moisture content of the air decreases (Koenigsberger, 2003, after Ahsan, 2017). Relative humidity is relatively highest in the monsoon (June to September) and moderately low in the winter seasons (December to February) (Figure 3.8).

*Table 3.4: Monthly mean wind speed and direction in Dhaka city (Data source: BMD, 2016).*

| **Month** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Season** | **Hot-Dry (m/s)** | | | **Hot-Wet (m/s)** | | | | | | **Cool-Dry (m/s)** | | |
| | **Pre monsoon** | | | **Monsoon** | | | | **Post monsoon** | | **Winter** | | |
| **1961-1970** | 4.4 | 6.5 | 5.7 | 5.6 | 5.5 | 5.2 | 5.0 | 3.8 | 3.1 | 3.2 | 3.3 | 3.1 |
| **1971-1980** | 4.7 | 5.6 | 4.9 | 4.5 | 4.8 | 4.8 | 3.9 | 3.8 | 3.5 | 2.8 | 3.0 | 3.5 |
| **1981-1990** | 4.7 | 5.6 | 4.7 | 4.4 | 4.3 | 4.2 | 4.1 | 4.1 | 2.6 | 2.9 | 3.0 | 3.7 |
| **1991-2000** | 3.3 | 3.4 | 3.5 | 3.3 | 3.1 | 3.2 | 2.8 | 2.9 | 2.2 | 2.3 | 2.5 | 2.8 |
| **2001-2010** | 4.2 | 4.3 | 4.0 | 3.3 | 3.5 | 3.3 | 3.9 | 3.7 | 3.3 | 2.8 | 3.1 | 3.3 |
| **2011-2016** | 2.6 | 2.6 | 2.9 | 2.5 | 2.5 | 2.6 | 2.4 | 2.2 | 2.3 | 2.2 | 2.4 | 2.5 |
| **Direction** | S,NW,NNW, W | S,SW,SE | S,E, SE | S,SE | S.SE,SW | S,SE,S.E | SE, S,E,SW | SE, NE, NW, S, W, E | N.NW,NE,W | N, W, NW, NNW, E | NW, N,W | NW, N,S, E,W, NE |

### d. Wind speed

Air flow is significant thought for comfortable environment. Table 3.4 presents (Appendix C5) the meteorological data (1961-2016) was measured in open air and published for Dhaka city (BDM, 2016).The data (1961-2016) shows the wind speed in Dhaka city, is comparatively high in the monsoon period (June to September) where having the highest wind speed in June (5.6 m/s) and the prevailing wind direction is South easterly while the lowest wind speed is 2.2-2.3m/s in October to December and prevailing wind direction is North westerly during this month.

The prevailing wind speed in Dhaka city from the meteorological data (1961-2016), based on measurements in open locations shown in Figure 3.9.

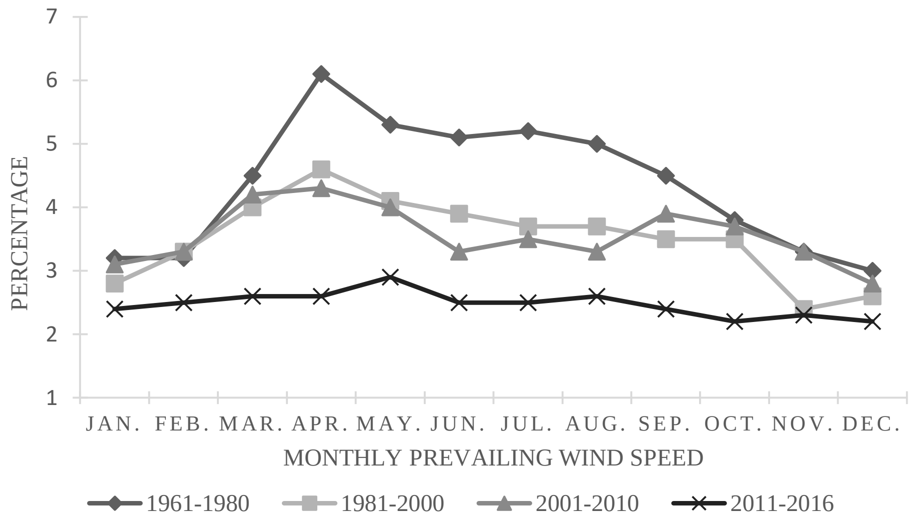



*Figure 3.9: Monthly prevailing wind speed profile for the year 1961-1980, 1981-2000, 2001-2010 and 2011-2016 (Data source: BMD, 2016)*

### *3.2.2 Selection of simulation tool*

It is difficult to simulate light-dependent industrial production spaces precisely, with available knowledge and simulation program. In market, there are many lighting simulation tools available. The Tools Directory of Building Energy Software (US-DOE, updated in August 12, 2014) listed 48 tools under the "lighting system" category, among them 21 were advertising daylighting as a key aspect ( Reinhart et al., 2007). The listed computer-based tools have different level of prediction accuracy and modelling capacities. For example LUMEN MICRO (Baty, 1996) and SUPERLITE (Modest 1982) can measure daylight under strict boundary limitations, whereas, some other software can measure complex model geometry and arbitrary environments, such as LIGHTSCAPE (Khodulev et al., 1996) and RADIANCA (Ward, 1998), with photorealistic rendering capacity to evaluate quality of lighting in 3D space. For the evaluation of the daylighting concept to ensure production benefit, a suitable simulation tool is required (Joarder, 2011), which

i. has high prediction capability for indoor daylight distribution;

ii. can model simple to complex geometry with surrounding environments; and

iii. can provide climate based daylight metrics as output (e.g. DA and UDI).

A backward ray tracing software package for lighting simulation RADIANCE, was validated for accurate prediction of the distribution of indoor daylight environments by many researchers, for example, Du, et al., (2009), Ibarra, et al., (2009), Bryan, et al., (2002) and Reinhart, et al., (2001). RADIANCE can predict light levels accurately; however, RADIANCE does not have any built-in-graphical interface to generate physical model. It is possible to use other software as modeling interface for RADIANCE, e.g. AUTOCAD and ECOTECT.

Among the RADIANCE based ray tracer, a limited number of software are able to calculate climate based metrics as final output, such as 3D SOLAR, GENELUX, LIGHTSWITCH WIZARD, S.P.O.T, LIGHT SOLVE and DAYSIM.

In this research, DAYSIM was selected for daylight simulation analysis which fulfilled the above mentioned three criteria as well. DA, UDI>2000, $DA_{max}$ above 5% and illumination on a specific point can be calculated by using DAYSIM simulation program. DAYSIM use RADIANCE (backward) raytracer combined with a daylight coefficient approach (Tregenza, 1983). DAYSIM considers Perez all weather sky luminance models (Perez, et al., 1990; 1993) and can afford more than 365 X 24 = 8760 hours data for each sensor point. DAYSIM have been validated comprehensively and effectively for daylighting analysis (Reinhart et al., 2009, after Iqbal, 2015).

### *3.2.3 Selection criteria of the case RMG building for simulation analysis*

The case RMG building has been selected based on the basis of some criteria for survey in order to investigate the visual quality of interior space of RMG factories in Dhaka region. The criteria for case RMG building selection were based on the following aspects.

a) The RMG factory should be enlisted with Bangladesh Garment Manufacturers and Exporters Association (BGMEA)

b) The RMG factory should have to be located within greater Dhaka region (e.g. Dhaka, Savar, Gazipur and Narayanganj).

c) The RMG building should be designed as a RMG (e.g. not converted or located in mixed used building) and built in accordance with the Building Construction Regulations of the concerned authority.

d) RMG building should have to be regular in shape and minimum complexity of design for effective daylight simulation.

e) Minimum width of the building has to be more than 20m, which will be difficult to be illuminated by vertical façade windows only and should have enough depth to incorporate light well space.

f) The building should not exceed six story in height and frame structured building is preferred.

g) The RMG building should have typical floor plan and should have designed with light well.

The case RMG building with two rectangular shaped light well was selected for primary investigation based on the above criteria. The survey covered a broad area through a physical observation about the physical characteristics of RMG building including ceiling heights, depth of building, window height and numbers, and other relevant features (Table 3.5).

Considering the mentioned selection criteria, the six storied Global Attire Ltd., Pathalia, Nolambaghbari, Mirjanagar, Savar, was selected as case RMG building for simulation study (Figure 3.10 to Figure 3.14). The case building have a 9m wide road as site access on the east side of the building which is the main access for the RMG building. The site is surrounded by cultivation lands on its three sides. Some single storied service buildings are situated at south-west corner and south side on the site (Figure 3.15). As the three sides are surrounded by cultivated lands, there is no obstruction and have opportunity of daylight exposure through sides of the building as well. For the simulation study, production space (92m X 52m) was selected, which is located at the 2$^{nd}$ floor of the building with 4.05m clear height and 8.4m high from ground level. These information will help in generating models in simulation studies and fixing simulation parameters.

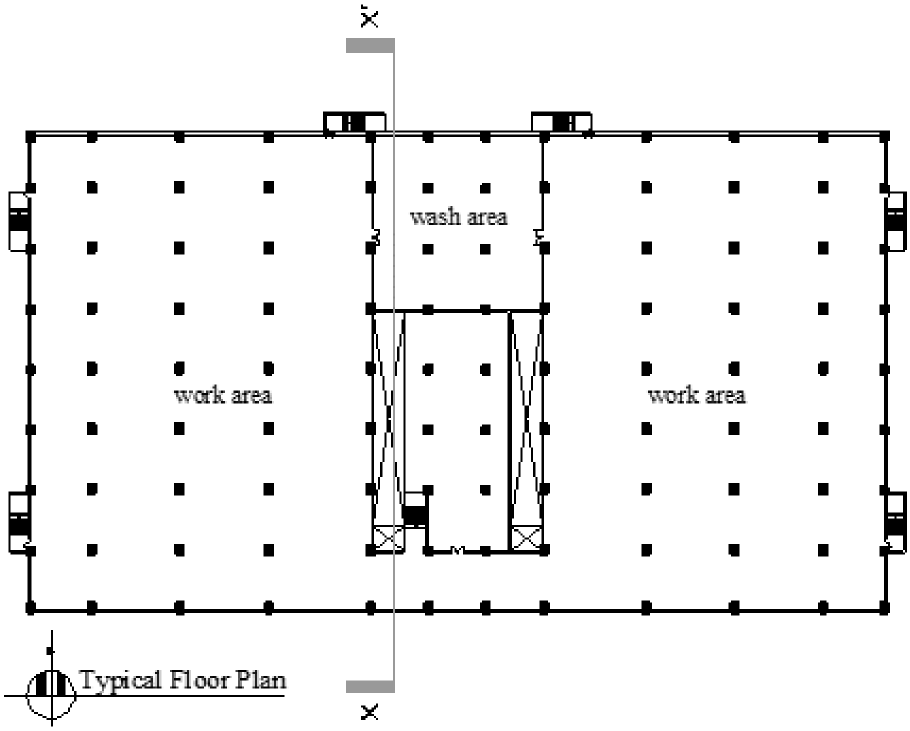



*Figure 3.10: Typical Floor Plan of surveyed RMG building*

*Figure 3.11: Present scenarios of RMG factories*


*Figure 3.12: Front side of the case RMG building*

*Figure 3.13: South elevation of the case RMG building*

*Figure 3.14: Light well of the case RMG building*

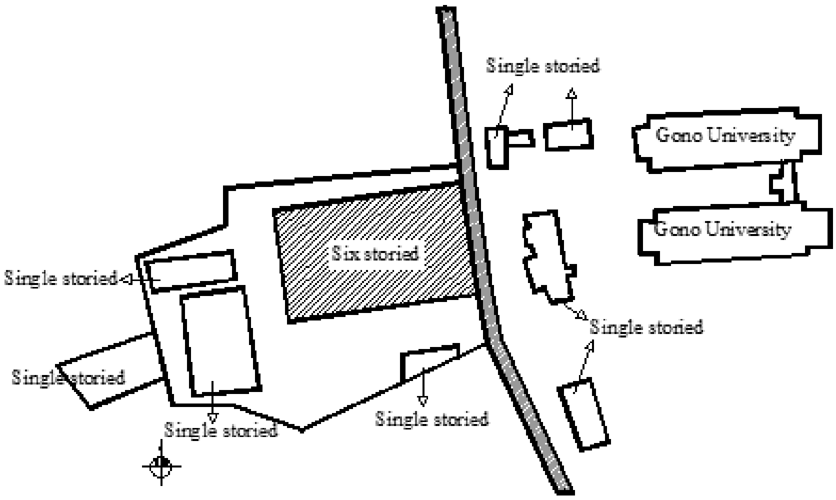



*Figure 3.15: RMG building site and surrounding area*

### *3.2.4 Formation of 3-d model of the case RMG for computer simulation*

For the simulation study, 2nd floor of the six storied Global Attire ready-made garment building located at 8.4m high from ground level was selected as the case space. The floor was 4,784 sqm (92m X 52m), which was located at 2nd floor of the building. The clear height of the floor was 4.05m and floor to floor height was 4.2m.

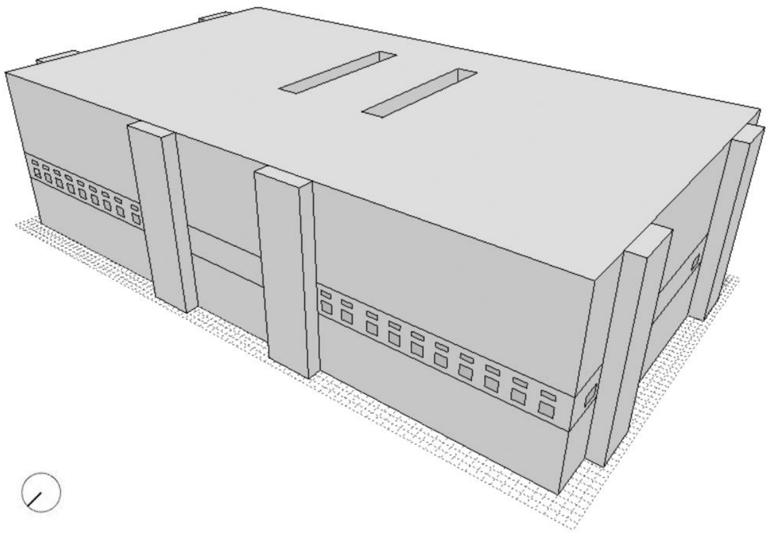


*Figure 3.16: 3-dimentional exterior view of the case RMG building*

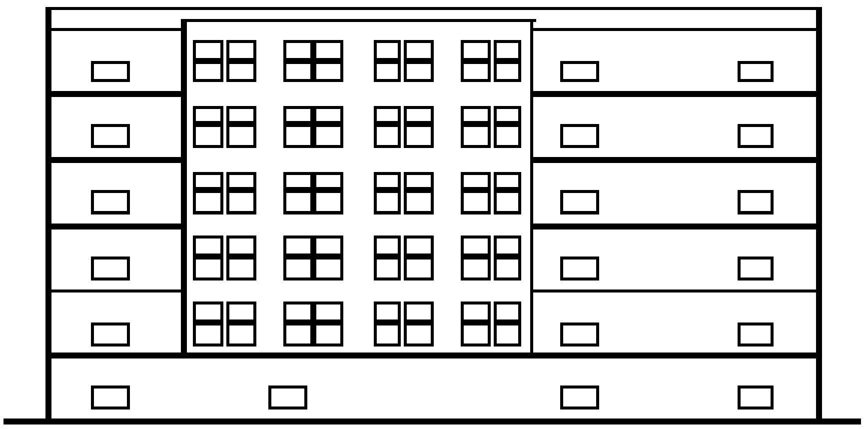


*Figure 3.17: Building Section XX through north-south direction (Section XX'; Figure 3.10).*

The shape of the case building is rectangular with typical floor plans. There are 37 nos of windows with 37 nos of high windows located in north and south directions; and 10 nos of windows located in east and west directions (Figure 3.16) at each floor.

There are two nos of light wells which are elongated towards north south direction having 28 nos of windows with 28 nos of high windows located in east and west directions at each floor (Figure 3.16 and Figure 3.17). A building section through north south direction shown in Figure 3.18. The outdoor and indoor conditions were kept constant as found during field investigation.

The simulation was done using same nos and sizes of windows, sill height, lintel height, work plane height, materials and surrounding which was found during field survey shown in Table 3.5.

*Table 3.5: Parameter of simulation modeling (found from Field survey)*

| **Sl. no.** | **Parameters** | **Specifications** |
|---|---|---|
| **1.** | Arrival time | 8:00am |
| **2.** | Departure time | 5:00am |
| **3.** | Total floor area | 28,704m2 |
| **4.** | Ceiling height | 4.05m |
| **5.** | Average height of interior partition walls | 4.05m |
| **6.** | Average height of work plane | 0.76m |
| **7.** | Total no of viewing windows | 84 no of windows at each floor |
| **8.** | Total no of high windows | 37 no of high windows at each floor |
| **9.** | Window size | 7.25sqm, 2.025sqm, 3.17sqm |
| **10.** | High window size | 0.9sqm, 2sqm |
| **11.** | Sill level | 0.7m |
| **12.** | Lintel level | 2.65m |
| **13.** | Effective window position | North and south direction |
| **14.** | External shading | Neglected for its non-effectiveness (0.25m) |
| **15.** | Floor finish | Homogenous tiles |
| **16.** | Wall finish | Plaster and plastic paint |

Different configurations of light wells were analysed to find out suitable material/space for light well perimeter walls or surroundings, light well positions, light well shapes and ratio of the volume of light well with respect to the volume of the building.

### *3.2.5 Identifying sensor points*

The entire floor was divided into grids, with reference to the structural grids, for simulation purposes. Through the middle of column grids, eleven axes in XX' direction (east-west) and eight axes in YY' (north-south) are intersected into 88 points. Sensors were located in the 88 intersection points, at work plane height (0.76m from floor level). Each intersection point of the grid was coded according to the number-letter system shown in the Figure 3.18 and presented in the Table 3.6.

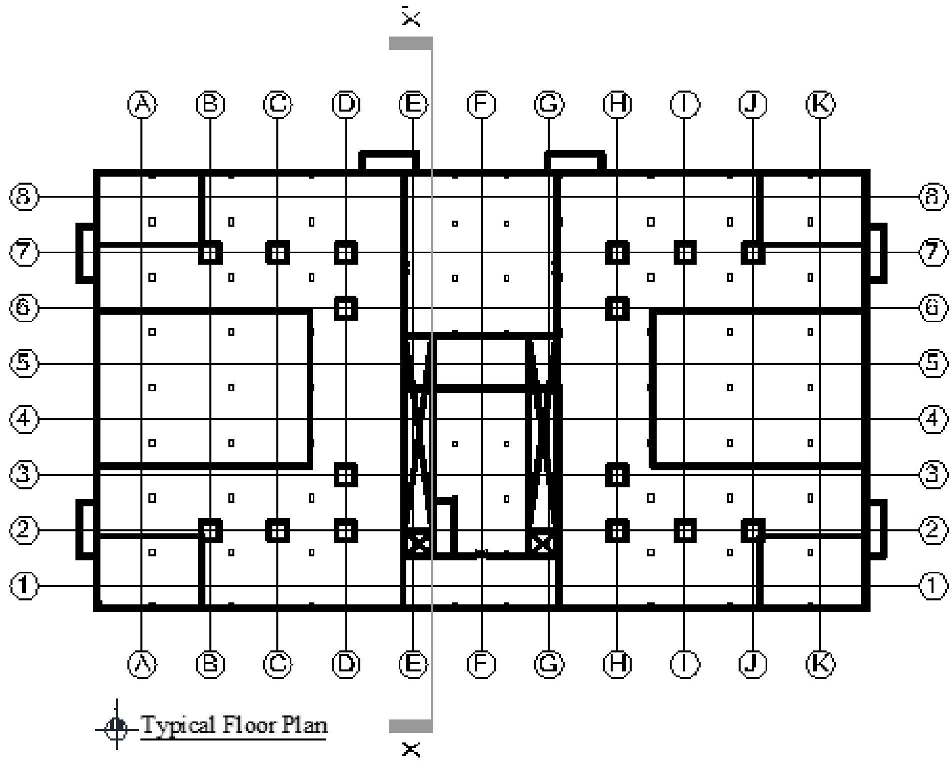



*Figure 3.18: Location of sensor points in the plan of case building.*

*Table 3.6: Codes with intersection points (88 nos.) for simulation study.*

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1A | 1B | 1C | 1D | 1E | 1F | 1G | 1H | 1I | 1J | 1K |
| 2 | 2A | 2B | 2C | 2D | 2E | 2F | 2G | 2H | 2I | 2J | 2K |
| 3 | 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I | 3J | 3K |
| 4 | 4A | 4B | 4C | 4D | 4E | 4F | 4G | 4H | 4I | 4J | 4K |
| 5 | 5A | 5B | 5C | 5D | 5E | 5F | 5G | 5H | 5I | 5J | 5K |
| 6 | 6A | 6B | 6C | 6D | 6E | 6F | 6G | 6H | 6I | 6J | 6K |
| 7 | 7A | 7B | 7C | 7D | 7E | 7F | 7G | 7H | 7I | 7J | 7K |
| 8 | 8A | 8B | 8C | 8D | 8E | 8F | 8G | 8H | 8I | 8J | 8K |

| |
|---|
| Visible Nodes 88 nos |
| Core sensor points 2B, 2C, 2D, 2H, 2I, 2J, 3D, 3H, 6D, 6H, 7B, 7C, 7D, 7H, 7I and 7J |

Sixteen sensor points was found common capable to show the daylight level that are not affected after placing different configurations of light wells in different locations in the case building (Figure 3.18). These sixteen points (2B, 2C, 2D, 2H, 2I, 2J, 3D, 3H, 6D, 6H, 7B, 7C, 7D, 7H, 7I and 7J) were considered as core work plane sensor points. The calculations consider Daylight Autonomy (DA), Maximum Daylight Autonomy ($DA_{max}$) and Useful Daylight Illuminance (UDI) metrics. Dynamic metric simulation can consider all possible sky models throughout the year. The overall illumination for each skylight types has been evaluated based on following criteria.

i. Annual average DA of the core sensor points
ii. Annual average illumination based on glare index ratio ($DA_{max}$) of the core sensor points
iii. UDI value of the core sensor points

### *3.2.6 Identifying the metrics for daylight simulation performance evaluation*

Annual dynamic daylight metric methods can be used to precisely compute time series of illuminance and luminance in buildings (Reinhart and Anderson, 2006; Reinhart, 2001; Reinhart and Walkenhorst, 2001; Mardaljevic, 2000), have been shown in current studies on daylight simulation. These time series can be used to compute annual dynamic daylight performance metrics e.g. DA and UDI to quantify the daylit quality of a given building design (Reinhart et al. 2006; Nabil and Mardaljevic, 2005), and annual energy savings from reduced electric lighting use.

**Annual Daylight Autonomy (DA)** is defined as the percentage of time over a year at which daylight can provide a given illuminance for a given point (Architectural Energy Corporation, 2006).

**Useful daylight Index (UDI)** is defined as providing ambient light at the work plane at illuminance levels between 100 lux to 2,000 lux (9fc to 185fc). Above 2,000 lux, heat gains and glare become potential problems. Potential UDI metrics give thresholds using bins (too low, useful, and too high) for certain percentages of the work plane (EDR, 2017). Below 100 lux is not considered as visible light and working light. It provides full credit only to value between 100 lux and 2000 lux as useful daylight illumination range. And above 2,000 lux range are not useful. 2000 lux is the extreme level, above which daylight is not wanted because of potential glare or overheating.

**Maximum Daylight Autonomy ($DA_{max}$)** is an incremental summing method that uses a maximum illuminance bound instead of a minimum. It is used as indicator of glare or unwanted heat gains. The threshold typically is ten times the illuminance criterion, though this value is not grounded in a specific glare or heat gain study (EDR). For example, if 300 lux is the threshold than over 300 X 10 = 3000 lux will be counted as $DA_{max}$ must not exceed 1% for more than 5% of a critical working plane area (CHPS, 2006).

### *3.2.7 Defining a time-basis and other simulation parameters*

Static and Dynamic simulation was done considering the actual building material properties in the 3-d model with surroundings, found during physical survey (Table 3.7) of the case RMG building (Global Attire limited, Savar).

*Table 3.7: Material properties from field survey.*

| Building elements | Material description | Material properties |
|---|---|---|
| **Ceiling** | Metal insulated with aluminum fuel paper | 80% diffuse reflectance |
| **Walls** | Brick with plaster, either side | 70% diffuse reflectance |
| **Floor** | Net cement finishing | 40% diffuse reflectance |
| **Window** | Single glazed low-e aluminum frame | 90% visual transmittance |
| **Furniture** | Plywood | 60% diffuse reflectance |
| **Mullions** | Aluminum | 50% diffuse reflectance |
| **External ground** | Grass | 25% diffuse reflectance |
| **Light well** | Single glazed low-e aluminum frame | Transmission: 90%<br>Pollution factor: 0.70<br>Framing factor: 0.90<br>Maintenance factor: 0.85 |

In annual CBDM simulation method, calculation of hourly illumination was done for the whole year at 88 intersecting grid points. Each points provides 8,760 (365 X 24) illumination data, considering 24 hours of the day and 3,285 (365 X 9) data considering 9 hours of daylight time from 8:00 AM to 5:00 PM (Table 3.8). Simulation analysis was done considering 300 lux of illumination threshold.

*Table 3.8: Static and Dynamic daylight simulation parameters*

| Sl. no. | parameters | specifications |
|---|---|---|
| **1.** | Location | Within grater Dhaka Region, Bangladesh |
| **2.** | Longitude | 90.25°N |
| **3.** | Latitude | 23.95°E |
| **4.** | Time zone | +6 GMT |
| **5.** | Time | For static simulation: 12:30 PM |
| | | For dynamic metrics: 8:00 AM to 6:00 PM |
| **6.** | Date | For static simulation: 1st April 2014 |
| | | For dynamic metrics: whole year |
| **7.** | Sky model | For dynamic metrics: whole year |
| | | For dynamic metrics: Perez all possible sky model round the year. |
| **8.** | Unit of dimension | SI, metric (m, cm, mm) |
| **9.** | Daylight properties of sky window glaze portion | Transmission: 90% |
| | | Pollution factor: 0.70 |
| | | Framing factor: 0.90 |
| | | Maintenance factor: 0.85 |

DAYSIM uses RADIANCE (backward) raytracer combined with a daylight coefficient (DC) approach (Tregenza and waters, 1983) considering Perez all weather sky luminance model (Perez, 1993). Both RADIANCE and DAYSIM have been validated comprehensively and successfully for daylighting analysis (Reinhart and Walkenhorst, 2001). Table 3.9 summarizes the non-default RADIANCE simulation parameter for the simulation analysis recommended by Reinhart (2010) for complex geometry.

*Table 3.9: Utilized RADIANCE simulation parameters in DAYSIM (Reinhart, 2010)*

| Ambient bounce | Ambient division | Ambient sampling | Ambient accuracy | Ambient resolution | Specular threshold | Direct sampling |
|---|---|---|---|---|---|---|
| 5 | 1000 | 20 | 0.1 | 300 | 0.15 | 0.2 |

### *3.2.8 Identifying approach for the evaluation process*

A dynamic daylight performance metrics has been calculated for multiple sensor points in the space, the result can be presented through graphical presentations as contour plots and false colour maps. These graphical presentations present how daylight is distributed throughout a space. However, for a rating system it is more desirable sometimes to come up with single metrics for a space.

The core sensor points are shown in the Table 3.9. This is the approach that has been used for the daylight autonomy calculations (Reinhart, 2006).In this study, core work plane sensor approach was applied. Common sensor points uninterrupted by the voids of light well configurations represent the core work plane sensor.

Due to make interrelationship between different sensors in a lighting zone, Nabil and Mardaljevic (2005) mention to group all work plane sensors together and consider daylight only "usefull", if all work plane sensors synchronously lie in the recommended 100 lux to 2000 lux range. For this simulation study, DA, $DA_{max}$ and UDI were measured with the average value of all the core sensor points of the floor.

## 3.3 Summery

This Chapter discusses the methodology for simulation study and selection criteria of case RMG building. The results of detail simulation analysis of case building for available light well configurations have been presented in the next Chapter 4. The next Chapter 4 also discusses the strategies to allocate function of RMG building and maintenance of light well for getting better result to improve the luminous environment of RMG building.

# CHAPTER FOUR: SIMULATION ANALYSIS AND RESULTS

Preamble

Evaluation of available light well configuration performance

Static daylight simulation results

Dynamic daylight simulation results

Strategies to improve illumination condition of RMG

Summary

# CHAPTER FOUR: SIMULATION ANALYSIS AND RESULTS

## 4.1 Preamble

Chapter 2 have discussed the basic information which is necessary to identify the parameters of simulation study. Chapter 3 have reviewed the detail methodology for field investigations and simulation studies. This chapter consists of the descriptions and outputs of simulation analysis based on the outcomes of previous two chapters. This chapter consists of three major parts. The first part describes the outcomes of static metrics which consider one sky model. The second part presents the results of dynamic metrics which consider all possible sky models in a year and third part states the strategies to incorporate proper daylight illumination into the interior space of the RMG building with reference to the results of simulation analysis (based on previous two parts) and understanding from the literature review in Chapter 2. The thesis is concluded in the last Chapter 5 by presenting a summary of this Chapter 4 with referencing the aim and objectives of this research and make recommendation for further study.

## 4.2 Performance of light well configurations

For comparative studies, performance metrics can be used. Performance metrics can be used to make a standard of a light well configuration for RMG industries, evaluating other available types of light well configurations. These metrics generally syndicates some individual sub-metrics into a single entire rating and specify pass or fail measures for each sub-metrics (Reinhart et al. 2006).

In this research, simulation was done in two metrics as following:

- Static metrics which consider one sky model.
- Dynamic metrics, which considers all possible sky models of a year. 9 hours of a day was considered from 8:00AM to 5:00PM for this study.

Simulation parameters e.g. intensity, time, duration and material properties were kept same and constant, described on previous Chapter 3 (Table 3.7, 3.8 and 3.9) for both static and dynamic simulation process.

Dynamic Daylight Simulation include pre-processing step through a set of daylight coefficient, calculated for each sensor points, and post processing steps through the daylight coefficient, that combined with the climate data (annual time series of internal luminance and illuminance). Dynamic daylight simulation processes vary upon the time due to change of sky conditions, compared with static daylight modelling concepts.

The upper and lower limit of work plane illumination were fixed to 2000 lux and 300 lux which was illustrated in Section 2.2.3. Therefore, the goal of the simulation analysis was to keep minimum 300 lux daylight illumination at each sensor points at work plane height.

## 4.3 Static daylight simulation results

Considering single sky condition, static daylight simulations were done at a fixed time of the year. The fixed time for the simulations is 1st April at 12:30pm. 77-88 sensor points were taken for simulation results in the work plane of 0.76 m height from the floor level which was described in Section 3.2.4. In this research, overcast was considered as sky condition and for design illumination level, 16500 lux was considered for Dhaka (Khan, 2005; cited from Joarder, 2007).

*Table 4.1: Static daylight simulation results of present situation and three available light well configuration suitable for RMG building.*

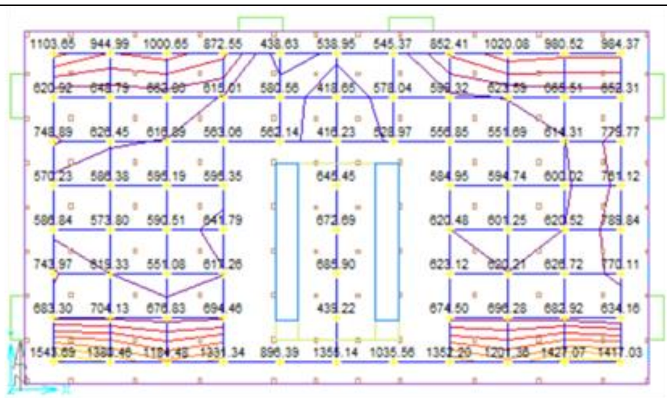
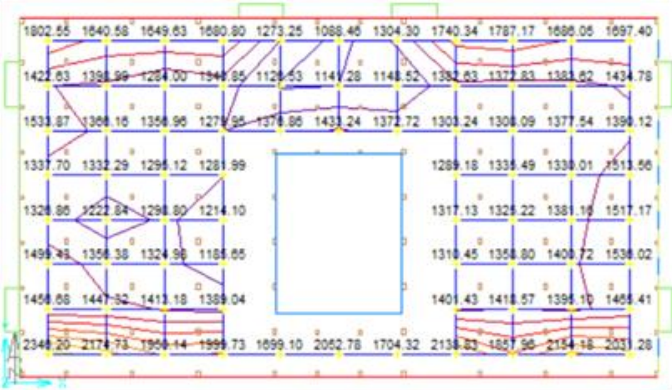
| **Coding** | **Simulation Result** | **Illumination Level** |
|---|---|---|
| **LWC 01** |  | Average illumination level = 745 lux<br>Minimum 400 lux<br>Maximum 1500 lux<br>Visual Node - 80 |
| In present situation LWC01 static daylight simulation result on the sensor points. | | |

*Table 4.1: Continued*

| **Coding** | **Simulation Result** | **Illumination Level** |
|---|---|---|

| | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | **K** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 1544 | 1380 | 1184 | 1331 | 896 | 1355 | 1036 | 1352 | 1201 | 1427 | 1417 |
| **2** | 683 | 704 | 647 | 694 | **LW** | 439 | **LW** | 675 | 696 | 683 | 634 |
| **3** | 744 | 619 | 551 | 617 | **LW** | 686 | **LW** | 623 | 620 | 627 | 770 |
| **4** | 587 | 574 | 591 | 642 | **LW** | 673 | **LW** | 620 | 601 | 621 | 790 |
| **5** | 570 | 586 | 595 | 595 | **LW** | 645 | **LW** | 585 | 595 | 600 | 761 |
| **6** | 749 | 626 | 617 | 563 | 562 | 416 | 529 | 557 | 551 | 614 | 780 |
| **7** | 621 | 649 | 663 | 615 | 581 | 419 | 578 | 599 | 624 | 666 | 652 |
| **8** | 1104 | 945 | 1001 | 873 | 438 | 539 | 545 | 852 | 1020 | 981 | 985 |

**LWC 02**

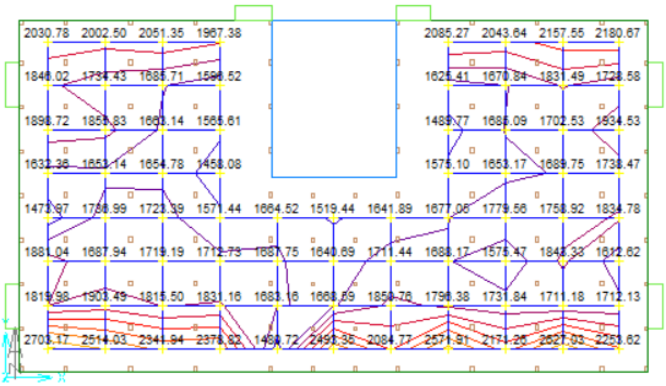


Average illumination level = 1483lux
Minimum 1000 lux
Maximum 2400 lux
Visual Node - 76

LWC 02 static daylight simulation result on the sensor points.

| | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | **K** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2346 | 2175 | 1950 | 2000 | 1699 | 2053 | 1704 | 2139 | 1858 | 2154 | 2031 |
| **2** | 1457 | 1447 | 1413 | 1389 | **LW** | **LW** | **LW** | 1401 | 1419 | 1395 | 1465 |
| **3** | 1499 | 1356 | 1325 | 1186 | **LW** | **LW** | **LW** | 1310 | 1359 | 1401 | 1536 |
| **4** | 1327 | 1223 | 1299 | 1214 | **LW** | **LW** | **LW** | 1317 | 1325 | 1381 | 1517 |
| **5** | 1338 | 1332 | 1295 | 1282 | **LW** | **LW** | **LW** | 1289 | 1335 | 1330 | 1514 |
| **6** | 1534 | 1366 | 1357 | 1280 | 1377 | 1433 | 1373 | 1303 | 1308 | 1378 | 1390 |
| **7** | 1423 | 1399 | 1284 | 1341 | 1127 | 1141 | 1149 | 1383 | 1373 | 1384 | 1435 |
| **8** | 1803 | 1641 | 1650 | 1681 | 1273 | 1088 | 1304 | 1740 | 1787 | 1636 | 1697 |

**LWC 03**



Average illumination level = 1834 lux
Minimum 1400 lux
Maximum 2800 lux
Visual Node - 76

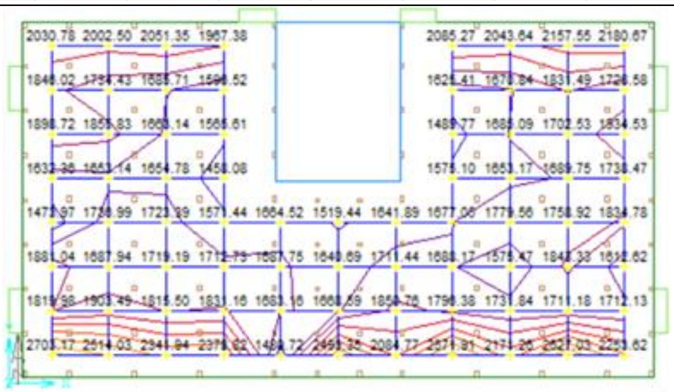
LWC 03 static daylight simulation result on the sensor points.

*Table 4.1: Continued*

| Coding | Simulation Result | Illumination Level |
|---|---|---|

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2703 | 2514 | 2342 | 2379 | 1481 | 2493 | 2085 | 2572 | 2171 | 2627 | 2254 |
| **2** | 1820 | 1903 | 1816 | 1831 | 1683 | 1669 | 1851 | 1796 | 1732 | 1711 | 1712 |
| **3** | 1881 | 1688 | 1719 | 1713 | 1688 | 1641 | 1711 | 1688 | 1575 | 1843 | 1613 |
| **4** | 1474 | 1737 | 1723 | 1571 | 1665 | 1519 | 1642 | 1677 | 1780 | 1759 | 1835 |
| **5** | 1632 | 1653 | 1655 | 1458 | **LW** | **LW** | **LW** | 1575 | 1653 | 1690 | 1738 |
| **6** | 1899 | 1856 | 1663 | 1566 | **LW** | **LW** | **LW** | 1490 | 1685 | 1703 | 1935 |
| **7** | 1846 | 1734 | 1686 | 1597 | **LW** | **LW** | **LW** | 1625 | 1671 | 1831 | 1729 |
| **8** | 2031 | 2003 | 2051 | 1967 | **LW** | **LW** | **LW** | 2086 | 2044 | 2158 | 2181 |

**LWC 04**



Average illumination level = 1705 lux
Minimum 1400 lux
Maximum 2400 lux
Visual Node - 76

LWC 04 static daylight simulation result on the sensor points.

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2597 | 2368 | 2235 | 2281 | 1804 | 2388 | 1969 | 2425 | 2038 | 2518 | 2169 |
| **2** | 1714 | 1794 | 1713 | 1729 | 1581 | 1546 | 1594 | 1682 | 1624 | 1612 | 1658 |
| **3** | 1775 | 1540 | 1629 | 1617 | 1506 | 1515 | 1519 | 1590 | 1473 | 1733 | 1626 |
| **4** | 1415 | 1629 | 1602 | 1500 | 1452 | 1446 | 1411 | 1584 | 1488 | 1652 | 1732 |
| **5** | 1531 | 1559 | 1548 | 1378 | **LW** | **LW** | **LW** | 1499 | 1546 | 1584 | 1640 |
| **6** | 1591 | 1449 | 1555 | 1460 | **LW** | **LW** | **LW** | 1405 | 1578 | 1600 | 1823 |
| **7** | 1461 | 1629 | 1571 | 1493 | **LW** | **LW** | **LW** | 1516 | 1557 | 1530 | 1609 |
| **8** | 1930 | 1897 | 1772 | 1862 | **LW** | **LW** | **LW** | 1823 | 1940 | 1862 | 1897 |

LWC 05 static daylight simulation result on the sensor points.

**LWC 05**

Average illumination level = 2135 lux
Minimum 1800 lux
Maximum 2800 lux
Visual Node - 80

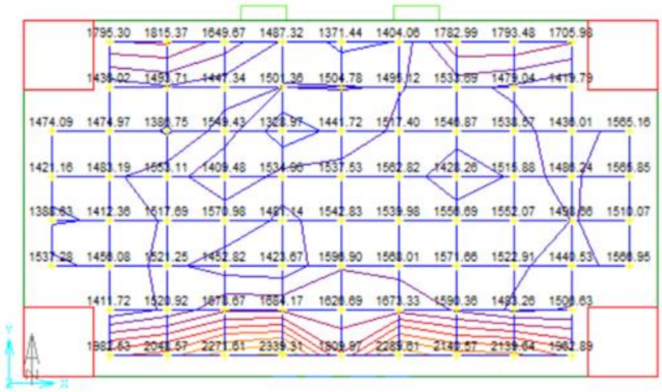
*Table 4.1: Continued*

| **Coding** | **Simulation Result** | **Illumination Level** |
|---|---|---|

| | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | **K** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **LW** | 2246 | 2692 | 2738 | 2702 | 2696 | 2754 | 2791 | 2598 | 2602 | **LW** |
| **2** | **LW** | 2255 | 1994 | 2166 | 2192 | 2098 | 2161 | 2095 | 2045 | 2074 | **LW** |
| **3** | 1993 | 2016 | 1971 | 2126 | 2119 | 2038 | 2055 | 2073 | 2062 | 1941 | 2053 |
| **4** | 1817 | 2069 | 1927 | 2048 | 2248 | 2024 | 2095 | 2104 | 2066 | 2011 | 2177 |
| **5** | 1818 | 1951 | 2047 | 2148 | 2097 | 2027 | 2039 | 2091 | 1959 | 1970 | 1977 |
| **6** | 2032 | 2061 | 2115 | 2097 | 2187 | 2217 | 1999 | 2074 | 2049 | 2046 | 2104 |
| **7** | **LW** | 2095 | 1909 | 2096 | 1973 | 1989 | 1999 | 2007 | 1990 | 1925 | **LW** |
| **8** | **LW** | 2107 | 2450 | 2158 | 1980 | 2000 | 2055 | 2431 | 2409 | 2154 | **LW** |

LWC 06 static daylight simulation result on the sensor points.

**LWC 06**



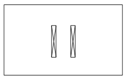
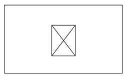
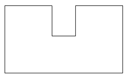
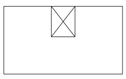
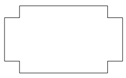
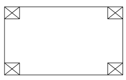
Average illumination level = 1591 lux
Minimum 1400 lux
Maximum 2400 lux
Visual Node - 80

| | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | **K** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **LW** | 1983 | 2049 | 2272 | 2339 | 1810 | 2290 | 2141 | 2140 | 1903 | **LW** |
| **2** | **LW** | 1412 | 1521 | 1679 | 1684 | 1627 | 1673 | 1590 | 4183 | 1507 | **LW** |
| **3** | 1537 | 1456 | 1521 | 1453 | 1424 | 1597 | 1568 | 1572 | 1523 | 1441 | 1567 |
| **4** | 1389 | 1412 | 1518 | 1571 | 1481 | 1543 | 1540 | 1557 | 1552 | 1499 | 1510 |
| **5** | 1421 | 1483 | 1553 | 1409 | 1535 | 1538 | 1563 | 1428 | 1516 | 1486 | 1566 |
| **6** | 1474 | 1475 | 1387 | 1549 | 1329 | 1442 | 1517 | 1547 | 1539 | 1436 | 1505 |
| **7** | **LW** | 1436 | 1494 | 1447 | 1501 | 1505 | 1495 | 1534 | 1479 | 1420 | **LW** |
| **8** | **LW** | 1795 | 1815 | 1650 | 1487 | 1371 | 1404 | 1783 | 1793 | 1706 | **LW** |

In Table 4.1, the results of static daylight simulation are presented. From the static daylight simulation results, more illumination level was found for LWC 05 and less illumination level was found for LWC 01 than required daylight level on the work plane height. LWC 02, LWC 03 and LWC 06 shown better illumination level than other light well configurations, considering average, minimum, and maximum values of illumination level on the sensor points.

The average, minimum and maximum results of Static Daylight Simulation and visual nodes of present situation and five available light well configurations (Section 2.6.1) suitable for RMG building are shown in Table 4.2.

*Table 4.2: Average, minimum and maximum results of Static daylight simulation.*

| Code | Figure | Visual node | Minimum | Maximum | Average |
|---|---|---|---|---|---|
| **LWC 01** |  | 80 | 400 | 1500 | 745 |
| **LWC 02** |  | 76 | 1000 | 2400 | 1483 |
| **LWC 03** |  | 76 | 1400 | 2800 | 1834 |
| **LWC 04** |  | 76 | 1400 | 2400 | 1705 |
| **LWC 05** |  | 80 | 1800 | 2800 | 2135 |
| **LWC 06** |  | 80 | 1400 | 2400 | 1591 |

## 4.4 Dynamic daylight simulation result

To finalize the most suitable light well configuration among the available light well configurations, the dynamic simulation was also executed, which considers all possible sky models and seasonal variation of solar position through a year. Dynamic metric daylight simulation results are shown in this section, considering work plane sensor (Reinhart, 2006) which was described in section 3.2.4.

### *4.4.1 Light well surroundings*

In this thesis, three basic types of light well configurations were considered (internal, semi-enclosed and attached). The main difference between semi-enclosed and attached type light well (Figure 4.1) is whether one or two sides of the light well surface is open or closed by wall(s) (Jaberansari, 2016).

This research, at the beginning, tried to identify what types of space or material should be used surrounding the light well using simulation method. In this phase following six options were compared first for case RMG building (Figure 4.1).

a. LWC 01: Two internal light wells surrounded on all sides by rooms or spaces (existing condition)

b. LWC 02: One internal light well combines the two light wells into a single light well

c. LWC03: Semi-enclosed light well (with the same volume of one internal light well) surrounded by rooms on three sides.

d. LWC 04: Attached light well (with the same volume of one internal light well) enclosed by one perimeter solid wall.

e. LWC 05: Four corner semi-enclosed light wells enclosed by rooms on two sides (with the total equal volume of one semi-enclosed light well).

f. LWC 06: Four corner attached light wells enclosed by two perimeter solid wall (with the total equal volume of one attached light well).

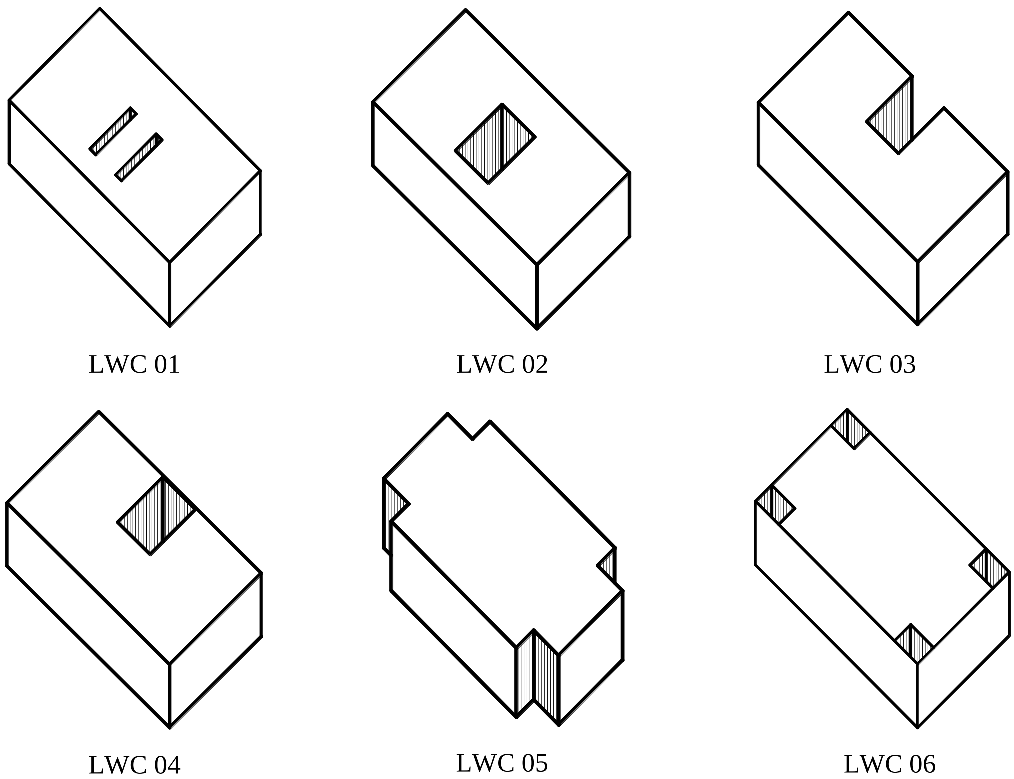
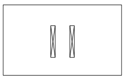



*Figure 4.1: Schematic 3-dimentional view of different light well configurations according to light well surrounding with codes (LWC 01-LWC 06)*

### *a. Dynamic daylight simulation for LWC 01*

Table 4.3 presents annual CBDM simulation result of the building with light wells in existing condition (LWC 01). It was found from Table 4.3 that the highest DA 94% is observed in the core sensor points 2B, 2C and 2J and the lowest DA 0% is observed in the core sensor points 6D and 6H. On the other hand, 7I and 7J sensor points show the best UDI value with highest $UDI_{100-2000}$ (95%) and lowest $UDI_{<100}$ (5%) and $UDI_{>2000}$ (0%). 6D shows the worst UDI value with lowest $UDI_{100-2000}$(30%) and highest $UDI_{<100}$(70%).

*Table 4.3: Annual CBDM simulation result of existing condition with two internal light wells (LWC 01)*

|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 94 | 1 | 2 | 79 | 20 |
| 2D | 93 | 0 | 2 | 85 | 13 |
| 2H | 92 | 0 | 2 | 94 | 4 |
| 2I | 93 | 0 | 2 | 83 | 15 |
| 2J | 94 | 0 | 2 | 80 | 18 |
| 3D | 57 | 0 | 7 | 93 | 0 |
| 3H | 52 | 0 | 7 | 93 | 0 |
| 6D | 0 | 0 | 70 | 30 | 0 |
| 6H | 0 | 0 | 58 | 42 | 0 |
| 7B | 65 | 0 | 6 | 94 | 0 |
| 7C | 55 | 0 | 7 | 93 | 0 |
| 7D | 4 | 0 | 18 | 82 | 0 |
| 7H | 30 | 0 | 9 | 91 | 0 |
| 7I | 64 | 0 | 5 | 95 | 0 |
| 7J | 72 | 0 | 5 | 95 | 0 |

### *b. Dynamic daylight simulation for LWC 02*

Table 4.4 presents annual CBDM simulation result of building with internal light well (LWC 02). It was found from Table 4.4 that the highest DA 93% is observed in the core sensor points 2C, 2D, 2H and 2J and the lowest DA 1% is observed in the core sensor point 6H. On the other hand, 3D sensor point show the best UDI value with highest UDI$_{100-2000}$(96%) and lowest UDI$_{>2000}$(0%). 6H shows the worst UDI value with lowest UDI$_{100-2000}$(64%) and highest UDI$_{<100}$(36%).

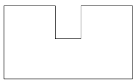
*Table 4.4: Annual CBDM simulation result of one internal light well combines the two light wells (LWC 02)*

| **Core points** | **DA (%)** | **DA$_{max}$ (%)** | **UDI$_{<100}$ (%)** | **UDI$_{100-2000}$ (%)** | **UDI$_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 92 | 0 | 2 | 91 | 7 |
| 2C | 93 | 0 | 2 | 89 | 9 |
| 2D | 93 | 0 | 2 | 85 | 13 |
| 2H | 93 | 0 | 2 | 89 | 9 |
| 2I | 92 | 0 | 2 | 90 | 8 |
| 2J | 93 | 0 | 2 | 89 | 9 |
| 3D | 80 | 0 | 4 | 96 | 0 |
| 3H | 55 | 0 | 7 | 93 | 0 |
| 6D | 31 | 0 | 20 | 80 | 0 |
| 6H | 1 | 0 | 36 | 64 | 0 |
| 7B | 60 | 0 | 7 | 93 | 0 |
| 7C | 61 | 0 | 6 | 94 | 0 |
| 7D | 36 | 0 | 12 | 88 | 0 |
| 7H | 25 | 0 | 14 | 86 | 0 |
| 7I | 58 | 0 | 6 | 94 | 0 |
| 7J | 63 | 0 | 6 | 94 | 0 |

### *c. Dynamic daylight simulation for LWC 03*

Table 4.5 presents annual CBDM simulation result of building with attached light well located at north (LWC 04). It was found from Table 4.5 that the highest DA 94% is observed in the core sensor points 2B, 2I and 2J and the lowest DA 69% is observed in the core sensor point 3H. On the other hand, 7D sensor point show the best UDI value with highest $UDI_{100-2000}$(97%) and lowest $UDI_{<100}$(2%) and $UDI_{>2000}$(0%). 2J shows the worst UDI value with lowest $UDI_{100-2000}$(80%) and highest $UDI_{>2000}$(18%).

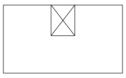
*Table 4.5: Annual CBDM simulation result of semi-enclosed light well surrounded by rooms on three sides. (LWC 03).*

|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 93 | 0 | 2 | 82 | 16 |
| 2D | 93 | 0 | 2 | 84 | 14 |
| 2H | 93 | 0 | 2 | 83 | 15 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 80 | 18 |
| 3D | 70 | 0 | 6 | 94 | 0 |
| 3H | 69 | 0 | 6 | 94 | 0 |
| 6D | 82 | 0 | 3 | 97 | 0 |
| 6H | 80 | 0 | 3 | 97 | 0 |
| 7B | 74 | 0 | 4 | 96 | 0 |
| 7C | 72 | 0 | 5 | 95 | 0 |
| 7D | 89 | 0 | 2 | 97 | 0 |
| 7H | 87 | 0 | 3 | 97 | 0 |
| 7I | 76 | 0 | 4 | 96 | 0 |
| 7J | 78 | 0 | 4 | 96 | 0 |

### *d. Dynamic daylight simulation for LWC 04*

Table 4.6 presents annual CBDM simulation result of building with attached light well located at south (LWC 03). It was found from Table 4.6 that the highest DA 94% is observed in the core sensor points 2C, 2I and 2J and the lowest DA 67% is observed in the core sensor points 3D, 7B and 7C. On the other hand, 7H sensor point shows the best UDI value with highest $UDI_{100\text{-}2000}$(97%). 2C show the worst UDI value with lowest $UDI_{100\text{-}2000}$(79%) and highest $UDI_{>2000}$(19%).

*Table 4.6: Annual CBDM simulation result of attached light well enclosed by one perimeter solid wall. (LWC 04).*

|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 85 | 13 |
| 2C | 94 | 1 | 2 | 79 | 19 |
| 2D | 92 | 0 | 2 | 88 | 10 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 80 | 18 |
| 3D | 67 | 0 | 6 | 94 | 0 |
| 3H | 68 | 0 | 6 | 94 | 0 |
| 6D | 75 | 0 | 5 | 95 | 0 |
| 6H | 76 | 0 | 4 | 96 | 0 |
| 7B | 67 | 0 | 6 | 94 | 0 |
| 7C | 67 | 0 | 6 | 94 | 0 |
| 7D | 85 | 0 | 3 | 96 | 1 |
| 7H | 86 | 0 | 3 | 97 | 1 |
| 7I | 75 | 0 | 4 | 96 | 0 |
| 7J | 69 | 0 | 5 | 95 | 0 |

### e. *Dynamic daylight simulation for LWC 05*

Table 4.7 presents annual CBDM simulation result of building with four corner semi-enclosed light wells enclosed by rooms on two sides (LWC 05). It was found from Table 4.7 that the highest DA 97% is observed in the core sensor points 2B and 2J and the lowest DA 0% is observed in the core sensor point 6D and 6H. On the other hand, 7C and 7I sensor points show the best UDI value with highest $UDI_{100\text{-}2000}$(97%) and lowest $UDI_{>2000}$(0%). 2J shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(40%) and highest $UDI_{>2000}$(59%).

*Table 4.7: Annual CBDM simulation result of attached light well enclosed by one perimeter solid wall. (LWC 05).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 97 | 29 | 1 | 45 | 54 |
| 2C | 95 | 2 | 2 | 77 | 21 |
| 2D | 93 | 0 | 2 | 83 | 15 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 95 | 1 | 2 | 79 | 19 |
| 2J | 97 | 33 | 1 | 40 | 59 |
| 3D | 68 | 0 | 6 | 94 | 0 |
| 3H | 68 | 0 | 6 | 94 | 0 |
| 6D | 0 | 0 | 37 | 63 | 0 |
| 6H | 0 | 0 | 33 | 67 | 0 |
| 7B | 95 | 2 | 2 | 86 | 13 |
| 7C | 83 | 0 | 3 | 97 | 0 |
| 7D | 33 | 0 | 9 | 91 | 0 |
| 7H | 30 | 0 | 9 | 91 | 0 |
| 7I | 84 | 0 | 3 | 97 | 0 |
| 7J | 96 | 3 | 2 | 80 | 18 |

### f. *Dynamic daylight simulation for LWC 06*

Table 4.8 presents annual CBDM simulation result of building with four corner attached light wells enclosed by two perimeter solid walls (LWC 06). It was found from Table 4.8 that the highest DA 94% is observed in the core sensor points 2C, 2D, 2H and 2I and the lowest DA 0% is observed in the core sensor points 6D and 6H. On the other hand, 7B and 7J sensor points shows the best UDI value with highest UDI$_{100-2000}$(97%) and lowest UDI$_{>2000}$(0%). 6D shows the worst UDI value with lowest UDI$_{100-2000}$(61%) and highest UDI$_{<100}$ (39%).

*Table 4.8: Annual CBDM simulation result of attached light well enclosed by one perimeter solid wall. (LWC 06).*

|  **Core points** | **DA (%)** | **93DA$_{max}$ (%)** | **UDI$_{<100}$ (%)** | **UDI$_{100-2000}$ (%)** | **UDI$_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 85 | 13 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 94 | 1 | 2 | 79 | 20 |
| 2H | 94 | 1 | 2 | 80 | 18 |
| 2I | 94 | 1 | 2 | 77 | 21 |
| 2J | 93 | 0 | 2 | 81 | 17 |
| 3D | 72 | 0 | 5 | 95 | 0 |
| 3H | 72 | 0 | 5 | 95 | 0 |
| 6D | 0 | 0 | 39 | 61 | 0 |
| 6H | 0 | 0 | 33 | 67 | 0 |
| 7B | 82 | 0 | 3 | 97 | 0 |
| 7C | 61 | 0 | 7 | 93 | 0 |
| 7D | 42 | 0 | 8 | 92 | 0 |
| 7H | 39 | 0 | 8 | 92 | 0 |
| 7I | 65 | 0 | 5 | 95 | 0 |
| 7J | 83 | 0 | 3 | 97 | 0 |

### *g. Comparison of the DDS result*

In this research, dynamic performance metrics were calculated for the core sensor points in the space for existing condition and recommended three types of light well configurations considering light well surroundings.

*Table 4.9: Summery results of dynamic simulation for available light well configurations considering light well surroundings.*

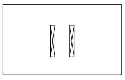
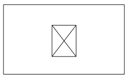
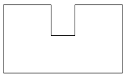
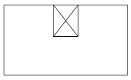
| |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| **Different strategies** | **LWC 01** | **LWC 02** | **LWC 03** | **LWC 04** | **LWC 05** | **LWC 06** |
| **DA** | 60 | 64 | 84 | 81 | 70 | 67 |
| **DAmax** | 0.1 | 0 | 0 | 0 | 4 | 0 |
| **UDI<100** | 13 | 8 | 3 | 4 | 8 | 8 |
| **UDI 100-2000** | 82 | 88 | 91 | 90 | 79 | 85 |
| **UDI>2000** | 5 | 3 | 6 | 6 | 13 | 7 |

Table 4.9 presents summery result of annual CBDM simulation for building with studied configurations of light well for RMG building considering the average value of core sensor points. From the rating system, the suitable configuration of light well was selected considering DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$.

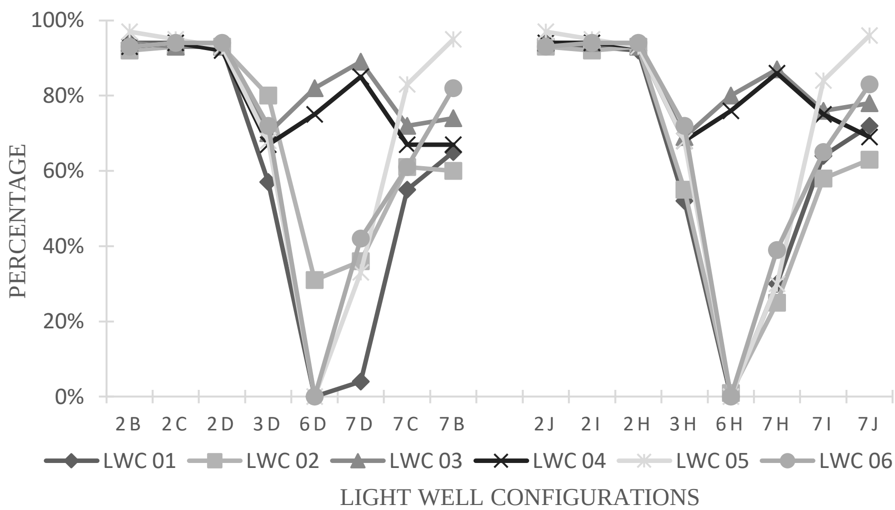



*Figure 4.2: DA performance analysis for studied light well configurations of RMG building in Dhaka.*

LWC 02, LWC 03 and LWC 04 performed better considering the value range of DA, $DA_{max}$ and UDI metrics concept. Figure 4.2, 4.3, 4.4, 4.5 and 4.6 show the comparison of different configurations of light well performance with respect to different dynamic metrics.

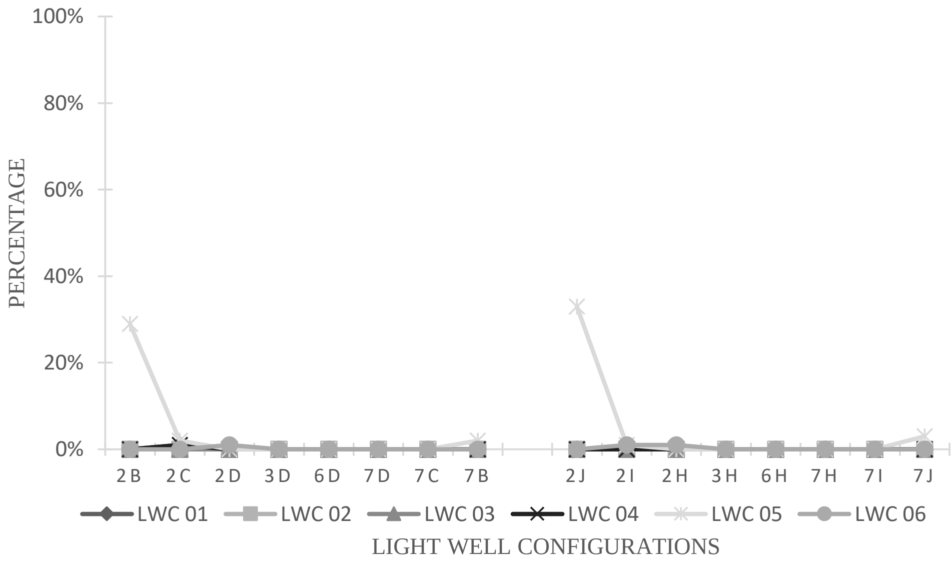



*Figure 4.3: $DA_{max}$ performance analysis for studied light well configurations of RMG building in Dhaka.*

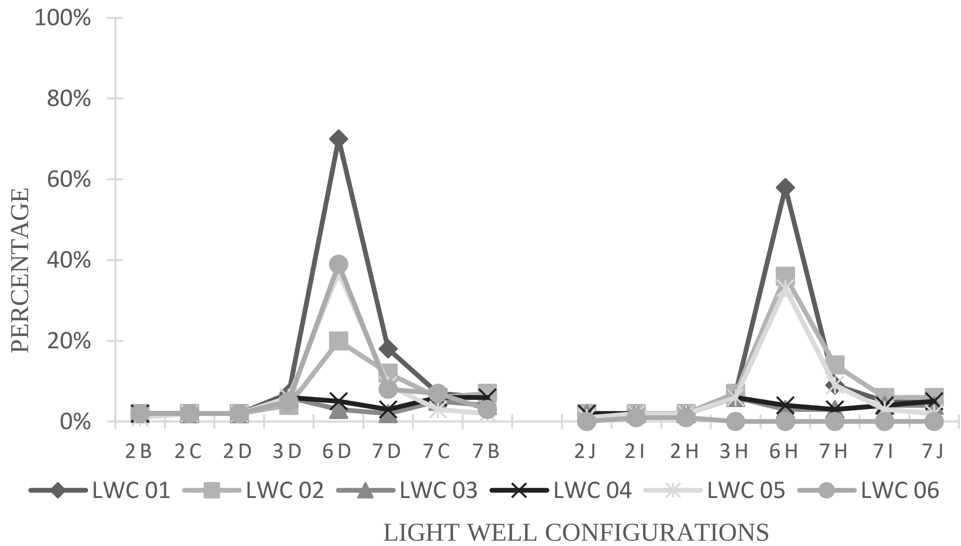



*Figure 4.4: $UDI_{<100}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

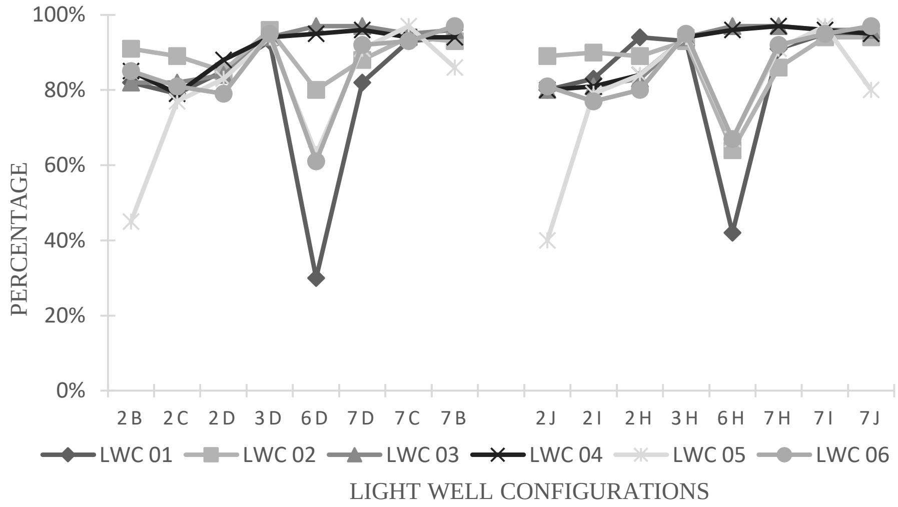



*Figure 4.5: UDI$_{100\text{-}2000}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

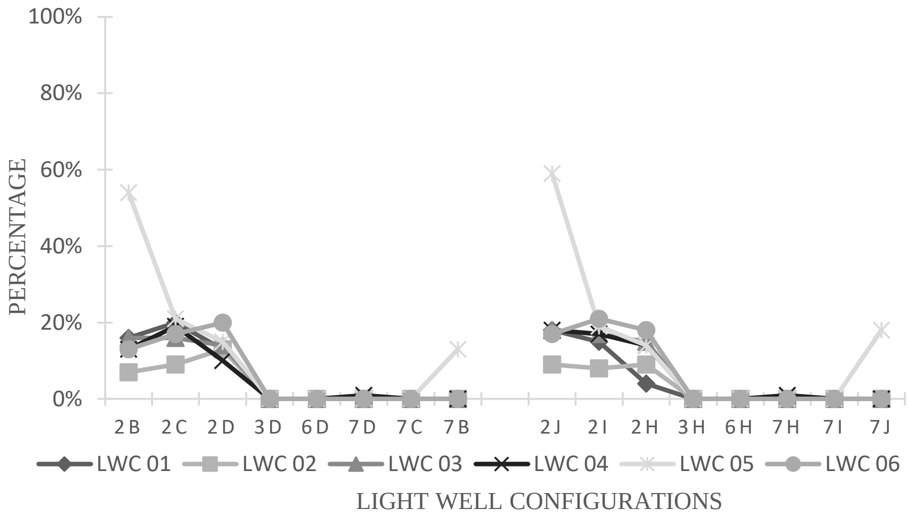



*Figure 4.6: UDI$_{>2000}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

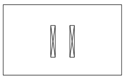
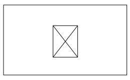
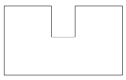
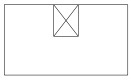
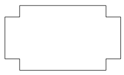
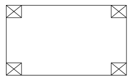
### *h. Rating system of the simulation results*

Ranking among the available light well configurations' simulated results is easier to construe using the dynamic metrics excluding DF (as DF consider only overcast sky condition) (Reinhart et al. 2006). Table 4.10 shows the ranking of the existing condition and three studied light well configurations according to the different metrics. When a metric led to different ranking for the core sensor points of the space, the average result for core work plane sensors were compared.

Among the studied light well configurations based on dynamic matrix simulation results, rating have been done to identify the most suitable light well configuration considering the average value of DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$ (Table 4.10). The rating was done considering the highest value of “5” and lowest value of “0” (Reinhart et al., 2006).

Summing the calculated rating points, the light well configuration LWC 03, semi enclosed type light well, performed the best with 23 points among the studied options. On the other hand, LWC 01, two internal light wells surrounded on all sides by rooms or spaces (existing condition) was performed as lowest achieved 6 points. LWC 04, attached light well also performed as one of the suitable light well configurations with 2$^{nd}$ rating (20 points). LWC 03, semi enclosed type light well, performed as the most suitable light well configurations (Figure 4.1 LWC 03).

*Table 4.10: Rating system of the simulation results*

| |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| **Different strategies** | **LWC 01** | **LWC 02** | **LWC 03** | **LWC 04** | **LWC 05** | **LWC 06** |
| **DA** | 0 | 1 | 5 | 4 | 3 | 2 |
| **DAmax** | 1 | 5 | 5 | 5 | 0 | 5 |
| **UDI<100** | 0 | 3 | 5 | 4 | 3 | 3 |
| **UDI 100-2000** | 1 | 3 | 5 | 4 | 0 | 2 |
| **UDI>2000** | 4 | 5 | 3 | 3 | 0 | 1 |
| **Ranking points** | 6 | 17 | 23 | 20 | 6 | 13 |
| **Ranking points** | 5$^{th}$ | 3$^{rd}$ | 1$^{st}$ | 2$^{nd}$ | 5$^{th}$ | 4$^{th}$ |

### *4.4.2 Light well location*

In this section, considering the locations, performance of following four types of light well (Figure 4.7), that is suitable to accommodate in case RMG building were studied, keeping the area of individual light well same.

Semi-enclosed light well (with the same volume of one internal light well) surrounded by rooms on three sides.

a) LWC 07: South oriented semi-enclosed light well surrounded by rooms on three sides.

b) LWC 08: North oriented semi-enclosed light well surrounded by rooms on three sides.

c) LWC 09: East oriented semi-enclosed light well surrounded by rooms on three sides.

d) LWC 10: West oriented semi-enclosed light well surrounded by rooms on three sides.

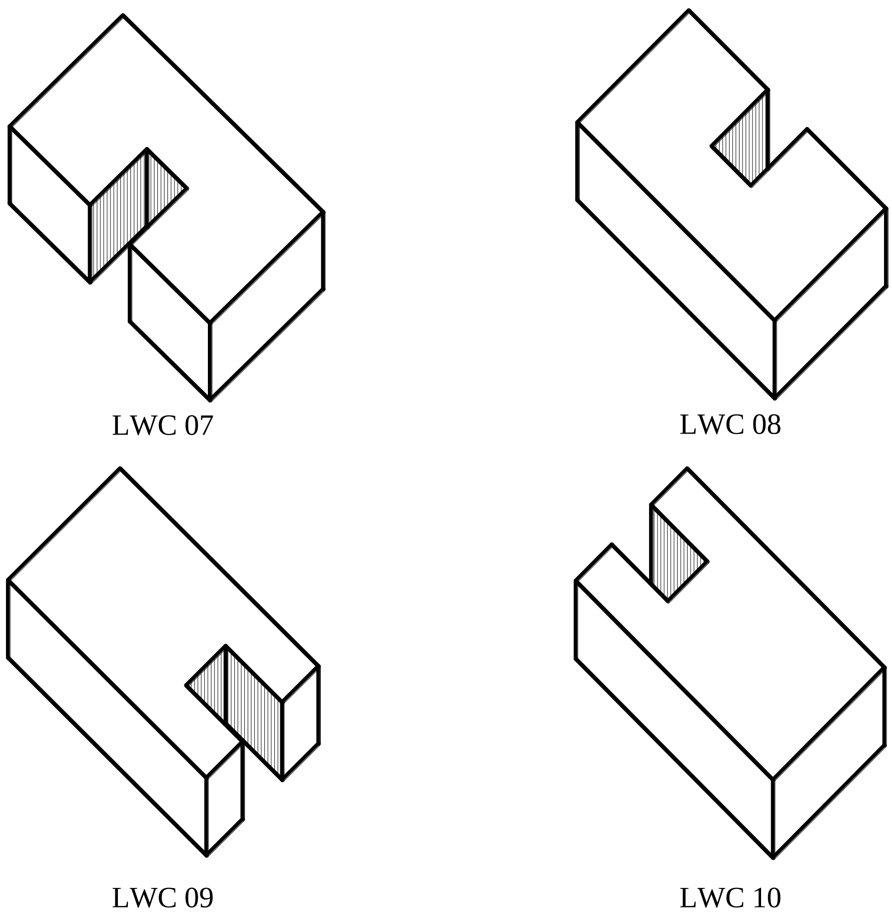
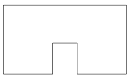



*Figure 4.7: Schematic 3-dimentional view of different light well configurations according to location with codes (LWC 07-LWC 10)*

### *a. Dynamic daylight simulation for LWC 07*

Table 4.11 presents annual CBDM simulation result of building with south oriented semi-enclosed light well (LWC 07). It was found from Table 4.11 that the highest DA 96% is observed in the core sensor points 2D and 2H and the lowest DA 7% is observed in the core sensor points 6D and 6H. On the other hand, 7J sensor point shows the best UDI value with highest $UDI_{100\text{-}2000}$(96%) and lowest $UDI_{>2000}$(0%). 2H shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(61%) and highest $UDI_{>2000}$(38%).

*Table 4.11: Annual CBDM simulation result of south oriented semi-enclosed light well (LWC 07).*

|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 81 | 17 |
| 2C | 95 | 2 | 2 | 77 | 21 |
| 2D | 96 | 14 | 1 | 61 | 38 |
| 2H | 96 | 14 | 2 | 61 | 38 |
| 2I | 95 | 2 | 2 | 77 | 21 |
| 2J | 93 | 0 | 2 | 85 | 13 |
| 3D | 92 | 0 | 2 | 93 | 4 |
| 3H | 91 | 0 | 2 | 95 | 2 |
| 6D | 7 | 0 | 23 | 77 | 0 |
| 6H | 7 | 0 | 20 | 80 | 0 |
| 7B | 66 | 0 | 6 | 94 | 0 |
| 7C | 62 | 0 | 6 | 94 | 0 |
| 7D | 39 | 0 | 9 | 91 | 0 |
| 7H | 60 | 0 | 6 | 94 | 0 |
| 7I | 64 | 0 | 6 | 94 | 0 |
| 7J | 75 | 0 | 4 | 96 | 0 |

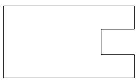
### *b. Dynamic daylight simulation for LWC 08*

The performance of the north oriented semi-enclosed light well, has been illustrated in previous Section 4.4.1c and Table 4.5.

### *c. Dynamic daylight simulation for LWC 09*

Table 4.12 presents annual CBDM simulation result of building with east oriented semi-enclosed light well (LWC 09). It was found from Table 4.12 that the highest DA 96% is observed in the core sensor points 2I and 2J and the lowest DA 0% is observed in the core sensor point 6D. On the other hand, 7I sensor point show the best UDI value with highest $UDI_{100-2000}$(98%) and lowest $UDI_{>2000}$(0%). 6D shows the worst UDI value with lowest $UDI_{100-2000}$(55%) and highest $UDI_{<100}$(45%).

*Table 4.12: Annual CBDM simulation result of east oriented semi-enclosed light well (LWC 09).*

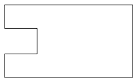
|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 84 | 14 |
| 2C | 94 | 0 | 2 | 80 | 18 |
| 2D | 93 | 0 | 2 | 82 | 16 |
| 2H | 94 | 1 | 2 | 78 | 20 |
| 2I | 96 | 14 | 1 | 61 | 38 |
| 2J | 96 | 18 | 1 | 55 | 43 |
| 3D | 62 | 0 | 6 | 94 | 0 |
| 3H | 91 | 0 | 2 | 97 | 1 |
| 6D | 0 | 0 | 45 | 55 | 0 |
| 6H | 83 | 2 | 4 | 93 | 3 |
| 7B | 69 | 0 | 5 | 95 | 0 |
| 7C | 59 | 0 | 6 | 94 | 0 |
| 7D | 14 | 0 | 13 | 87 | 0 |
| 7H | 72 | 0 | 5 | 95 | 0 |
| 7I | 91 | 0 | 2 | 98 | 0 |
| 7J | 93 | 0 | 2 | 93 | 4 |

### *d. Dynamic daylight simulation for LWC 10*

Table 4.13 presents annual CBDM simulation result of building with west oriented semi-enclosed light well (LWC 10). It was found from Table 4.13 that the highest DA

96% is observed in the core sensor points 2B and 2C and the lowest DA 0% is observed in the core sensor point 6H. On the other hand, 3D sensor point show the best UDI value with highest UDI$_{100\text{-}2000}$(97%) and lowest UDI>2000 (1%). 2B shows the worst UDI value with lowest UDI$_{100\text{-}2000}$(49%) and highest UDI$_{>2000}$(49%).

*Table 4.13: Annual CBDM simulation result of west oriented semi-enclosed light well (LWC 10).*

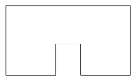
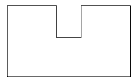
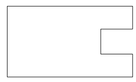
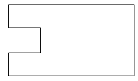
|  **Core points** | **DA (%)** | **DAmax (%)** | **UDI$_{<100}$ (%)** | **UDI$_{100\text{-}2000}$ (%)** | **UDI$_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 96 | 26 | 1 | 49 | 49 |
| 2C | 96 | 23 | 1 | 51 | 48 |
| 2D | 95 | 6 | 2 | 74 | 24 |
| 2H | 94 | 2 | 2 | 78 | 20 |
| 2I | 95 | 6 | 2 | 76 | 23 |
| 2J | 95 | 6 | 2 | 75 | 23 |
| 3D | 92 | 0 | 2 | 97 | 1 |
| 3H | 76 | 0 | 5 | 95 | 0 |
| 6D | 83 | 0 | 3 | 95 | 2 |
| 6H | 0 | 0 | 35 | 65 | 0 |
| 7B | 93 | 3 | 2 | 73 | 26 |
| 7C | 91 | 0 | 2 | 88 | 9 |
| 7D | 74 | 0 | 5 | 95 | 0 |
| 7H | 30 | 0 | 9 | 91 | 0 |
| 7I | 67 | 0 | 5 | 95 | 0 |
| 7J | 80 | 0 | 4 | 96 | 0 |

### *e. Comparison of the DDS result*

In this research, dynamic performance metrics were calculated for the core sensor points in the space for recommended four types of light well configurations considering locations.

Table 4.14 presents summery result of annual CBDM simulation for building with studied configurations of light well for RMG building considering locations of light well. From the rating system, the suitable configuration of light well was selected considering DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$.

*Table 4.14: Summary results of dynamic simulation for available light well configurations.*

| |  |  |  |  |
|---|---|---|---|---|
| **Different strategies** | **LWC 07** | **LWC 08** | **LWC 09** | **LWC 10** |
| **DA** | 71 | 84 | 75 | 79 |
| **DAmax** | 2 | 0 | 2 | 5 |
| **UDI<100** | 6 | 3 | 6 | 5 |
| **UDI 100-2000** | 84 | 91 | 84 | 81 |
| **UDI>2000** | 10 | 6 | 10 | 14 |

LWC 07, LWC 08 and LWC 09 performed better considering the value range of DA, $DA_{max}$ and UDI metrics concept. Figure 4.8, 4.9, 4.10, 4.11 and 4.12 show the comparison of different configurations of light well performance with respect to different dynamic metrics.

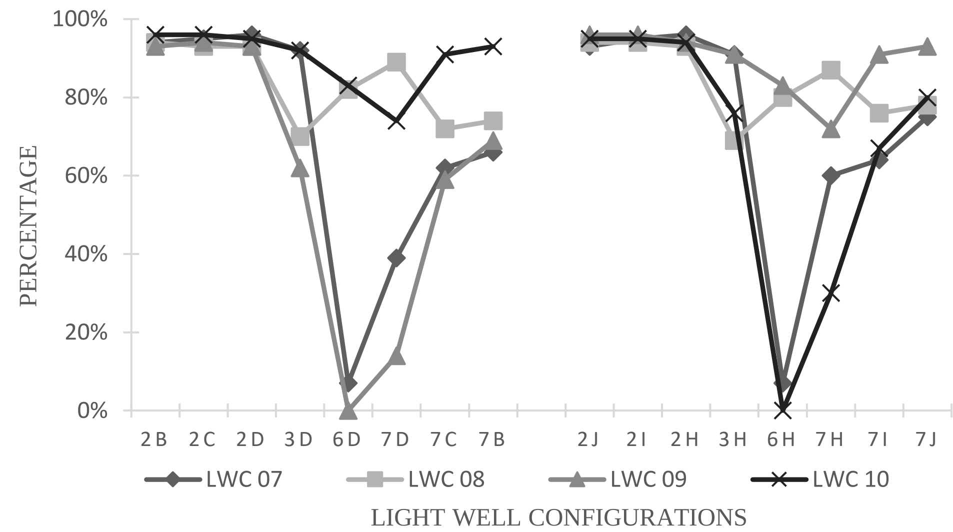



*Figure 4.8: DA performance analysis for studied light well configurations of RMG building in Dhaka.*

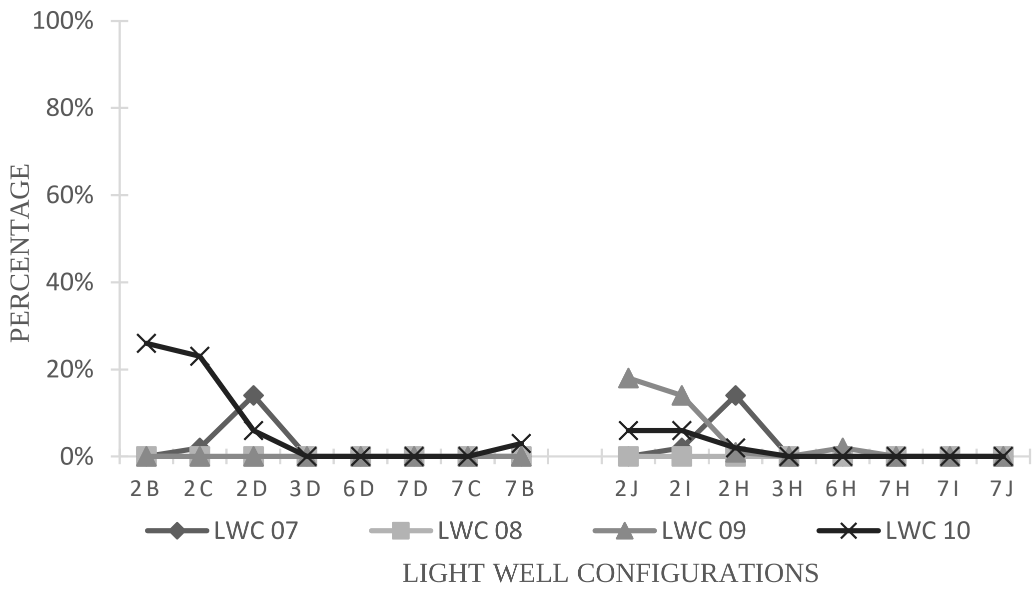



*Figure 4.9: $DA_{max}$ performance analysis for studied light well configurations of RMG building in Dhaka.*

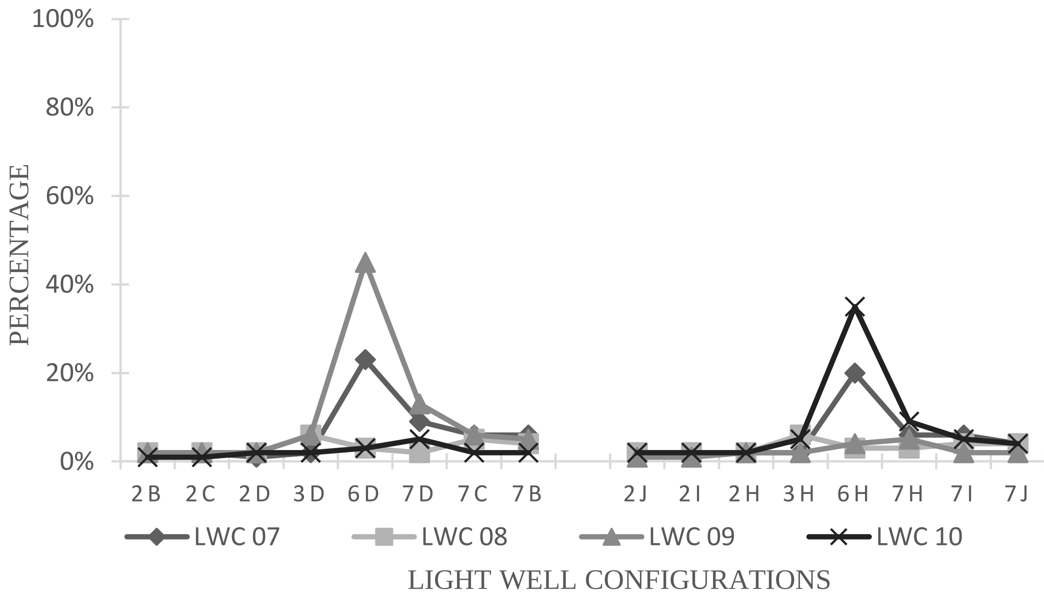



*Figure 4.10: $UDI_{<100}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

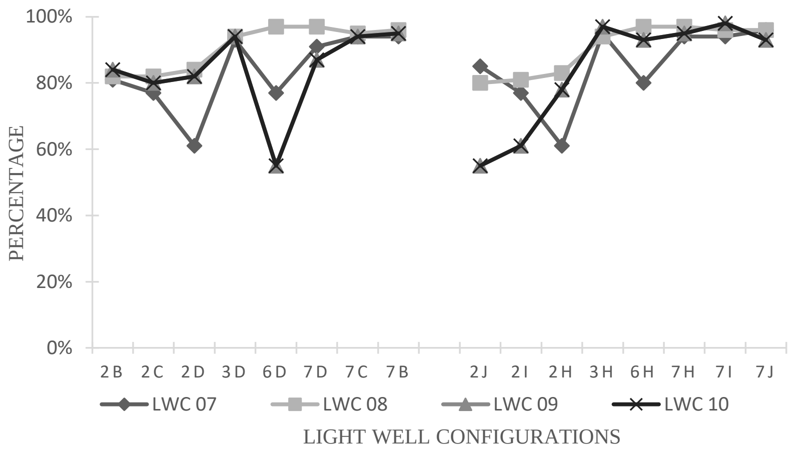



*Figure 4.11: $UDI_{100\text{-}2000}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

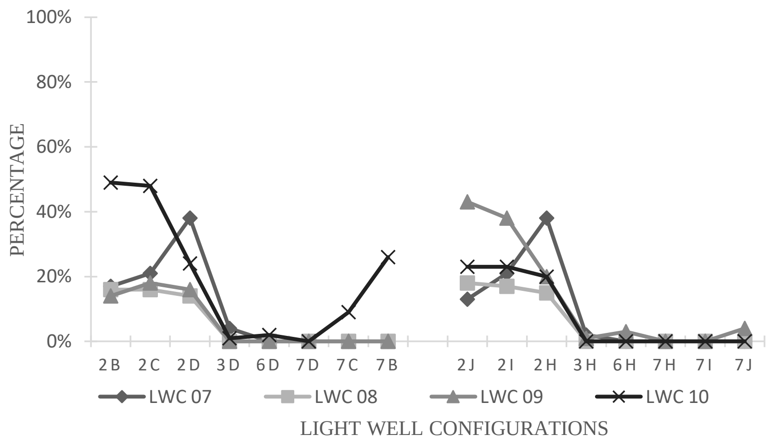



*Figure 4.12: $UDI_{>2000}$ performance analysis for studied light well configurations of RMG factories in Dhaka.*

### *f. Rating system of the simulation results*

Ranking among the available light well configurations' simulated results is easier to construe using the dynamic metrics excluding DF (as DF consider only overcast sky condition) (Reinhart et al. 2006). Table 4.15 shows the ranking of the four studied light well configurations considering location according to the different metrics. When a metric led to different ranking for the core sensor points of the space, the average result for core work plane sensors were compared.

Among the studied light well configurations based on dynamic matrix simulation results, rating have been done to identify the most suitable light well configuration considering the average value of DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100\text{-}2000}$ and $UDI_{>2000}$ (Table 4.15). The rating was done considering the highest value of "3" and lowest value of "0" (Reinhart et al., 2006).

Summing the calculated rating points, the light well configuration LWC 08 (LWC 03), north oriented semi-enclosed light well, performed the best with 15 points among the studied options. On the other hand, LWC 10, west oriented semi-enclosed light well was performed as lowest achieved only 4 point. LWC 07, south oriented semi-enclosed light well and LWC 09 east oriented semi-enclosed light well also performed better with 2nd and 3rd rating (8 points and 7 points). LWC 08, north oriented semi-enclosed light well, performed as the most suitable light well configurations (Figure 4.7 LWC 08).

*Table 4.15: Rating system of the simulation results*

| Different strategies | LWC 07 | LWC 08 | LWC 09 | LWC 10 |
|---|---|---|---|---|
| **DA** | 0 | 3 | 1 | 2 |
| **DAmax** | 2 | 3 | 2 | 0 |
| **UDI<100** | 1 | 3 | 1 | 2 |
| **UDI 100-2000** | 2 | 3 | 2 | 0 |
| **UDI>2000** | 2 | 3 | 2 | 0 |
| **Ranking points** | 7 | 15 | 8 | 4 |
| **Ranking points** | 3rd | 1st | 2nd | 4th |

### *4.4.3 Parametric study of the most suitable light well configuration*

Considering the north oriented semi-enclosed light well, parametric study was done to find out better result by varying different parameters. The main goal of this parametric study was to find out a suitable design factor such as feasible shape and proportion of light well configuration for RMG building.

Performance assessment measures was applied similar to previous section. For this parametric study the other parameters are kept constant as described in Chapter 3. Following two experimental situations on north oriented semi-enclosed light well, the parametric performance studies was done with following options.

- Experiment 1: by using different shapes of light well
- Experiment 2: by varying proportion of light well

In experiment 1, the study was conducted varying different shapes of light well on north oriented semi-enclosed light well, which was already found as most suitable light well configuration among other available light well configurations (described in section 4.4.2b). Experiment 2 was conducted varying different proportion of light well.

### *4.4.4 Parametric study with different shapes*

In this section, further, simulation was done to identify the shape of light well that will ensure uniform distribution of daylight in the adjacent area of light well. To compare this, light well with three basic shapes (i.e. square, circular and triangular) (Section 2.6.2) and rectangular shape (Table 3.5) in two orientations were selected for next phase of simulation analysis. Area was kept constant for different shapes of light well. Figure 4.15 shows the schematic plans with different shapes of light well accommodated with north oriented semi-enclosed light well.

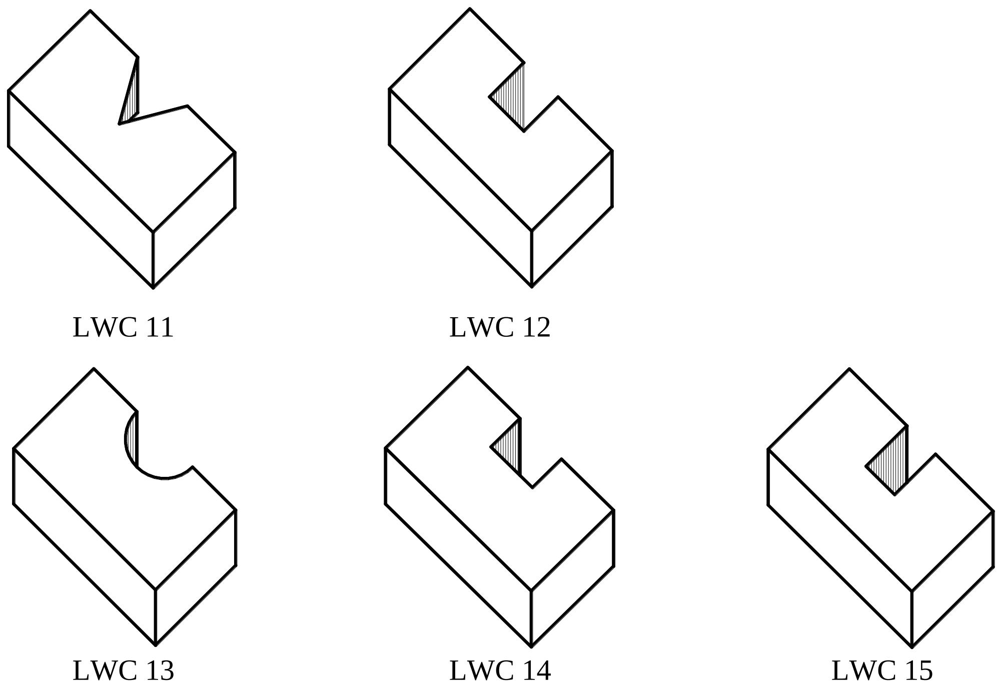
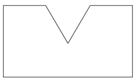



*Figure 4.13: Schematic 3-dimentional view with different shapes of north oriented semi-enclosed light well.*

### *a. Dynamic daylight simulation for LWC 11*

Table 4.16 presents annual CBDM simulation result of the building with triangular shaped north oriented semi-enclosed light well (LWC 11). It was found from Table 4.16 that the highest DA 95% is observed in the core sensor points 7D and 7H and the lowest DA 66% is observed in the core sensor point 3D. On the other hand, 6D, 6H, 7C and 7I sensor points show the best UDI value with highest UDI$_{100-2000}$(97%) and lowest UDI$_{<100}$(3%) and UDI$_{>2000}$(0%). 2J shows the worst UDI value with lowest UDI$_{100-2000}$(81%) and highest UDI$_{>2000}$(17%).

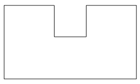
*Table 4.16: Annual CBDM simulation result of the triangular shaped north oriented semi-enclosed light well (LWC 11).*

|  **Core points** | **DA (%)** | **DA$_{max}$ (%)** | **UDI$_{<100}$ (%)** | **UDI$_{100-2000}$ (%)** | **UDI$_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 83 | 15 |
| 2C | 94 | 0 | 2 | 82 | 16 |
| 2D | 93 | 0 | 2 | 86 | 12 |
| 2H | 93 | 0 | 2 | 85 | 13 |
| 2I | 93 | 0 | 2 | 84 | 14 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 66 | 0 | 6 | 94 | 0 |
| 3H | 71 | 0 | 5 | 95 | 0 |
| 6D | 82 | 0 | 3 | 97 | 0 |
| 6H | 81 | 0 | 3 | 97 | 0 |
| 7B | 69 | 0 | 5 | 95 | 0 |
| 7C | 81 | 0 | 3 | 97 | 0 |
| 7D | 95 | 0 | 2 | 87 | 11 |
| 7H | 95 | 0 | 2 | 84 | 15 |
| 7I | 81 | 0 | 3 | 97 | 0 |
| 7J | 76 | 0 | 4 | 96 | 0 |

### *b. Dynamic daylight simulation for LWC 12*

Table 4.17 presents annual CBDM simulation result of the building with the square shaped north oriented semi-enclosed light well (LWC 12). It was found from Table 4.17 that the highest DA 94% is observed in the core sensor points 2B, 2C, 2I and 2J and the lowest DA 68% is observed in the core sensor point 3D. On the other hand, 7H sensor point show the best UDI value with highest $UDI_{100-2000}$(98%) and lowest $UDI_{<100}$(2%) and $UDI_{>2000}$(0%). 2B and 2I shows the worst UDI value with lowest $UDI_{100-2000}$(82%) and highest $UDI_{>2000}$(16%).

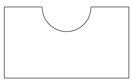
*Table 4.17: Annual CBDM simulation result of the square shaped north oriented semi-enclosed light well (LWC 12)*

|  **Core points** | **DA (%)** | $DA_{max}$ **(%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 94 | 0 | 2 | 83 | 15 |
| 2D | 93 | 0 | 2 | 86 | 12 |
| 2H | 93 | 0 | 2 | 86 | 12 |
| 2I | 94 | 0 | 2 | 82 | 16 |
| 2J | 94 | 0 | 2 | 83 | 15 |
| 3D | 68 | 0 | 6 | 94 | 0 |
| 3H | 73 | 0 | 5 | 95 | 0 |
| 6D | 82 | 0 | 3 | 97 | 0 |
| 6H | 84 | 0 | 3 | 97 | 0 |
| 7B | 72 | 0 | 5 | 95 | 0 |
| 7C | 75 | 0 | 4 | 96 | 0 |
| 7D | 91 | 0 | 2 | 97 | 1 |
| 7H | 91 | 0 | 2 | 98 | 0 |
| 7I | 71 | 0 | 5 | 95 | 0 |
| 7J | 78 | 0 | 4 | 96 | 0 |

### *c. Dynamic daylight simulation for LWC 13*

Table 4.18 presents annual CBDM simulation result of the building with the circular shaped north oriented semi-enclosed light well (LWC 13). It was found from Table 4.18 that the highest DA 97% is observed in the core sensor point 7D and the lowest DA 67% is observed in the core sensor point 3D. On the other hand, 6D sensor points show the best UDI value with highest $UDI_{100-2000}$ (98%) and lowest $UDI_{<100}$ (2%) and $UDI_{>2000}$ (0%). 7D shows the worst UDI value with lowest $UDI_{100-2000}$ (65%) and highest $UDI_{>2000}$ (34%).

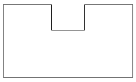
*Table 4.18: Annual CBDM simulation result of the circular shaped north oriented semi-enclosed light well (LWC 13).*

| <br>**Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 84 | 14 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 93 | 0 | 2 | 88 | 9 |
| 2H | 93 | 0 | 2 | 87 | 11 |
| 2I | 94 | 0 | 2 | 82 | 16 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 67 | 0 | 6 | 94 | 0 |
| 3H | 68 | 0 | 6 | 94 | 0 |
| 6D | 91 | 0 | 2 | 98 | 0 |
| 6H | 87 | 0 | 3 | 97 | 0 |
| 7B | 76 | 0 | 4 | 96 | 0 |
| 7C | 84 | 0 | 3 | 97 | 0 |
| 7D | 97 | 11 | 1 | 65 | 34 |
| 7H | 96 | 6 | 2 | 76 | 22 |
| 7I | 83 | 0 | 3 | 97 | 0 |
| 7J | 77 | 0 | 4 | 96 | 0 |

### *d. Dynamic daylight simulation for LWC 14*

Table 4.19 presents annual CBDM simulation result of the building with the rectangular shaped and elongated along east-west direction north oriented semi-enclosed light well (LWC 14). It was found from the table 4.19 that the highest DA 94% is observed in the core sensor points 2C, 2I, 2J and 7D and the lowest DA 63% is observed in the core sensor point 3D. On the other hand, 7C, 7I and 7J sensor points show the best UDI value with highest $UDI_{100\text{-}2000}$ (96%) and lowest $UDI_{>2000}$ (0%). 2I shows the worst UDI value with lowest $UDI_{100\text{-}2000}$ (81%) and highest $UDI_{>2000}$ (17%).

*Table 4.19: Annual CBDM simulation result of the rectangular elongated east-west direction shaped north oriented semi-enclosed light well (LWC 14).*

|  **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 85 | 13 |
| 2C | 94 | 0 | 2 | 82 | 16 |
| 2D | 93 | 0 | 2 | 86 | 12 |
| 2H | 93 | 0 | 2 | 86 | 12 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 83 | 15 |
| 3D | 63 | 0 | 6 | 94 | 0 |
| 3H | 68 | 0 | 6 | 94 | 0 |
| 6D | 88 | 1 | 3 | 94 | 3 |
| 6H | 89 | 1 | 3 | 94 | 3 |
| 7B | 68 | 0 | 5 | 95 | 0 |
| 7C | 77 | 0 | 4 | 96 | 0 |
| 7D | 94 | 2 | 2 | 86 | 12 |
| 7H | 93 | 2 | 2 | 87 | 11 |
| 7I | 80 | 0 | 4 | 96 | 0 |
| 7J | 76 | 0 | 4 | 96 | 0 |

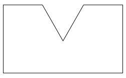
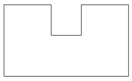
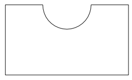
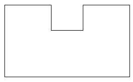
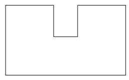
### *e. Dynamic daylight simulation for LWC 15*

The performance of the north oriented semi-enclosed light well with rectangular shaped and elongated along north-south direction, has been illustrated in previous Section 4.4.1c and Table 4.5.

### *f. Comparison of different shapes of light well*

Table 4.20 presents summery results of annual CBDM simulation with five light well configurations with different shapes within the north oriented semi-enclosed light well. The same performance evaluation process was followed, as before, and analysis shows, considering DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100\text{-}2000}$ and $UDI_{>2000}$.

*Table 4.20: Summery results of dynamic simulation for different light well shapes.*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Different strategies** | **LWC 11** | **LWC 12** | **LWC 13** | **LWC 14** | **LWC 15** |
| **DA** | 85 | 84 | 87 | 85 | 84 |
| **$DA_{max}$** | 0 | 0 | 1 | 0.4 | 0 |
| **UDI<100** | 3 | 3 | 3 | 3 | 3 |
| **UDI 100-2000** | 90 | 91 | 88 | 90 | 91 |
| **UDI>2000** | 7 | 5 | 9 | 7 | 6 |

Different shapes with attached type light well in north location configuration performances were compared in Figure 4.14, 4.15, 4.16, 4.17 and 4.18 with respect to different dynamic metrics.

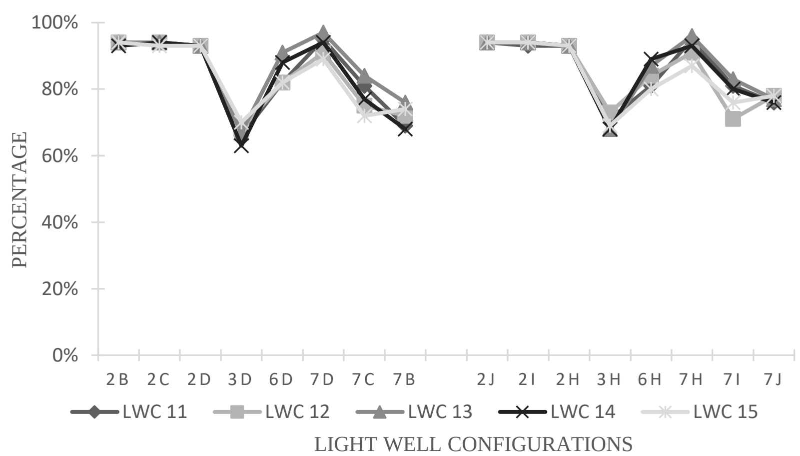



*Figure 4.14: DA performance analysis for studied light well configurations with different shapes of RMG building in Dhaka.*

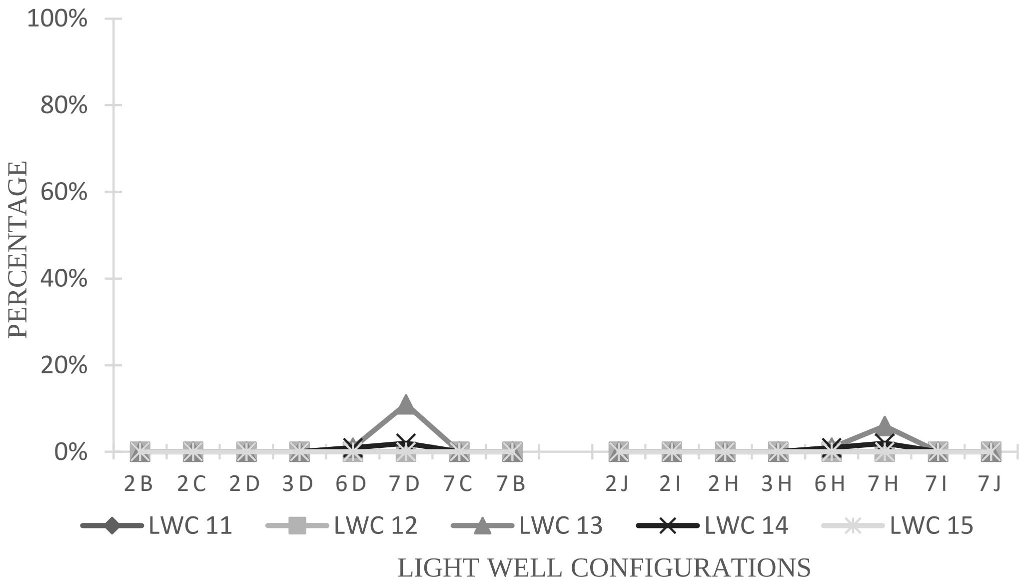



*Figure 4.15: DA$_{max}$ performance analysis for studied light well configurations with different shapes of RMG building in Dhaka.*

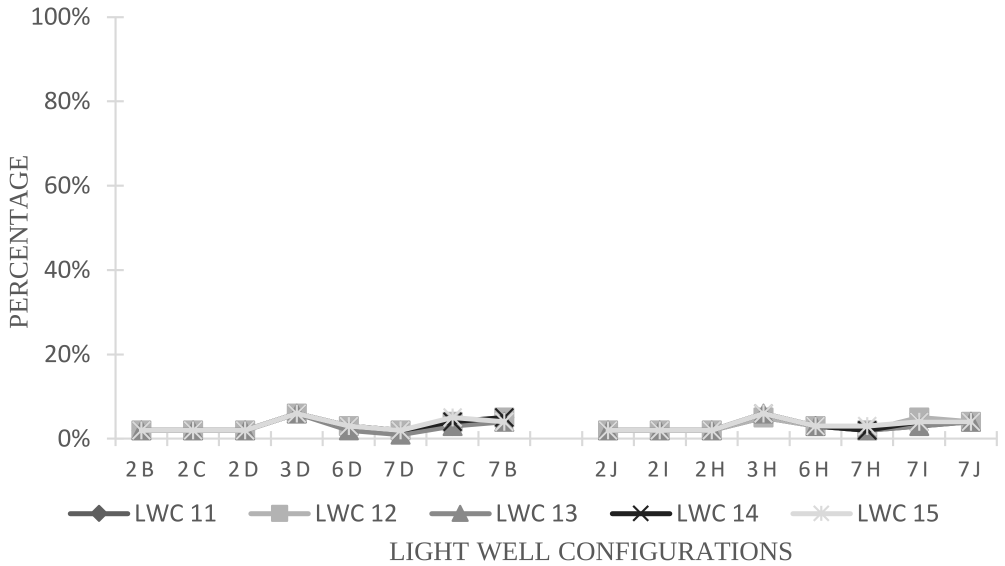



*Figure 4.16: UDI$_{<100}$ performance analysis for studied light well configurations with different shapes of RMG building in Dhaka.*

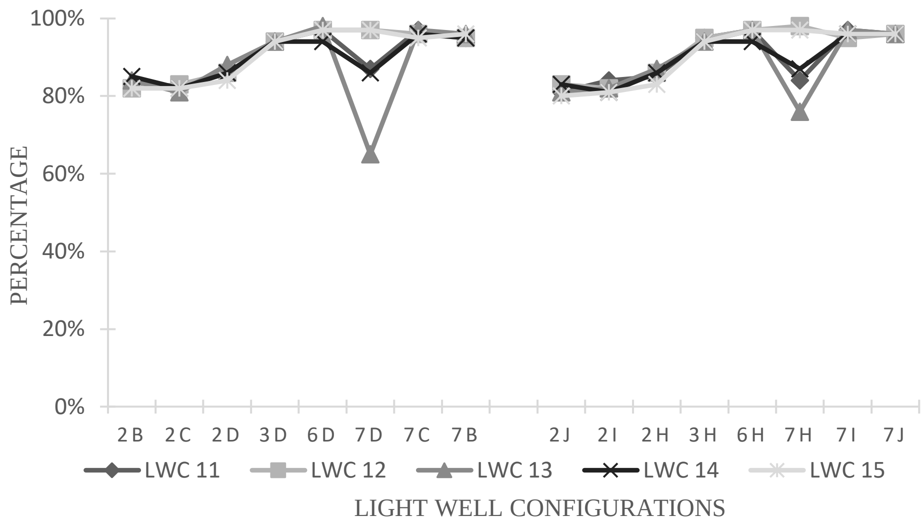



*Figure 4.17: UDI100-2000 performance analysis for studied light well configurations with different shapes of RMG building in Dhaka.*

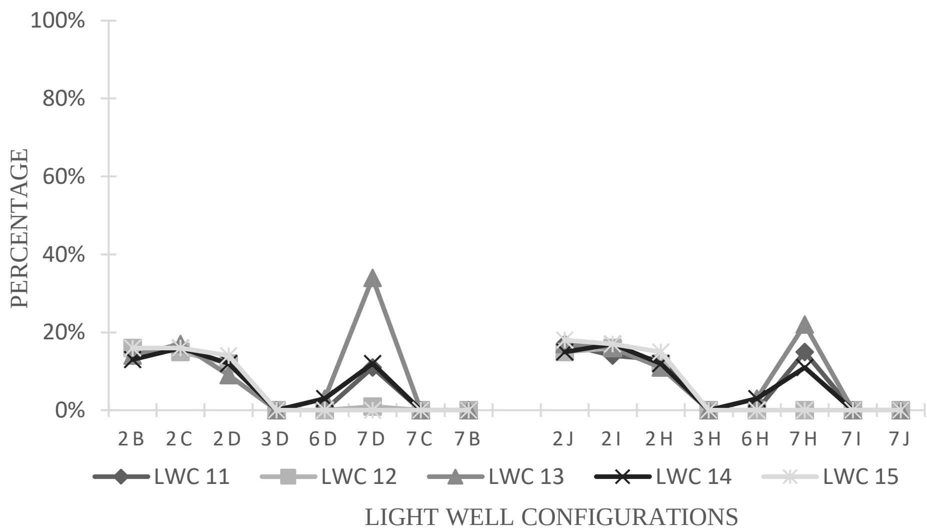


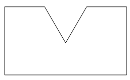
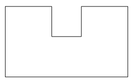
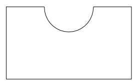
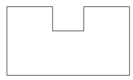
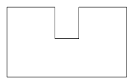

*Figure 4.18: UDI>2000 performance analysis for studied light well configurations with different shapes of RMG building in Dhaka.*

### g. Rating of different shape of light well

Table 4.21 shows the ranking of annual CBDM simulation with five light well configurations with different shapes within north oriented semi-enclosed light well. The same performance evaluation process was followed, as before, and rating analysis presents considering to the DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$ matrix.

Rating have been done to identify the most suitable light well configuration considering the average value of DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$ (Table 4.21). The rating was done considering the highest value of "4" and lowest value of "0" (Reinhart et al., 2006).

*Table 4.21: Rating system of the simulation results*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Different strategies** | **LWC 11** | **LWC 12** | **LWC 13** | **LWC 14** | **LWC 15** |
| **DA** | 3 | 1 | 4 | 3 | 1 |
| **$DA_{max}$** | 4 | 4 | 1 | 1 | 4 |
| **UDI<100** | 4 | 4 | 4 | 4 | 4 |
| **UDI 100-2000** | 2 | 4 | 0 | 2 | 4 |
| **UDI>2000** | 2 | 4 | 0 | 2 | 3 |
| **Rating points** | 15 | 17 | 9 | 12 | 16 |
| **Ranking** | 3rd | 1st | 5th | 4th | 2nd |

Summing the calculated rating points, the light well configuration LWC 12, square shaped with north oriented semi-enclosed light well, is found best with 17 points for the daylighting performance among the studied configurations. On the other hand, LWC 13, circular shaped within north oriented semi-enclosed light well performed poorly as lowest achieved only 9 points.

### *4.4.5 Parametric study with different proportion of light well*

In this Section, annual CBDM simulation was done on square shaped with north oriented semi-enclosed light well (LWC 12)which was found more superior than other studied configurations and shapes in the previous section of this chapter. For this experiment, square shaped with north oriented semi-enclosed typed light well was varied with different proportion with respect to the volume of the building. The square shaped with north oriented semi-enclosed light well was found as better result which proportion with respect to the volume of the building was 1:11.4 and this is near to 1:11. So that, the proportion of 1:11 and nearer proportion as 1:7, 1:8, 1:9, 1:10, 1:12, 1:13, 1:14 and 1:15 were selected for analysis for next phase of simulation studies. For this simulation phase, the other parameters remain constant as described in Chapter 3.

### *a. Dynamic daylight simulation for LWC 16*

Table 4.22 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:7 with respect to the volume of the building (LWC 16). It was found from Table 4.22 that the highest DA 97% is observed in the core sensor point 7D and the lowest DA 75% is observed in the core sensor point 7B. On the other hand, 7C and 7I sensor points show the best UDI value with highest $UDI_{100\text{-}2000}$(97%) and lowest $UDI_{<100}$(3%) and $UDI_{>2000}$(0%). 7D shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(58%) and highest $UDI_{>2000}$(40%).

*Table 4.22: Annual CBDM simulation result of square shaped north oriented semi-enclosed light well proportion of 1:7 with respect to the volume of the building (LWC16).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 82 | 16 |
| 2C | 94 | 1 | 2 | 79 | 19 |
| 2D | 94 | 0 | 2 | 82 | 17 |
| 2H | 93 | 0 | 2 | 83 | 15 |
| 2I | 94 | 1 | 2 | 79 | 19 |
| 2J | 94 | 0 | 2 | 79 | 19 |
| 3D | 81 | 0 | 4 | 96 | 0 |
| 3H | 80 | 0 | 4 | 96 | 0 |
| 6D | 96 | 11 | 2 | 68 | 30 |
| 6H | 96 | 10 | 2 | 71 | 27 |
| 7B | 75 | 0 | 4 | 96 | 0 |
| 7C | 82 | 0 | 3 | 97 | 0 |
| 7D | 97 | 17 | 1 | 58 | 40 |
| 7H | 96 | 18 | 1 | 60 | 39 |
| 7I | 83 | 0 | 3 | 97 | 0 |
| 7J | 77 | 0 | 4 | 96 | 0 |

### *b. Dynamic daylight simulation for LWC 17*

Table 4.23 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:8 with respect to the volume of the building (LWC 17). It was found from Table 4.23 that the highest DA 96% is observed in the core sensor points 7D and the lowest DA 71% is observed in the core sensor point 7B. On the other hand, 7I sensor point show the best UDI value with highest $UDI_{100-2000}$(97%) and lowest $UDI_{<100}$(3%) and $UDI_{>2000}$(0%). 7H shows the worst UDI value with lowest $UDI_{100-2000}$(73%) and highest $UDI_{>2000}$(25%).

*Table 4.23: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:8 with respect to the volume of the building (LWC 17).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 86 | 12 |
| 2C | 94 | 0 | 2 | 80 | 18 |
| 2D | 93 | 0 | 2 | 83 | 15 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 93 | 0 | 2 | 83 | 15 |
| 2J | 94 | 0 | 2 | 82 | 16 |
| 3D | 80 | 0 | 4 | 96 | 0 |
| 3H | 79 | 0 | 5 | 95 | 0 |
| 6D | 94 | 5 | 2 | 80 | 19 |
| 6H | 93 | 5 | 2 | 82 | 17 |
| 7B | 71 | 0 | 5 | 95 | 0 |
| 7C | 79 | 0 | 4 | 96 | 0 |
| 7D | 96 | 10 | 1 | 69 | 30 |
| 7H | 95 | 8 | 2 | 73 | 25 |
| 7I | 82 | 0 | 3 | 97 | 0 |
| 7J | 77 | 0 | 4 | 96 | 0 |

### c. *Dynamic daylight simulation for LWC 18*

Table 4.24 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:9 with respect to the volume of the building (LWC 18).. It was found from Table 4.24 that the highest DA 94% is observed in the core sensor points 2B, 2I, 2J, 7D and 7H and the lowest DA 69% is observed in the core sensor point 7B. On the other hand, 7C, 7I and 7J sensor points show the best UDI value with highest $UDI_{100-2000}$(96%) and lowest $UDI_{>2000}$(0%). 2I shows the worst UDI value with lowest $UDI_{100-2000}$(80%) and highest $UDI_{>2000}$(18%).

*Table 4.24: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:9 with respect to the volume of the building (LWC 18).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 93 | 0 | 2 | 82 | 16 |
| 2D | 93 | 0 | 2 | 87 | 11 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 94 | 0 | 2 | 80 | 18 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 78 | 0 | 5 | 95 | 0 |
| 3H | 78 | 0 | 5 | 95 | 0 |
| 6D | 92 | 0 | 2 | 93 | 5 |
| 6H | 92 | 0 | 2 | 93 | 5 |
| 7B | 69 | 0 | 5 | 95 | 0 |
| 7C | 78 | 0 | 4 | 96 | 0 |
| 7D | 94 | 0 | 2 | 87 | 11 |
| 7H | 94 | 0 | 2 | 83 | 15 |
| 7I | 80 | 0 | 4 | 96 | 0 |
| 7J | 76 | 0 | 4 | 96 | 0 |

### *d. Dynamic daylight simulation for LWC 19*

Table 4.25 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:10 with respect to the volume of the building (LWC 19). It was found from Table 4.25 that the highest DA 94% is observed in the core sensor points 2C, 2I and 2J and the lowest DA 71% is observed in the core sensor point 7B. On the other hand, 6D sensor point show the best UDI value with highest $UDI_{100-2000}$(97%) and lowest $UDI_{<100}$(2%) and $UDI_{>2000}$(1%). 2J shows the worst UDI value with lowest $UDI_{100-2000}$(81%) and highest $UDI_{>2000}$(18%).

*Table 4.25: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:10 with respect to the volume of the building (LWC 19).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 84 | 14 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 93 | 0 | 2 | 83 | 15 |
| 2H | 93 | 0 | 2 | 86 | 12 |
| 2I | 94 | 0 | 2 | 82 | 17 |
| 2J | 94 | 0 | 2 | 81 | 18 |
| 3D | 76 | 0 | 5 | 95 | 0 |
| 3H | 74 | 0 | 5 | 95 | 0 |
| 6D | 89 | 0 | 2 | 97 | 1 |
| 6H | 89 | 0 | 3 | 97 | 0 |
| 7B | 71 | 0 | 5 | 95 | 0 |
| 7C | 79 | 0 | 4 | 96 | 0 |
| 7D | 92 | 0 | 2 | 92 | 6 |
| 7H | 92 | 0 | 2 | 90 | 8 |
| 7I | 75 | 0 | 4 | 96 | 0 |
| 7J | 77 | 0 | 4 | 96 | 0 |

### *e. Dynamic daylight simulation for LWC 20*

Table 4.26 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:11 with respect to the volume of the building (LWC 20). It was found from Table 4.26 that the highest DA 94% is observed in the core sensor points 2B, 2C, 2I and 2J and the lowest DA 70% is observed in the core sensor point 7B. On the other hand, 6D and 6D sensor points show the best UDI value with highest $UDI_{100\text{-}2000}$(97%) and lowest $UDI_{<100}$(3%) and $UDI_{>2000}$(0%). 2C, 2I and 2J shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(81%) and highest $UDI_{>2000}$(17%).

*Table 4.26: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:11 with respect to the volume of the building (LWC 20).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 84 | 14 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 93 | 0 | 2 | 84 | 14 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 74 | 0 | 5 | 95 | 0 |
| 3H | 65 | 0 | 6 | 94 | 0 |
| 6D | 83 | 0 | 3 | 97 | 0 |
| 6H | 86 | 0 | 3 | 97 | 0 |
| 7B | 70 | 0 | 5 | 95 | 0 |
| 7C | 76 | 0 | 4 | 96 | 0 |
| 7D | 91 | 0 | 2 | 96 | 2 |
| 7H | 91 | 0 | 2 | 96 | 1 |
| 7I | 78 | 0 | 4 | 96 | 0 |
| 7J | 71 | 0 | 5 | 95 | 0 |

### *f. Dynamic daylight simulation for LWC 21*

Table 4.27 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of the building (LWC 21). It was found from Table 4.27 that the highest DA 94% is observed in the core sensor points 2B, 2C, 2I and 2J and the lowest DA 68% is observed in the core sensor point 3H. On the other hand, 7H sensor point show the best UDI value with highest $UDI_{100\text{-}2000}$(98%) and lowest $UDI_{<100}$(2%) and $UDI_{>2000}$(0%). 2C and 2I shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(81%) and highest $UDI_{>2000}$(17%).

*Table 4.27: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of the building (LWC 21).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 92 | 0 | 2 | 89 | 9 |
| 2H | 93 | 0 | 2 | 86 | 12 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 82 | 16 |
| 3D | 72 | 0 | 5 | 95 | 0 |
| 3H | 68 | 0 | 6 | 94 | 0 |
| 6D | 82 | 0 | 3 | 97 | 0 |
| 6H | 82 | 0 | 3 | 97 | 0 |
| 7B | 69 | 0 | 5 | 95 | 0 |
| 7C | 74 | 0 | 4 | 96 | 0 |
| 7D | 88 | 0 | 3 | 97 | 0 |
| 7H | 91 | 0 | 2 | 98 | 0 |
| 7I | 75 | 0 | 4 | 96 | 0 |
| 7J | 78 | 0 | 4 | 96 | 0 |

### *g. Dynamic daylight simulation for LWC 22*

Table 4.28 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:13 with respect to the volume of the building (LWC 22). It was found from Table 4.28 that the highest DA 94% is observed in the core sensor points 2H, 2I and 2J and the lowest DA 62% is observed in the core sensor point 3D. On the other hand, 7H sensor point show the best UDI value with highest $UDI_{100-2000}$(98%) and lowest $UDI_{<100}$(2%) and $UDI_{>2000}$(0%). 2I and 2J shows the worst UDI value with lowest $UDI_{100-2000}$(81%) and highest $UDI_{>2000}$(17%).

*Table 4.28: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:13 with respect to the volume of the building (LWC 22).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100-2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 83 | 15 |
| 2C | 93 | 0 | 2 | 82 | 16 |
| 2D | 93 | 0 | 2 | 83 | 15 |
| 2H | 94 | 0 | 2 | 82 | 16 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 62 | 0 | 6 | 94 | 0 |
| 3H | 69 | 0 | 5 | 95 | 0 |
| 6D | 79 | 0 | 4 | 96 | 0 |
| 6H | 82 | 0 | 3 | 97 | 0 |
| 7B | 66 | 0 | 6 | 94 | 0 |
| 7C | 72 | 0 | 5 | 95 | 0 |
| 7D | 86 | 0 | 3 | 97 | 0 |
| 7H | 91 | 0 | 2 | 98 | 0 |
| 7I | 75 | 0 | 4 | 96 | 0 |
| 7J | 74 | 0 | 5 | 95 | 0 |

### *h. Dynamic daylight simulation for LWC 23*

Table 4.29 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:14 with respect to the volume of the building (LWC 23). It was found from Table 4.29 that the highest DA 94% is observed in the core sensor points 2B, 2C, 2H, 2I and 2J and the lowest DA 65% is observed in the core sensor point 6D. On the other hand, 7D, and 7H sensor points show the best UDI value with highest $UDI_{100\text{-}2000}$(97%) and lowest $UDI_{<100}$(3%) and $UDI_{>2000}$(0%). 2J shows the worst UDI value with lowest $UDI_{100\text{-}2000}$(80%) and highest $UDI_{>2000}$(18%).

*Table 4.29: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:14 with respect to the volume of the building (LWC 23).*

| **Core points** | **DA (%)** | **$DA_{max}$ (%)** | **$UDI_{<100}$ (%)** | **$UDI_{100\text{-}2000}$ (%)** | **$UDI_{>2000}$ (%)** |
|---|---|---|---|---|---|
| 2B | 94 | 0 | 2 | 82 | 16 |
| 2C | 94 | 0 | 2 | 81 | 17 |
| 2D | 93 | 0 | 2 | 85 | 13 |
| 2H | 94 | 0 | 2 | 83 | 15 |
| 2I | 94 | 0 | 2 | 81 | 17 |
| 2J | 94 | 0 | 2 | 80 | 18 |
| 3D | 68 | 0 | 6 | 94 | 0 |
| 3H | 69 | 0 | 6 | 94 | 0 |
| 6D | 65 | 0 | 6 | 94 | 0 |
| 6H | 76 | 0 | 4 | 96 | 0 |
| 7B | 70 | 0 | 5 | 95 | 0 |
| 7C | 69 | 0 | 5 | 95 | 0 |
| 7D | 84 | 0 | 3 | 97 | 0 |
| 7H | 88 | 0 | 3 | 97 | 0 |
| 7I | 73 | 0 | 5 | 95 | 0 |
| 7J | 75 | 0 | 4 | 96 | 0 |

### i. *Dynamic daylight simulation for LWC 24*

Table 4.30 presents annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:15 with respect to the volume of the building (LWC 24). It was found from Table 4.30 that the highest DA 94% is observed in the core sensor points 2C and 2J and the lowest DA 67% is observed in the core sensor point 3H. On the other hand, 7D and 7H sensor points show the best UDI value with highest $UDI_{100-2000}$(97%) and lowest $UDI_{<100}$(0%) and $UDI_{>2000}$(0%). 2C shows the worst UDI value with lowest $UDI_{100-2000}$(80%) and highest $UDI_{>2000}$(18%).

*Table 4.30: Annual CBDM simulation result of the building with square shaped north oriented semi-enclosed light well proportion of 1:15 with respect to the volume of the building (LWC 24).*

| Core points | DA (%) | $DA_{max}$ (%) | $UDI_{<100}$ (%) | $UDI_{100-2000}$ (%) | $UDI_{>2000}$ (%) |
|---|---|---|---|---|---|
| 2B | 93 | 0 | 2 | 85 | 13 |
| 2C | 94 | 0 | 2 | 80 | 18 |
| 2D | 93 | 0 | 2 | 84 | 14 |
| 2H | 93 | 0 | 2 | 84 | 14 |
| 2I | 93 | 0 | 2 | 83 | 15 |
| 2J | 94 | 0 | 2 | 81 | 17 |
| 3D | 72 | 0 | 5 | 95 | 0 |
| 3H | 67 | 0 | 6 | 94 | 0 |
| 6D | 72 | 0 | 5 | 95 | 0 |
| 6H | 72 | 0 | 5 | 95 | 0 |
| 7B | 68 | 0 | 5 | 95 | 0 |
| 7C | 69 | 0 | 5 | 95 | 0 |
| 7D | 86 | 0 | 3 | 97 | 0 |
| 7H | 86 | 0 | 3 | 97 | 0 |
| 7I | 75 | 0 | 4 | 96 | 0 |
| 7J | 75 | 0 | 4 | 96 | 0 |

### *j. Comparison of different Proportions of light well*

Table 4.31 presents summery result of annual CBDM simulation for square shaped north oriented semi-enclosed light well with different proportion with respect to the volume of the building. The same performance evaluation process was followed, as before, and analysis shows, according to the DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$.

*Table 4.31: Summery results of dynamic simulation for square shaped north oriented semi-enclosed light well with different proportion with respect to the volume of the building.*

| Different strategies | LWC 16 | LWC 17 | LWC 18 | LWC 19 | LWC 20 | LWC 21 | LWC 22 | LWC 23 | LWC 24 |
|---|---|---|---|---|---|---|---|---|---|
| **Proportion** | **1:07** | **1:08** | **1:09** | **1:10** | **1:11** | **1:12** | **1:13** | **1:14** | **1:15** |
| **DA** | 89 | 88 | 87 | 86 | 84 | 84 | 82 | 81 | 81 |
| **DAmax** | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **UDI<100** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| **UDI 100-2000** | 82 | 86 | 89 | 90 | 91 | 91 | 91 | 90 | 91 |
| **UDI>2000** | 15 | 11 | 8 | 7 | 6 | 5 | 6 | 6 | 6 |

Different experimental proportion with respect to the volume of the building of square shaped north oriented semi-enclosed light well were compared in Figure 4.19, 4.20, 4.21, 4.22 and 4.23 with respect to different dynamic metrics.

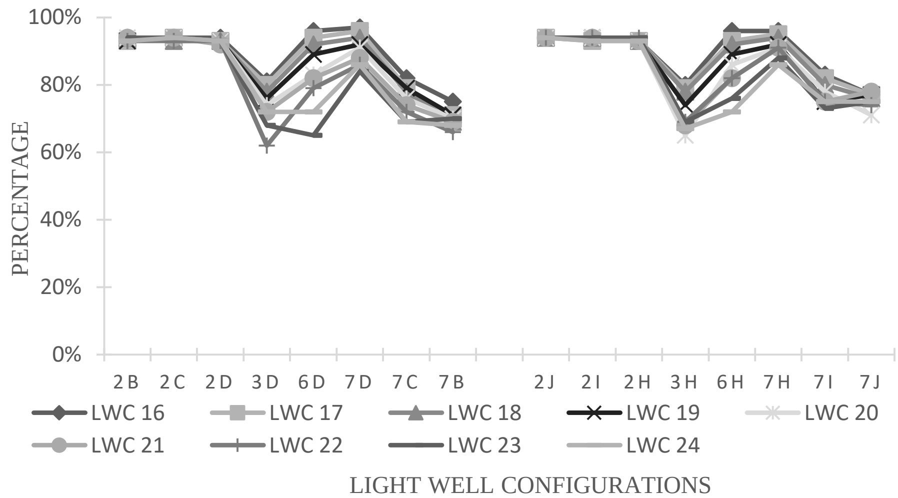



*Figure 4.19: DA performance analysis for studied light well configured types and shapes with different experimental proportions of RMG factories in Dhaka.*

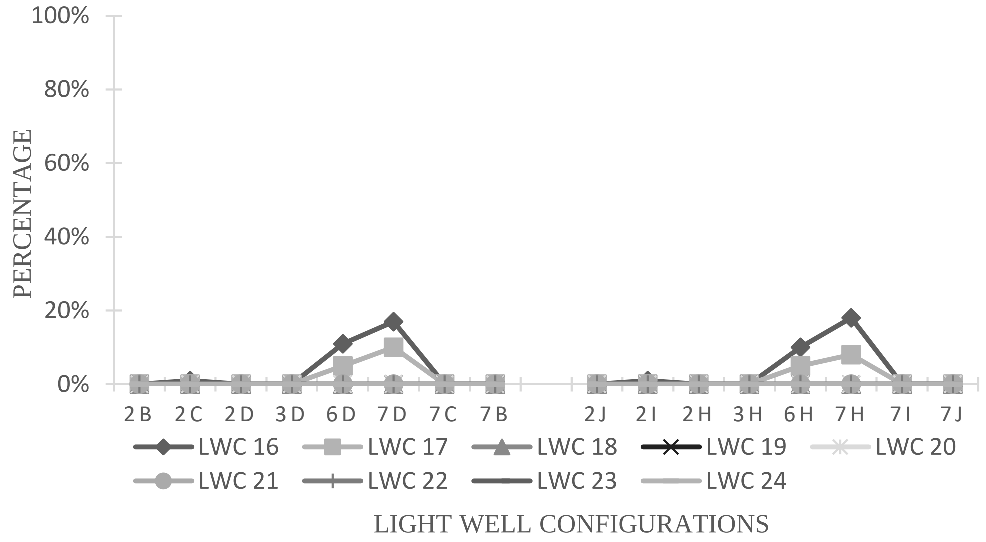



*Figure 4.20: $DA_{max}$ performance analysis for studied light well configured types and shapes with different experimental proportions of RMG factories in Dhaka.*

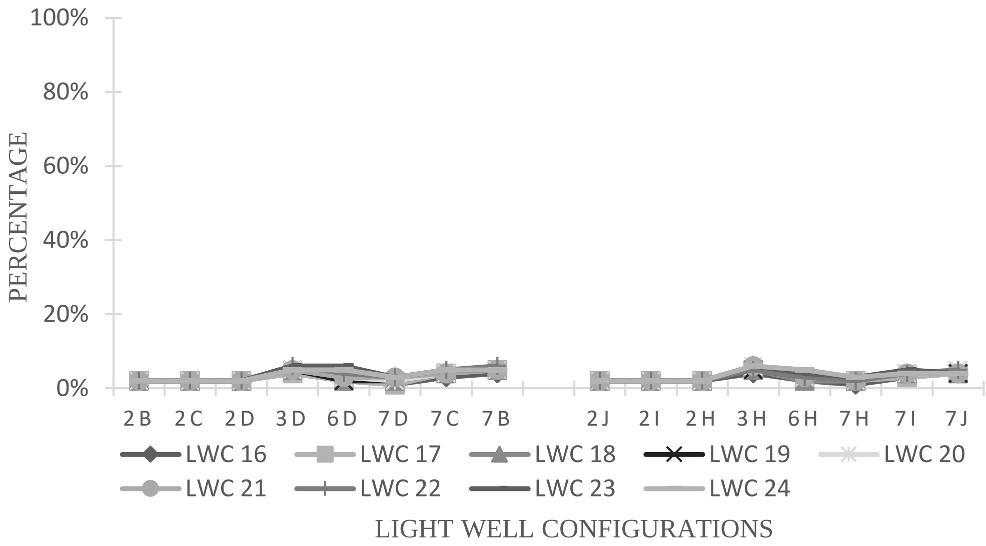



*Figure 4.21: $UDI_{<100}$ performance analysis for studied light well configured types and shapes with different experimental proportions of RMG factories in Dhaka.*

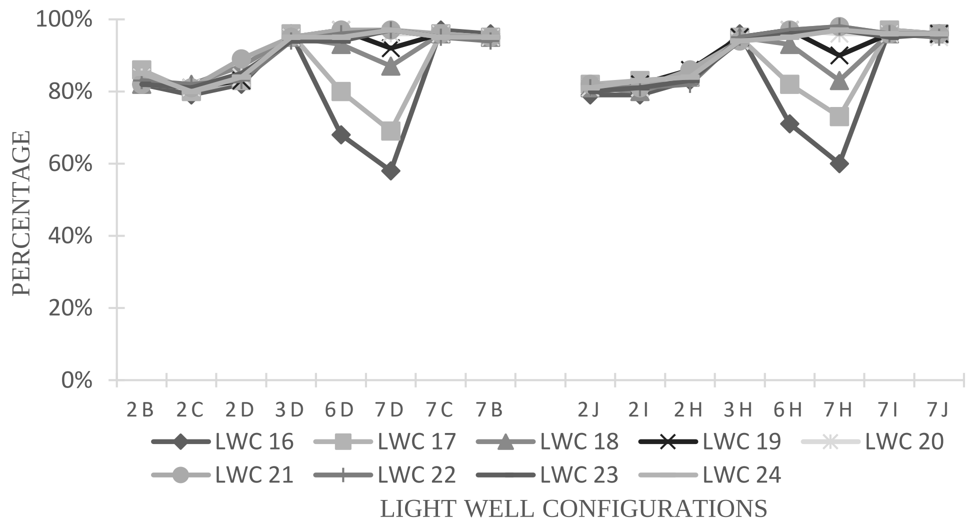



*Figure 4.22: UDI$_{100\text{-}2000}$ performance analysis for studied light well configured types and shapes with different experimental proportions of RMG factories in Dhaka.*

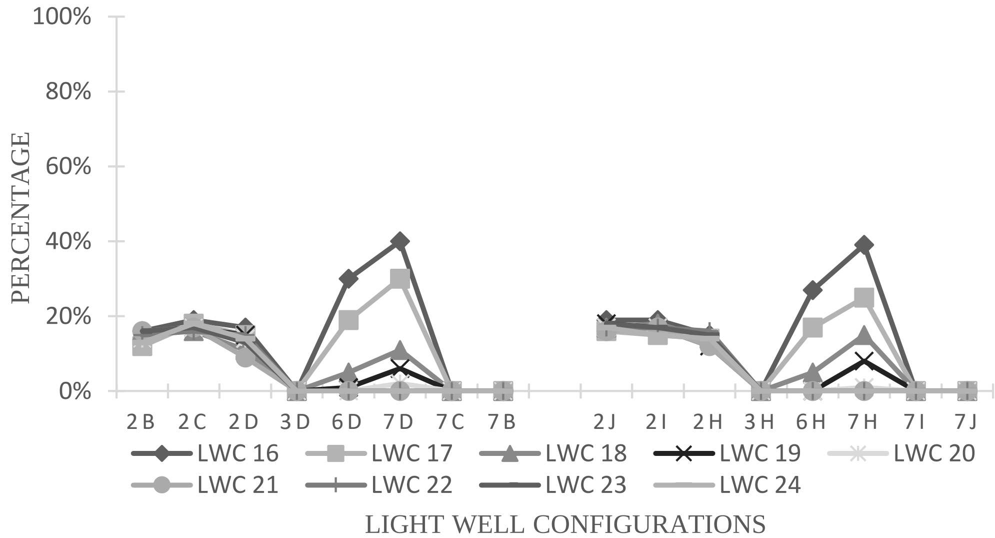



*Figure 4.23: UDI$_{>2000}$ performance analysis for studied light well configured types and shapes with different experimental proportions of RMG factories in Dhaka.*

### *k. Rating of different proportion of light wells*

Table 4.32 shows the ranking of annual CBDM simulation for square shaped north oriented semi-enclosed light well with different proportion with respect to the volume of the building. The same performance evaluation process was followed, as before, and analysis shows, according to the DA, DA$_{max}$, UDI$_{<100}$, UDI$_{100\text{-}2000}$and UDI$_{>2000}$.

*Table 4.32: Rating system of simulation results*

| Different strategies | LWC 16 | LWC 17 | LWC 18 | LWC 19 | LWC 20 | LWC 21 | LWC 22 | LWC 23 | LWC 24 |
|---|---|---|---|---|---|---|---|---|---|
| **Proportion** | **1:07** | **1:08** | **1:09** | **1:10** | **1:11** | **1:12** | **1:13** | **1:14** | **1:15** |
| **DA** | 8 | 7 | 6 | 5 | 4 | 4 | 2 | 1 | 1 |
| **DAmax** | 0 | 1 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| **UDI<100** | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 1 | 1 |
| **UDI 100-2000** | 0 | 1 | 2 | 4 | 8 | 8 | 8 | 4 | 8 |
| **UDI>2000** | 0 | 1 | 2 | 3 | 7 | 8 | 7 | 7 | 7 |
| **Rating points** | 16 | 18 | 26 | 28 | 35 | 36 | 33 | 21 | 25 |
| **Ranking** | 9th | 8th | 5th | 4th | 2nd | 1st | 3rd | 7th | 6th |

Rating have been done to identify the most suitable proportion of light well configuration considering the average value of DA, $DA_{max}$, $UDI_{<100}$, $UDI_{100-2000}$ and $UDI_{>2000}$(Table 4.32). The rating are done considering the highest value of "8" and lowest value of "0" (Reinhart et al., 2006).

Summing all the rating points, the light well configuration with square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of the building (LWC 21), is found best with 36 points for the daylighting performance among the studied other configurations. On the other hand, proportion of 1:7 (LWC 16) was performed as lowest achieved only 16 points.

So, the square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of the building (LWC 21), is recommended as the best for daylighting performance.

## 4.5 Strategies to improve illumination condition of RMG

This Section presents some strategies to improve illumination condition of RMG building.

### *4.5.1 Strategies to assign functions of RMG*

Labour force is an important input in industrial production (Yunus, 2012). And alternatively, the industry plays a key role in employment generation and to make a provision of income to the poor (Hasan, et al., 2016). In garment industry, the worker do highly critical job (Hasan, et al., 2016) such as, sewing, cutting and ironing where require more illumination than general office work. Incorporation of light well can improve the illumination condition of interior spaces of RMG building. To get advantage of light well properly, the more critical function where require maximum illumination should be allocated at top floor to get maximum daylighting. In case of light well, the higher floors indicate higher lighting levels than lower levels (Figure 4.26). Adequate lighting level can be achieved towards top floors. So, the functions such as loading unloading, warehouse, and office work should be allocated based on the lighting requirement. From literature review and standards, it was found that other functions require less illumination than production floor (Table 2.2 and Table 2.3). So, the production floor should be arranged in the top floor to get maximum daylighting.

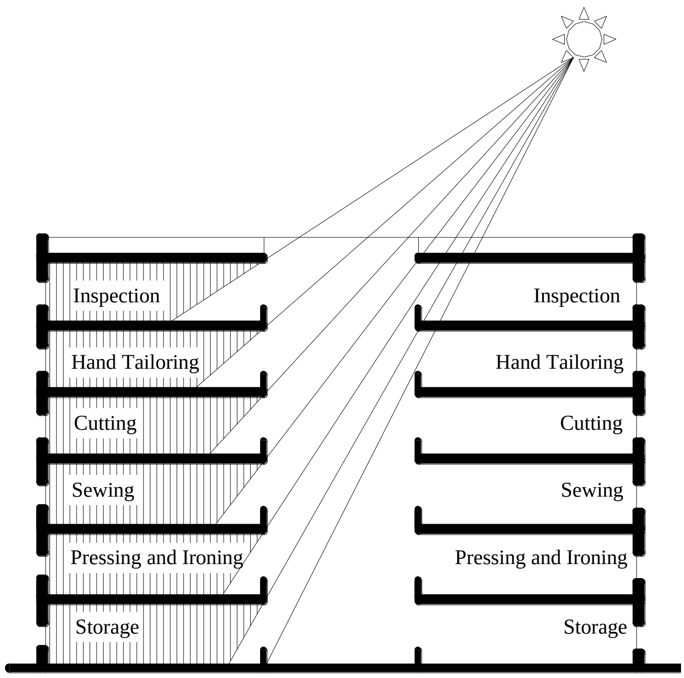



*Figure 4.24: Lighting distribution among the floors*

### *4.5.2 Strategies to proper maintenance of light well*

After incorporation of light well, it is necessary to ensure maintenance and to keep clean. Because of harshly environment and heavy rain and location of the north side, the outer surfaces of light well contain most of the dirt. Usually, it requires to clean inside and outside of the light well.

Light well cleaning is difficult because the deep space accumulates more dirt and stains, requiring extra scrubbing and access issues. A wide brush will quickly and easily clean the light well surfaces specially for very dirty surfaces. Light well can be cleaned using an nLite pole in combination with a bore hair or nylon brush. So, care should be taken and maintenance needs to be ensured by professionals.

## 4.6 Summary

This Chapter has accomplished the second and third objectives of the research. The second objective has been achieved by establishing a suitable light well configuration among different available light well configurations as an option for incorporation of useful daylight in the interior of RMG building in a more efficient way. For experiment, comparison were made between static metric and dynamic metric simulation results. LWC 08 (Square shaped north oriented semi-enclosed light well) found as most suitable light well configuration for RMG building in context of Dhaka, which can ensure uniform illumination level for RMG throughout the year.

The third objective has been reached by evaluating the performance of different experimental parametric configurations such as using different shapes and different proportions of light well with north oriented semi-enclosed light well, which was found as most suitable light well in context of Dhaka. Square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of the building (LWC 21) is found as the most suitable parametric configuration of light well.

The Chapter 4 leads to the presentation of the accomplishment of the objectives of research in next Chapter 5 with recommendation and suggestion for further research work.

# CHAPTER FIVE: CONCLUSION

# CHAPTER FIVE: CONCLUSION

## 5.1 Preamble

The first Chapter introduces the research. The theoretical background of the research and a strong understanding of light well configurations and different parametric standards were delivered in Chapter 2.The different steps of the methodologies which was followed in simulation study, have explained in Chapter 3. The static and the detail dynamic performance analysis and rating system of simulated results were presented and discussed to find out the most suitable light well configuration in Chapter 4. Parametric simulation study was also done to find out the best possible parametric configuration of the suitable light well configuration. This Chapter will conclude the research with accomplishment of the objectives which was stated in Chapter 1 and deliver some recommendations for incorporation of light well in RMG buildings and make suggestion for further research work.

## 5.2 Achievement of the objectives

The achievement of the objectives of this research, developed in Chapter 1 (Section 1.4) are discussed in this section as following.

### *5.2.1 Benefits of light wells*

The first objective was to rationalize the benefits of light wells in deep plan RMG buildings. To achieve this objective literature review on light well was accomplished at first. From literature review, the following benefits were found.

- Light wells increase daylight penetration in the core space of the building and reduce heating loads creating for artificial lighting especially in deep plan building.

- Light wells improve environmental benefits such as, solar gain in winter, reduce energy losses and natural ventilation.

- Light well also act as a buffer space sheltering from wind, rain and other outdoor environmental factors while remaining the outdoor effects such as fresh air, natural light and sunshine.
- By using plant filled light well, air could be filtered and particulates removed when it enters hollow space.
- Effective incorporation of light well in deep plan RMG building can accommodate daylight to meet the visual and psychological needs of RMG workers e.g. increase view, productivity, and aesthetics.
- Daylighting from light wells not only save potential energy but also make a higher standards of living and working environment.

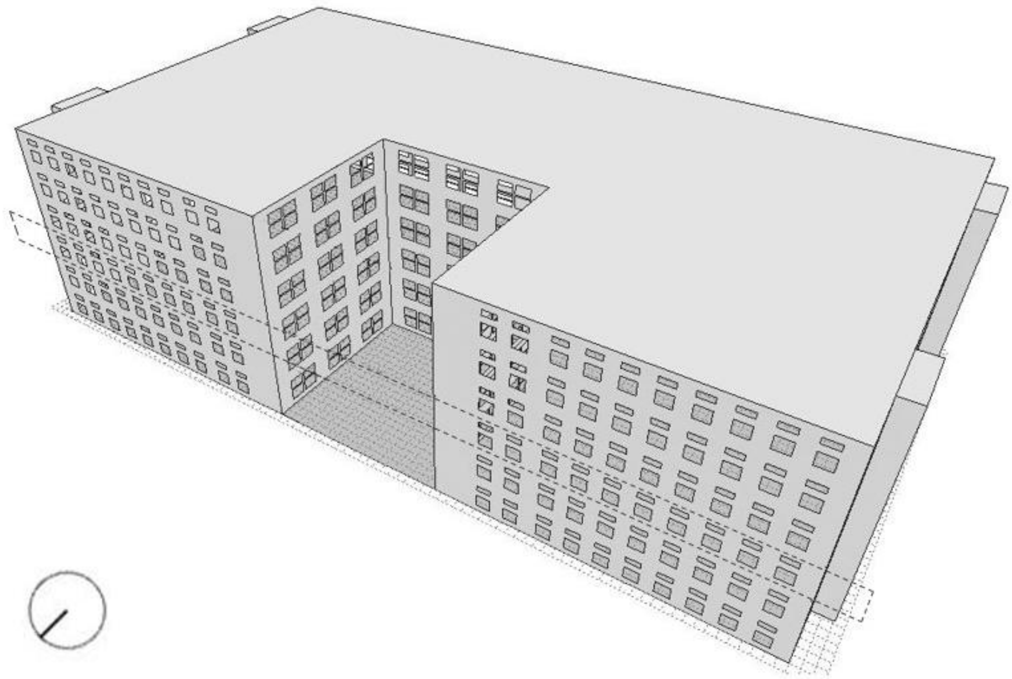


*Figure 5.1: Square shaped north oriented semi-enclosed light well (LWC 12)*

### *5.2.1 Identification of the best possible parametric configuration of light well*

The second objective was to find out a suitable light well configuration for RMG building to increase useful daylight in interior space of RMG building in Dhaka city. In order to accomplish this objective at first literature review was accompanied to find out the suitable light well configuration for RMG buildings. Later the static and dynamic simulation performance metrics were accompanied on the three recommended light well configurations and three basic shapes (i.e. square, circular and triangular) and rectangular shape in two orientations for RMG buildings to find out the most suitable light well type. Square shaped north oriented semi-enclosed type light well (LWC 12) (Figure 5.1) was found as the most suitable light well configuration for RMG building from the performance metrics rating system.

### *5.2.2 Effective ratio of light well to building volume in context of RMG building*

The third objective was to identify the effective ratio of light well with respect to the volume in context of RMG building. To achieve this objective, experimental parametric study was done by varying different proportion of light well with respect to the volume of the building (LWC 12), which was established as most suitable light well configuration in context of Dhaka as the outcome of Objective 2.

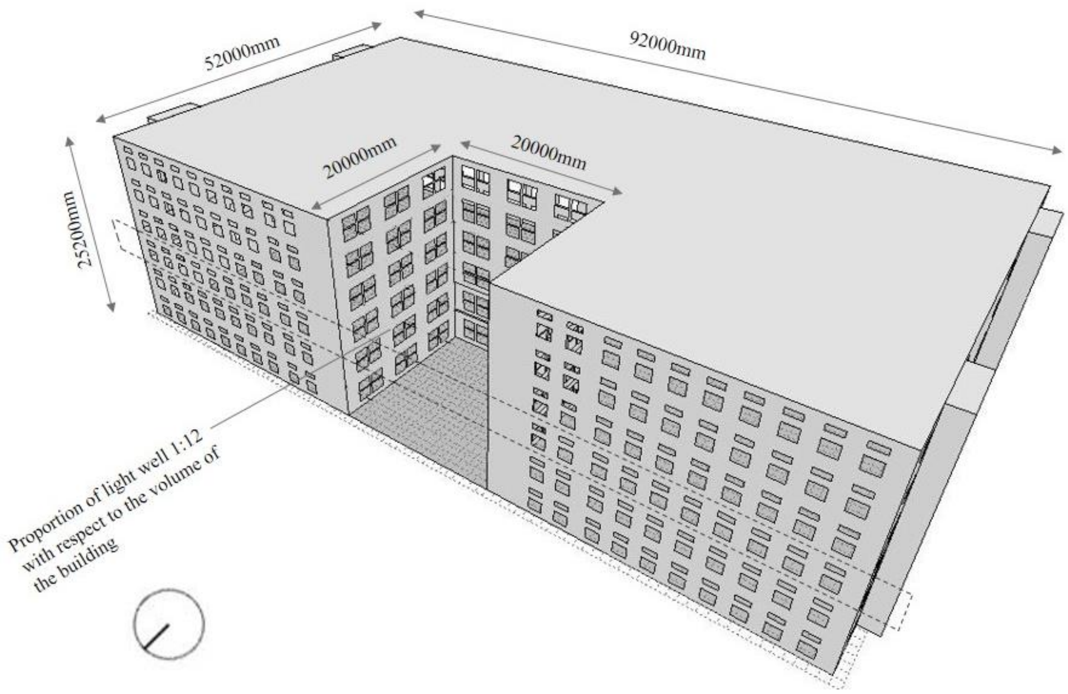



*Figure 5.2: Square shaped north oriented semi-enclosed light well proportion of 1:12 (LWC 21)*

After analysis of the performance of this experimental parametric study, proportion of 1:12 with respect to the volume of the building (LWC 21) was found better than other proportions of light well for case RMG Building. So, square shaped north oriented semi-enclosed light well proportion of 1:12 (LWC 21) with respect to the building volume for a six storied RMG building (Figure 5.2) was found as the best studied parametric configuration in context of Dhaka in this research work.

## 5.3 Recommendations

The following recommendations are given in order to progress the luminous environment by incorporating light well in the RMG building, in context of Dhaka.

- Use square shaped north oriented semi-enclosed light well proportion of 1:12 with respect to the volume of six storied RMG building, which was found in this research as most suitable parametric configuration of light well for useful daylight illumination among other studies light well configurations.

## 5.4 Suggestions for Future Research work

For future extent, some essential facts required to keep in mind for RMG factory building with reference to light well are following.

- In this research a proportion of 1:12 with respect to the building volume for RMG building is recommended for six storied RMG building located in Dhaka. Further research is needed to identify the ratio for RMG building with other stories, e.g. 2, 3, 4, 5, 7, 8… story RMG building and also for other types of building located in different cities.
- More research is required to measure the psychological impact of daylight inclusion through light well for RMG buildings.
- The significances of daylight inclusion through light well on overall energy savings for RMG buildings need to be studied.
- More studies can be done to fix appropriate comfort levels of daylight, artificial light and the total visual environment for RMG building daylighted through light well.

- Exploration can be done to find out the effect of daylight inclusion on workers effectiveness to increase productivity for RMG building daylighted through light well.
- Further research is required to control temperature through light well, keeping useful daylight which have not done in this research for RMG buildings.

It is anticipated that the research can be used as a basis for future research to investigate other features which described above associated with illumination condition of RMG buildings.

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# APPENDIX

**Appendix A** presents the specification of tools and simulation software.

**Appendix B** presents the detail annual CBDM simulation results.

**Appendix C** presents the meteorological data of Dhaka.

# Appendix A: Specifications

## A1: About ECOTECT software

ECOTECT v5.20

The Ecotect software was developed by Dr. Andrew Marsh as part of his PhD thesis in the University of Western Australia. It is a very useful tool for architects to test the environmental impact on their design scheme even at an early design stage. Autodesk Ecotect is very user-friendly software that could potentially integrate with the architectural design process. The 3D models were first generated in the ECOTECT, to study the distribution and uniformity of daylight within the interior space using the split-flux method. Thermal performance analysis in Autodesk Ecotect is based on the Chartered Institution of Building Services Engineers (CIBSE) admittance method and thus inherits its limitations. Hence, the need to use more detailed thermal simulation tools during the final stage of a building design or research project.

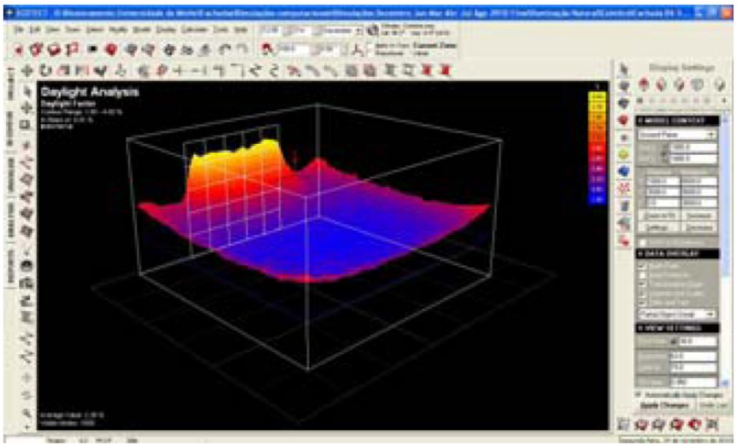


*Figure 0.1: ECOTECT main screen*

For daylighting performance analysis, Ecotect software was used to obtain illuminance levels and daylight factor (DF) for glazings. It is an environmental assessment tool that allows simulating a model in terms of thermal, acoustic and lighting, having several detailed analysis functions with a visual and interactive display that presents test results directly within the context of the model of the building.

Ecotect 5.6 tool offers a range of lighting analysis options. The main focus is on daylighting analysis. It implements the Building Research Establishments (BRE) split flux method for determining the natural light levels at points within a model. This is based on the Daylight Factor concept which is a ratio of the illuminance at a particular point within an enclosure to the simultaneous unobstructed outdoor illuminance. Figure presents the main screen of Ecotect for daylighting calculation.

Currently, the new version of Ecotect software is “Autodesk Ecotect Analysis”. It is now sustainable design analysis software with a comprehensive concept-to-detail sustainable building design tool. Ecotect Analysis offers a wide range of simulation and building energy analysis functionality that can improve performance of existing buildings and new building designs. This new version also allows simulation types shown in older versions (thermal performance, solar radiation and daylighting) whole building energy analysis; water usage and cost evaluation; shadows and reflections. For correct assessment of the values in daylighting simulations was required to produce the climate file from "epw" file (EnergyPlus) to “.wea” file in Ecotect 5.6. According to the latitude of the location the outside illuminance is calculated. Although the exterior illuminance obtained by software Ecotect present differences of the real situation, it is known that such values depend on the latitude of the location and do not affect the daylight factor obtained by computational simulation.

In this research the program used to calculate distribution of daylight on a specified work plane above the floor at a specific time (12.30 pm)

## A2: About DAYSIM software

DAYSIM version 2.1P4

DAYSIM is a validated daylighting analysis software that calculates the annual daylight availability in arbitrary buildings based on the RADIANCE backward raytracer. DAYSIM allows users to model dynamic facades systems ranging from standard venetian blinds to state-of-the-art light redirecting elements, switchable glazings and combinations thereof. Users may further specify complex electric lighting systems and controls including manual light switches, occupancy sensors and photocell controlled dimming.Simulation outputs range from climate-baseddaylighting metrics such as daylight autonomy and useful daylight illuminance to annual glare and electric lighting energy use. DAYSIM also generates hourly schedules for occupancy, electric lighting loads and shading device status which can be directly coupled with thermal simulation engines such as EnergyPlus, eQuest and TRNSYS.

DAYSIM is a *simulation engine* meaning that it consists of a series of command line programs that carry out the different simulation steps. DAYSIM users may choose from a variety of Graphical User Interfaces which call DAYSIM from within Rhinoceros, SketchUp and Ecotect.DaySim Standard is a travel demand microsimulation software package that works in conjunction withany of a number of traffic and transit assignment packages to forecast a population's response to changesin transport infrastructure or policy. DaySim Standard uses an integrated system of discrete choicemodels to simulate long term choices for each household, and the activity and travel choices for a 24 hourperiod for each household member. It uses48 half-hour time periods across the day as the basicunitsoftemporal resolution, and uses either individual parcels of land or block-sized microzones as the basic unitsof spatial resolution.

# Appendix B: Detail DAYSIM simulation results

# Appendix B1

## Table B1: Detail DAYSIM result of LWC 01

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9.2 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 17199512 |
| 1B | 0.76 | 9.5 | 98 | 99 | 61 | 1 | 17 | 82 | 0 | 18883974 |
| 1C | 0.76 | 9.3 | 98 | 99 | 61 | 1 | 17 | 82 | 0 | 19071334 |
| 1D | 0.76 | 9.6 | 98 | 99 | 60 | 1 | 17 | 82 | 0 | 18919062 |
| 1E | 0.76 | 8 | 98 | 99 | 53 | 1 | 23 | 76 | 0 | 15725910 |
| 1F | 0.76 | 8.9 | 98 | 99 | 55 | 1 | 21 | 78 | 0 | 17358204 |
| 1G | 0.76 | 7.2 | 98 | 99 | 41 | 1 | 31 | 68 | 18 | 13052593 |
| 1H | 0.76 | 8.2 | 98 | 99 | 49 | 1 | 27 | 72 | 0 | 16346397 |
| 1I | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18479448 |
| 1J | 0.76 | 9.7 | 98 | 99 | 60 | 1 | 16 | 83 | 0 | 19065136 |
| 1K | 0.76 | 9.4 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 17379416 |
| 2A | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 91 | 7 | 96 | 4171375 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4437733 |
| 2C | 0.76 | 3 | 94 | 97 | 1 | 2 | 79 | 20 | 96 | 4884532 |
| 2D | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 85 | 13 | 95 | 4120397 |
| 2F | 0.76 | 0.1 | 0 | 12 | 0 | 100 | 0 | 0 | 0 | 137473 |
| 2H | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3547046 |
| 2I | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4316625 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4708750 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 87 | 11 | 96 | 4333638 |
| 3A | 0.76 | 1.8 | 88 | 95 | 0 | 3 | 97 | 0 | 92 | 2917684 |
| 3B | 0.76 | 1 | 68 | 88 | 0 | 6 | 94 | 0 | 75 | 1587956 |
| 3C | 0.76 | 0.9 | 65 | 87 | 0 | 6 | 94 | 0 | 73 | 1548545 |
| 3D | 0.76 | 0.8 | 57 | 84 | 0 | 7 | 93 | 0 | 63 | 1379832 |
| 3F | 0.76 | 0 | 0 | 4 | 0 | 100 | 0 | 0 | 0 | 43252 |
| 3H | 0.76 | 0.8 | 52 | 82 | 0 | 7 | 93 | 0 | 54 | 1254692 |
| 3I | 0.76 | 1 | 75 | 90 | 0 | 5 | 95 | 0 | 83 | 1730400 |
| 3J | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1779478 |
| 3K | 0.76 | 2.3 | 93 | 97 | 0 | 2 | 95 | 3 | 95 | 3614834 |
| 4A | 0.76 | 0.6 | 39 | 75 | 0 | 11 | 89 | 0 | 18 | 980992 |
| 4B | 0.76 | 0.5 | 16 | 63 | 0 | 16 | 84 | 0 | 0 | 752199 |
| 4C | 0.76 | 0.4 | 5 | 52 | 0 | 25 | 75 | 0 | 0 | 595646 |
| 4D | 0.76 | 0.4 | 4 | 52 | 0 | 25 | 75 | 0 | 0 | 589616 |
| 4F | 0.76 | 0 | 0 | 2 | 0 | 100 | 0 | 0 | 0 | 22831 |
| 4H | 0.76 | 0.3 | 1 | 48 | 0 | 26 | 74 | 0 | 0 | 540775 |
| 4I | 0.76 | 0.4 | 12 | 60 | 0 | 17 | 83 | 0 | 0 | 683343 |
| 4J | 0.76 | 0.6 | 45 | 78 | 0 | 9 | 91 | 0 | 31 | 1014511 |
| 4K | 0.76 | 1.9 | 90 | 96 | 0 | 3 | 95 | 2 | 93 | 3011490 |
| 5A | 0.76 | 0.6 | 21 | 66 | 0 | 15 | 85 | 0 | 7 | 833402 |
| 5B | 0.76 | 0.4 | 0 | 44 | 0 | 32 | 68 | 0 | 0 | 507371 |

**Table B1:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5C | 0.76 | 0.3 | 0 | 34 | 0 | 47 | 53 | 0 | 0 | 394245 |
| 5D | 0.76 | 0.2 | 0 | 25 | 0 | 73 | 27 | 0 | 0 | 288165 |
| 5F | 0.76 | 0 | 0 | 2 | 0 | 100 | 0 | 0 | 0 | 19643 |
| 5H | 0.76 | 0.2 | 0 | 28 | 0 | 64 | 36 | 0 | 0 | 314243 |
| 5I | 0.76 | 0.3 | 0 | 40 | 0 | 34 | 66 | 0 | 0 | 454302 |
| 5J | 0.76 | 0.5 | 18 | 67 | 0 | 14 | 86 | 0 | 4 | 771118 |
| 5K | 0.76 | 2.1 | 91 | 96 | 0 | 3 | 94 | 4 | 93 | 3146014 |
| 6A | 0.76 | 1.9 | 84 | 93 | 0 | 3 | 97 | 0 | 86 | 2730198 |
| 6B | 0.76 | 0.6 | 6 | 61 | 0 | 17 | 83 | 0 | 0 | 716229 |
| 6C | 0.76 | 0.4 | 0 | 43 | 0 | 31 | 69 | 0 | 0 | 492492 |
| 6D | 0.76 | 0.2 | 0 | 26 | 0 | 70 | 30 | 0 | 0 | 300561 |
| 6E | 0.76 | 0.2 | 0 | 17 | 0 | 100 | 0 | 0 | 0 | 198260 |
| 6F | 0.76 | 0.1 | 0 | 10 | 0 | 100 | 0 | 0 | 0 | 113542 |
| 6G | 0.76 | 0.2 | 0 | 19 | 0 | 99 | 1 | 0 | 0 | 213931 |
| 6H | 0.76 | 0.3 | 0 | 30 | 0 | 58 | 42 | 0 | 0 | 337199 |
| 6I | 0.76 | 0.4 | 0 | 44 | 0 | 27 | 73 | 0 | 0 | 499457 |
| 6J | 0.76 | 0.6 | 20 | 69 | 0 | 13 | 87 | 0 | 4 | 800512 |
| 6K | 0.76 | 2 | 89 | 95 | 0 | 3 | 95 | 2 | 91 | 2914895 |
| 7A | 0.76 | 1.9 | 83 | 93 | 0 | 3 | 97 | 0 | 85 | 2231227 |
| 7B | 0.76 | 1.2 | 65 | 86 | 0 | 6 | 94 | 0 | 50 | 1344643 |
| 7C | 0.76 | 1.1 | 55 | 83 | 0 | 7 | 93 | 0 | 32 | 1177953 |
| 7D | 0.76 | 0.6 | 4 | 59 | 0 | 18 | 82 | 0 | 0 | 689819 |
| 7E | 0.76 | 0.2 | 0 | 23 | 0 | 88 | 12 | 0 | 0 | 264891 |
| 7F | 0.76 | 0.1 | 0 | 10 | 0 | 100 | 0 | 0 | 0 | 118165 |
| 7G | 0.76 | 0.3 | 0 | 26 | 0 | 73 | 27 | 0 | 0 | 297675 |
| 7H | 0.76 | 0.8 | 30 | 75 | 0 | 9 | 91 | 0 | 3 | 911779 |
| 7I | 0.76 | 1.2 | 64 | 87 | 0 | 5 | 95 | 0 | 47 | 1305412 |
| 7J | 0.76 | 1.3 | 72 | 89 | 0 | 5 | 95 | 0 | 62 | 1456154 |
| 7K | 0.76 | 1.7 | 83 | 93 | 0 | 3 | 97 | 0 | 87 | 2093424 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 74 | 25 | 98 | 5891998 |
| 8B | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4249823 |
| 8C | 0.76 | 4.5 | 94 | 97 | 0 | 2 | 97 | 1 | 97 | 4037540 |
| 8D | 0.76 | 3.5 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3155806 |
| 8E | 0.76 | 0.3 | 0 | 31 | 0 | 54 | 46 | 0 | 0 | 370823 |
| 8F | 0.76 | 0.1 | 0 | 12 | 0 | 100 | 0 | 0 | 0 | 135544 |
| 8G | 0.76 | 0.4 | 0 | 35 | 0 | 44 | 56 | 0 | 0 | 397707 |
| 8H | 0.76 | 3.8 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3386039 |
| 8I | 0.76 | 4.5 | 95 | 97 | 0 | 2 | 97 | 1 | 97 | 4080633 |
| 8J | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4309299 |
| 8K | 0.76 | 5.6 | 97 | 98 | 4 | 1 | 66 | 33 | 94 | 6245625 |
| | | | | | | | | | | |
| Average value | | | 52 | | 8 | 24 | 63 | 13 | | |

# Appendix B2

## Table B2: Detail DAYSIM result of LWC 02

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.6 | 98 | 99 | 53 | 1 | 23 | 75 | 0 | 16189535 |
| 1B | 0.76 | 8.3 | 98 | 99 | 53 | 1 | 24 | 75 | 0 | 17105148 |
| 1C | 0.76 | 8.8 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 17987750 |
| 1D | 0.76 | 9.1 | 98 | 99 | 54 | 1 | 22 | 77 | 0 | 17797516 |
| 1E | 0.76 | 8 | 98 | 99 | 52 | 1 | 26 | 73 | 0 | 15090925 |
| 1F | 0.76 | 8.9 | 98 | 99 | 53 | 1 | 24 | 75 | 0 | 16782404 |
| 1G | 0.76 | 7.5 | 98 | 99 | 49 | 1 | 28 | 71 | 0 | 14111006 |
| 1H | 0.76 | 8.5 | 98 | 99 | 53 | 1 | 23 | 76 | 0 | 17292204 |
| 1I | 0.76 | 8.5 | 98 | 99 | 54 | 1 | 23 | 75 | 0 | 17603428 |
| 1J | 0.76 | 8.9 | 98 | 99 | 54 | 1 | 20 | 79 | 0 | 17690672 |
| 1K | 0.76 | 8.7 | 98 | 99 | 54 | 1 | 20 | 79 | 0 | 16219926 |
| 2A | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 96 | 2 | 95 | 3704982 |
| 2B | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 91 | 7 | 95 | 3833907 |
| 2C | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 89 | 9 | 95 | 3920805 |
| 2D | 0.76 | 2.7 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4424237 |
| 2H | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 89 | 9 | 95 | 3947917 |
| 2I | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 90 | 8 | 95 | 3852503 |
| 2J | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 89 | 9 | 95 | 3986373 |
| 2K | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 93 | 5 | 96 | 4042098 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 92 | 2958647 |
| 3B | 0.76 | 0.8 | 61 | 85 | 0 | 7 | 93 | 0 | 67 | 1384703 |
| 3C | 0.76 | 1 | 72 | 89 | 0 | 5 | 95 | 0 | 81 | 1712516 |
| 3D | 0.76 | 1.5 | 80 | 92 | 0 | 4 | 96 | 0 | 88 | 2405091 |
| 3H | 0.76 | 0.8 | 55 | 84 | 0 | 7 | 93 | 0 | 63 | 1324001 |
| 3I | 0.76 | 0.7 | 49 | 81 | 0 | 8 | 92 | 0 | 51 | 1215912 |
| 3J | 0.76 | 0.9 | 68 | 88 | 0 | 6 | 94 | 0 | 75 | 1493676 |
| 3K | 0.76 | 2 | 92 | 96 | 0 | 2 | 96 | 2 | 94 | 3119872 |
| 4A | 0.76 | 0.5 | 15 | 63 | 0 | 17 | 83 | 0 | 1 | 751984 |
| 4B | 0.76 | 0.4 | 4 | 55 | 0 | 23 | 77 | 0 | 0 | 634446 |
| 4C | 0.76 | 0.5 | 22 | 62 | 0 | 20 | 80 | 0 | 1 | 743541 |
| 4D | 0.76 | 1.2 | 66 | 86 | 0 | 7 | 93 | 0 | 78 | 1866547 |
| 4H | 0.76 | 0.3 | 1 | 50 | 0 | 26 | 74 | 0 | 0 | 562472 |
| 4I | 0.76 | 0.4 | 9 | 58 | 0 | 18 | 82 | 0 | 0 | 661898 |
| 4J | 0.76 | 0.5 | 22 | 68 | 0 | 13 | 87 | 0 | 2 | 795102 |
| 4K | 0.76 | 1.9 | 91 | 96 | 0 | 3 | 95 | 3 | 93 | 3007156 |
| 5A | 0.76 | 0.5 | 6 | 56 | 0 | 23 | 77 | 0 | 0 | 656826 |
| 5B | 0.76 | 0.3 | 0 | 37 | 0 | 43 | 57 | 0 | 0 | 430789 |
| 5C | 0.76 | 0.4 | 0 | 46 | 0 | 36 | 64 | 0 | 0 | 530345 |

**Table B2:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5D | 0.76 | 1 | 58 | 81 | 0 | 9 | 91 | 0 | 69 | 1552475 |
| 5H | 0.76 | 0.3 | 0 | 35 | 0 | 54 | 46 | 0 | 0 | 397799 |
| 5I | 0.76 | 0.3 | 0 | 33 | 0 | 50 | 50 | 0 | 0 | 372227 |
| 5J | 0.76 | 0.4 | 2 | 56 | 0 | 20 | 80 | 0 | 0 | 620538 |
| 5K | 0.76 | 1.7 | 87 | 94 | 0 | 3 | 95 | 2 | 89 | 2576670 |
| 6A | 0.76 | 1.7 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 2457830 |
| 6B | 0.76 | 0.5 | 0 | 54 | 0 | 22 | 78 | 0 | 0 | 633141 |
| 6C | 0.76 | 0.4 | 0 | 50 | 0 | 27 | 73 | 0 | 0 | 579797 |
| 6D | 0.76 | 0.6 | 31 | 66 | 0 | 20 | 80 | 0 | 28 | 901399 |
| 6E | 0.76 | 2.5 | 87 | 95 | 7 | 3 | 87 | 11 | 73 | 5027098 |
| 6F | 0.76 | 3.3 | 91 | 96 | 14 | 2 | 68 | 30 | 65 | 6261746 |
| 6G | 0.76 | 2.4 | 86 | 94 | 7 | 3 | 87 | 10 | 73 | 4488444 |
| 6H | 0.76 | 0.4 | 1 | 45 | 0 | 36 | 64 | 0 | 0 | 507620 |
| 6I | 0.76 | 0.4 | 0 | 44 | 0 | 28 | 72 | 0 | 0 | 499780 |
| 6J | 0.76 | 0.6 | 23 | 73 | 0 | 10 | 90 | 0 | 3 | 854265 |
| 6K | 0.76 | 1.8 | 88 | 95 | 0 | 3 | 95 | 2 | 91 | 2766053 |
| 7A | 0.76 | 1.4 | 74 | 90 | 0 | 5 | 95 | 0 | 74 | 1754587 |
| 7B | 0.76 | 1.1 | 60 | 85 | 0 | 7 | 93 | 0 | 41 | 1250820 |
| 7C | 0.76 | 1.1 | 61 | 85 | 0 | 6 | 94 | 0 | 45 | 1262533 |
| 7D | 0.76 | 0.8 | 36 | 73 | 0 | 12 | 88 | 0 | 18 | 953005 |
| 7E | 0.76 | 0.7 | 35 | 68 | 0 | 19 | 81 | 0 | 31 | 950880 |
| 7F | 0.76 | 0.6 | 38 | 67 | 0 | 21 | 79 | 0 | 40 | 1010775 |
| 7G | 0.76 | 0.6 | 32 | 66 | 0 | 19 | 81 | 0 | 23 | 868396 |
| 7H | 0.76 | 0.7 | 25 | 69 | 0 | 14 | 86 | 0 | 2 | 829552 |
| 7I | 0.76 | 1.1 | 58 | 85 | 0 | 6 | 94 | 0 | 37 | 1200203 |
| 7J | 0.76 | 1.1 | 63 | 87 | 0 | 6 | 94 | 0 | 47 | 1277554 |
| 7K | 0.76 | 1.4 | 80 | 92 | 0 | 4 | 96 | 0 | 80 | 1774558 |
| 8A | 0.76 | 5 | 96 | 98 | 1 | 2 | 83 | 15 | 97 | 5329437 |
| 8B | 0.76 | 4 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3669395 |
| 8C | 0.76 | 3.7 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3451951 |
| 8D | 0.76 | 3.7 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3207062 |
| 8E | 0.76 | 0.4 | 0 | 47 | 0 | 36 | 64 | 0 | 0 | 543652 |
| 8F | 0.76 | 0.3 | 0 | 38 | 0 | 50 | 50 | 0 | 0 | 433265 |
| 8G | 0.76 | 0.5 | 1 | 51 | 0 | 27 | 73 | 0 | 0 | 584675 |
| 8H | 0.76 | 3.7 | 93 | 97 | 0 | 2 | 98 | 0 | 95 | 3317143 |
| 8I | 0.76 | 3.8 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3546161 |
| 8J | 0.76 | 3.9 | 94 | 97 | 0 | 2 | 98 | 0 | 96 | 3729212 |
| 8K | 0.76 | 5.3 | 97 | 98 | 3 | 1 | 73 | 25 | 95 | 5867122 |
| | | | | | | | | | | |
| Average value | | | 60 | | 8 | 11 | 76 | 13 | | |

# Appendix B3

## Table B3: Detail DAYSIM result of LWC03 (LWC08 or LWC15)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9.1 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 17170132 |
| 1B | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18783296 |
| 1C | 0.76 | 8.8 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18391800 |
| 1D | 0.76 | 8.9 | 98 | 99 | 54 | 1 | 22 | 77 | 0 | 17824484 |
| 1E | 0.76 | 7.4 | 98 | 99 | 48 | 1 | 30 | 69 | 0 | 14470330 |
| 1F | 0.76 | 8 | 98 | 99 | 47 | 1 | 29 | 70 | 0 | 15587193 |
| 1G | 0.76 | 7.4 | 98 | 99 | 46 | 1 | 28 | 70 | 0 | 13958110 |
| 1H | 0.76 | 9.4 | 98 | 99 | 60 | 1 | 17 | 82 | 0 | 18795014 |
| 1I | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18578316 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 18 | 81 | 0 | 18662752 |
| 1K | 0.76 | 9.1 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 17025824 |
| 2A | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4238622 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4524604 |
| 2C | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4403747 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4296916 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 91 | 6 | 95 | 3777365 |
| 2F | 0.76 | 2.1 | 91 | 96 | 0 | 2 | 94 | 3 | 94 | 3447923 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3564346 |
| 2H | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4297156 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4624681 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4746197 |
| 2K | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 91 | 7 | 95 | 4059311 |
| 3A | 0.76 | 2 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3133657 |
| 3B | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 80 | 1668461 |
| 3C | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 83 | 1741235 |
| 3D | 0.76 | 1 | 70 | 89 | 0 | 6 | 94 | 0 | 79 | 1644130 |
| 3E | 0.76 | 1.3 | 81 | 92 | 0 | 4 | 96 | 0 | 87 | 1907885 |
| 3F | 0.76 | 1.3 | 79 | 92 | 0 | 4 | 96 | 0 | 85 | 1871760 |
| 3G | 0.76 | 1.1 | 71 | 90 | 0 | 5 | 95 | 0 | 81 | 1652961 |
| 3H | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 80 | 1655670 |
| 3I | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 86 | 1830225 |
| 3J | 0.76 | 1.1 | 75 | 91 | 0 | 5 | 95 | 0 | 84 | 1761790 |
| 3K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3449549 |
| 4A | 0.76 | 0.7 | 44 | 77 | 0 | 10 | 90 | 0 | 24 | 1041711 |
| 4B | 0.76 | 0.5 | 17 | 65 | 0 | 15 | 85 | 0 | 0 | 766414 |
| 4C | 0.76 | 0.5 | 17 | 64 | 0 | 15 | 85 | 0 | 0 | 758766 |
| 4D | 0.76 | 0.8 | 48 | 80 | 0 | 8 | 92 | 0 | 43 | 1122574 |
| 4E | 0.76 | 2 | 85 | 94 | 0 | 3 | 97 | 0 | 90 | 2249647 |

**Table B3:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4F | 0.76 | 2.5 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 2763200 |
| 4G | 0.76 | 2.1 | 87 | 95 | 0 | 3 | 97 | 0 | 91 | 2371466 |
| 4H | 0.76 | 0.9 | 56 | 83 | 0 | 7 | 93 | 0 | 55 | 1210939 |
| 4I | 0.76 | 0.5 | 25 | 69 | 0 | 13 | 87 | 0 | 3 | 823483 |
| 4J | 0.76 | 0.6 | 39 | 76 | 0 | 10 | 90 | 0 | 21 | 958978 |
| 4K | 0.76 | 2.1 | 92 | 96 | 1 | 2 | 94 | 4 | 94 | 3233749 |
| 5A | 0.76 | 0.7 | 29 | 71 | 0 | 12 | 88 | 0 | 11 | 913010 |
| 5B | 0.76 | 0.4 | 0 | 49 | 0 | 25 | 75 | 0 | 0 | 571870 |
| 5C | 0.76 | 0.5 | 1 | 55 | 0 | 21 | 79 | 0 | 0 | 632512 |
| 5D | 0.76 | 1.2 | 68 | 87 | 0 | 5 | 95 | 0 | 66 | 1543843 |
| 5H | 0.76 | 1.2 | 64 | 86 | 0 | 6 | 94 | 0 | 56 | 1459818 |
| 5I | 0.76 | 0.6 | 15 | 66 | 0 | 14 | 86 | 0 | 0 | 771410 |
| 5J | 0.76 | 0.6 | 23 | 70 | 0 | 13 | 87 | 0 | 6 | 828015 |
| 5K | 0.76 | 2.1 | 91 | 96 | 0 | 2 | 94 | 3 | 93 | 3201605 |
| 6A | 0.76 | 1.9 | 83 | 93 | 0 | 3 | 97 | 0 | 85 | 2658227 |
| 6B | 0.76 | 0.8 | 39 | 78 | 0 | 9 | 91 | 0 | 9 | 1004745 |
| 6C | 0.76 | 0.7 | 26 | 70 | 0 | 13 | 87 | 0 | 8 | 872251 |
| 6D | 0.76 | 1.9 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2326703 |
| 6H | 0.76 | 1.9 | 80 | 93 | 0 | 3 | 97 | 0 | 85 | 2294505 |
| 6I | 0.76 | 0.8 | 34 | 75 | 0 | 10 | 90 | 0 | 14 | 948050 |
| 6J | 0.76 | 0.7 | 40 | 78 | 0 | 9 | 91 | 0 | 17 | 984086 |
| 6K | 0.76 | 2.2 | 91 | 96 | 1 | 2 | 93 | 4 | 94 | 3353973 |
| 7A | 0.76 | 1.9 | 85 | 94 | 0 | 3 | 97 | 0 | 86 | 2300338 |
| 7B | 0.76 | 1.4 | 74 | 91 | 0 | 4 | 96 | 0 | 73 | 1650428 |
| 7C | 0.76 | 1.4 | 72 | 89 | 0 | 5 | 95 | 0 | 70 | 1642789 |
| 7D | 0.76 | 2.6 | 89 | 95 | 0 | 2 | 97 | 0 | 93 | 3142354 |
| 7H | 0.76 | 2.5 | 87 | 95 | 0 | 3 | 97 | 0 | 91 | 2979808 |
| 7I | 0.76 | 1.5 | 76 | 91 | 0 | 4 | 96 | 0 | 76 | 1748237 |
| 7J | 0.76 | 1.5 | 78 | 91 | 0 | 4 | 96 | 0 | 76 | 1687087 |
| 7K | 0.76 | 1.7 | 85 | 94 | 0 | 3 | 97 | 0 | 89 | 2222105 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 73 | 26 | 98 | 6036941 |
| 8B | 0.76 | 4.4 | 95 | 97 | 0 | 2 | 97 | 1 | 97 | 4223924 |
| 8C | 0.76 | 4.4 | 95 | 97 | 0 | 2 | 96 | 2 | 97 | 4300990 |
| 8D | 0.76 | 4.9 | 95 | 98 | 0 | 2 | 81 | 17 | 98 | 5175603 |
| 8H | 0.76 | 5 | 96 | 98 | 0 | 2 | 81 | 17 | 97 | 5145600 |
| 8I | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4476645 |
| 8J | 0.76 | 4.8 | 96 | 98 | 0 | 2 | 95 | 4 | 97 | 4503136 |
| 8K | 0.76 | 5.6 | 97 | 98 | 4 | 1 | 66 | 33 | 94 | 6228366 |
| | | | | | | | | | | |
| Average value | | | 75 | | 8 | 5 | 81 | 14 | | |

## Appendix B4

### Table B4: Detail DAYSIM result of LWC 04

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16783844 |
| 1B | 0.76 | 9.2 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18493556 |
| 1C | 0.76 | 8.7 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 18175898 |
| 1D | 0.76 | 8.9 | 98 | 99 | 53 | 1 | 22 | 77 | 0 | 17817518 |
| 1E | 0.76 | 7.4 | 98 | 99 | 47 | 1 | 30 | 69 | 0 | 14379822 |
| 1F | 0.76 | 7.8 | 98 | 99 | 46 | 1 | 30 | 69 | 1 | 15299952 |
| 1G | 0.76 | 7.1 | 98 | 99 | 45 | 1 | 30 | 69 | 4 | 13666024 |
| 1H | 0.76 | 9.1 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18301176 |
| 1I | 0.76 | 8.8 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 18337520 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 17 | 82 | 0 | 18738580 |
| 1K | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 19 | 80 | 0 | 16765847 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 90 | 8 | 96 | 4179815 |
| 2B | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 86 | 12 | 95 | 4117267 |
| 2C | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 82 | 17 | 96 | 4462510 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4248180 |
| 2E | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 89 | 8 | 95 | 3855257 |
| 2F | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 6 | 95 | 3649952 |
| 2G | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 89 | 9 | 95 | 3982100 |
| 2H | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4389089 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4569189 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4574654 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 88 | 10 | 96 | 4338022 |
| 3A | 0.76 | 1.9 | 88 | 95 | 0 | 3 | 97 | 0 | 92 | 2994816 |
| 3B | 0.76 | 1 | 72 | 89 | 0 | 6 | 94 | 0 | 79 | 1684575 |
| 3C | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 78 | 1629690 |
| 3D | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 83 | 1732485 |
| 3E | 0.76 | 1.2 | 73 | 90 | 0 | 5 | 95 | 0 | 84 | 1849526 |
| 3F | 0.76 | 1.2 | 70 | 89 | 0 | 6 | 94 | 0 | 81 | 1818305 |
| 3G | 0.76 | 1.1 | 70 | 89 | 0 | 5 | 95 | 0 | 83 | 1815916 |
| 3H | 0.76 | 1 | 68 | 88 | 0 | 6 | 94 | 0 | 79 | 1673347 |
| 3I | 0.76 | 1 | 73 | 90 | 0 | 5 | 95 | 0 | 83 | 1728868 |
| 3J | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1798830 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 3 | 95 | 3544341 |
| 4A | 0.76 | 0.6 | 32 | 70 | 0 | 13 | 87 | 0 | 10 | 889085 |
| 4B | 0.76 | 0.5 | 15 | 63 | 0 | 16 | 84 | 0 | 0 | 743403 |
| 4C | 0.76 | 0.5 | 29 | 68 | 0 | 13 | 87 | 0 | 8 | 841280 |
| 4D | 0.76 | 0.8 | 53 | 81 | 0 | 8 | 92 | 0 | 60 | 1268244 |
| 4E | 0.76 | 1.7 | 81 | 93 | 0 | 4 | 96 | 0 | 89 | 2602135 |

**Table B4:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4F | 0.76 | 2.1 | 85 | 94 | 0 | 3 | 97 | 0 | 92 | 3056140 |
| 4G | 0.76 | 1.8 | 82 | 93 | 0 | 4 | 96 | 0 | 90 | 2585804 |
| 4H | 0.76 | 0.8 | 52 | 81 | 0 | 8 | 92 | 0 | 60 | 1246609 |
| 4I | 0.76 | 0.5 | 31 | 70 | 0 | 13 | 87 | 0 | 10 | 860898 |
| 4J | 0.76 | 0.6 | 45 | 78 | 0 | 9 | 91 | 0 | 32 | 1029199 |
| 4K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 3 | 94 | 3234757 |
| 5A | 0.76 | 0.5 | 12 | 61 | 0 | 17 | 83 | 0 | 1 | 736678 |
| 5B | 0.76 | 0.4 | 0 | 47 | 0 | 30 | 70 | 0 | 0 | 546441 |
| 5C | 0.76 | 0.5 | 17 | 62 | 0 | 19 | 81 | 0 | 0 | 736144 |
| 5D | 0.76 | 1.1 | 60 | 83 | 0 | 8 | 92 | 0 | 69 | 1588322 |
| 5H | 0.76 | 1.2 | 66 | 86 | 0 | 7 | 93 | 0 | 73 | 1703787 |
| 5I | 0.76 | 0.5 | 21 | 65 | 0 | 17 | 83 | 0 | 0 | 763396 |
| 5J | 0.76 | 0.6 | 30 | 73 | 0 | 11 | 89 | 0 | 10 | 880950 |
| 5K | 0.76 | 1.9 | 89 | 96 | 0 | 3 | 95 | 2 | 92 | 2989598 |
| 6A | 0.76 | 1.6 | 80 | 92 | 0 | 4 | 96 | 0 | 81 | 2408803 |
| 6B | 0.76 | 0.6 | 23 | 70 | 0 | 12 | 88 | 0 | 1 | 845798 |
| 6C | 0.76 | 0.7 | 30 | 70 | 0 | 15 | 85 | 0 | 15 | 892701 |
| 6D | 0.76 | 1.7 | 75 | 90 | 0 | 5 | 95 | 0 | 84 | 2403015 |
| 6H | 0.76 | 1.8 | 79 | 91 | 0 | 4 | 96 | 0 | 86 | 2533621 |
| 6I | 0.76 | 0.7 | 32 | 72 | 0 | 14 | 86 | 0 | 20 | 919149 |
| 6J | 0.76 | 0.8 | 48 | 81 | 0 | 8 | 92 | 0 | 25 | 1061684 |
| 6K | 0.76 | 2 | 89 | 96 | 1 | 3 | 94 | 4 | 92 | 3013925 |
| 7A | 0.76 | 1.6 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 2009044 |
| 7B | 0.76 | 1.3 | 69 | 88 | 0 | 5 | 95 | 0 | 64 | 1503921 |
| 7C | 0.76 | 1.4 | 69 | 88 | 0 | 5 | 95 | 0 | 71 | 1647587 |
| 7D | 0.76 | 2.3 | 85 | 94 | 0 | 3 | 96 | 1 | 92 | 3273502 |
| 7H | 0.76 | 2.5 | 87 | 95 | 0 | 3 | 96 | 2 | 93 | 3424749 |
| 7I | 0.76 | 1.5 | 74 | 90 | 0 | 4 | 96 | 0 | 77 | 1747033 |
| 7J | 0.76 | 1.3 | 74 | 90 | 0 | 5 | 95 | 0 | 70 | 1552743 |
| 7K | 0.76 | 1.5 | 81 | 93 | 0 | 4 | 96 | 0 | 84 | 1927141 |
| 8A | 0.76 | 5.6 | 96 | 98 | 1 | 1 | 76 | 22 | 98 | 5755254 |
| 8B | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 96 | 3 | 97 | 4360229 |
| 8C | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4508910 |
| 8D | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 78 | 21 | 98 | 5295801 |
| 8H | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 75 | 24 | 97 | 5562412 |
| 8I | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 93 | 6 | 97 | 4523550 |
| 8J | 0.76 | 4.5 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4246290 |
| 8K | 0.76 | 5.8 | 97 | 98 | 4 | 1 | 66 | 32 | 94 | 6228603 |
| | | | | | | | | | | |
| Average value | | | 74 | | 8 | 5 | 80 | 14 | | |

## Appendix B5

### Table B5: Detail DAYSIM result of LWC 05

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| B | 0.76 | 10.5 | 98 | 99 | 68 | 1 | 15 | 84 | 0 | 20266528 |
| 1C | 0.76 | 9.2 | 98 | 99 | 61 | 1 | 20 | 79 | 0 | 18920064 |
| 1D | 0.76 | 9.1 | 98 | 99 | 55 | 1 | 21 | 78 | 0 | 18135904 |
| 1E | 0.76 | 8.3 | 98 | 99 | 52 | 1 | 23 | 76 | 0 | 15620270 |
| 1F | 0.76 | 7.3 | 98 | 99 | 50 | 1 | 26 | 73 | 0 | 14299117 |
| 1G | 0.76 | 8.3 | 98 | 99 | 51 | 1 | 24 | 75 | 0 | 15422634 |
| 1H | 0.76 | 9.2 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18549488 |
| 1I | 0.76 | 9.5 | 98 | 99 | 63 | 1 | 15 | 84 | 0 | 19392022 |
| 1J | 0.76 | 11.1 | 99 | 99 | 72 | 1 | 12 | 87 | 0 | 21109138 |
| 2B | 0.76 | 5.6 | 97 | 98 | 29 | 1 | 45 | 54 | 63 | 10113882 |
| 2C | 0.76 | 3.2 | 95 | 97 | 2 | 2 | 77 | 21 | 97 | 5308672 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4281730 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 89 | 9 | 95 | 3773540 |
| 2F | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 89 | 9 | 95 | 3889775 |
| 2G | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 87 | 11 | 95 | 4054007 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4265654 |
| 2I | 0.76 | 2.9 | 95 | 97 | 1 | 2 | 79 | 19 | 97 | 5021867 |
| 2J | 0.76 | 5.8 | 97 | 99 | 33 | 1 | 40 | 59 | 39 | 11113118 |
| 3A | 0.76 | 3.2 | 94 | 97 | 0 | 2 | 80 | 19 | 96 | 5006730 |
| 3B | 0.76 | 1.7 | 85 | 94 | 0 | 4 | 96 | 0 | 91 | 2747796 |
| 3C | 0.76 | 1.1 | 73 | 90 | 0 | 5 | 95 | 0 | 79 | 1771566 |
| 3D | 0.76 | 0.9 | 68 | 88 | 0 | 6 | 94 | 0 | 75 | 1591999 |
| 3E | 0.76 | 0.9 | 67 | 88 | 0 | 6 | 94 | 0 | 72 | 1524712 |
| 3F | 0.76 | 0.8 | 52 | 83 | 0 | 7 | 93 | 0 | 57 | 1297766 |
| 3G | 0.76 | 0.9 | 65 | 88 | 0 | 6 | 94 | 0 | 71 | 1514201 |
| 3H | 0.76 | 0.9 | 68 | 89 | 0 | 6 | 94 | 0 | 76 | 1581766 |
| 3I | 0.76 | 1.1 | 82 | 92 | 0 | 4 | 96 | 0 | 88 | 1971049 |
| 3J | 0.76 | 1.7 | 90 | 95 | 0 | 3 | 97 | 0 | 93 | 2945924 |
| 3K | 0.76 | 3.4 | 95 | 98 | 1 | 2 | 68 | 30 | 97 | 5513302 |
| 4A | 0.76 | 0.9 | 54 | 82 | 0 | 7 | 93 | 0 | 54 | 1336129 |
| 4B | 0.76 | 0.7 | 48 | 79 | 0 | 8 | 92 | 0 | 41 | 1143593 |
| 4C | 0.76 | 0.5 | 21 | 65 | 0 | 15 | 85 | 0 | 4 | 793210 |
| 4D | 0.76 | 0.4 | 15 | 61 | 0 | 17 | 83 | 0 | 0 | 712308 |
| 4E | 0.76 | 0.4 | 4 | 52 | 0 | 24 | 76 | 0 | 0 | 594762 |
| 4F | 0.76 | 0.4 | 8 | 55 | 0 | 20 | 80 | 0 | 0 | 628608 |
| 4G | 0.76 | 0.3 | 3 | 50 | 0 | 25 | 75 | 0 | 0 | 569408 |
| 4H | 0.76 | 0.4 | 12 | 58 | 0 | 17 | 83 | 0 | 0 | 668049 |
| 4I | 0.76 | 0.6 | 33 | 73 | 0 | 10 | 90 | 0 | 16 | 907683 |
| 4J | 0.76 | 0.9 | 69 | 89 | 0 | 5 | 95 | 0 | 73 | 1536295 |

**Table B5:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4K | 0.76 | 2.3 | 93 | 97 | 1 | 2 | 93 | 5 | 95 | 3589186 |
| 5A | 0.76 | 0.9 | 49 | 79 | 0 | 8 | 92 | 0 | 29 | 1140162 |
| 5B | 0.76 | 0.7 | 27 | 71 | 0 | 12 | 88 | 0 | 2 | 878903 |
| 5C | 0.76 | 0.4 | 0 | 49 | 0 | 25 | 75 | 0 | 0 | 572810 |
| 5D | 0.76 | 0.3 | 0 | 39 | 0 | 38 | 62 | 0 | 0 | 445162 |
| 5E | 0.76 | 0.2 | 0 | 28 | 0 | 67 | 33 | 0 | 0 | 319684 |
| 5F | 0.76 | 0.2 | 0 | 26 | 0 | 72 | 28 | 0 | 0 | 298240 |
| 5G | 0.76 | 0.2 | 0 | 29 | 0 | 64 | 36 | 0 | 0 | 324487 |
| 5H | 0.76 | 0.3 | 0 | 38 | 0 | 38 | 62 | 0 | 0 | 429862 |
| 5I | 0.76 | 0.4 | 0 | 57 | 0 | 18 | 82 | 0 | 0 | 641534 |
| 5J | 0.76 | 0.9 | 62 | 86 | 0 | 6 | 94 | 0 | 50 | 1278280 |
| 5K | 0.76 | 2.3 | 92 | 96 | 1 | 2 | 94 | 4 | 95 | 3430380 |
| 6A | 0.76 | 2.9 | 91 | 96 | 0 | 2 | 96 | 2 | 94 | 3803016 |
| 6B | 0.76 | 1.4 | 73 | 90 | 0 | 5 | 95 | 0 | 71 | 1718369 |
| 6C | 0.76 | 0.7 | 18 | 69 | 0 | 12 | 88 | 0 | 1 | 842420 |
| 6D | 0.76 | 0.4 | 0 | 39 | 0 | 37 | 63 | 0 | 0 | 458652 |
| 6E | 0.76 | 0.2 | 0 | 24 | 0 | 82 | 18 | 0 | 0 | 279105 |
| 6F | 0.76 | 0.1 | 0 | 18 | 0 | 100 | 0 | 0 | 0 | 205740 |
| 6G | 0.76 | 0.2 | 0 | 26 | 0 | 72 | 28 | 0 | 0 | 296012 |
| 6H | 0.76 | 0.4 | 0 | 40 | 0 | 33 | 67 | 0 | 0 | 460198 |
| 6I | 0.76 | 0.7 | 30 | 75 | 0 | 9 | 91 | 0 | 7 | 909579 |
| 6J | 0.76 | 1.6 | 83 | 93 | 0 | 4 | 96 | 0 | 87 | 1989630 |
| 6K | 0.76 | 3.7 | 96 | 98 | 3 | 2 | 82 | 16 | 97 | 4858750 |
| 7B | 0.76 | 4.7 | 95 | 98 | 2 | 2 | 86 | 13 | 97 | 4915368 |
| 7C | 0.76 | 1.8 | 83 | 93 | 0 | 3 | 97 | 0 | 85 | 2102594 |
| 7D | 0.76 | 0.9 | 33 | 76 | 0 | 9 | 91 | 0 | 7 | 965956 |
| 7E | 0.76 | 0.3 | 0 | 33 | 0 | 46 | 54 | 0 | 0 | 390968 |
| 7F | 0.76 | 0.2 | 0 | 17 | 0 | 100 | 0 | 0 | 0 | 200332 |
| 7G | 0.76 | 0.3 | 0 | 36 | 0 | 39 | 61 | 0 | 0 | 401322 |
| 7H | 0.76 | 0.8 | 30 | 75 | 0 | 9 | 91 | 0 | 6 | 917861 |
| 7I | 0.76 | 1.7 | 84 | 94 | 0 | 3 | 97 | 0 | 85 | 2001633 |
| 7J | 0.76 | 4.9 | 96 | 98 | 3 | 2 | 80 | 18 | 97 | 5152223 |
| 8B | 0.76 | 8.4 | 98 | 98 | 21 | 1 | 47 | 52 | 85 | 8530348 |
| 8C | 0.76 | 5 | 96 | 98 | 0 | 2 | 90 | 9 | 97 | 4922813 |
| 8D | 0.76 | 3.6 | 92 | 97 | 0 | 2 | 98 | 0 | 95 | 3350720 |
| 8E | 0.76 | 0.4 | 0 | 39 | 0 | 36 | 64 | 0 | 0 | 463810 |
| 8F | 0.76 | 0.2 | 0 | 21 | 0 | 99 | 1 | 0 | 0 | 239730 |
| 8G | 0.76 | 0.4 | 0 | 41 | 0 | 30 | 70 | 0 | 0 | 472753 |
| 8H | 0.76 | 3.5 | 93 | 97 | 0 | 2 | 98 | 0 | 95 | 3206382 |
| 8I | 0.76 | 4.8 | 96 | 98 | 0 | 1 | 91 | 8 | 97 | 4789398 |
| 8J | 0.76 | 8.1 | 98 | 99 | 23 | 1 | 45 | 54 | 80 | 8391780 |
| Average value | | | 57 | | 8 | 17 | 69 | 14 | | |

## Appendix B6

### Table B6: Detail DAYSIM result of LWC 06

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1B | 0.76 | 7.7 | 98 | 99 | 49 | 1 | 32 | 67 | 0 | 15223131 |
| 1C | 0.76 | 9 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18676484 |
| 1D | 0.76 | 9.2 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18648988 |
| 1E | 0.76 | 9.2 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 17714600 |
| 1F | 0.76 | 7.1 | 98 | 99 | 48 | 1 | 28 | 71 | 0 | 14077531 |
| 1G | 0.76 | 9.2 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 17860640 |
| 1H | 0.76 | 9.4 | 98 | 99 | 61 | 1 | 17 | 82 | 0 | 19000882 |
| 1I | 0.76 | 9 | 98 | 99 | 59 | 1 | 21 | 78 | 0 | 18653128 |
| 1J | 0.76 | 7.7 | 98 | 99 | 46 | 1 | 35 | 64 | 5 | 14604291 |
| 2B | 0.76 | 2.7 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4406416 |
| 2C | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4635714 |
| 2D | 0.76 | 2.9 | 94 | 97 | 1 | 2 | 79 | 20 | 96 | 4911532 |
| 2E | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4530046 |
| 2F | 0.76 | 2.5 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4345286 |
| 2G | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4352648 |
| 2H | 0.76 | 2.8 | 94 | 97 | 1 | 2 | 80 | 18 | 96 | 4659482 |
| 2I | 0.76 | 3.2 | 94 | 97 | 1 | 2 | 77 | 21 | 97 | 5174516 |
| 2J | 0.76 | 2.9 | 93 | 97 | 0 | 2 | 81 | 17 | 96 | 4664503 |
| 3A | 0.76 | 1.7 | 83 | 93 | 0 | 4 | 96 | 0 | 85 | 2721330 |
| 3B | 0.76 | 1 | 66 | 87 | 0 | 6 | 94 | 0 | 76 | 1605919 |
| 3C | 0.76 | 1 | 68 | 88 | 0 | 6 | 94 | 0 | 78 | 1649626 |
| 3D | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 82 | 1770029 |
| 3E | 0.76 | 1.1 | 75 | 91 | 0 | 5 | 95 | 0 | 84 | 1827349 |
| 3F | 0.76 | 1 | 73 | 90 | 0 | 5 | 95 | 0 | 82 | 1775289 |
| 3G | 0.76 | 1 | 67 | 88 | 0 | 6 | 94 | 0 | 77 | 1643977 |
| 3H | 0.76 | 1.1 | 72 | 90 | 0 | 5 | 95 | 0 | 82 | 1770733 |
| 3I | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 81 | 1723853 |
| 3J | 0.76 | 1.2 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1881791 |
| 3K | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 96 | 2 | 95 | 3512859 |
| 4A | 0.76 | 0.6 | 35 | 70 | 0 | 14 | 86 | 0 | 18 | 903425 |
| 4B | 0.76 | 0.5 | 22 | 65 | 0 | 16 | 84 | 0 | 3 | 767270 |
| 4C | 0.76 | 0.5 | 18 | 62 | 0 | 17 | 83 | 0 | 2 | 728917 |
| 4D | 0.76 | 0.4 | 16 | 60 | 0 | 18 | 82 | 0 | 2 | 706036 |
| 4E | 0.76 | 0.5 | 20 | 62 | 0 | 16 | 84 | 0 | 6 | 752442 |
| 4F | 0.76 | 0.5 | 21 | 64 | 0 | 15 | 85 | 0 | 7 | 779915 |
| 4G | 0.76 | 0.4 | 17 | 59 | 0 | 19 | 81 | 0 | 3 | 698816 |
| 4H | 0.76 | 0.5 | 21 | 64 | 0 | 15 | 85 | 0 | 6 | 777035 |
| 4I | 0.76 | 0.5 | 27 | 68 | 0 | 14 | 86 | 0 | 7 | 819507 |
| 4J | 0.76 | 0.7 | 47 | 78 | 0 | 9 | 91 | 0 | 33 | 1038231 |
| 4K | 0.76 | 2.1 | 91 | 96 | 0 | 3 | 94 | 3 | 94 | 3228028 |

**Table B6:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5A | 0.76 | 0.5 | 22 | 64 | 0 | 17 | 83 | 0 | 7 | 780345 |
| 5B | 0.76 | 0.4 | 4 | 53 | 0 | 25 | 75 | 0 | 0 | 605443 |
| 5C | 0.76 | 0.3 | 0 | 45 | 0 | 32 | 68 | 0 | 0 | 513699 |
| 5D | 0.76 | 0.4 | 0 | 48 | 0 | 26 | 74 | 0 | 0 | 542774 |
| 5E | 0.76 | 0.3 | 0 | 34 | 0 | 53 | 47 | 0 | 0 | 389124 |
| 5F | 0.76 | 0.2 | 0 | 31 | 0 | 61 | 39 | 0 | 0 | 350796 |
| 5G | 0.76 | 0.3 | 0 | 42 | 0 | 35 | 65 | 0 | 0 | 474507 |
| 5H | 0.76 | 0.4 | 0 | 46 | 0 | 29 | 71 | 0 | 0 | 520433 |
| 5I | 0.76 | 0.4 | 0 | 50 | 0 | 25 | 75 | 0 | 0 | 565241 |
| 5J | 0.76 | 0.6 | 43 | 77 | 0 | 10 | 90 | 0 | 24 | 992109 |
| 5K | 0.76 | 2.1 | 91 | 96 | 1 | 3 | 94 | 4 | 94 | 3251780 |
| 6A | 0.76 | 1.8 | 82 | 93 | 0 | 4 | 96 | 0 | 84 | 2769454 |
| 6B | 0.76 | 0.7 | 31 | 70 | 0 | 13 | 87 | 0 | 23 | 934565 |
| 6C | 0.76 | 0.5 | 10 | 60 | 0 | 18 | 82 | 0 | 0 | 695149 |
| 6D | 0.76 | 0.4 | 0 | 39 | 0 | 39 | 61 | 0 | 0 | 448112 |
| 6E | 0.76 | 0.2 | 0 | 29 | 0 | 60 | 40 | 0 | 0 | 338798 |
| 6F | 0.76 | 0.2 | 0 | 22 | 0 | 89 | 11 | 0 | 0 | 246614 |
| 6G | 0.76 | 0.3 | 0 | 33 | 0 | 53 | 47 | 0 | 0 | 369671 |
| 6H | 0.76 | 0.4 | 0 | 42 | 0 | 33 | 67 | 0 | 0 | 482500 |
| 6I | 0.76 | 0.5 | 10 | 60 | 0 | 17 | 83 | 0 | 0 | 695480 |
| 6J | 0.76 | 0.8 | 48 | 80 | 0 | 9 | 91 | 0 | 41 | 1138342 |
| 6K | 0.76 | 2 | 90 | 96 | 1 | 3 | 94 | 3 | 93 | 3287777 |
| 7B | 0.76 | 1.9 | 82 | 93 | 0 | 3 | 97 | 0 | 89 | 2560189 |
| 7C | 0.76 | 1.2 | 61 | 85 | 0 | 7 | 93 | 0 | 50 | 1331002 |
| 7D | 0.76 | 0.9 | 42 | 78 | 0 | 8 | 92 | 0 | 17 | 1016907 |
| 7E | 0.76 | 0.4 | 0 | 39 | 0 | 37 | 63 | 0 | 0 | 444090 |
| 7F | 0.76 | 0.2 | 0 | 24 | 0 | 79 | 21 | 0 | 0 | 272123 |
| 7G | 0.76 | 0.3 | 0 | 33 | 0 | 48 | 52 | 0 | 0 | 377230 |
| 7H | 0.76 | 0.9 | 39 | 78 | 0 | 8 | 92 | 0 | 15 | 996691 |
| 7I | 0.76 | 1.2 | 65 | 86 | 0 | 5 | 95 | 0 | 55 | 1394666 |
| 7J | 0.76 | 2 | 83 | 93 | 0 | 3 | 97 | 0 | 89 | 2649401 |
| 8B | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 77 | 21 | 97 | 5314622 |
| 8C | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 3 | 97 | 4379212 |
| 8D | 0.76 | 3.4 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3161077 |
| 8E | 0.76 | 0.5 | 0 | 49 | 0 | 24 | 76 | 0 | 0 | 572318 |
| 8F | 0.76 | 0.3 | 0 | 33 | 0 | 52 | 48 | 0 | 0 | 370020 |
| 8G | 0.76 | 0.4 | 0 | 48 | 0 | 25 | 75 | 0 | 0 | 542554 |
| 8H | 0.76 | 3.7 | 93 | 97 | 0 | 2 | 98 | 0 | 95 | 3345964 |
| 8I | 0.76 | 4.4 | 95 | 97 | 0 | 2 | 96 | 2 | 97 | 4185287 |
| 8J | 0.76 | 5 | 95 | 98 | 1 | 2 | 78 | 20 | 98 | 5282211 |
| Average value | | | 53 | | 6 | 15 | 74 | 11 | | |

# Appendix B7

## Table B7: Detail DAYSIM result of LWC 07

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 21 | 78 | 0 | 17261040 |
| 1B | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 19 | 80 | 0 | 18819066 |
| 1C | 0.76 | 9.4 | 98 | 99 | 61 | 1 | 17 | 82 | 0 | 19244498 |
| 1D | 0.76 | 10.2 | 98 | 99 | 64 | 1 | 15 | 84 | 0 | 19881164 |
| 1H | 0.76 | 10.2 | 98 | 99 | 66 | 1 | 15 | 84 | 0 | 20174598 |
| 1I | 0.76 | 9.2 | 98 | 99 | 60 | 1 | 19 | 80 | 0 | 18930536 |
| 1J | 0.76 | 9.5 | 98 | 99 | 60 | 1 | 17 | 82 | 0 | 18815384 |
| 1K | 0.76 | 9.5 | 98 | 99 | 63 | 1 | 18 | 81 | 0 | 17552520 |
| 2A | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 87 | 11 | 96 | 4388419 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4541859 |
| 2C | 0.76 | 3.1 | 95 | 97 | 2 | 2 | 77 | 21 | 97 | 5195701 |
| 2D | 0.76 | 3.9 | 96 | 98 | 14 | 1 | 61 | 38 | 97 | 6669519 |
| 2H | 0.76 | 4 | 96 | 98 | 14 | 2 | 61 | 38 | 97 | 6697546 |
| 2I | 0.76 | 3.1 | 95 | 97 | 2 | 2 | 77 | 21 | 97 | 5192267 |
| 2J | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4237870 |
| 2K | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 87 | 11 | 96 | 4330889 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3077446 |
| 3B | 0.76 | 1.1 | 76 | 91 | 0 | 5 | 95 | 0 | 85 | 1817878 |
| 3C | 0.76 | 1.2 | 78 | 91 | 0 | 5 | 95 | 0 | 87 | 2002852 |
| 3D | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 93 | 4 | 95 | 3866410 |
| 3H | 0.76 | 2.2 | 91 | 96 | 0 | 2 | 95 | 2 | 95 | 3815199 |
| 3I | 0.76 | 1.2 | 80 | 92 | 0 | 4 | 96 | 0 | 88 | 2076135 |
| 3J | 0.76 | 1.2 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1925622 |
| 3K | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 94 | 4 | 95 | 3752004 |
| 4A | 0.76 | 0.6 | 35 | 72 | 0 | 12 | 88 | 0 | 12 | 924204 |
| 4B | 0.76 | 0.5 | 17 | 63 | 0 | 17 | 83 | 0 | 1 | 754503 |
| 4C | 0.76 | 0.6 | 37 | 74 | 0 | 11 | 89 | 0 | 32 | 1005569 |
| 4D | 0.76 | 1.3 | 77 | 91 | 0 | 5 | 95 | 0 | 88 | 2178172 |
| 4H | 0.76 | 1.4 | 80 | 92 | 0 | 4 | 96 | 0 | 88 | 2324523 |
| 4I | 0.76 | 0.6 | 40 | 77 | 0 | 10 | 90 | 0 | 34 | 1038059 |
| 4J | 0.76 | 0.7 | 52 | 82 | 0 | 8 | 92 | 0 | 49 | 1159755 |
| 4K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 94 | 3269591 |
| 5A | 0.76 | 0.5 | 16 | 63 | 0 | 17 | 83 | 0 | 2 | 760934 |
| 5B | 0.76 | 0.4 | 0 | 56 | 0 | 20 | 80 | 0 | 0 | 646136 |
| 5C | 0.76 | 0.4 | 0 | 47 | 0 | 32 | 68 | 0 | 0 | 536985 |
| 5D | 0.76 | 0.6 | 35 | 70 | 0 | 15 | 85 | 0 | 35 | 973518 |
| 5E | 0.76 | 1.8 | 85 | 94 | 0 | 4 | 95 | 2 | 93 | 2845078 |
| 5F | 0.76 | 2.3 | 89 | 95 | 0 | 3 | 89 | 9 | 95 | 3692225 |

**Table B7:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5G | 0.76 | 1.9 | 85 | 94 | 0 | 3 | 95 | 1 | 92 | 2950552 |
| 5H | 0.76 | 0.7 | 47 | 79 | 0 | 9 | 91 | 0 | 55 | 1198509 |
| 5I | 0.76 | 0.4 | 2 | 57 | 0 | 20 | 80 | 0 | 0 | 644201 |
| 5J | 0.76 | 0.5 | 18 | 68 | 0 | 14 | 86 | 0 | 2 | 784074 |
| 5K | 0.76 | 1.9 | 90 | 96 | 0 | 3 | 94 | 3 | 92 | 3045788 |
| 6A | 0.76 | 1.7 | 83 | 93 | 0 | 4 | 96 | 0 | 84 | 2565142 |
| 6B | 0.76 | 0.5 | 1 | 57 | 0 | 19 | 81 | 0 | 0 | 659163 |
| 6C | 0.76 | 0.5 | 0 | 52 | 0 | 23 | 77 | 0 | 0 | 594269 |
| 6D | 0.76 | 0.5 | 7 | 56 | 0 | 23 | 77 | 0 | 0 | 650262 |
| 6E | 0.76 | 0.6 | 33 | 68 | 0 | 15 | 85 | 0 | 22 | 903100 |
| 6F | 0.76 | 0.7 | 38 | 72 | 0 | 12 | 88 | 0 | 41 | 1073945 |
| 6G | 0.76 | 0.6 | 34 | 69 | 0 | 13 | 87 | 0 | 22 | 913653 |
| 6H | 0.76 | 0.5 | 7 | 59 | 0 | 20 | 80 | 0 | 0 | 676508 |
| 6I | 0.76 | 0.5 | 1 | 58 | 0 | 17 | 83 | 0 | 0 | 662157 |
| 6J | 0.76 | 0.7 | 31 | 75 | 0 | 10 | 90 | 0 | 8 | 903089 |
| 6K | 0.76 | 2.1 | 91 | 96 | 1 | 2 | 94 | 4 | 94 | 3212972 |
| 7A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 83 | 2046024 |
| 7B | 0.76 | 1.2 | 66 | 87 | 0 | 6 | 94 | 0 | 55 | 1375151 |
| 7C | 0.76 | 1.2 | 62 | 85 | 0 | 6 | 94 | 0 | 46 | 1284431 |
| 7D | 0.76 | 0.8 | 39 | 77 | 0 | 9 | 91 | 0 | 9 | 978624 |
| 7E | 0.76 | 0.4 | 0 | 50 | 0 | 27 | 73 | 0 | 0 | 581517 |
| 7F | 0.76 | 0.3 | 0 | 38 | 0 | 49 | 51 | 0 | 0 | 427513 |
| 7G | 0.76 | 0.5 | 1 | 55 | 0 | 20 | 80 | 0 | 0 | 625111 |
| 7H | 0.76 | 1 | 60 | 85 | 0 | 6 | 94 | 0 | 42 | 1206397 |
| 7I | 0.76 | 1.2 | 64 | 87 | 0 | 6 | 94 | 0 | 49 | 1296975 |
| 7J | 0.76 | 1.4 | 75 | 91 | 0 | 4 | 96 | 0 | 71 | 1560465 |
| 7K | 0.76 | 1.7 | 85 | 94 | 0 | 3 | 97 | 0 | 88 | 2173383 |
| 8A | 0.76 | 5.7 | 96 | 98 | 1 | 1 | 72 | 27 | 98 | 6113955 |
| 8B | 0.76 | 4.3 | 94 | 97 | 0 | 2 | 97 | 1 | 97 | 4055027 |
| 8C | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4231082 |
| 8D | 0.76 | 3.7 | 93 | 97 | 0 | 2 | 98 | 0 | 95 | 3397365 |
| 8E | 0.76 | 0.4 | 0 | 43 | 0 | 33 | 67 | 0 | 0 | 505993 |
| 8F | 0.76 | 0.2 | 0 | 29 | 0 | 62 | 38 | 0 | 0 | 327903 |
| 8G | 0.76 | 0.5 | 0 | 56 | 0 | 18 | 82 | 0 | 0 | 637444 |
| 8H | 0.76 | 3.5 | 93 | 97 | 0 | 2 | 98 | 0 | 95 | 3231807 |
| 8I | 0.76 | 4.3 | 94 | 97 | 0 | 2 | 98 | 1 | 97 | 3952639 |
| 8J | 0.76 | 4.9 | 96 | 98 | 0 | 1 | 94 | 5 | 97 | 4587400 |
| 8K | 0.76 | 5.7 | 97 | 98 | 4 | 1 | 65 | 34 | 94 | 6290677 |
| | | | | | | | | | | |
| Average value | | | 62 | | 7 | 9 | 79 | 12 | | |

# Appendix B8

## Table B8: Detail DAYSIM result of LWC 09

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 17105460 |
| 1B | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18704374 |
| 1C | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 19044964 |
| 1D | 0.76 | 9.5 | 98 | 99 | 58 | 1 | 18 | 81 | 0 | 18727138 |
| 1E | 0.76 | 7.4 | 98 | 99 | 48 | 1 | 30 | 69 | 0 | 14501701 |
| 1F | 0.76 | 8 | 98 | 99 | 48 | 1 | 29 | 70 | 0 | 15620567 |
| 1G | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 29 | 70 | 1 | 13879393 |
| 1H | 0.76 | 9.7 | 98 | 99 | 62 | 1 | 16 | 83 | 0 | 19150500 |
| 1I | 0.76 | 9.6 | 98 | 99 | 62 | 1 | 17 | 82 | 0 | 19505836 |
| 1J | 0.76 | 9.9 | 98 | 99 | 63 | 1 | 15 | 84 | 0 | 19466600 |
| 1K | 0.76 | 10 | 98 | 99 | 65 | 1 | 16 | 83 | 0 | 18198828 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 89 | 9 | 96 | 4177604 |
| 2B | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4304009 |
| 2C | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4523329 |
| 2D | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4315918 |
| 2E | 0.76 | 2.1 | 91 | 96 | 0 | 2 | 94 | 4 | 94 | 3482560 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3581586 |
| 2G | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 89 | 9 | 95 | 3922779 |
| 2H | 0.76 | 3.1 | 94 | 97 | 1 | 2 | 78 | 20 | 97 | 5041653 |
| 2I | 0.76 | 4.2 | 96 | 98 | 14 | 1 | 61 | 38 | 96 | 6729423 |
| 2J | 0.76 | 4.7 | 96 | 98 | 18 | 1 | 55 | 43 | 92 | 7283574 |
| 2K | 0.76 | 4.4 | 96 | 98 | 11 | 1 | 58 | 41 | 97 | 6759947 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3059269 |
| 3B | 0.76 | 1 | 72 | 90 | 0 | 6 | 94 | 0 | 80 | 1685459 |
| 3C | 0.76 | 0.9 | 65 | 87 | 0 | 6 | 94 | 0 | 72 | 1526559 |
| 3D | 0.76 | 0.9 | 62 | 86 | 0 | 6 | 94 | 0 | 69 | 1485770 |
| 3E | 0.76 | 0.8 | 56 | 85 | 0 | 7 | 93 | 0 | 61 | 1346836 |
| 3F | 0.76 | 0.8 | 55 | 84 | 0 | 7 | 93 | 0 | 62 | 1333058 |
| 3G | 0.76 | 1 | 71 | 89 | 0 | 5 | 95 | 0 | 80 | 1637253 |
| 3H | 0.76 | 2.1 | 91 | 96 | 0 | 2 | 97 | 1 | 94 | 3310235 |
| 3I | 0.76 | 10 | 98 | 99 | 41 | 1 | 33 | 66 | 54 | 10192755 |
| 3J | 0.76 | 12 | 98 | 99 | 48 | 1 | 27 | 72 | 35 | 11330730 |
| 3K | 0.76 | 6.9 | 98 | 99 | 34 | 1 | 33 | 66 | 75 | 9134963 |
| 4A | 0.76 | 0.6 | 40 | 75 | 0 | 11 | 89 | 0 | 19 | 996931 |
| 4B | 0.76 | 0.5 | 14 | 63 | 0 | 16 | 84 | 0 | 0 | 733748 |
| 4C | 0.76 | 0.4 | 11 | 57 | 0 | 20 | 80 | 0 | 0 | 653964 |
| 4D | 0.76 | 0.4 | 6 | 53 | 0 | 22 | 78 | 0 | 0 | 600763 |
| 4E | 0.76 | 0.3 | 0 | 48 | 0 | 25 | 75 | 0 | 0 | 549102 |
| 4F | 0.76 | 0.4 | 3 | 54 | 0 | 21 | 79 | 0 | 0 | 607377 |
| 4G | 0.76 | 0.7 | 51 | 81 | 0 | 8 | 92 | 0 | 40 | 1100377 |
| 4H | 0.76 | 2.1 | 90 | 96 | 0 | 3 | 95 | 2 | 94 | 3254809 |

**Table B8:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5A | 0.76 | 0.6 | 21 | 66 | 0 | 14 | 86 | 0 | 7 | 831717 |
| 5B | 0.76 | 0.4 | 0 | 49 | 0 | 24 | 76 | 0 | 0 | 562043 |
| 5C | 0.76 | 0.3 | 0 | 36 | 0 | 42 | 58 | 0 | 0 | 413978 |
| 5D | 0.76 | 0.2 | 0 | 31 | 0 | 59 | 41 | 0 | 0 | 354953 |
| 5E | 0.76 | 0.2 | 0 | 26 | 0 | 71 | 29 | 0 | 0 | 297298 |
| 5F | 0.76 | 0.3 | 0 | 36 | 0 | 45 | 55 | 0 | 0 | 401111 |
| 5G | 0.76 | 0.5 | 24 | 68 | 0 | 15 | 85 | 0 | 8 | 797114 |
| 5H | 0.76 | 1.9 | 87 | 95 | 2 | 3 | 93 | 4 | 91 | 3126360 |
| 6A | 0.76 | 1.9 | 85 | 94 | 0 | 3 | 97 | 0 | 86 | 2765176 |
| 6B | 0.76 | 0.6 | 10 | 65 | 0 | 13 | 87 | 0 | 0 | 759191 |
| 6C | 0.76 | 0.4 | 0 | 45 | 0 | 28 | 72 | 0 | 0 | 514528 |
| 6D | 0.76 | 0.3 | 0 | 34 | 0 | 45 | 55 | 0 | 0 | 393035 |
| 6E | 0.76 | 0.2 | 0 | 29 | 0 | 62 | 38 | 0 | 0 | 327288 |
| 6F | 0.76 | 0.2 | 0 | 28 | 0 | 63 | 37 | 0 | 0 | 311115 |
| 6G | 0.76 | 0.5 | 16 | 65 | 0 | 16 | 84 | 0 | 3 | 736543 |
| 6H | 0.76 | 1.6 | 83 | 93 | 2 | 4 | 93 | 3 | 85 | 2643817 |
| 6I | 0.76 | 9.1 | 98 | 99 | 48 | 1 | 32 | 67 | 0 | 17775996 |
| 6J | 0.76 | 11.1 | 98 | 99 | 54 | 1 | 27 | 72 | 0 | 20874152 |
| 6K | 0.76 | 6.1 | 97 | 98 | 39 | 1 | 34 | 65 | 61 | 9495204 |
| 7A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2055692 |
| 7B | 0.76 | 1.3 | 69 | 88 | 0 | 5 | 95 | 0 | 62 | 1476695 |
| 7C | 0.76 | 1.1 | 59 | 85 | 0 | 6 | 94 | 0 | 39 | 1223218 |
| 7D | 0.76 | 0.7 | 14 | 67 | 0 | 13 | 87 | 0 | 0 | 786702 |
| 7E | 0.76 | 0.3 | 0 | 33 | 0 | 47 | 53 | 0 | 0 | 380884 |
| 7F | 0.76 | 0.2 | 0 | 23 | 0 | 90 | 10 | 0 | 0 | 253466 |
| 7G | 0.76 | 0.5 | 2 | 56 | 0 | 18 | 82 | 0 | 0 | 626254 |
| 7H | 0.76 | 1.2 | 72 | 89 | 0 | 5 | 95 | 0 | 70 | 1571122 |
| 7I | 0.76 | 2.5 | 91 | 96 | 0 | 2 | 98 | 0 | 95 | 3348662 |
| 7J | 0.76 | 2.9 | 93 | 97 | 0 | 2 | 93 | 4 | 96 | 4006098 |
| 7K | 0.76 | 3 | 94 | 97 | 0 | 2 | 93 | 5 | 96 | 4167763 |
| 8A | 0.76 | 5.7 | 96 | 98 | 1 | 1 | 71 | 27 | 98 | 6125121 |
| 8B | 0.76 | 4.3 | 94 | 97 | 0 | 2 | 98 | 1 | 97 | 4034924 |
| 8C | 0.76 | 3.8 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3572689 |
| 8D | 0.76 | 3.3 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3041262 |
| 8E | 0.76 | 0.4 | 0 | 44 | 0 | 26 | 74 | 0 | 0 | 523018 |
| 8F | 0.76 | 0.2 | 0 | 24 | 0 | 83 | 17 | 0 | 0 | 270185 |
| 8G | 0.76 | 0.5 | 4 | 60 | 0 | 16 | 84 | 0 | 0 | 674498 |
| 8H | 0.76 | 3.7 | 94 | 97 | 0 | 2 | 98 | 0 | 96 | 3514646 |
| 8I | 0.76 | 5.1 | 96 | 98 | 0 | 1 | 89 | 9 | 98 | 4935863 |
| 8J | 0.76 | 5.2 | 96 | 98 | 0 | 1 | 86 | 13 | 98 | 5189121 |
| 8K | 0.76 | 6.3 | 97 | 98 | 8 | 1 | 52 | 47 | 94 | 7002008 |
| Average value | | | 63 | | 12 | 13 | 68 | 20 | | |

# Appendix B9

## Table B9: Detail DAYSIM result of LWC 10

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 10.2 | 98 | 99 | 64 | 1 | 16 | 83 | 0 | 19050312 |
| 1B | 0.76 | 10.5 | 98 | 99 | 67 | 1 | 15 | 84 | 0 | 20558228 |
| 1C | 0.76 | 10.2 | 98 | 99 | 66 | 1 | 15 | 84 | 0 | 20511168 |
| 1D | 0.76 | 9.9 | 98 | 99 | 63 | 1 | 15 | 84 | 0 | 19749740 |
| 1E | 0.76 | 8 | 98 | 99 | 51 | 1 | 25 | 73 | 0 | 15525556 |
| 1F | 0.76 | 8.4 | 98 | 99 | 49 | 1 | 25 | 74 | 0 | 16337032 |
| 1G | 0.76 | 7.3 | 98 | 99 | 47 | 1 | 28 | 71 | 0 | 14371740 |
| 1H | 0.76 | 10 | 98 | 99 | 63 | 1 | 16 | 83 | 0 | 19732468 |
| 1I | 0.76 | 9.8 | 98 | 99 | 62 | 1 | 17 | 82 | 0 | 19821084 |
| 1J | 0.76 | 10.1 | 98 | 99 | 63 | 1 | 15 | 84 | 0 | 19952676 |
| 1K | 0.76 | 9.9 | 98 | 99 | 66 | 1 | 16 | 83 | 0 | 18507716 |
| 2A | 0.76 | 5.1 | 96 | 98 | 22 | 1 | 50 | 48 | 92 | 7744961 |
| 2B | 0.76 | 5.3 | 96 | 98 | 26 | 1 | 49 | 49 | 75 | 8091033 |
| 2C | 0.76 | 4.9 | 96 | 98 | 23 | 1 | 51 | 48 | 81 | 7757550 |
| 2D | 0.76 | 3.4 | 95 | 97 | 6 | 2 | 74 | 24 | 97 | 5558365 |
| 2E | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4565174 |
| 2F | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 85 | 13 | 95 | 4135238 |
| 2G | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 85 | 13 | 95 | 4185325 |
| 2H | 0.76 | 2.9 | 94 | 97 | 2 | 2 | 78 | 20 | 96 | 4862384 |
| 2I | 0.76 | 3.2 | 95 | 97 | 6 | 2 | 76 | 23 | 97 | 5491381 |
| 2J | 0.76 | 3.3 | 95 | 97 | 6 | 2 | 75 | 23 | 97 | 5462968 |
| 2K | 0.76 | 3.1 | 95 | 97 | 0 | 2 | 78 | 21 | 97 | 5158184 |
| 3A | 0.76 | 8.4 | 98 | 99 | 43 | 1 | 34 | 64 | 56 | 10706496 |
| 3B | 0.76 | 16.7 | 98 | 99 | 64 | 1 | 16 | 83 | 0 | 15726020 |
| 3C | 0.76 | 14.2 | 98 | 99 | 58 | 1 | 22 | 77 | 0 | 14180850 |
| 3D | 0.76 | 2.5 | 92 | 96 | 0 | 2 | 97 | 1 | 94 | 3908660 |
| 3E | 0.76 | 1.1 | 73 | 90 | 0 | 5 | 95 | 0 | 81 | 1886918 |
| 3F | 0.76 | 0.9 | 64 | 87 | 0 | 6 | 94 | 0 | 73 | 1547748 |
| 3G | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 79 | 1670095 |
| 3H | 0.76 | 1.1 | 76 | 91 | 0 | 5 | 95 | 0 | 85 | 1863243 |
| 3I | 0.76 | 1.2 | 80 | 92 | 0 | 5 | 95 | 0 | 88 | 2008454 |
| 3J | 0.76 | 1.4 | 85 | 93 | 0 | 4 | 96 | 0 | 90 | 2264173 |
| 3K | 0.76 | 2.6 | 94 | 97 | 1 | 2 | 91 | 7 | 96 | 4190625 |
| 4D | 0.76 | 2.5 | 89 | 95 | 0 | 3 | 91 | 6 | 93 | 3822833 |
| 4E | 0.76 | 0.8 | 51 | 80 | 0 | 8 | 92 | 0 | 50 | 1261941 |
| 4F | 0.76 | 0.5 | 19 | 63 | 0 | 17 | 83 | 0 | 3 | 756252 |
| 4G | 0.76 | 0.4 | 15 | 60 | 0 | 17 | 83 | 0 | 1 | 708888 |
| 4H | 0.76 | 0.5 | 20 | 64 | 0 | 14 | 86 | 0 | 6 | 769088 |
| 4I | 0.76 | 0.5 | 26 | 70 | 0 | 12 | 88 | 0 | 13 | 857354 |
| 4J | 0.76 | 0.8 | 59 | 84 | 0 | 7 | 93 | 0 | 56 | 1251265 |
| 4K | 0.76 | 2.4 | 93 | 97 | 1 | 2 | 90 | 8 | 95 | 3785538 |
| 5D | 0.76 | 2.5 | 87 | 95 | 0 | 3 | 87 | 10 | 91 | 3896444 |

**Table B9:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 5E | 0.76 | 0.6 | 36 | 70 | 0 | 14 | 86 | 0 | 19 | 964588 |
| 5F | 0.76 | 0.3 | 0 | 42 | 0 | 36 | 64 | 0 | 0 | 486883 |
| 5G | 0.76 | 0.2 | 0 | 33 | 0 | 53 | 47 | 0 | 0 | 375676 |
| 5H | 0.76 | 0.3 | 0 | 40 | 0 | 35 | 65 | 0 | 0 | 454619 |
| 5I | 0.76 | 0.4 | 0 | 49 | 0 | 23 | 77 | 0 | 0 | 557401 |
| 5J | 0.76 | 0.7 | 37 | 76 | 0 | 9 | 91 | 0 | 21 | 961699 |
| 5K | 0.76 | 2.2 | 91 | 96 | 1 | 2 | 93 | 5 | 94 | 3384268 |
| 6A | 0.76 | 7.7 | 97 | 98 | 51 | 1 | 34 | 64 | 2 | 12106938 |
| 6B | 0.76 | 16.1 | 99 | 99 | 66 | 1 | 17 | 82 | 0 | 31794536 |
| 6C | 0.76 | 13.4 | 98 | 99 | 59 | 1 | 26 | 73 | 0 | 24745098 |
| 6D | 0.76 | 2 | 83 | 93 | 0 | 3 | 95 | 2 | 85 | 3149850 |
| 6E | 0.76 | 0.5 | 20 | 61 | 0 | 23 | 77 | 0 | 7 | 770351 |
| 6F | 0.76 | 0.2 | 0 | 28 | 0 | 59 | 41 | 0 | 0 | 330457 |
| 6G | 0.76 | 0.2 | 0 | 28 | 0 | 63 | 37 | 0 | 0 | 320316 |
| 6H | 0.76 | 0.4 | 0 | 39 | 0 | 35 | 65 | 0 | 0 | 439671 |
| 6I | 0.76 | 0.6 | 5 | 66 | 0 | 13 | 87 | 0 | 0 | 748869 |
| 6J | 0.76 | 0.8 | 50 | 82 | 0 | 7 | 93 | 0 | 29 | 1086376 |
| 6K | 0.76 | 2.3 | 92 | 96 | 1 | 2 | 93 | 5 | 95 | 3454671 |
| 7A | 0.76 | 4.2 | 94 | 97 | 1 | 2 | 64 | 34 | 97 | 5774659 |
| 7B | 0.76 | 3.9 | 93 | 97 | 3 | 2 | 73 | 26 | 97 | 5467774 |
| 7C | 0.76 | 3.1 | 91 | 96 | 0 | 2 | 88 | 9 | 95 | 4155418 |
| 7D | 0.76 | 1.5 | 74 | 90 | 0 | 5 | 95 | 0 | 75 | 1947027 |
| 7E | 0.76 | 0.5 | 12 | 61 | 0 | 21 | 79 | 0 | 0 | 727096 |
| 7F | 0.76 | 0.2 | 0 | 27 | 0 | 66 | 34 | 0 | 0 | 311952 |
| 7G | 0.76 | 0.4 | 0 | 42 | 0 | 28 | 72 | 0 | 0 | 477351 |
| 7H | 0.76 | 0.8 | 30 | 75 | 0 | 9 | 91 | 0 | 3 | 915588 |
| 7I | 0.76 | 1.3 | 67 | 88 | 0 | 5 | 95 | 0 | 52 | 1349901 |
| 7J | 0.76 | 1.5 | 80 | 92 | 0 | 4 | 96 | 0 | 80 | 1743013 |
| 7K | 0.76 | 1.9 | 86 | 95 | 0 | 3 | 97 | 0 | 90 | 2406726 |
| 8A | 0.76 | 6.4 | 97 | 98 | 6 | 1 | 50 | 49 | 98 | 7308345 |
| 8B | 0.76 | 5.7 | 96 | 98 | 0 | 1 | 69 | 30 | 98 | 6010291 |
| 8C | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 84 | 15 | 98 | 5212733 |
| 8D | 0.76 | 3.6 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3674186 |
| 8E | 0.76 | 0.6 | 7 | 59 | 0 | 20 | 80 | 0 | 0 | 702684 |
| 8F | 0.76 | 0.2 | 0 | 28 | 0 | 62 | 38 | 0 | 0 | 322473 |
| 8G | 0.76 | 0.5 | 0 | 54 | 0 | 17 | 83 | 0 | 0 | 617482 |
| 8H | 0.76 | 3.6 | 93 | 97 | 0 | 2 | 98 | 0 | 96 | 3369935 |
| 8I | 0.76 | 4.4 | 95 | 98 | 0 | 2 | 97 | 1 | 97 | 4134094 |
| 8J | 0.76 | 4.8 | 96 | 98 | 0 | 2 | 93 | 5 | 97 | 4568233 |
| 8K | 0.76 | 5.8 | 97 | 98 | 2 | 1 | 64 | 35 | 98 | 6305776 |
| Average value | | | 68 | | 14 | 10 | 67 | 23 | | |

# Appendix B10

## Table B10: Detail DAYSIM result of LWC 11

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16781192 |
| 1B | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 18 | 81 | 0 | 18488174 |
| 1C | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18721776 |
| 1D | 0.76 | 9.4 | 98 | 99 | 58 | 1 | 18 | 81 | 0 | 18475262 |
| 1E | 0.76 | 7.3 | 98 | 99 | 47 | 1 | 30 | 68 | 0 | 14135324 |
| 1F | 0.76 | 7.8 | 98 | 99 | 47 | 1 | 29 | 70 | 1 | 15333426 |
| 1G | 0.76 | 7.1 | 98 | 99 | 44 | 1 | 31 | 68 | 6 | 13445253 |
| 1H | 0.76 | 9.2 | 98 | 99 | 58 | 1 | 18 | 81 | 0 | 18353484 |
| 1I | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18626740 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 18 | 81 | 0 | 18496946 |
| 1K | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 16606498 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 94 | 4 | 96 | 4003543 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4403971 |
| 2C | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4391586 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4128292 |
| 2E | 0.76 | 2 | 91 | 96 | 0 | 2 | 96 | 1 | 94 | 3377349 |
| 2F | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3566091 |
| 2G | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3678249 |
| 2H | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4247522 |
| 2I | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4313518 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4549463 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 91 | 7 | 96 | 4219711 |
| 3A | 0.76 | 2 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3070159 |
| 3B | 0.76 | 1 | 69 | 88 | 0 | 6 | 94 | 0 | 76 | 1567533 |
| 3C | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 76 | 1568972 |
| 3D | 0.76 | 1 | 66 | 88 | 0 | 6 | 94 | 0 | 75 | 1529369 |
| 3E | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 75 | 1508366 |
| 3F | 0.76 | 1 | 64 | 87 | 0 | 6 | 94 | 0 | 71 | 1435192 |
| 3G | 0.76 | 0.9 | 63 | 87 | 0 | 6 | 94 | 0 | 71 | 1430245 |
| 3H | 0.76 | 1 | 71 | 89 | 0 | 5 | 95 | 0 | 79 | 1631557 |
| 3I | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 78 | 1582360 |
| 3J | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1766083 |
| 3K | 0.76 | 2.4 | 93 | 97 | 1 | 2 | 93 | 5 | 95 | 3711777 |
| 4A | 0.76 | 0.7 | 40 | 76 | 0 | 10 | 90 | 0 | 15 | 993203 |
| 4B | 0.76 | 0.5 | 15 | 65 | 0 | 14 | 86 | 0 | 0 | 762947 |
| 4C | 0.76 | 0.5 | 13 | 63 | 0 | 15 | 85 | 0 | 0 | 731090 |
| 4D | 0.76 | 0.6 | 29 | 71 | 0 | 11 | 89 | 0 | 0 | 848259 |
| 4E | 0.76 | 1 | 59 | 86 | 0 | 6 | 94 | 0 | 52 | 1252272 |
| 4F | 0.76 | 1.4 | 74 | 90 | 0 | 5 | 95 | 0 | 76 | 1602774 |
| 4G | 0.76 | 1.1 | 61 | 87 | 0 | 6 | 94 | 0 | 57 | 1303736 |

**Table B10:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 35 | 74 | 0 | 10 | 90 | 0 | 6 | 918447 |
| 4I | 0.76 | 0.5 | 16 | 66 | 0 | 13 | 87 | 0 | 0 | 760911 |
| 4J | 0.76 | 0.7 | 46 | 79 | 0 | 9 | 91 | 0 | 26 | 1022658 |
| 4K | 0.76 | 2 | 91 | 96 | 0 | 3 | 95 | 3 | 93 | 3040217 |
| 5A | 0.76 | 0.6 | 13 | 64 | 0 | 15 | 85 | 0 | 1 | 772102 |
| 5B | 0.76 | 0.4 | 0 | 52 | 0 | 20 | 80 | 0 | 0 | 601923 |
| 5C | 0.76 | 0.5 | 0 | 54 | 0 | 20 | 80 | 0 | 0 | 616571 |
| 5D | 0.76 | 0.8 | 36 | 76 | 0 | 9 | 91 | 0 | 13 | 967990 |
| 5E | 0.76 | 2.4 | 88 | 95 | 0 | 3 | 97 | 0 | 92 | 2549898 |
| 5G | 0.76 | 2.2 | 86 | 94 | 0 | 3 | 97 | 0 | 90 | 2369712 |
| 5H | 0.76 | 0.9 | 45 | 80 | 0 | 8 | 92 | 0 | 20 | 1061956 |
| 5I | 0.76 | 0.5 | 1 | 60 | 0 | 15 | 85 | 0 | 0 | 688969 |
| 5J | 0.76 | 0.6 | 17 | 68 | 0 | 13 | 87 | 0 | 1 | 784024 |
| 5K | 0.76 | 1.9 | 90 | 96 | 0 | 3 | 95 | 2 | 92 | 2949368 |
| 6A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2433024 |
| 6B | 0.76 | 0.7 | 25 | 74 | 0 | 9 | 91 | 0 | 1 | 895989 |
| 6C | 0.76 | 0.9 | 40 | 79 | 0 | 8 | 92 | 0 | 16 | 1014243 |
| 6D | 0.76 | 1.8 | 82 | 93 | 0 | 3 | 97 | 0 | 83 | 2034526 |
| 6E | 0.76 | 6 | 96 | 98 | 8 | 1 | 71 | 27 | 91 | 6306814 |
| 6G | 0.76 | 6.3 | 96 | 98 | 9 | 1 | 73 | 26 | 93 | 6522362 |
| 6H | 0.76 | 1.9 | 81 | 93 | 0 | 3 | 97 | 0 | 82 | 2046426 |
| 6I | 0.76 | 0.9 | 47 | 81 | 0 | 7 | 93 | 0 | 19 | 1072854 |
| 6J | 0.76 | 0.7 | 29 | 74 | 0 | 10 | 90 | 0 | 6 | 891095 |
| 6K | 0.76 | 2 | 90 | 96 | 1 | 3 | 94 | 4 | 92 | 3089882 |
| 7A | 0.76 | 1.6 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 1980540 |
| 7B | 0.76 | 1.3 | 69 | 88 | 0 | 5 | 95 | 0 | 59 | 1473782 |
| 7C | 0.76 | 1.8 | 81 | 93 | 0 | 3 | 97 | 0 | 82 | 1987667 |
| 7D | 0.76 | 4.3 | 95 | 98 | 0 | 2 | 87 | 11 | 97 | 4574526 |
| 7H | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 84 | 15 | 97 | 4962303 |
| 7I | 0.76 | 1.8 | 81 | 93 | 0 | 3 | 97 | 0 | 82 | 1988182 |
| 7J | 0.76 | 1.4 | 76 | 91 | 0 | 4 | 96 | 0 | 70 | 1593719 |
| 7K | 0.76 | 1.7 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2120033 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 73 | 26 | 98 | 6038153 |
| 8B | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4458691 |
| 8C | 0.76 | 5.5 | 96 | 98 | 0 | 1 | 82 | 17 | 98 | 5228486 |
| 8D | 0.76 | 14 | 98 | 99 | 48 | 1 | 26 | 72 | 29 | 13508069 |
| 8H | 0.76 | 13.3 | 98 | 99 | 41 | 1 | 30 | 69 | 46 | 12325402 |
| 8I | 0.76 | 5.4 | 96 | 98 | 0 | 1 | 84 | 14 | 98 | 5212742 |
| 8J | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4491054 |
| 8K | 0.76 | 5.5 | 97 | 98 | 3 | 1 | 71 | 28 | 95 | 5985125 |
| Average value | | | 73 | | 9 | 5 | 79 | 16 | | |

# Appendix B11

## Table B11: Detail DAYSIM result of LWC 12

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16752042 |
| 1B | 0.76 | 9.3 | 98 | 99 | 59 | 1 | 20 | 79 | 0 | 18507794 |
| 1C | 0.76 | 9.1 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18630784 |
| 1D | 0.76 | 9.3 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 18286468 |
| 1E | 0.76 | 7.3 | 98 | 99 | 47 | 1 | 31 | 68 | 0 | 14169523 |
| 1F | 0.76 | 8 | 98 | 99 | 48 | 1 | 28 | 71 | 0 | 15466818 |
| 1G | 0.76 | 7.1 | 98 | 99 | 45 | 1 | 30 | 69 | 5 | 13545375 |
| 1H | 0.76 | 9 | 98 | 99 | 56 | 1 | 21 | 78 | 0 | 18003136 |
| 1I | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18665632 |
| 1J | 0.76 | 9.5 | 98 | 99 | 59 | 1 | 17 | 82 | 0 | 18577594 |
| 1K | 0.76 | 9.3 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 16987544 |
| 2A | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 93 | 5 | 95 | 3974072 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4422406 |
| 2C | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4366454 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4153341 |
| 2E | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 96 | 2 | 94 | 3496932 |
| 2F | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3722187 |
| 2G | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3710994 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4177929 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4406607 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4460058 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 93 | 5 | 96 | 4178934 |
| 3A | 0.76 | 1.8 | 87 | 95 | 0 | 3 | 97 | 0 | 92 | 2905563 |
| 3B | 0.76 | 0.9 | 68 | 88 | 0 | 6 | 94 | 0 | 75 | 1541385 |
| 3C | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 78 | 1604566 |
| 3D | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 76 | 1558521 |
| 3E | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 76 | 1534233 |
| 3F | 0.76 | 1.2 | 78 | 91 | 0 | 5 | 95 | 0 | 85 | 1752220 |
| 3G | 0.76 | 1.1 | 71 | 90 | 0 | 5 | 95 | 0 | 80 | 1598772 |
| 3H | 0.76 | 1.1 | 73 | 90 | 0 | 5 | 95 | 0 | 83 | 1694378 |
| 3I | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 86 | 1828827 |
| 3J | 0.76 | 1.1 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1843986 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 2 | 94 | 3434883 |
| 4A | 0.76 | 0.6 | 32 | 71 | 0 | 13 | 87 | 0 | 8 | 891527 |
| 4B | 0.76 | 0.4 | 6 | 60 | 0 | 17 | 83 | 0 | 0 | 685728 |
| 4C | 0.76 | 0.6 | 32 | 74 | 0 | 10 | 90 | 0 | 11 | 918182 |
| 4D | 0.76 | 0.7 | 35 | 73 | 0 | 11 | 89 | 0 | 3 | 910944 |
| 4E | 0.76 | 1.3 | 75 | 91 | 0 | 5 | 95 | 0 | 78 | 1612634 |
| 4F | 0.76 | 1.6 | 76 | 91 | 0 | 4 | 96 | 0 | 80 | 1775594 |
| 4G | 0.76 | 1.3 | 69 | 89 | 0 | 5 | 95 | 0 | 71 | 1486910 |

**Table B11:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 39 | 76 | 0 | 10 | 90 | 0 | 11 | 964605 |
| 4I | 0.76 | 0.6 | 26 | 70 | 0 | 12 | 88 | 0 | 2 | 837275 |
| 4J | 0.76 | 0.7 | 46 | 79 | 0 | 9 | 91 | 0 | 24 | 1016640 |
| 4K | 0.76 | 1.9 | 91 | 96 | 0 | 3 | 95 | 2 | 93 | 2997484 |
| 5A | 0.76 | 0.5 | 14 | 65 | 0 | 14 | 86 | 0 | 1 | 778619 |
| 5B | 0.76 | 0.4 | 0 | 44 | 0 | 31 | 69 | 0 | 0 | 505331 |
| 5C | 0.76 | 0.5 | 0 | 53 | 0 | 23 | 77 | 0 | 0 | 607907 |
| 5D | 0.76 | 1.1 | 61 | 85 | 0 | 7 | 93 | 0 | 48 | 1325241 |
| 5E | 0.76 | 5.2 | 95 | 98 | 0 | 2 | 87 | 11 | 97 | 4648731 |
| 5F | 0.76 | 7.2 | 97 | 98 | 8 | 1 | 67 | 31 | 98 | 6362716 |
| 5G | 0.76 | 5.3 | 95 | 98 | 0 | 2 | 86 | 12 | 97 | 4697239 |
| 5H | 0.76 | 1.2 | 64 | 86 | 0 | 6 | 94 | 0 | 57 | 1417294 |
| 5I | 0.76 | 0.6 | 15 | 69 | 0 | 12 | 88 | 0 | 0 | 798493 |
| 5J | 0.76 | 0.6 | 20 | 70 | 0 | 12 | 88 | 0 | 2 | 815791 |
| 5K | 0.76 | 2 | 90 | 96 | 0 | 3 | 95 | 3 | 92 | 3017112 |
| 6A | 0.76 | 1.7 | 83 | 93 | 0 | 4 | 96 | 0 | 84 | 2514492 |
| 6B | 0.76 | 0.6 | 11 | 65 | 0 | 13 | 87 | 0 | 0 | 768517 |
| 6C | 0.76 | 0.7 | 22 | 69 | 0 | 13 | 87 | 0 | 5 | 847000 |
| 6D | 0.76 | 2 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2369254 |
| 6H | 0.76 | 2.1 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2449190 |
| 6I | 0.76 | 0.8 | 32 | 74 | 0 | 10 | 90 | 0 | 12 | 930206 |
| 6J | 0.76 | 0.8 | 44 | 80 | 0 | 8 | 92 | 0 | 16 | 1017352 |
| 6K | 0.76 | 1.9 | 90 | 96 | 1 | 3 | 94 | 4 | 92 | 2964177 |
| 7A | 0.76 | 1.5 | 77 | 91 | 0 | 4 | 96 | 0 | 78 | 1860551 |
| 7B | 0.76 | 1.4 | 72 | 89 | 0 | 5 | 95 | 0 | 65 | 1561648 |
| 7C | 0.76 | 1.6 | 75 | 90 | 0 | 4 | 96 | 0 | 72 | 1711540 |
| 7D | 0.76 | 2.9 | 91 | 96 | 0 | 2 | 97 | 1 | 94 | 3432410 |
| 7H | 0.76 | 2.9 | 91 | 96 | 0 | 2 | 98 | 0 | 95 | 3374134 |
| 7I | 0.76 | 1.4 | 71 | 89 | 0 | 5 | 95 | 0 | 65 | 1564972 |
| 7J | 0.76 | 1.5 | 78 | 91 | 0 | 4 | 96 | 0 | 74 | 1642144 |
| 7K | 0.76 | 1.6 | 83 | 93 | 0 | 4 | 96 | 0 | 87 | 2041758 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 76 | 23 | 98 | 5828385 |
| 8B | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 95 | 4 | 97 | 4476727 |
| 8C | 0.76 | 4.3 | 95 | 97 | 0 | 2 | 97 | 1 | 97 | 4168833 |
| 8D | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 80 | 18 | 98 | 5249530 |
| 8H | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 80 | 19 | 98 | 5312716 |
| 8I | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 4 | 97 | 4377479 |
| 8J | 0.76 | 4.4 | 95 | 98 | 0 | 2 | 97 | 2 | 97 | 4235032 |
| 8K | 0.76 | 5.3 | 97 | 98 | 3 | 1 | 72 | 27 | 95 | 5878116 |
| Average value | | | 74 | | 8 | 5 | 81 | 14 | | |

# Appendix B12

## Table B12: Detail DAYSIM result of LWC 13

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16782388 |
| 1B | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18268284 |
| 1C | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18287580 |
| 1D | 0.76 | 8.5 | 98 | 99 | 52 | 1 | 23 | 76 | 0 | 17274040 |
| 1E | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 31 | 68 | 1 | 13979317 |
| 1F | 0.76 | 8.1 | 98 | 99 | 48 | 1 | 28 | 71 | 0 | 15578417 |
| 1G | 0.76 | 7 | 98 | 99 | 45 | 1 | 30 | 69 | 6 | 13448455 |
| 1H | 0.76 | 9 | 98 | 99 | 56 | 1 | 21 | 78 | 0 | 18041972 |
| 1I | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18529576 |
| 1J | 0.76 | 9 | 98 | 99 | 56 | 1 | 19 | 80 | 0 | 18003600 |
| 1K | 0.76 | 9.4 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 17183862 |
| 2A | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3799426 |
| 2B | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 84 | 14 | 96 | 4336490 |
| 2C | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4567624 |
| 2D | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 88 | 9 | 95 | 4005658 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 94 | 3 | 95 | 3581966 |
| 2F | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3538130 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 96 | 2 | 94 | 3452291 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 87 | 11 | 96 | 4122703 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4410231 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4598498 |
| 2K | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 91 | 7 | 96 | 4293179 |
| 3A | 0.76 | 2.1 | 90 | 96 | 0 | 3 | 97 | 0 | 94 | 3315320 |
| 3B | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 81 | 1695048 |
| 3C | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 78 | 1623022 |
| 3D | 0.76 | 1 | 67 | 89 | 0 | 6 | 94 | 0 | 76 | 1555416 |
| 3E | 0.76 | 0.9 | 61 | 86 | 0 | 6 | 94 | 0 | 66 | 1372951 |
| 3F | 0.76 | 0.9 | 61 | 86 | 0 | 6 | 94 | 0 | 67 | 1378553 |
| 3G | 0.76 | 1 | 67 | 88 | 0 | 6 | 94 | 0 | 74 | 1502906 |
| 3H | 0.76 | 1 | 68 | 88 | 0 | 6 | 94 | 0 | 76 | 1561298 |
| 3I | 0.76 | 1 | 75 | 90 | 0 | 5 | 95 | 0 | 83 | 1675336 |
| 3J | 0.76 | 1.1 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1848408 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 2 | 95 | 3444369 |
| 4A | 0.76 | 0.6 | 32 | 72 | 0 | 12 | 88 | 0 | 8 | 901733 |
| 4B | 0.76 | 0.5 | 23 | 71 | 0 | 11 | 89 | 0 | 1 | 844478 |
| 4C | 0.76 | 0.6 | 22 | 69 | 0 | 13 | 87 | 0 | 1 | 812475 |
| 4D | 0.76 | 0.7 | 37 | 75 | 0 | 9 | 91 | 0 | 7 | 937363 |
| 4E | 0.76 | 0.9 | 56 | 85 | 0 | 6 | 94 | 0 | 51 | 1201069 |
| 4F | 0.76 | 1 | 55 | 84 | 0 | 7 | 93 | 0 | 44 | 1183403 |
| 4G | 0.76 | 0.9 | 51 | 83 | 0 | 7 | 93 | 0 | 34 | 1121606 |

**Table B12:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 39 | 78 | 0 | 8 | 92 | 0 | 16 | 1003109 |
| 4I | 0.76 | 0.6 | 22 | 69 | 0 | 12 | 88 | 0 | 1 | 812846 |
| 4J | 0.76 | 0.7 | 55 | 83 | 0 | 7 | 93 | 0 | 40 | 1132272 |
| 4K | 0.76 | 2.1 | 92 | 96 | 1 | 2 | 94 | 4 | 94 | 3210653 |
| 5A | 0.76 | 0.5 | 13 | 64 | 0 | 14 | 86 | 0 | 1 | 769375 |
| 5B | 0.76 | 0.4 | 0 | 51 | 0 | 21 | 79 | 0 | 0 | 590620 |
| 5C | 0.76 | 0.6 | 16 | 70 | 0 | 11 | 89 | 0 | 1 | 817073 |
| 5D | 0.76 | 1.2 | 66 | 87 | 0 | 5 | 95 | 0 | 54 | 1359418 |
| 5E | 0.76 | 2 | 84 | 94 | 0 | 3 | 97 | 0 | 87 | 2163232 |
| 5F | 0.76 | 2.8 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 2781726 |
| 5G | 0.76 | 1.9 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2058602 |
| 5H | 0.76 | 1.2 | 64 | 87 | 0 | 6 | 94 | 0 | 54 | 1358441 |
| 5I | 0.76 | 0.6 | 21 | 72 | 0 | 11 | 89 | 0 | 1 | 841485 |
| 5J | 0.76 | 0.6 | 30 | 76 | 0 | 9 | 91 | 0 | 7 | 906201 |
| 5K | 0.76 | 2.2 | 92 | 96 | 1 | 2 | 92 | 5 | 95 | 3360951 |
| 6A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 81 | 2313314 |
| 6B | 0.76 | 0.8 | 41 | 79 | 0 | 8 | 92 | 0 | 10 | 1003424 |
| 6C | 0.76 | 1 | 51 | 82 | 0 | 7 | 93 | 0 | 29 | 1127998 |
| 6D | 0.76 | 2.8 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3026254 |
| 6E | 0.76 | 10.7 | 98 | 98 | 26 | 1 | 46 | 53 | 76 | 8582163 |
| 6G | 0.76 | 8.8 | 97 | 98 | 15 | 1 | 59 | 40 | 93 | 7287895 |
| 6H | 0.76 | 2.5 | 87 | 95 | 0 | 3 | 97 | 0 | 91 | 2659212 |
| 6I | 0.76 | 1 | 56 | 84 | 0 | 7 | 93 | 0 | 34 | 1222520 |
| 6J | 0.76 | 0.7 | 36 | 77 | 0 | 9 | 91 | 0 | 11 | 954227 |
| 6K | 0.76 | 1.8 | 88 | 95 | 1 | 3 | 94 | 3 | 90 | 2803822 |
| 7A | 0.76 | 1.6 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 1987680 |
| 7B | 0.76 | 1.5 | 76 | 91 | 0 | 4 | 96 | 0 | 72 | 1684205 |
| 7C | 0.76 | 2 | 84 | 94 | 0 | 3 | 97 | 0 | 87 | 2261103 |
| 7D | 0.76 | 6.7 | 97 | 98 | 11 | 1 | 65 | 34 | 93 | 6515098 |
| 7H | 0.76 | 5.3 | 96 | 98 | 6 | 2 | 76 | 22 | 98 | 5679702 |
| 7I | 0.76 | 1.9 | 83 | 94 | 0 | 3 | 97 | 0 | 85 | 2170672 |
| 7J | 0.76 | 1.4 | 77 | 91 | 0 | 4 | 96 | 0 | 74 | 1653869 |
| 7K | 0.76 | 1.6 | 83 | 93 | 0 | 4 | 96 | 0 | 87 | 2020711 |
| 8A | 0.76 | 5.6 | 96 | 98 | 1 | 1 | 75 | 23 | 98 | 5836694 |
| 8B | 0.76 | 4.9 | 96 | 98 | 0 | 2 | 92 | 6 | 97 | 4635796 |
| 8C | 0.76 | 5.3 | 96 | 98 | 0 | 1 | 83 | 15 | 98 | 5205027 |
| 8D | 0.76 | 9.8 | 98 | 99 | 29 | 1 | 44 | 55 | 57 | 9934148 |
| 8H | 0.76 | 9.4 | 98 | 98 | 32 | 1 | 43 | 56 | 52 | 12999249 |
| 8I | 0.76 | 5.5 | 96 | 98 | 0 | 1 | 80 | 18 | 98 | 5373412 |
| 8J | 0.76 | 4.5 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4337645 |
| 8K | 0.76 | 5.6 | 97 | 98 | 3 | 1 | 69 | 30 | 95 | 6129352 |
| | | | | | | | | | | |
| Average value | | | 76 | | 9 | 4 | 79 | 16 | | |

# Appendix B13

## Table B13: Detail DAYSIM result of LWC 14

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16743405 |
| 1B | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18235244 |
| 1C | 0.76 | 9 | 98 | 99 | 57 | 1 | 20 | 79 | 0 | 18379696 |
| 1D | 0.76 | 9.3 | 98 | 99 | 57 | 1 | 19 | 80 | 0 | 18208126 |
| 1E | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 31 | 68 | 0 | 13965746 |
| 1F | 0.76 | 7.8 | 98 | 99 | 47 | 1 | 29 | 70 | 1 | 15273821 |
| 1G | 0.76 | 7.3 | 98 | 99 | 46 | 1 | 28 | 70 | 0 | 13862496 |
| 1H | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18407064 |
| 1I | 0.76 | 9 | 98 | 99 | 57 | 1 | 20 | 79 | 0 | 18442056 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 18 | 81 | 0 | 18478730 |
| 1K | 0.76 | 8.8 | 98 | 99 | 57 | 1 | 19 | 80 | 0 | 16513902 |
| 2A | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 93 | 5 | 95 | 3983827 |
| 2B | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4258631 |
| 2C | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4502380 |
| 2D | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4198417 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3668980 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 96 | 2 | 95 | 3529620 |
| 2G | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 94 | 3 | 95 | 3594057 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4159373 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4503181 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4431080 |
| 2K | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4345747 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3069212 |
| 3B | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 78 | 1647055 |
| 3C | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 79 | 1631817 |
| 3D | 0.76 | 0.9 | 63 | 87 | 0 | 6 | 94 | 0 | 71 | 1444270 |
| 3E | 0.76 | 1 | 67 | 88 | 0 | 6 | 94 | 0 | 74 | 1476483 |
| 3F | 0.76 | 0.9 | 64 | 87 | 0 | 6 | 94 | 0 | 71 | 1433421 |
| 3G | 0.76 | 1 | 71 | 90 | 0 | 6 | 94 | 0 | 80 | 1598169 |
| 3H | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 77 | 1579269 |
| 3I | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1741898 |
| 3J | 0.76 | 1.1 | 79 | 91 | 0 | 5 | 95 | 0 | 86 | 1799736 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 3 | 95 | 3488158 |
| 4A | 0.76 | 0.6 | 40 | 75 | 0 | 10 | 90 | 0 | 13 | 978959 |
| 4B | 0.76 | 0.5 | 17 | 67 | 0 | 13 | 87 | 0 | 0 | 783414 |
| 4C | 0.76 | 0.5 | 20 | 67 | 0 | 13 | 87 | 0 | 0 | 790738 |
| 4D | 0.76 | 0.8 | 45 | 80 | 0 | 8 | 92 | 0 | 29 | 1056749 |
| 4E | 0.76 | 1 | 59 | 85 | 0 | 6 | 94 | 0 | 54 | 1251692 |
| 4F | 0.76 | 1.2 | 67 | 88 | 0 | 5 | 95 | 0 | 66 | 1404468 |
| 4G | 0.76 | 1.3 | 74 | 90 | 0 | 5 | 95 | 0 | 76 | 1557078 |

**Table B13:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4I | 0.76 | 0.5 | 19 | 68 | 0 | 13 | 87 | 0 | 0 | 796078 |
| 4J | 0.76 | 0.7 | 45 | 79 | 0 | 9 | 91 | 0 | 24 | 1011370 |
| 4K | 0.76 | 1.9 | 90 | 96 | 0 | 3 | 95 | 2 | 92 | 2919803 |
| 5A | 0.76 | 0.6 | 15 | 65 | 0 | 14 | 86 | 0 | 2 | 784505 |
| 5B | 0.76 | 0.4 | 0 | 50 | 0 | 23 | 77 | 0 | 0 | 580093 |
| 5C | 0.76 | 0.6 | 7 | 62 | 0 | 16 | 84 | 0 | 0 | 717659 |
| 5D | 0.76 | 1.3 | 69 | 88 | 0 | 5 | 95 | 0 | 63 | 1510683 |
| 5E | 0.76 | 3 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3056710 |
| 5F | 0.76 | 3.5 | 92 | 97 | 0 | 2 | 97 | 1 | 96 | 3613870 |
| 5G | 0.76 | 3 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3103372 |
| 5H | 0.76 | 1.4 | 70 | 89 | 0 | 5 | 95 | 0 | 66 | 1586168 |
| 5I | 0.76 | 0.7 | 28 | 75 | 0 | 10 | 90 | 0 | 1 | 892147 |
| 5J | 0.76 | 0.6 | 20 | 70 | 0 | 12 | 88 | 0 | 3 | 816692 |
| 5K | 0.76 | 2.1 | 91 | 96 | 1 | 3 | 94 | 4 | 93 | 3143595 |
| 6A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2410747 |
| 6B | 0.76 | 0.7 | 31 | 75 | 0 | 9 | 91 | 0 | 3 | 930267 |
| 6C | 0.76 | 0.9 | 45 | 79 | 0 | 9 | 91 | 0 | 25 | 1063683 |
| 6D | 0.76 | 2.5 | 88 | 95 | 1 | 3 | 94 | 3 | 91 | 3067581 |
| 6H | 0.76 | 2.7 | 89 | 95 | 1 | 3 | 94 | 3 | 93 | 3282829 |
| 6I | 0.76 | 1 | 53 | 83 | 0 | 7 | 93 | 0 | 32 | 1168097 |
| 6J | 0.76 | 0.7 | 30 | 75 | 0 | 10 | 90 | 0 | 8 | 901686 |
| 6K | 0.76 | 1.9 | 89 | 95 | 1 | 3 | 94 | 3 | 91 | 2904002 |
| 7A | 0.76 | 1.6 | 77 | 91 | 0 | 4 | 96 | 0 | 78 | 1863525 |
| 7B | 0.76 | 1.3 | 68 | 88 | 0 | 5 | 95 | 0 | 59 | 1461633 |
| 7C | 0.76 | 1.7 | 77 | 91 | 0 | 4 | 96 | 0 | 76 | 1842064 |
| 7D | 0.76 | 3.6 | 94 | 97 | 2 | 2 | 86 | 12 | 95 | 4383852 |
| 7H | 0.76 | 3.6 | 93 | 97 | 2 | 2 | 87 | 11 | 96 | 4374516 |
| 7I | 0.76 | 1.7 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 1965394 |
| 7J | 0.76 | 1.4 | 76 | 91 | 0 | 4 | 96 | 0 | 73 | 1625580 |
| 7K | 0.76 | 1.7 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2105404 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 73 | 25 | 98 | 5989375 |
| 8B | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4355636 |
| 8C | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 93 | 6 | 97 | 4541967 |
| 8D | 0.76 | 6.6 | 97 | 98 | 13 | 1 | 58 | 41 | 96 | 6966631 |
| 8H | 0.76 | 6.2 | 97 | 98 | 10 | 1 | 64 | 34 | 98 | 6738591 |
| 8I | 0.76 | 5.3 | 96 | 98 | 0 | 1 | 88 | 11 | 98 | 4977138 |
| 8J | 0.76 | 5 | 96 | 98 | 0 | 1 | 92 | 6 | 97 | 4683613 |
| 8K | 0.76 | 5.4 | 97 | 98 | 3 | 1 | 72 | 27 | 95 | 5903348 |
| | | | | | | | | | | |
| Average value | | | 75 | | 8 | 5 | 81 | 15 | | |

# Appendix B14

## Table B14: Detail DAYSIM result of LWC 16 (1:7)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 16990772 |
| 1B | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18540260 |
| 1C | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18475636 |
| 1D | 0.76 | 9.2 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 18225464 |
| 1E | 0.76 | 7.4 | 98 | 99 | 48 | 1 | 29 | 70 | 0 | 14475546 |
| 1F | 0.76 | 8 | 98 | 99 | 48 | 1 | 28 | 71 | 0 | 15634710 |
| 1G | 0.76 | 7.2 | 98 | 99 | 45 | 1 | 30 | 69 | 3 | 13733417 |
| 1H | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 17990316 |
| 1I | 0.76 | 8.9 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18515364 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 17 | 82 | 0 | 18666478 |
| 1K | 0.76 | 9 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 16765990 |
| 2A | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 90 | 8 | 96 | 4202673 |
| 2B | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4417331 |
| 2C | 0.76 | 2.9 | 94 | 97 | 1 | 2 | 79 | 19 | 96 | 4845829 |
| 2D | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 17 | 96 | 4507937 |
| 2E | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 89 | 9 | 96 | 4089615 |
| 2F | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 91 | 7 | 95 | 3897859 |
| 2G | 0.76 | 2.3 | 93 | 96 | 0 | 2 | 92 | 6 | 95 | 3827324 |
| 2H | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4320715 |
| 2I | 0.76 | 2.9 | 94 | 97 | 1 | 2 | 79 | 19 | 96 | 4805246 |
| 2J | 0.76 | 2.9 | 94 | 97 | 0 | 2 | 79 | 19 | 96 | 4866790 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4289990 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3064506 |
| 3B | 0.76 | 1 | 73 | 90 | 0 | 5 | 95 | 0 | 80 | 1702099 |
| 3C | 0.76 | 1.2 | 81 | 92 | 0 | 4 | 96 | 0 | 88 | 1950907 |
| 3D | 0.76 | 1.3 | 81 | 92 | 0 | 4 | 96 | 0 | 88 | 2013228 |
| 3E | 0.76 | 1.6 | 85 | 94 | 0 | 4 | 96 | 0 | 91 | 2174456 |
| 3F | 0.76 | 1.7 | 85 | 94 | 0 | 3 | 97 | 0 | 91 | 2350427 |
| 3G | 0.76 | 1.6 | 85 | 93 | 0 | 4 | 96 | 0 | 91 | 2210729 |
| 3H | 0.76 | 1.3 | 80 | 92 | 0 | 4 | 96 | 0 | 87 | 2000589 |
| 3I | 0.76 | 1.1 | 72 | 89 | 0 | 5 | 95 | 0 | 82 | 1699976 |
| 3J | 0.76 | 1.1 | 79 | 91 | 0 | 5 | 95 | 0 | 86 | 1856393 |
| 3K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 96 | 2 | 94 | 3406699 |
| 4A | 0.76 | 0.7 | 42 | 77 | 0 | 10 | 90 | 0 | 18 | 1015884 |
| 4B | 0.76 | 0.6 | 31 | 73 | 0 | 11 | 89 | 0 | 4 | 895755 |
| 4C | 0.76 | 0.7 | 46 | 80 | 0 | 9 | 91 | 0 | 35 | 1075086 |
| 4D | 0.76 | 1.7 | 82 | 93 | 0 | 4 | 96 | 0 | 88 | 2117762 |
| 4E | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 87 | 11 | 97 | 4608879 |
| 4F | 0.76 | 4.4 | 95 | 97 | 0 | 2 | 85 | 13 | 97 | 4741756 |

**Table B14:** Continued

| **Core points** | **H** | **DF [%]** | **DA [%]** | **$DA_{con}$ [%]** | **$DA_{max}$ [%]** | **$UDI_{<100}$ [%]** | **$UDI_{100-2000}$ [%]** | **$UDI_{>2000}$ [%]** | **DSP [%]** | **annual light exposure [luxh]** |
|---|---|---|---|---|---|---|---|---|---|---|
| 4G | 0.76 | 4.1 | 95 | 97 | 0 | 2 | 90 | 8 | 97 | 4323101 |
| 4H | 0.76 | 1.8 | 82 | 93 | 0 | 4 | 96 | 0 | 88 | 2202662 |
| 4I | 0.76 | 0.8 | 54 | 82 | 0 | 8 | 92 | 0 | 49 | 1172674 |
| 4J | 0.76 | 0.7 | 48 | 80 | 0 | 9 | 91 | 0 | 35 | 1069954 |
| 4K | 0.76 | 2 | 92 | 96 | 0 | 3 | 94 | 3 | 94 | 3179265 |
| 5A | 0.76 | 0.6 | 20 | 68 | 0 | 14 | 86 | 0 | 5 | 832154 |
| 5B | 0.76 | 0.5 | 6 | 65 | 0 | 14 | 86 | 0 | 0 | 748162 |
| 5C | 0.76 | 0.9 | 51 | 81 | 0 | 8 | 92 | 0 | 35 | 1140871 |
| 5D | 0.76 | 4 | 95 | 97 | 4 | 2 | 81 | 17 | 94 | 4846429 |
| 5H | 0.76 | 4 | 94 | 97 | 4 | 2 | 82 | 16 | 97 | 4943979 |
| 5I | 0.76 | 0.9 | 51 | 81 | 0 | 8 | 92 | 0 | 35 | 1170591 |
| 5J | 0.76 | 0.7 | 35 | 76 | 0 | 10 | 90 | 0 | 12 | 930914 |
| 5K | 0.76 | 2 | 90 | 96 | 0 | 3 | 94 | 3 | 92 | 3046942 |
| 6A | 0.76 | 1.7 | 81 | 93 | 0 | 4 | 96 | 0 | 83 | 2461964 |
| 6B | 0.76 | 0.7 | 32 | 75 | 0 | 10 | 90 | 0 | 6 | 931937 |
| 6C | 0.76 | 1.2 | 67 | 87 | 0 | 6 | 94 | 0 | 57 | 1475273 |
| 6D | 0.76 | 4.8 | 96 | 98 | 11 | 2 | 68 | 30 | 91 | 6139584 |
| 6H | 0.76 | 5.1 | 96 | 98 | 10 | 2 | 71 | 27 | 96 | 6469179 |
| 6I | 0.76 | 1.2 | 67 | 87 | 0 | 6 | 94 | 0 | 60 | 1530704 |
| 6J | 0.76 | 0.9 | 53 | 83 | 0 | 7 | 93 | 0 | 35 | 1134441 |
| 6K | 0.76 | 2 | 91 | 96 | 1 | 3 | 94 | 4 | 93 | 3141614 |
| 7A | 0.76 | 1.6 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 1993466 |
| 7B | 0.76 | 1.5 | 75 | 90 | 0 | 4 | 96 | 0 | 73 | 1694130 |
| 7C | 0.76 | 1.9 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2194251 |
| 7D | 0.76 | 5.6 | 97 | 98 | 17 | 1 | 58 | 40 | 78 | 7563738 |
| 7H | 0.76 | 5.8 | 96 | 98 | 18 | 1 | 60 | 39 | 87 | 7751972 |
| 7I | 0.76 | 1.9 | 83 | 93 | 0 | 3 | 97 | 0 | 86 | 2238751 |
| 7J | 0.76 | 1.5 | 77 | 91 | 0 | 4 | 96 | 0 | 74 | 1683099 |
| 7K | 0.76 | 1.7 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2130939 |
| 8A | 0.76 | 5.4 | 96 | 98 | 1 | 1 | 75 | 23 | 98 | 5861695 |
| 8B | 0.76 | 4.5 | 95 | 97 | 0 | 2 | 97 | 2 | 97 | 4216487 |
| 8C | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 91 | 7 | 97 | 4611682 |
| 8D | 0.76 | 7.8 | 97 | 99 | 31 | 1 | 41 | 58 | 65 | 9292494 |
| 8H | 0.76 | 7.7 | 98 | 98 | 29 | 1 | 43 | 56 | 77 | 9230121 |
| 8I | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 87 | 12 | 97 | 5003199 |
| 8J | 0.76 | 4.7 | 96 | 98 | 0 | 2 | 93 | 5 | 97 | 4535599 |
| 8K | 0.76 | 5.5 | 97 | 98 | 4 | 1 | 67 | 31 | 94 | 6147740 |
| Average value | | | 82 | | 10 | 4 | 78 | 18 | | |

## Appendix B15

### Table B15: Detail DAYSIM result of LWC 17 (1:8)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16863528 |
| 1B | 0.76 | 9.1 | 98 | 99 | 57 | 1 | 20 | 79 | 0 | 18334296 |
| 1C | 0.76 | 8.7 | 98 | 99 | 55 | 1 | 22 | 77 | 0 | 18121834 |
| 1D | 0.76 | 8.7 | 98 | 99 | 53 | 1 | 23 | 76 | 0 | 17624396 |
| 1E | 0.76 | 7.3 | 98 | 99 | 48 | 1 | 29 | 69 | 0 | 14361831 |
| 1F | 0.76 | 7.9 | 98 | 99 | 47 | 1 | 28 | 70 | 0 | 15479387 |
| 1G | 0.76 | 7.1 | 98 | 99 | 45 | 1 | 29 | 69 | 3 | 13590820 |
| 1H | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18482090 |
| 1I | 0.76 | 8.8 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18313096 |
| 1J | 0.76 | 9.2 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18406424 |
| 1K | 0.76 | 9 | 98 | 99 | 57 | 1 | 20 | 80 | 0 | 16866668 |
| 2A | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 93 | 5 | 95 | 3949852 |
| 2B | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 86 | 12 | 96 | 4200798 |
| 2C | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4633293 |
| 2D | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4360085 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3653403 |
| 2F | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 94 | 3 | 95 | 3622547 |
| 2G | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3703366 |
| 2H | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4312522 |
| 2I | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4289621 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4449979 |
| 2K | 0.76 | 2.5 | 94 | 97 | 0 | 2 | 90 | 8 | 96 | 4204843 |
| 3A | 0.76 | 2 | 90 | 95 | 0 | 3 | 97 | 0 | 93 | 3219454 |
| 3B | 0.76 | 0.9 | 67 | 88 | 0 | 6 | 94 | 0 | 74 | 1533411 |
| 3C | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 80 | 1668330 |
| 3D | 0.76 | 1.2 | 80 | 92 | 0 | 4 | 96 | 0 | 87 | 1928558 |
| 3E | 0.76 | 1.2 | 78 | 91 | 0 | 5 | 95 | 0 | 84 | 1805511 |
| 3F | 0.76 | 1.6 | 84 | 93 | 0 | 4 | 96 | 0 | 91 | 2168628 |
| 3G | 0.76 | 1.3 | 80 | 92 | 0 | 4 | 96 | 0 | 87 | 1935039 |
| 3H | 0.76 | 1.2 | 79 | 92 | 0 | 5 | 95 | 0 | 86 | 1920307 |
| 3I | 0.76 | 1.2 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1912028 |
| 3J | 0.76 | 1.1 | 79 | 91 | 0 | 5 | 95 | 0 | 86 | 1833346 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 2 | 95 | 3560697 |
| 4A | 0.76 | 0.6 | 34 | 72 | 0 | 13 | 87 | 0 | 9 | 906793 |
| 4B | 0.76 | 0.5 | 18 | 67 | 0 | 13 | 87 | 0 | 0 | 788302 |
| 4C | 0.76 | 0.7 | 44 | 79 | 0 | 9 | 91 | 0 | 33 | 1062739 |
| 4D | 0.76 | 1.4 | 75 | 90 | 0 | 5 | 95 | 0 | 80 | 1785699 |
| 4E | 0.76 | 2.9 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3236323 |
| 4F | 0.76 | 3.1 | 92 | 96 | 0 | 2 | 97 | 1 | 95 | 3467246 |
| 4G | 0.76 | 2.9 | 92 | 96 | 0 | 2 | 98 | 0 | 95 | 3213952 |
| 4H | 0.76 | 1.4 | 76 | 91 | 0 | 5 | 95 | 0 | 81 | 1823078 |

**Table B15:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4I | 0.76 | 0.7 | 48 | 80 | 0 | 8 | 92 | 0 | 35 | 1080183 |
| 4J | 0.76 | 0.7 | 51 | 81 | 0 | 8 | 92 | 0 | 38 | 1100829 |
| 4K | 0.76 | 2 | 92 | 96 | 0 | 3 | 94 | 3 | 94 | 3128524 |
| 5A | 0.76 | 0.5 | 16 | 65 | 0 | 15 | 85 | 0 | 3 | 786881 |
| 5B | 0.76 | 0.4 | 0 | 53 | 0 | 22 | 78 | 0 | 0 | 615567 |
| 5C | 0.76 | 0.8 | 40 | 77 | 0 | 10 | 90 | 0 | 22 | 1009193 |
| 5D | 0.76 | 2.9 | 92 | 96 | 2 | 2 | 91 | 7 | 94 | 3693215 |
| 5H | 0.76 | 2.9 | 91 | 96 | 2 | 2 | 92 | 6 | 95 | 3729268 |
| 5I | 0.76 | 0.8 | 51 | 81 | 0 | 8 | 92 | 0 | 32 | 1122692 |
| 5J | 0.76 | 0.7 | 35 | 76 | 0 | 10 | 90 | 0 | 13 | 933016 |
| 5K | 0.76 | 2 | 90 | 96 | 0 | 3 | 95 | 3 | 92 | 3020912 |
| 6A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 80 | 2333394 |
| 6B | 0.76 | 0.7 | 29 | 74 | 0 | 10 | 90 | 0 | 5 | 919254 |
| 6C | 0.76 | 1.1 | 66 | 87 | 0 | 6 | 94 | 0 | 57 | 1420991 |
| 6D | 0.76 | 3.8 | 94 | 97 | 5 | 2 | 80 | 19 | 93 | 4933976 |
| 6H | 0.76 | 3.8 | 93 | 97 | 5 | 2 | 82 | 17 | 96 | 5097629 |
| 6I | 0.76 | 1 | 60 | 84 | 0 | 7 | 93 | 0 | 45 | 1317298 |
| 6J | 0.76 | 0.8 | 54 | 83 | 0 | 7 | 93 | 0 | 32 | 1127629 |
| 6K | 0.76 | 2 | 90 | 96 | 1 | 3 | 94 | 3 | 92 | 3000222 |
| 7A | 0.76 | 1.7 | 81 | 93 | 0 | 4 | 96 | 0 | 84 | 2061275 |
| 7B | 0.76 | 1.4 | 71 | 89 | 0 | 5 | 95 | 0 | 66 | 1571227 |
| 7C | 0.76 | 1.7 | 79 | 92 | 0 | 4 | 96 | 0 | 82 | 2029138 |
| 7D | 0.76 | 4.8 | 96 | 98 | 10 | 1 | 69 | 30 | 93 | 6122575 |
| 7H | 0.76 | 4.7 | 95 | 98 | 8 | 2 | 73 | 25 | 97 | 6124241 |
| 7I | 0.76 | 1.8 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2106286 |
| 7J | 0.76 | 1.5 | 77 | 91 | 0 | 4 | 96 | 0 | 74 | 1672023 |
| 7K | 0.76 | 1.6 | 82 | 93 | 0 | 4 | 96 | 0 | 86 | 2027565 |
| 8A | 0.76 | 5.5 | 96 | 98 | 1 | 1 | 77 | 22 | 98 | 5684691 |
| 8B | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4364334 |
| 8C | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 87 | 12 | 98 | 5010294 |
| 8D | 0.76 | 7.1 | 97 | 98 | 22 | 1 | 48 | 50 | 87 | 8023321 |
| 8H | 0.76 | 7.4 | 97 | 98 | 21 | 1 | 49 | 50 | 91 | 8388747 |
| 8I | 0.76 | 5 | 96 | 98 | 0 | 2 | 89 | 10 | 97 | 4796848 |
| 8J | 0.76 | 4.8 | 96 | 98 | 0 | 2 | 94 | 5 | 97 | 4537183 |
| 8K | 0.76 | 5.4 | 97 | 98 | 4 | 1 | 70 | 29 | 94 | 6007862 |
| | | | | | | | | | | |
| Average value | | | 80 | | 9 | 4 | 80 | 16 | | |

# Appendix B16

## Table B16: Detail DAYSIM result of LWC 18 (1:9)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 16920280 |
| 1B | 0.76 | 9 | 98 | 99 | 57 | 1 | 20 | 79 | 0 | 18297304 |
| 1C | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18880218 |
| 1D | 0.76 | 9.1 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 18187212 |
| 1E | 0.76 | 7.2 | 98 | 99 | 47 | 1 | 30 | 69 | 0 | 14133454 |
| 1F | 0.76 | 7.8 | 98 | 99 | 47 | 1 | 29 | 70 | 0 | 15333991 |
| 1G | 0.76 | 7.1 | 98 | 99 | 45 | 1 | 30 | 69 | 2 | 13652992 |
| 1H | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18388568 |
| 1I | 0.76 | 9.4 | 98 | 99 | 61 | 1 | 18 | 81 | 0 | 19093648 |
| 1J | 0.76 | 9.4 | 98 | 99 | 59 | 1 | 17 | 82 | 0 | 18657382 |
| 1K | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 17216302 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 91 | 7 | 96 | 4164895 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4459067 |
| 2C | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4388528 |
| 2D | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 87 | 11 | 95 | 3994233 |
| 2E | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3521958 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 95 | 3 | 95 | 3512912 |
| 2G | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 6 | 95 | 3685798 |
| 2H | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4262060 |
| 2I | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4621025 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4549956 |
| 2K | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 87 | 11 | 96 | 4394885 |
| 3A | 0.76 | 1.8 | 88 | 95 | 0 | 3 | 97 | 0 | 92 | 2896679 |
| 3B | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 84 | 1808369 |
| 3C | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 80 | 1686658 |
| 3D | 0.76 | 1.2 | 78 | 91 | 0 | 5 | 95 | 0 | 85 | 1831665 |
| 3E | 0.76 | 1.2 | 77 | 91 | 0 | 5 | 95 | 0 | 83 | 1754717 |
| 3F | 0.76 | 1.3 | 78 | 91 | 0 | 5 | 95 | 0 | 85 | 1827751 |
| 3G | 0.76 | 1.2 | 79 | 92 | 0 | 5 | 95 | 0 | 86 | 1854346 |
| 3H | 0.76 | 1.2 | 79 | 92 | 0 | 5 | 95 | 0 | 87 | 1906363 |
| 3I | 0.76 | 1.2 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1902856 |
| 3J | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 86 | 1808119 |
| 3K | 0.76 | 2.3 | 93 | 97 | 1 | 2 | 93 | 5 | 95 | 3687506 |
| 4A | 0.76 | 0.6 | 36 | 73 | 0 | 11 | 89 | 0 | 10 | 933708 |
| 4B | 0.76 | 0.6 | 28 | 72 | 0 | 11 | 89 | 0 | 6 | 882373 |
| 4C | 0.76 | 0.6 | 32 | 71 | 0 | 12 | 88 | 0 | 6 | 880769 |
| 4D | 0.76 | 1.2 | 69 | 88 | 0 | 5 | 95 | 0 | 73 | 1532948 |
| 4E | 0.76 | 2.2 | 87 | 95 | 0 | 3 | 97 | 0 | 91 | 2516467 |
| 4F | 0.76 | 2.7 | 90 | 96 | 0 | 2 | 98 | 0 | 94 | 2980357 |
| 4G | 0.76 | 2.2 | 88 | 95 | 0 | 3 | 97 | 0 | 93 | 2597882 |

**Table B16:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 1.2 | 71 | 89 | 0 | 5 | 95 | 0 | 75 | 1592639 |
| 4I | 0.76 | 0.7 | 38 | 76 | 0 | 10 | 90 | 0 | 19 | 979032 |
| 4J | 0.76 | 0.7 | 48 | 80 | 0 | 8 | 92 | 0 | 31 | 1048451 |
| 4K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 3 | 94 | 3200220 |
| 5A | 0.76 | 0.6 | 15 | 65 | 0 | 15 | 85 | 0 | 3 | 786962 |
| 5B | 0.76 | 0.5 | 1 | 59 | 0 | 17 | 83 | 0 | 0 | 676307 |
| 5C | 0.76 | 0.6 | 23 | 69 | 0 | 14 | 86 | 0 | 3 | 835414 |
| 5D | 0.76 | 2.1 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2509227 |
| 5H | 0.76 | 2.1 | 85 | 94 | 0 | 3 | 97 | 0 | 90 | 2621670 |
| 5I | 0.76 | 0.7 | 31 | 73 | 0 | 11 | 89 | 0 | 9 | 904553 |
| 5J | 0.76 | 0.6 | 28 | 73 | 0 | 12 | 88 | 0 | 8 | 876244 |
| 5K | 0.76 | 2 | 91 | 96 | 0 | 3 | 94 | 3 | 93 | 3172606 |
| 6A | 0.76 | 1.7 | 81 | 93 | 0 | 4 | 96 | 0 | 83 | 2484392 |
| 6B | 0.76 | 0.7 | 21 | 70 | 0 | 12 | 88 | 0 | 1 | 844035 |
| 6C | 0.76 | 0.9 | 49 | 80 | 0 | 8 | 92 | 0 | 33 | 1137827 |
| 6D | 0.76 | 3.1 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3705879 |
| 6H | 0.76 | 3.1 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3711052 |
| 6I | 0.76 | 1 | 56 | 83 | 0 | 7 | 93 | 0 | 40 | 1249454 |
| 6J | 0.76 | 0.8 | 52 | 83 | 0 | 7 | 93 | 0 | 29 | 1113130 |
| 6K | 0.76 | 1.9 | 89 | 95 | 1 | 3 | 94 | 3 | 91 | 2897931 |
| 7A | 0.76 | 1.6 | 78 | 91 | 0 | 4 | 96 | 0 | 80 | 1895287 |
| 7B | 0.76 | 1.4 | 69 | 88 | 0 | 5 | 95 | 0 | 63 | 1513761 |
| 7C | 0.76 | 1.7 | 78 | 92 | 0 | 4 | 96 | 0 | 81 | 1978722 |
| 7D | 0.76 | 3.7 | 94 | 97 | 0 | 2 | 87 | 11 | 97 | 4463203 |
| 7H | 0.76 | 4 | 94 | 97 | 0 | 2 | 83 | 15 | 97 | 4767445 |
| 7I | 0.76 | 1.7 | 80 | 92 | 0 | 4 | 96 | 0 | 83 | 2001280 |
| 7J | 0.76 | 1.4 | 76 | 91 | 0 | 4 | 96 | 0 | 72 | 1629118 |
| 7K | 0.76 | 1.7 | 85 | 94 | 0 | 3 | 97 | 0 | 89 | 2190136 |
| 8A | 0.76 | 5.6 | 96 | 98 | 1 | 1 | 75 | 24 | 98 | 5851207 |
| 8B | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4450203 |
| 8C | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 88 | 10 | 97 | 4898733 |
| 8D | 0.76 | 5.9 | 97 | 98 | 4 | 1 | 65 | 33 | 98 | 6282909 |
| 8H | 0.76 | 6.1 | 97 | 98 | 5 | 1 | 65 | 33 | 98 | 6408257 |
| 8I | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 92 | 6 | 97 | 4560631 |
| 8J | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4444360 |
| 8K | 0.76 | 5.4 | 97 | 98 | 3 | 1 | 72 | 27 | 94 | 5891866 |
| | | | | | | | | | | |
| Average value | | | 79 | | 8 | 4 | 81 | 15 | | |

# Appendix B17

## Table B17: Detail DAYSIM result of LWC 19 (1:10)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16828716 |
| 1B | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18336852 |
| 1C | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18459860 |
| 1D | 0.76 | 9.3 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 18311676 |
| 1E | 0.76 | 7.2 | 98 | 99 | 47 | 1 | 30 | 68 | 0 | 14134460 |
| 1F | 0.76 | 8.2 | 98 | 99 | 49 | 1 | 27 | 72 | 0 | 15877749 |
| 1G | 0.76 | 7 | 98 | 99 | 44 | 1 | 32 | 67 | 5 | 13408997 |
| 1H | 0.76 | 9.1 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18289768 |
| 1I | 0.76 | 9.4 | 98 | 99 | 61 | 1 | 17 | 82 | 0 | 19161158 |
| 1J | 0.76 | 9.2 | 98 | 99 | 57 | 1 | 19 | 80 | 0 | 18394036 |
| 1K | 0.76 | 8.8 | 98 | 99 | 56 | 1 | 20 | 79 | 0 | 16527981 |
| 2A | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4268043 |
| 2B | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4367854 |
| 2C | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4422746 |
| 2D | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4416475 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 5 | 95 | 3626064 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3551332 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3526076 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4216949 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4480471 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4533699 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 88 | 10 | 96 | 4330293 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3111251 |
| 3B | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 82 | 1754607 |
| 3C | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 78 | 1631172 |
| 3D | 0.76 | 1.1 | 70 | 89 | 0 | 6 | 94 | 0 | 80 | 1650404 |
| 3E | 0.76 | 1.1 | 76 | 91 | 0 | 5 | 95 | 0 | 83 | 1709230 |
| 3F | 0.76 | 1.2 | 75 | 90 | 0 | 5 | 95 | 0 | 83 | 1728296 |
| 3G | 0.76 | 1.1 | 73 | 90 | 0 | 5 | 95 | 0 | 82 | 1676947 |
| 3H | 0.76 | 1.2 | 79 | 92 | 0 | 5 | 95 | 0 | 87 | 1878832 |
| 3I | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 85 | 1837198 |
| 3J | 0.76 | 1.1 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1873038 |
| 3K | 0.76 | 2.2 | 93 | 97 | 0 | 2 | 95 | 3 | 95 | 3615825 |
| 4A | 0.76 | 0.6 | 32 | 71 | 0 | 13 | 87 | 0 | 9 | 896945 |
| 4B | 0.76 | 0.5 | 11 | 62 | 0 | 17 | 83 | 0 | 0 | 714786 |
| 4C | 0.76 | 0.6 | 27 | 69 | 0 | 13 | 87 | 0 | 1 | 818901 |
| 4D | 0.76 | 0.9 | 53 | 82 | 0 | 7 | 93 | 0 | 51 | 1190667 |
| 4E | 0.76 | 1.7 | 81 | 93 | 0 | 4 | 96 | 0 | 86 | 2022942 |
| 4F | 0.76 | 1.9 | 83 | 93 | 0 | 3 | 97 | 0 | 89 | 2264257 |
| 4G | 0.76 | 1.5 | 79 | 92 | 0 | 4 | 96 | 0 | 84 | 1869688 |
| 4H | 0.76 | 0.9 | 56 | 83 | 0 | 7 | 93 | 0 | 53 | 1231864 |
| 4I | 0.76 | 0.6 | 34 | 74 | 0 | 11 | 89 | 0 | 12 | 918010 |

**Table B17:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4J | 0.76 | 0.7 | 49 | 81 | 0 | 8 | 92 | 0 | 36 | 1080953 |
| 4K | 0.76 | 2 | 91 | 96 | 1 | 3 | 94 | 3 | 94 | 3215917 |
| 5A | 0.76 | 0.5 | 13 | 63 | 0 | 16 | 84 | 0 | 2 | 756903 |
| 5B | 0.76 | 0.4 | 0 | 47 | 0 | 27 | 73 | 0 | 0 | 548113 |
| 5C | 0.76 | 0.6 | 12 | 64 | 0 | 16 | 84 | 0 | 0 | 744909 |
| 5D | 0.76 | 1.6 | 76 | 91 | 0 | 4 | 96 | 0 | 79 | 1919165 |
| 5E | 0.76 | 8.4 | 97 | 98 | 17 | 1 | 59 | 39 | 83 | 7389445 |
| 5F | 0.76 | 6.7 | 96 | 98 | 9 | 1 | 71 | 27 | 96 | 6030298 |
| 5G | 0.76 | 3.6 | 92 | 97 | 0 | 2 | 89 | 9 | 96 | 4023970 |
| 5H | 0.76 | 1.6 | 77 | 91 | 0 | 4 | 96 | 0 | 82 | 1966666 |
| 5I | 0.76 | 0.6 | 22 | 70 | 0 | 13 | 87 | 0 | 1 | 829804 |
| 5J | 0.76 | 0.6 | 23 | 71 | 0 | 12 | 88 | 0 | 5 | 838380 |
| 5K | 0.76 | 2 | 91 | 96 | 0 | 3 | 94 | 3 | 93 | 3083925 |
| 6A | 0.76 | 1.7 | 83 | 93 | 0 | 4 | 96 | 0 | 84 | 2528161 |
| 6B | 0.76 | 0.7 | 30 | 74 | 0 | 10 | 90 | 0 | 4 | 917827 |
| 6C | 0.76 | 0.9 | 44 | 79 | 0 | 9 | 91 | 0 | 26 | 1061536 |
| 6D | 0.76 | 2.5 | 88 | 95 | 0 | 3 | 97 | 1 | 92 | 3045307 |
| 6H | 0.76 | 2.6 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3121185 |
| 6I | 0.76 | 0.8 | 40 | 77 | 0 | 10 | 90 | 0 | 23 | 1022134 |
| 6J | 0.76 | 0.8 | 49 | 81 | 0 | 8 | 92 | 0 | 25 | 1060614 |
| 6K | 0.76 | 1.9 | 89 | 95 | 1 | 3 | 94 | 3 | 91 | 2899832 |
| 7A | 0.76 | 1.6 | 80 | 92 | 0 | 4 | 96 | 0 | 82 | 1983423 |
| 7B | 0.76 | 1.3 | 68 | 88 | 0 | 5 | 95 | 0 | 58 | 1445986 |
| 7C | 0.76 | 1.7 | 79 | 92 | 0 | 4 | 96 | 0 | 81 | 1917514 |
| 7D | 0.76 | 3.4 | 93 | 97 | 0 | 2 | 91 | 7 | 96 | 4143123 |
| 7H | 0.76 | 3.5 | 93 | 97 | 0 | 2 | 89 | 9 | 96 | 4249357 |
| 7I | 0.76 | 1.7 | 80 | 93 | 0 | 4 | 96 | 0 | 82 | 1982220 |
| 7J | 0.76 | 1.4 | 77 | 91 | 0 | 4 | 96 | 0 | 73 | 1641800 |
| 7K | 0.76 | 1.8 | 86 | 94 | 0 | 3 | 97 | 0 | 90 | 2248854 |
| 8A | 0.76 | 5.6 | 96 | 98 | 1 | 1 | 72 | 26 | 98 | 6077910 |
| 8B | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4523624 |
| 8C | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 92 | 6 | 97 | 4563443 |
| 8D | 0.76 | 6 | 97 | 98 | 5 | 1 | 64 | 35 | 98 | 6396839 |
| 8H | 0.76 | 6.2 | 97 | 98 | 6 | 1 | 63 | 36 | 98 | 6606468 |
| 8I | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 89 | 9 | 97 | 4849288 |
| 8J | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4280864 |
| 8K | 0.76 | 5.4 | 97 | 98 | 3 | 1 | 71 | 27 | 95 | 5951985 |
| Average value | | | 77 | | 8 | 5 | 80 | 15 | | |

# Appendix B18

## Table B18: Detail DAYSIM result of LWC 20 (1:11)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16820724 |
| 1B | 0.76 | 9 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18355256 |
| 1C | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 18365292 |
| 1D | 0.76 | 8.8 | 98 | 99 | 54 | 1 | 22 | 77 | 0 | 17790784 |
| 1E | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 31 | 68 | 0 | 14172507 |
| 1F | 0.76 | 8.1 | 98 | 99 | 48 | 1 | 29 | 70 | 0 | 15597527 |
| 1G | 0.76 | 6.6 | 98 | 99 | 41 | 1 | 33 | 66 | 11 | 13049373 |
| 1H | 0.76 | 9 | 98 | 99 | 56 | 1 | 21 | 78 | 0 | 18137164 |
| 1I | 0.76 | 9.2 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18872496 |
| 1J | 0.76 | 9.5 | 98 | 99 | 60 | 1 | 17 | 82 | 0 | 18784598 |
| 1K | 0.76 | 9.1 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 16974180 |
| 2A | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3846290 |
| 2B | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 84 | 14 | 96 | 4347294 |
| 2C | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4553159 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4203439 |
| 2E | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 93 | 5 | 94 | 3541242 |
| 2F | 0.76 | 2 | 91 | 96 | 0 | 2 | 96 | 2 | 94 | 3383481 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 95 | 3536469 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4269223 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4552699 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4590129 |
| 2K | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 90 | 8 | 96 | 4190080 |
| 3A | 0.76 | 2 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3165548 |
| 3B | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 82 | 1737175 |
| 3C | 0.76 | 1 | 71 | 89 | 0 | 6 | 94 | 0 | 78 | 1640981 |
| 3D | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 82 | 1698725 |
| 3E | 0.76 | 1 | 70 | 89 | 0 | 6 | 94 | 0 | 78 | 1597789 |
| 3F | 0.76 | 1 | 66 | 87 | 0 | 6 | 94 | 0 | 73 | 1473748 |
| 3G | 0.76 | 1.1 | 76 | 91 | 0 | 5 | 95 | 0 | 85 | 1721668 |
| 3H | 0.76 | 1 | 65 | 87 | 0 | 6 | 94 | 0 | 75 | 1530348 |
| 3I | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 86 | 1832221 |
| 3J | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 85 | 1794721 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 3 | 95 | 3515978 |
| 4A | 0.76 | 0.6 | 34 | 72 | 0 | 12 | 88 | 0 | 11 | 918832 |
| 4B | 0.76 | 0.5 | 20 | 68 | 0 | 13 | 87 | 0 | 1 | 811045 |
| 4C | 0.76 | 0.5 | 16 | 64 | 0 | 15 | 85 | 0 | 0 | 752480 |
| 4D | 0.76 | 0.7 | 39 | 76 | 0 | 10 | 90 | 0 | 18 | 970026 |
| 4E | 0.76 | 1.4 | 74 | 91 | 0 | 5 | 95 | 0 | 78 | 1679547 |
| 4F | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 84 | 1904336 |
| 4G | 0.76 | 1.4 | 74 | 91 | 0 | 5 | 95 | 0 | 79 | 1675413 |

**Table B18:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.8 | 46 | 80 | 0 | 8 | 92 | 0 | 38 | 1084344 |
| 4I | 0.76 | 0.6 | 28 | 70 | 0 | 12 | 88 | 0 | 5 | 853435 |
| 4J | 0.76 | 0.7 | 50 | 81 | 0 | 8 | 92 | 0 | 35 | 1076163 |
| 4K | 0.76 | 2 | 91 | 96 | 0 | 3 | 95 | 3 | 93 | 3065288 |
| 5A | 0.76 | 0.6 | 20 | 68 | 0 | 13 | 87 | 0 | 4 | 831285 |
| 5B | 0.76 | 0.4 | 0 | 53 | 0 | 21 | 79 | 0 | 0 | 616485 |
| 5C | 0.76 | 0.6 | 9 | 65 | 0 | 14 | 86 | 0 | 0 | 752834 |
| 5D | 0.76 | 1.1 | 63 | 85 | 0 | 7 | 93 | 0 | 53 | 1366790 |
| 5E | 0.76 | 6.3 | 96 | 98 | 2 | 2 | 77 | 21 | 98 | 5393033 |
| 5F | 0.76 | 8.5 | 97 | 98 | 15 | 1 | 58 | 41 | 92 | 7310457 |
| 5G | 0.76 | 5.1 | 94 | 97 | 0 | 2 | 88 | 10 | 97 | 4479640 |
| 5H | 0.76 | 1.2 | 66 | 87 | 0 | 6 | 94 | 0 | 62 | 1476472 |
| 5I | 0.76 | 0.6 | 12 | 66 | 0 | 14 | 86 | 0 | 0 | 759891 |
| 5J | 0.76 | 0.5 | 18 | 68 | 0 | 14 | 86 | 0 | 3 | 785750 |
| 5K | 0.76 | 2 | 91 | 96 | 0 | 3 | 94 | 3 | 93 | 3052128 |
| 6A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2409060 |
| 6B | 0.76 | 0.6 | 14 | 67 | 0 | 12 | 88 | 0 | 0 | 793104 |
| 6C | 0.76 | 0.8 | 42 | 78 | 0 | 9 | 91 | 0 | 22 | 1034581 |
| 6D | 0.76 | 2.1 | 83 | 94 | 0 | 3 | 97 | 0 | 87 | 2514685 |
| 6H | 0.76 | 2.3 | 86 | 95 | 0 | 3 | 97 | 0 | 91 | 2744106 |
| 6I | 0.76 | 0.8 | 30 | 74 | 0 | 11 | 89 | 0 | 13 | 928629 |
| 6J | 0.76 | 0.7 | 35 | 77 | 0 | 9 | 91 | 0 | 11 | 947405 |
| 6K | 0.76 | 1.8 | 88 | 95 | 1 | 3 | 94 | 3 | 90 | 2804827 |
| 7A | 0.76 | 1.6 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2004048 |
| 7B | 0.76 | 1.3 | 70 | 89 | 0 | 5 | 95 | 0 | 64 | 1513967 |
| 7C | 0.76 | 1.5 | 76 | 91 | 0 | 4 | 96 | 0 | 73 | 1742082 |
| 7D | 0.76 | 2.9 | 91 | 96 | 0 | 2 | 96 | 2 | 94 | 3512285 |
| 7H | 0.76 | 3 | 91 | 96 | 0 | 2 | 96 | 1 | 95 | 3516283 |
| 7I | 0.76 | 1.6 | 78 | 92 | 0 | 4 | 96 | 0 | 78 | 1844243 |
| 7J | 0.76 | 1.3 | 71 | 89 | 0 | 5 | 95 | 0 | 61 | 1469062 |
| 7K | 0.76 | 1.7 | 83 | 93 | 0 | 4 | 96 | 0 | 87 | 2046607 |
| 8A | 0.76 | 5.3 | 96 | 98 | 1 | 1 | 77 | 21 | 98 | 5751408 |
| 8B | 0.76 | 4.4 | 94 | 97 | 0 | 2 | 97 | 1 | 97 | 4039770 |
| 8C | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4524428 |
| 8D | 0.76 | 5.4 | 96 | 98 | 0 | 2 | 75 | 24 | 98 | 5590850 |
| 8H | 0.76 | 5.8 | 96 | 98 | 1 | 1 | 71 | 27 | 98 | 5897690 |
| 8I | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 93 | 6 | 97 | 4516372 |
| 8J | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 3 | 97 | 4336125 |
| 8K | 0.76 | 5.5 | 97 | 98 | 4 | 1 | 70 | 29 | 94 | 6034105 |
| | | | | | | | | | | |
| Average value | | | 75 | | 8 | 5 | 81 | 15 | | |

## Appendix B19

### Table B19: Detail DAYSIM result of LWC 21 (1:12)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16855888 |
| 1B | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 20 | 79 | 0 | 18212708 |
| 1C | 0.76 | 8.7 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 18192180 |
| 1D | 0.76 | 9.4 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18461946 |
| 1E | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 31 | 68 | 0 | 14084345 |
| 1F | 0.76 | 7.7 | 98 | 99 | 46 | 1 | 29 | 70 | 1 | 15258573 |
| 1G | 0.76 | 6.8 | 98 | 99 | 43 | 1 | 32 | 67 | 6 | 13256701 |
| 1H | 0.76 | 8.9 | 98 | 99 | 55 | 1 | 22 | 77 | 0 | 17986032 |
| 1I | 0.76 | 9 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18653392 |
| 1J | 0.76 | 9.2 | 98 | 99 | 57 | 1 | 19 | 80 | 0 | 18329664 |
| 1K | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 17000220 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 91 | 7 | 96 | 4075109 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4443815 |
| 2C | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4344687 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4167865 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 5 | 95 | 3679809 |
| 2F | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3663709 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 93 | 5 | 94 | 3587626 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4269108 |
| 2I | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4421338 |
| 2J | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4450989 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4273085 |
| 3A | 0.76 | 1.9 | 88 | 95 | 0 | 3 | 97 | 0 | 93 | 3040782 |
| 3B | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 79 | 1699623 |
| 3C | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 77 | 1611292 |
| 3D | 0.76 | 1 | 71 | 89 | 0 | 5 | 95 | 0 | 80 | 1659932 |
| 3E | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 77 | 1574198 |
| 3F | 0.76 | 1 | 63 | 86 | 0 | 6 | 94 | 0 | 71 | 1438849 |
| 3G | 0.76 | 1 | 67 | 88 | 0 | 6 | 94 | 0 | 76 | 1540744 |
| 3H | 0.76 | 1 | 70 | 89 | 0 | 5 | 95 | 0 | 80 | 1672963 |
| 3I | 0.76 | 1 | 71 | 90 | 0 | 6 | 94 | 0 | 82 | 1676408 |
| 3J | 0.76 | 1.2 | 81 | 92 | 0 | 4 | 96 | 0 | 87 | 1924670 |
| 3K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3456065 |
| 4A | 0.76 | 0.6 | 33 | 71 | 0 | 13 | 87 | 0 | 9 | 901812 |
| 4B | 0.76 | 0.5 | 22 | 68 | 0 | 13 | 87 | 0 | 1 | 809093 |
| 4C | 0.76 | 0.5 | 25 | 68 | 0 | 13 | 87 | 0 | 4 | 827073 |
| 4D | 0.76 | 0.6 | 34 | 72 | 0 | 12 | 88 | 0 | 5 | 902853 |
| 4E | 0.76 | 1.2 | 67 | 88 | 0 | 6 | 94 | 0 | 69 | 1437813 |
| 4F | 0.76 | 1.5 | 78 | 91 | 0 | 4 | 96 | 0 | 82 | 1785948 |
| 4G | 0.76 | 1.2 | 70 | 89 | 0 | 5 | 95 | 0 | 73 | 1515974 |

**Table B19:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 40 | 76 | 0 | 10 | 90 | 0 | 24 | 998250 |
| 4I | 0.76 | 0.5 | 25 | 69 | 0 | 13 | 87 | 0 | 3 | 823369 |
| 4J | 0.76 | 0.6 | 46 | 79 | 0 | 9 | 91 | 0 | 29 | 1022501 |
| 4K | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 94 | 3263674 |
| 5A | 0.76 | 0.6 | 15 | 64 | 0 | 15 | 85 | 0 | 2 | 779941 |
| 5B | 0.76 | 0.4 | 0 | 48 | 0 | 26 | 74 | 0 | 0 | 551626 |
| 5C | 0.76 | 0.5 | 1 | 58 | 0 | 19 | 81 | 0 | 0 | 664112 |
| 5D | 0.76 | 1.1 | 62 | 85 | 0 | 7 | 93 | 0 | 52 | 1357455 |
| 5E | 0.76 | 3.9 | 93 | 97 | 0 | 2 | 95 | 3 | 96 | 3719714 |
| 5F | 0.76 | 6.3 | 96 | 98 | 3 | 2 | 75 | 23 | 98 | 5704527 |
| 5G | 0.76 | 5 | 95 | 98 | 0 | 2 | 88 | 10 | 97 | 4511198 |
| 5H | 0.76 | 1.1 | 61 | 85 | 0 | 6 | 94 | 0 | 52 | 1366542 |
| 5I | 0.76 | 0.5 | 4 | 61 | 0 | 17 | 83 | 0 | 0 | 692275 |
| 5J | 0.76 | 0.5 | 19 | 68 | 0 | 14 | 86 | 0 | 4 | 789043 |
| 5K | 0.76 | 2 | 90 | 96 | 1 | 3 | 94 | 4 | 92 | 3078668 |
| 6A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 80 | 2358820 |
| 6B | 0.76 | 0.7 | 22 | 72 | 0 | 10 | 90 | 0 | 1 | 871402 |
| 6C | 0.76 | 0.7 | 27 | 71 | 0 | 12 | 88 | 0 | 10 | 887907 |
| 6D | 0.76 | 2 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2335692 |
| 6H | 0.76 | 1.9 | 80 | 93 | 0 | 3 | 97 | 0 | 83 | 2272455 |
| 6I | 0.76 | 0.7 | 29 | 73 | 0 | 12 | 88 | 0 | 11 | 905811 |
| 6J | 0.76 | 0.8 | 49 | 82 | 0 | 7 | 93 | 0 | 24 | 1073388 |
| 6K | 0.76 | 1.8 | 88 | 95 | 1 | 3 | 94 | 3 | 91 | 2818450 |
| 7A | 0.76 | 1.7 | 82 | 93 | 0 | 4 | 96 | 0 | 84 | 2066931 |
| 7B | 0.76 | 1.3 | 70 | 88 | 0 | 5 | 95 | 0 | 62 | 1499727 |
| 7C | 0.76 | 1.5 | 72 | 89 | 0 | 5 | 95 | 0 | 69 | 1639884 |
| 7D | 0.76 | 2.8 | 90 | 96 | 0 | 2 | 97 | 1 | 94 | 3247490 |
| 7H | 0.76 | 2.8 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3299710 |
| 7I | 0.76 | 1.6 | 76 | 91 | 0 | 4 | 96 | 0 | 75 | 1747355 |
| 7J | 0.76 | 1.5 | 78 | 91 | 0 | 4 | 96 | 0 | 75 | 1662176 |
| 7K | 0.76 | 1.8 | 86 | 95 | 0 | 3 | 97 | 0 | 90 | 2305705 |
| 8A | 0.76 | 5.2 | 96 | 98 | 1 | 1 | 79 | 20 | 98 | 5653387 |
| 8B | 0.76 | 4.5 | 95 | 97 | 0 | 2 | 97 | 2 | 97 | 4233754 |
| 8C | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 93 | 5 | 97 | 4539712 |
| 8D | 0.76 | 5.4 | 96 | 98 | 0 | 2 | 78 | 21 | 98 | 5433411 |
| 8H | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 79 | 19 | 98 | 5354246 |
| 8I | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 93 | 5 | 97 | 4509506 |
| 8J | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 4 | 97 | 4487236 |
| 8K | 0.76 | 5.3 | 97 | 98 | 3 | 1 | 72 | 26 | 95 | 5862758 |
| Average value | | | 74 | | 8 | 5 | 81 | 14 | | |

## Appendix B20

### Table B20: Detail DAYSIM result of LWC 22 (1:13)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16853912 |
| 1B | 0.76 | 9.2 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 18557272 |
| 1C | 0.76 | 8.7 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 18265884 |
| 1D | 0.76 | 8.8 | 98 | 99 | 53 | 1 | 22 | 77 | 0 | 17761324 |
| 1E | 0.76 | 7.2 | 98 | 99 | 47 | 1 | 31 | 68 | 0 | 14183229 |
| 1F | 0.76 | 8.1 | 98 | 99 | 48 | 1 | 28 | 71 | 0 | 15707095 |
| 1G | 0.76 | 7 | 98 | 99 | 44 | 1 | 32 | 67 | 6 | 13396193 |
| 1H | 0.76 | 9.4 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18651298 |
| 1I | 0.76 | 9.3 | 98 | 99 | 60 | 1 | 18 | 81 | 0 | 18951722 |
| 1J | 0.76 | 9.7 | 98 | 99 | 60 | 1 | 17 | 83 | 0 | 19004728 |
| 1K | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 16910036 |
| 2A | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 91 | 6 | 96 | 4052473 |
| 2B | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4372855 |
| 2C | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 82 | 16 | 96 | 4397126 |
| 2D | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4296888 |
| 2E | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 93 | 5 | 95 | 3580866 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 94 | 3525735 |
| 2G | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 95 | 3 | 94 | 3453940 |
| 2H | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4478712 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4467584 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4505114 |
| 2K | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 89 | 9 | 96 | 4277796 |
| 3A | 0.76 | 2 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3114507 |
| 3B | 0.76 | 1 | 74 | 90 | 0 | 5 | 95 | 0 | 82 | 1739468 |
| 3C | 0.76 | 1 | 70 | 89 | 0 | 6 | 94 | 0 | 77 | 1627164 |
| 3D | 0.76 | 0.9 | 62 | 86 | 0 | 6 | 94 | 0 | 71 | 1454960 |
| 3E | 0.76 | 1.1 | 77 | 91 | 0 | 5 | 95 | 0 | 83 | 1715452 |
| 3F | 0.76 | 0.9 | 63 | 87 | 0 | 6 | 94 | 0 | 72 | 1432593 |
| 3G | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 79 | 1585086 |
| 3H | 0.76 | 1 | 69 | 89 | 0 | 5 | 95 | 0 | 81 | 1654716 |
| 3I | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 80 | 1644082 |
| 3J | 0.76 | 1.1 | 78 | 91 | 0 | 5 | 95 | 0 | 86 | 1808347 |
| 3K | 0.76 | 2.2 | 93 | 96 | 0 | 2 | 95 | 3 | 95 | 3567476 |
| 4A | 0.76 | 0.6 | 33 | 71 | 0 | 13 | 87 | 0 | 9 | 902078 |
| 4B | 0.76 | 0.5 | 24 | 69 | 0 | 12 | 88 | 0 | 3 | 838189 |
| 4C | 0.76 | 0.5 | 15 | 63 | 0 | 16 | 84 | 0 | 0 | 731897 |
| 4D | 0.76 | 0.7 | 37 | 75 | 0 | 10 | 90 | 0 | 13 | 952716 |
| 4E | 0.76 | 1 | 57 | 85 | 0 | 6 | 94 | 0 | 55 | 1250253 |
| 4F | 0.76 | 1.3 | 72 | 89 | 0 | 5 | 95 | 0 | 75 | 1582668 |
| 4G | 0.76 | 1.2 | 68 | 89 | 0 | 5 | 95 | 0 | 71 | 1456006 |

**Table B20:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 41 | 78 | 0 | 9 | 91 | 0 | 27 | 1021292 |
| 4I | 0.76 | 0.6 | 27 | 70 | 0 | 12 | 88 | 0 | 5 | 846338 |
| 4J | 0.76 | 0.7 | 46 | 79 | 0 | 9 | 91 | 0 | 30 | 1033236 |
| 4K | 0.76 | 2 | 92 | 96 | 0 | 3 | 95 | 3 | 93 | 3091287 |
| 5A | 0.76 | 0.5 | 10 | 58 | 0 | 19 | 81 | 0 | 0 | 698940 |
| 5B | 0.76 | 0.4 | 0 | 47 | 0 | 27 | 73 | 0 | 0 | 540801 |
| 5C | 0.76 | 0.4 | 0 | 53 | 0 | 23 | 77 | 0 | 0 | 605980 |
| 5D | 0.76 | 1 | 59 | 84 | 0 | 7 | 93 | 0 | 45 | 1262603 |
| 5E | 0.76 | 3.1 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3138726 |
| 5F | 0.76 | 4.4 | 94 | 97 | 0 | 2 | 90 | 9 | 97 | 4300552 |
| 5G | 0.76 | 3.9 | 93 | 97 | 0 | 2 | 95 | 3 | 96 | 3776268 |
| 5H | 0.76 | 1.2 | 66 | 87 | 0 | 6 | 94 | 0 | 60 | 1453270 |
| 5I | 0.76 | 0.5 | 3 | 61 | 0 | 16 | 84 | 0 | 0 | 700046 |
| 5J | 0.76 | 0.5 | 21 | 70 | 0 | 13 | 87 | 0 | 4 | 814842 |
| 5K | 0.76 | 1.8 | 88 | 95 | 0 | 3 | 95 | 2 | 91 | 2814754 |
| 6A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 80 | 2343650 |
| 6B | 0.76 | 0.6 | 5 | 61 | 0 | 15 | 85 | 0 | 0 | 708234 |
| 6C | 0.76 | 0.7 | 26 | 72 | 0 | 11 | 89 | 0 | 6 | 889208 |
| 6D | 0.76 | 1.8 | 79 | 92 | 0 | 4 | 96 | 0 | 82 | 2142960 |
| 6H | 0.76 | 1.9 | 82 | 93 | 0 | 3 | 97 | 0 | 85 | 2290671 |
| 6I | 0.76 | 0.7 | 27 | 72 | 0 | 12 | 88 | 0 | 8 | 888610 |
| 6J | 0.76 | 0.7 | 32 | 76 | 0 | 10 | 90 | 0 | 10 | 921937 |
| 6K | 0.76 | 1.9 | 89 | 95 | 1 | 3 | 94 | 4 | 91 | 2942142 |
| 7A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 80 | 1921282 |
| 7B | 0.76 | 1.2 | 66 | 86 | 0 | 6 | 94 | 0 | 51 | 1369198 |
| 7C | 0.76 | 1.4 | 72 | 90 | 0 | 5 | 95 | 0 | 68 | 1619474 |
| 7D | 0.76 | 2.4 | 86 | 95 | 0 | 3 | 97 | 0 | 91 | 2823532 |
| 7H | 0.76 | 2.8 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 3233430 |
| 7I | 0.76 | 1.5 | 75 | 90 | 0 | 4 | 96 | 0 | 71 | 1669580 |
| 7J | 0.76 | 1.4 | 74 | 90 | 0 | 5 | 95 | 0 | 67 | 1542589 |
| 7K | 0.76 | 1.7 | 85 | 94 | 0 | 3 | 97 | 0 | 89 | 2192979 |
| 8A | 0.76 | 5.2 | 96 | 98 | 1 | 2 | 79 | 20 | 98 | 5604403 |
| 8B | 0.76 | 4.9 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4461597 |
| 8C | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 3 | 97 | 4340284 |
| 8D | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 82 | 17 | 98 | 5120349 |
| 8H | 0.76 | 5 | 96 | 98 | 0 | 2 | 84 | 14 | 97 | 4987597 |
| 8I | 0.76 | 5.1 | 96 | 98 | 0 | 2 | 91 | 8 | 97 | 4699202 |
| 8J | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4259876 |
| 8K | 0.76 | 5.8 | 97 | 98 | 4 | 1 | 64 | 34 | 94 | 6343043 |
| Average value | | | 73 | | 8 | 5 | 81 | 14 | | |

# Appendix B21

## Table B21: Detail DAYSIM result of LWC 23 (1:14)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16857360 |
| 1B | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18220764 |
| 1C | 0.76 | 8.9 | 98 | 99 | 58 | 1 | 20 | 79 | 0 | 18525996 |
| 1D | 0.76 | 8.9 | 98 | 99 | 54 | 1 | 22 | 77 | 0 | 17815048 |
| 1E | 0.76 | 7.2 | 98 | 99 | 46 | 1 | 31 | 67 | 0 | 14093762 |
| 1F | 0.76 | 7.9 | 98 | 99 | 47 | 1 | 28 | 71 | 0 | 15469992 |
| 1G | 0.76 | 6.5 | 98 | 99 | 39 | 1 | 35 | 64 | 12 | 12822934 |
| 1H | 0.76 | 9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18199244 |
| 1I | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 21 | 78 | 0 | 18752796 |
| 1J | 0.76 | 9.2 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 18373588 |
| 1K | 0.76 | 9.1 | 98 | 99 | 59 | 1 | 19 | 80 | 0 | 17074568 |
| 2A | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 91 | 7 | 96 | 4082433 |
| 2B | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 82 | 16 | 96 | 4501425 |
| 2C | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4545788 |
| 2D | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4115689 |
| 2E | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 5 | 95 | 3655646 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 3 | 94 | 3504558 |
| 2G | 0.76 | 2 | 90 | 96 | 0 | 3 | 95 | 2 | 94 | 3319983 |
| 2H | 0.76 | 2.6 | 94 | 97 | 0 | 2 | 83 | 15 | 96 | 4374556 |
| 2I | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4510333 |
| 2J | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4632098 |
| 2K | 0.76 | 2.4 | 93 | 97 | 0 | 2 | 92 | 6 | 95 | 4002627 |
| 3A | 0.76 | 2 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3159618 |
| 3B | 0.76 | 1 | 70 | 89 | 0 | 6 | 94 | 0 | 76 | 1603978 |
| 3C | 0.76 | 1 | 71 | 89 | 0 | 5 | 95 | 0 | 79 | 1677296 |
| 3D | 0.76 | 1 | 68 | 89 | 0 | 6 | 94 | 0 | 77 | 1595300 |
| 3E | 0.76 | 0.9 | 60 | 85 | 0 | 7 | 93 | 0 | 66 | 1365986 |
| 3F | 0.76 | 1 | 65 | 87 | 0 | 6 | 94 | 0 | 74 | 1476678 |
| 3G | 0.76 | 1 | 71 | 90 | 0 | 6 | 94 | 0 | 80 | 1623554 |
| 3H | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 80 | 1640670 |
| 3I | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 83 | 1701331 |
| 3J | 0.76 | 1.1 | 79 | 92 | 0 | 5 | 95 | 0 | 86 | 1849213 |
| 3K | 0.76 | 2.4 | 93 | 97 | 1 | 2 | 93 | 5 | 95 | 3782627 |
| 4A | 0.76 | 0.5 | 22 | 67 | 0 | 15 | 85 | 0 | 4 | 817605 |
| 4B | 0.76 | 0.5 | 14 | 64 | 0 | 15 | 85 | 0 | 0 | 744940 |
| 4C | 0.76 | 0.5 | 12 | 61 | 0 | 17 | 83 | 0 | 0 | 702802 |
| 4D | 0.76 | 0.6 | 27 | 68 | 0 | 13 | 87 | 0 | 0 | 813988 |
| 4E | 0.76 | 0.9 | 53 | 83 | 0 | 7 | 93 | 0 | 46 | 1188900 |
| 4F | 0.76 | 1.2 | 71 | 89 | 0 | 5 | 95 | 0 | 74 | 1535273 |
| 4G | 0.76 | 1 | 62 | 87 | 0 | 6 | 94 | 0 | 65 | 1343808 |

**Table B21:** Continued

| **Core points** | **H** | **DF [%]** | **DA [%]** | **$DA_{con}$ [%]** | **$DA_{max}$ [%]** | **$UDI_{<100}$ [%]** | **$UDI_{100-2000}$ [%]** | **$UDI_{>2000}$ [%]** | **DSP [%]** | **annual light exposure [luxh]** |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.7 | 35 | 74 | 0 | 11 | 89 | 0 | 8 | 925388 |
| 4I | 0.76 | 0.6 | 29 | 72 | 0 | 11 | 89 | 0 | 10 | 882245 |
| 4J | 0.76 | 0.7 | 47 | 79 | 0 | 9 | 91 | 0 | 33 | 1043570 |
| 4K | 0.76 | 2.1 | 92 | 96 | 1 | 2 | 94 | 4 | 94 | 3211535 |
| 5A | 0.76 | 0.5 | 11 | 60 | 0 | 17 | 83 | 0 | 1 | 725911 |
| 5B | 0.76 | 0.4 | 0 | 55 | 0 | 18 | 82 | 0 | 0 | 636107 |
| 5C | 0.76 | 0.5 | 0 | 55 | 0 | 19 | 81 | 0 | 0 | 627981 |
| 5D | 0.76 | 0.7 | 30 | 73 | 0 | 11 | 89 | 0 | 12 | 907626 |
| 5E | 0.76 | 2.9 | 91 | 96 | 0 | 2 | 98 | 0 | 94 | 2906616 |
| 5F | 0.76 | 4.2 | 94 | 97 | 0 | 2 | 93 | 5 | 97 | 4016735 |
| 5G | 0.76 | 3 | 90 | 96 | 0 | 2 | 98 | 0 | 94 | 2948916 |
| 5H | 0.76 | 1 | 55 | 83 | 0 | 7 | 93 | 0 | 39 | 1217073 |
| 5I | 0.76 | 0.5 | 1 | 57 | 0 | 19 | 81 | 0 | 0 | 652736 |
| 5J | 0.76 | 0.6 | 20 | 69 | 0 | 13 | 87 | 0 | 4 | 807565 |
| 5K | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 95 | 2 | 91 | 2904561 |
| 6A | 0.76 | 1.6 | 79 | 92 | 0 | 4 | 96 | 0 | 79 | 2355188 |
| 6B | 0.76 | 0.6 | 12 | 67 | 0 | 12 | 88 | 0 | 0 | 790341 |
| 6C | 0.76 | 0.7 | 21 | 71 | 0 | 11 | 89 | 0 | 2 | 847948 |
| 6D | 0.76 | 1.2 | 65 | 86 | 0 | 6 | 94 | 0 | 55 | 1451192 |
| 6H | 0.76 | 1.7 | 76 | 91 | 0 | 4 | 96 | 0 | 77 | 1976070 |
| 6I | 0.76 | 0.7 | 24 | 71 | 0 | 12 | 88 | 0 | 6 | 863250 |
| 6J | 0.76 | 0.7 | 33 | 76 | 0 | 10 | 90 | 0 | 10 | 926835 |
| 6K | 0.76 | 1.8 | 87 | 95 | 1 | 3 | 94 | 3 | 89 | 2740052 |
| 7A | 0.76 | 1.7 | 81 | 92 | 0 | 4 | 96 | 0 | 82 | 2016502 |
| 7B | 0.76 | 1.4 | 70 | 89 | 0 | 5 | 95 | 0 | 63 | 1515863 |
| 7C | 0.76 | 1.3 | 69 | 88 | 0 | 5 | 95 | 0 | 62 | 1499720 |
| 7D | 0.76 | 2.1 | 84 | 94 | 0 | 3 | 97 | 0 | 89 | 2519869 |
| 7H | 0.76 | 2.4 | 88 | 95 | 0 | 3 | 97 | 0 | 92 | 2890520 |
| 7I | 0.76 | 1.5 | 73 | 90 | 0 | 5 | 95 | 0 | 68 | 1617383 |
| 7J | 0.76 | 1.4 | 75 | 90 | 0 | 4 | 96 | 0 | 70 | 1580113 |
| 7K | 0.76 | 1.7 | 84 | 94 | 0 | 3 | 97 | 0 | 88 | 2131210 |
| 8A | 0.76 | 5.2 | 96 | 98 | 1 | 1 | 79 | 19 | 98 | 5625973 |
| 8B | 0.76 | 4.8 | 95 | 98 | 0 | 2 | 94 | 4 | 97 | 4584898 |
| 8C | 0.76 | 4.5 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4291974 |
| 8D | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 87 | 12 | 97 | 4832968 |
| 8H | 0.76 | 4.9 | 96 | 98 | 0 | 2 | 84 | 14 | 97 | 4943674 |
| 8I | 0.76 | 4.5 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4296627 |
| 8J | 0.76 | 4.9 | 96 | 98 | 0 | 2 | 94 | 5 | 97 | 4532452 |
| 8K | 0.76 | 5.4 | 97 | 98 | 4 | 1 | 70 | 29 | 94 | 5991566 |
| | | | | | | | | | | |
| Average value | | | 71 | | 8 | 5 | 81 | 13 | | |

# Appendix B22

## Table B22: Detail DAYSIM result of LWC 24 (1:15)

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 22 | 77 | 0 | 16835096 |
| 1B | 0.76 | 8.9 | 98 | 99 | 57 | 1 | 21 | 78 | 0 | 18150548 |
| 1C | 0.76 | 8.8 | 98 | 99 | 56 | 1 | 21 | 78 | 0 | 18319916 |
| 1D | 0.76 | 8.8 | 98 | 99 | 53 | 1 | 22 | 77 | 0 | 17753792 |
| 1E | 0.76 | 7.2 | 98 | 99 | 47 | 1 | 30 | 69 | 0 | 14235572 |
| 1F | 0.76 | 7.9 | 98 | 99 | 47 | 1 | 29 | 70 | 0 | 15495069 |
| 1G | 0.76 | 6.9 | 98 | 99 | 44 | 1 | 32 | 67 | 6 | 13409538 |
| 1H | 0.76 | 8.9 | 98 | 99 | 56 | 1 | 21 | 78 | 0 | 18128348 |
| 1I | 0.76 | 9.1 | 98 | 99 | 58 | 1 | 18 | 81 | 0 | 18714520 |
| 1J | 0.76 | 9 | 98 | 99 | 55 | 1 | 20 | 79 | 0 | 18077888 |
| 1K | 0.76 | 8.9 | 98 | 99 | 58 | 1 | 19 | 80 | 0 | 16795060 |
| 2A | 0.76 | 2.4 | 93 | 96 | 0 | 2 | 93 | 5 | 95 | 3943535 |
| 2B | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 85 | 13 | 96 | 4182289 |
| 2C | 0.76 | 2.8 | 94 | 97 | 0 | 2 | 80 | 18 | 96 | 4685904 |
| 2D | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4224051 |
| 2E | 0.76 | 2.3 | 92 | 96 | 0 | 2 | 90 | 8 | 95 | 3813375 |
| 2F | 0.76 | 2.1 | 92 | 96 | 0 | 2 | 94 | 4 | 94 | 3499147 |
| 2G | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 92 | 6 | 95 | 3674234 |
| 2H | 0.76 | 2.5 | 93 | 97 | 0 | 2 | 84 | 14 | 96 | 4272138 |
| 2I | 0.76 | 2.6 | 93 | 97 | 0 | 2 | 83 | 15 | 96 | 4332981 |
| 2J | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 81 | 17 | 96 | 4515735 |
| 2K | 0.76 | 2.7 | 94 | 97 | 0 | 2 | 85 | 13 | 96 | 4489197 |
| 3A | 0.76 | 1.9 | 89 | 95 | 0 | 3 | 97 | 0 | 93 | 3053992 |
| 3B | 0.76 | 1 | 70 | 89 | 0 | 6 | 94 | 0 | 77 | 1620652 |
| 3C | 0.76 | 0.9 | 63 | 86 | 0 | 6 | 94 | 0 | 71 | 1478387 |
| 3D | 0.76 | 1 | 72 | 90 | 0 | 5 | 95 | 0 | 82 | 1694108 |
| 3E | 0.76 | 0.9 | 65 | 88 | 0 | 6 | 94 | 0 | 72 | 1481319 |
| 3F | 0.76 | 0.9 | 63 | 86 | 0 | 6 | 94 | 0 | 71 | 1444984 |
| 3G | 0.76 | 1 | 69 | 89 | 0 | 6 | 94 | 0 | 78 | 1598373 |
| 3H | 0.76 | 1 | 67 | 88 | 0 | 6 | 94 | 0 | 77 | 1585230 |
| 3I | 0.76 | 1.1 | 76 | 90 | 0 | 5 | 95 | 0 | 84 | 1764702 |
| 3J | 0.76 | 1.1 | 80 | 92 | 0 | 5 | 95 | 0 | 87 | 1879800 |
| 3K | 0.76 | 2.2 | 92 | 96 | 0 | 2 | 95 | 2 | 95 | 3463860 |
| 4A | 0.76 | 0.6 | 31 | 71 | 0 | 13 | 87 | 0 | 6 | 877795 |
| 4B | 0.76 | 0.5 | 23 | 69 | 0 | 12 | 88 | 0 | 3 | 838055 |
| 4C | 0.76 | 0.5 | 16 | 63 | 0 | 15 | 85 | 0 | 0 | 734895 |
| 4D | 0.76 | 0.6 | 32 | 72 | 0 | 11 | 89 | 0 | 4 | 877599 |
| 4E | 0.76 | 0.9 | 48 | 81 | 0 | 7 | 93 | 0 | 39 | 1117058 |
| 4F | 0.76 | 1.1 | 63 | 86 | 0 | 6 | 94 | 0 | 64 | 1347796 |
| 4G | 0.76 | 1 | 59 | 86 | 0 | 6 | 94 | 0 | 57 | 1263963 |

**Table B22:** Continued

| Core points | H | DF [%] | DA [%] | $DA_{con}$ [%] | $DA_{max}$ [%] | $UDI_{<100}$ [%] | $UDI_{100-2000}$ [%] | $UDI_{>2000}$ [%] | DSP [%] | annual light exposure [luxh] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4H | 0.76 | 0.8 | 46 | 81 | 0 | 8 | 92 | 0 | 37 | 1100113 |
| 4I | 0.76 | 0.5 | 22 | 69 | 0 | 13 | 87 | 0 | 4 | 819612 |
| 4J | 0.76 | 0.7 | 53 | 82 | 0 | 8 | 92 | 0 | 44 | 1134398 |
| 4K | 0.76 | 2 | 91 | 96 | 0 | 3 | 95 | 2 | 93 | 3039652 |
| 5A | 0.76 | 0.5 | 11 | 60 | 0 | 18 | 82 | 0 | 1 | 721950 |
| 5B | 0.76 | 0.4 | 0 | 53 | 0 | 20 | 80 | 0 | 0 | 618470 |
| 5C | 0.76 | 0.4 | 0 | 49 | 0 | 25 | 75 | 0 | 0 | 565744 |
| 5D | 0.76 | 0.9 | 49 | 80 | 0 | 8 | 92 | 0 | 29 | 1098467 |
| 5E | 0.76 | 2.4 | 86 | 95 | 0 | 3 | 97 | 0 | 90 | 2465454 |
| 5F | 0.76 | 3.4 | 92 | 97 | 0 | 2 | 98 | 0 | 95 | 3336051 |
| 5G | 0.76 | 2.6 | 89 | 95 | 0 | 3 | 97 | 0 | 92 | 2658179 |
| 5H | 0.76 | 0.9 | 47 | 79 | 0 | 8 | 92 | 0 | 27 | 1084719 |
| 5I | 0.76 | 0.5 | 8 | 65 | 0 | 14 | 86 | 0 | 0 | 748874 |
| 5J | 0.76 | 0.6 | 24 | 71 | 0 | 12 | 88 | 0 | 6 | 842990 |
| 5K | 0.76 | 2 | 90 | 96 | 0 | 3 | 94 | 3 | 93 | 3077727 |
| 6A | 0.76 | 1.6 | 78 | 92 | 0 | 4 | 96 | 0 | 78 | 2267953 |
| 6B | 0.76 | 0.6 | 13 | 66 | 0 | 13 | 87 | 0 | 0 | 783547 |
| 6C | 0.76 | 0.6 | 13 | 65 | 0 | 15 | 85 | 0 | 1 | 768377 |
| 6D | 0.76 | 1.5 | 72 | 89 | 0 | 5 | 95 | 0 | 67 | 1721305 |
| 6H | 0.76 | 1.5 | 72 | 89 | 0 | 5 | 95 | 0 | 68 | 1742453 |
| 6I | 0.76 | 0.7 | 29 | 74 | 0 | 10 | 90 | 0 | 7 | 906176 |
| 6J | 0.76 | 0.7 | 40 | 79 | 0 | 8 | 92 | 0 | 14 | 988220 |
| 6K | 0.76 | 1.9 | 89 | 95 | 1 | 3 | 94 | 3 | 91 | 2889071 |
| 7A | 0.76 | 1.5 | 77 | 91 | 0 | 4 | 96 | 0 | 78 | 1875040 |
| 7B | 0.76 | 1.3 | 68 | 88 | 0 | 5 | 95 | 0 | 58 | 1431007 |
| 7C | 0.76 | 1.4 | 69 | 88 | 0 | 5 | 95 | 0 | 61 | 1516592 |
| 7D | 0.76 | 2.3 | 86 | 94 | 0 | 3 | 97 | 0 | 90 | 2669591 |
| 7H | 0.76 | 2.4 | 86 | 95 | 0 | 3 | 97 | 0 | 91 | 2737679 |
| 7I | 0.76 | 1.5 | 75 | 91 | 0 | 4 | 96 | 0 | 74 | 1682558 |
| 7J | 0.76 | 1.4 | 75 | 90 | 0 | 4 | 96 | 0 | 70 | 1563172 |
| 7K | 0.76 | 1.8 | 86 | 95 | 0 | 3 | 97 | 0 | 90 | 2310494 |
| 8A | 0.76 | 5.3 | 96 | 98 | 1 | 1 | 79 | 20 | 98 | 5638262 |
| 8B | 0.76 | 4.7 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4441433 |
| 8C | 0.76 | 4.5 | 95 | 97 | 0 | 2 | 96 | 2 | 97 | 4217730 |
| 8D | 0.76 | 4.9 | 95 | 98 | 0 | 2 | 86 | 13 | 97 | 4916042 |
| 8H | 0.76 | 5.2 | 96 | 98 | 0 | 2 | 83 | 16 | 98 | 5108375 |
| 8I | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 95 | 3 | 97 | 4365736 |
| 8J | 0.76 | 4.6 | 95 | 98 | 0 | 2 | 96 | 2 | 97 | 4259029 |
| 8K | 0.76 | 5.7 | 97 | 98 | 4 | 1 | 66 | 33 | 94 | 6224225 |
| Average value | | | 72 | | 8 | 5 | 81 | 13 | | |

## Appendix C: Meteorological Data of Dhaka.

### Table C1: Monthly Average Cloud Amount of Dhaka

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Index | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11111 | 1961 | 2 | 3 | 3 | 3 | 4 | 6 | 6 | 6 | 6 | 4 | 2 | 1 |
| 11111 | 1962 | 1 | 2 | 1 | 3 | 5 | 7 | 6 | 6 | 5 | 4 | 1 | 1 |
| 11111 | 1963 | 1 | 1 | 1 | 4 | 5 | 6 | 7 | 6 | 5 | 4 | 1 | 2 |
| 11111 | 1964 | 1 | 2 | 2 | 5 | 4 | 6 | 7 | 6 | 6 | 5 | 2 | 1 |
| 11111 | 1965 | 1 | 2 | 2 | 3 | 5 | 7 | 6 | 7 | 6 | 4 | 1 | 3 |
| 11111 | 1966 | *** | 0 | 0 | 3 | 3 | 7 | 6 | 6 | 5 | 3 | 2 | 2 |
| 11111 | 1967 | 2 | 1 | 3 | 3 | 5 | 5 | 6 | 6 | 6 | 3 | 1 | 2 |
| 11111 | 1968 | 1 | 2 | 2 | 4 | 5 | 6 | 6 | 6 | 5 | 4 | 3 | 1 |
| 11111 | 1969 | 1 | 1 | 3 | 3 | 4 | 6 | 6 | 6 | 5 | 3 | 2 | 2 |
| 11111 | 1970 | 2 | 2 | 3 | 3 | 4 | 6 | 6 | 6 | 6 | 4 | 2 | 0 |
| 11111 | 1972 | 1 | 2 | 2 | 4 | 5 | 6 | 6 | 7 | 5 | 3 | 2 | 1 |
| 11111 | 1973 | 0 | 2 | 2 | 4 | 6 | 6 | *** | 7 | 7 | 4 | 3 | 1 |
| 11111 | 1975 | 1 | 2 | 1 | 3 | 5 | 6 | 7 | 6 | 6 | 4 | 3 | 1 |
| 11111 | 1976 | 1 | 1 | 2 | 4 | 5 | 6 | 7 | 6 | 5 | 3 | 3 | 1 |
| 11111 | 1977 | 1 | 2 | 3 | 5 | 6 | 7 | 7 | 6 | 5 | 3 | 3 | 1 |
| 11111 | 1978 | 1 | 2 | 2 | 3 | 6 | 6 | 6 | 6 | 6 | 4 | 2 | 1 |
| 11111 | 1979 | 1 | 2 | 2 | 3 | 3 | 6 | 6 | 6 | 5 | 3 | 2 | 1 |
| 11111 | 1980 | 1 | 2 | 3 | 4 | 4 | 6 | 6 | 5 | 5 | 4 | 2 | 1 |
| 11111 | 1981 | 2 | 1 | 4 | 4 | 5 | 5 | 7 | 6 | 5 | 2 | 1 | 2 |
| 11111 | 1982 | 0 | 2 | 2 | 4 | 3 | 6 | 6 | 6 | 5 | 2 | 2 | 1 |
| 11111 | 1983 | 2 | 2 | 3 | 4 | 4 | 6 | 6 | 6 | 6 | 4 | 2 | 1 |
| 11111 | 1984 | 1 | 2 | 2 | 3 | 5 | 7 | 6 | 6 | 5 | 4 | 1 | 1 |
| 11111 | 1985 | 2 | 1 | 3 | 4 | 5 | 6 | 6 | 6 | 6 | 3 | 2 | 1 |
| 11111 | 1986 | 1 | 2 | 1 | 5 | 4 | 6 | 7 | 6 | 6 | 3 | 2 | 2 |
| 11111 | 1987 | 1 | 1 | 3 | 4 | 3 | 5 | 7 | 6 | 6 | 3 | 3 | 1 |
| 11111 | 1988 | 1 | 2 | 3 | 4 | 6 | 6 | 6 | 7 | 6 | 4 | 2 | 1 |
| 11111 | 1989 | 0 | 1 | 2 | 3 | 5 | 6 | 6 | 6 | 6 | 4 | 1 | 1 |
| 11111 | 1990 | 0 | 3 | 4 | 4 | 5 | 6 | 7 | 6 | 6 | 4 | 3 | 2 |
| 11111 | 1991 | 2 | 1 | 2 | 4 | 6 | 6 | 6 | 6 | 6 | 4 | 2 | 2 |
| 11111 | 1992 | 1 | 2 | 1 | 3 | 4 | 5 | 7 | 6 | 5 | 3 | 3 | 1 |
| 11111 | 1993 | 1 | 2 | 2 | 4 | 5 | 6 | 6 | 7 | 6 | 4 | 1 | 1 |

**Table C1:** Continued

| Index | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11111 | 1995 | 2 | 2 | 2 | 3 | 5 | 6 | 6 | 6 | 6 | 4 | 3 | 1 |
| 11111 | 1996 | 1 | 1 | 2 | 3 | 5 | 5 | 6 | 6 | 5 | 3 | 1 | 1 |
| 11111 | 1997 | 2 | 2 | 2 | 4 | 4 | 6 | 6 | 6 | 6 | 2 | 2 | 3 |
| 11111 | 1998 | 3 | 2 | 3 | 4 | 5 | 5 | 7 | 6 | 5 | 4 | 3 | 0 |
| 11111 | 1999 | 1 | 1 | 1 | 3 | 5 | 6 | 7 | 7 | 6 | 5 | 2 | 1 |
| 11111 | 2000 | 1 | 3 | 3 | 4 | 5 | 6 | 6 | 6 | 6 | 4 | 1 | 1 |
| 11111 | 2001 | 1 | 1 | 2 | 3 | 5 | 6 | 6 | 6 | 6 | 5 | 3 | 1 |
| 11111 | 2002 | 2 | 1 | 3 | 5 | 6 | 7 | 7 | 7 | 6 | 4 | 3 | 1 |
| 11111 | 2003 | 1 | 2 | 3 | 4 | 5 | 7 | 6 | 6 | 6 | 5 | 1 | 2 |
| 11111 | 2004 | 2 | 1 | 3 | 5 | 5 | 6 | 7 | 6 | 6 | 3 | 1 | 1 |
| 11111 | 2005 | 2 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 6 | 5 | 1 | 1 |
| 11111 | 2006 | 1 | 1 | 2 | 4 | 5 | 7 | 7 | 6 | 6 | 4 | 3 | 0 |
| 11111 | 2007 | 1 | 2 | 1 | 4 | 4 | 6 | 7 | 6 | 6 | 4 | 2 | 1 |
| 11111 | 2008 | 2 | 2 | 4 | 3 | 5 | 6 | 7 | 6 | 6 | 4 | 1 | 2 |
| 11111 | 2009 | 0 | 1 | 2 | 3 | 5 | 6 | 7 | 7 | 6 | 3 | 2 | 1 |
| 11111 | 2010 | 1 | 1 | 3 | 5 | 5 | 6 | 6 | 6 | 6 | 4 | 1 | 2 |
| 11111 | 2011 | 1 | 1 | 3 | 3 | 5 | 6 | 6 | 7 | 6 | 3 | 1 | 1 |
| 11111 | 2012 | 2 | 1 | 2 | 4 | 4 | 6 | 7 | 6 | 6 | 4 | 2 | 1 |
| 11111 | 2013 | 0 | 1 | 2 | 3 | 6 | 6 | 6 | 6 | 6 | 5 | 1 | 1 |
| 11111 | 2014 | 1 | 1 | 2 | 2 | 5 | 6 | 6 | 6 | 5 | 3 | 1 | 2 |
| 11111 | 2015 | 2 | 1 | 2 | 5 | 5 | 6 | 7 | 6 | 5 | 3 | 1 | 2 |
| 11111 | 2016 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 6 | 6 | 4 | 2 | 1 |

**Table C2: Monthly Average Sunshine Hour of Dhaka.**

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Index | Yr. | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11111 | 1961 | 8.5 | 7.7 | 8.4 | 8.9 | 8.2 | 4.1 | 5.8 | 5.1 | 5.8 | 7.3 | 9.1 | 9.2 | 7.4 |
| 11111 | 1962 | 9.4 | 9.2 | 10 | 8.5 | 8.5 | 4.1 | 6.7 | 4.1 | 6.3 | 7 | 9.9 | 9.3 | 7.8 |
| 11111 | 1963 | 9.4 | 9.9 | 9.2 | 8.5 | 8.1 | 4.9 | 5.2 | 6.3 | 6.6 | 7.4 | 9.6 | 9.2 | 7.9 |
| 11111 | 1964 | 8.7 | 8.9 | 8.5 | *** | 8.3 | 5.6 | 4.6 | 6.5 | 5.9 | ** | 8.9 | 9.4 | 7.6 |
| 11111 | 1965 | 8 | 8.9 | 9.5 | 9.3 | 9.1 | 4.2 | 5.5 | 4.7 | 5.7 | 8.1 | 9.9 | 7.7 | 7.6 |
| 11111 | 1966 | 8.1 | 9.6 | 8.5 | 9.2 | 8.8 | 3.8 | 5.9 | 5.5 | 5.7 | 7.8 | 8 | 8.3 | 7.5 |
| 11111 | 1967 | 8 | 9 | 7.9 | 8.7 | 9.1 | 6.8 | 6 | 5.7 | 4.8 | 8 | 9.8 | 8.6 | 7.8 |
| 11111 | 1968 | 8.3 | 8.4 | 7.9 | 8.1 | 8.1 | 4 | 5.7 | 5.5 | 6 | 6.7 | 8.3 | 8.5 | 7.2 |
| 11111 | 1969 | 9.2 | 8.6 | 7.9 | 8.2 | 9.7 | 4.8 | 5.4 | 5.3 | 6.3 | 8.2 | 8.9 | 8.8 | 7.6 |
| 11111 | 1970 | 9 | 9.8 | 8.9 | 8.8 | 8.9 | 5.6 | 4.5 | 6.4 | 5.8 | 7.2 | 9 | 10.2 | 7.9 |
| 11111 | 1971 | 8.4 | 10 | 11 | *** | *** | *** | *** | *** | *** | ** | *** | *** | 9.9 |
| 11111 | 1972 | *** | ** | *** | *** | *** | *** | *** | *** | *** | ** | 7.8 | 9.9 | 8.9 |
| 11111 | 1973 | 9.9 | 9.3 | 9 | 9.2 | 6.8 | 5.2 | 6.3 | 6.8 | 5.7 | 7.7 | 7.6 | 9.3 | 7.8 |
| 11111 | 1974 | 9.8 | 10.7 | 9 | 10 | 8.2 | 5.7 | 2.6 | 5.7 | 6.1 | 7.6 | 8.5 | 9.8 | 7.8 |
| 11111 | 1975 | 9.6 | 9.6 | 9.6 | 10.2 | 8.7 | 7.3 | 4.2 | 7.1 | 5.4 | 6.5 | 8.4 | 9.6 | 8.1 |
| 11111 | 1976 | 9.5 | 9.5 | 10 | 10 | 8.4 | 4.6 | 5.8 | 5.7 | 8.5 | 9.2 | 7.8 | 8.9 | 8.2 |
| 11111 | 1977 | 7.5 | 8.3 | 9.6 | 7.8 | 7.6 | 4.7 | 5.1 | 6.2 | 7.2 | 7.8 | 7.1 | 8.1 | 7.3 |
| 11111 | 1978 | 8.9 | 9 | 7.5 | 7.9 | 5.7 | 4.1 | 4.2 | 6.3 | 5.1 | 7.5 | 8.4 | 8.6 | 7 |
| 11111 | 1979 | 7.7 | 8.8 | 8.6 | 8.6 | *** | 4.6 | 4.5 | 5.4 | 5.2 | 8.4 | 7 | 8.1 | 7 |
| 11111 | 1980 | 8.1 | 8.4 | 8.2 | 8.8 | 7 | 4.4 | 4 | 5.8 | 5.7 | 6.7 | 9.2 | 7.6 | 7 |
| 11111 | 1981 | 6.9 | 7.8 | 6.7 | 7.1 | 7.8 | 6.5 | 3 | 6.1 | 4.9 | 8.6 | 8.6 | 7.1 | 6.8 |
| 11111 | 1982 | 7.6 | 7 | 7.1 | 7.3 | 8.2 | 4.2 | 5.2 | 5.7 | 5.8 | 8.1 | 7.8 | 7.5 | 6.8 |
| 11111 | 1983 | 7.2 | 8 | 7.8 | 7.3 | 7.9 | 5.9 | *** | 5.6 | 4.8 | 6.4 | *** | 7.9 | 6.9 |
| 11111 | 1984 | 7.6 | 7.9 | 8.6 | 8.7 | 6.2 | 3.5 | 4.2 | 4.3 | 5.3 | 6.2 | 9.5 | 8.3 | 6.8 |
| 11111 | 1985 | 7.8 | 8.6 | 8.2 | 7.4 | 6.3 | 4.4 | 4.1 | 6.1 | 6 | 8.7 | 8.2 | 8 | 7 |
| 11111 | 1986 | 7.5 | 8.9 | 9.1 | 8.5 | 8.5 | 10.3 | *** | 5.8 | 4.4 | 7.3 | 7.6 | 8.1 | 7.9 |
| 11111 | 1987 | 8.7 | 8.8 | 8.6 | 7.5 | 9 | 6.5 | 3.1 | 4.9 | 5.5 | 8.3 | 7.8 | 8.3 | 7.3 |
| 11111 | 1988 | 8.1 | 8.1 | 8.2 | 7.6 | 6.7 | 4.5 | 4.6 | 3.9 | 6 | 8.3 | 7.7 | 7.4 | 6.8 |
| 11111 | 1989 | 8.4 | 8.9 | 8.4 | 8.7 | 6.9 | 6 | 4.7 | 6.9 | 4.2 | 6.1 | 8.5 | 7.3 | 7.1 |
| 11111 | 1992 | *** | ** | *** | *** | 7.1 | 6.1 | 4 | 4.9 | 5.7 | 6.4 | 7.2 | 7.5 | 6.2 |
| 11111 | 1993 | 6.3 | 7.4 | 7.8 | 7.8 | 6.2 | 5.4 | 4.1 | 3.6 | 4.8 | 5.8 | 7.4 | 7.5 | 6.2 |
| 11111 | 1994 | 6.9 | 7.6 | 7.3 | 7.4 | 7.2 | 4.6 | 5.4 | 5.4 | 6.2 | 7.1 | 6.1 | 7.3 | 6.6 |
| 11111 | 1995 | 7.2 | 6.2 | 7.7 | 8.5 | 6.6 | 4.7 | 4.2 | 4.6 | 3.9 | 7.1 | 6.8 | 7.1 | 6.3 |

**Table C2:** Continued

| Index | Yr | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11111 | 1996 | 7.5 | 8.9 | 9 | 7 | 7.7 | 4.5 | 3.9 | 3.8 | 5.4 | 7.8 | 8.6 | 6.6 | 6.8 |
| 11111 | 1997 | 5.2 | 7.5 | 7.7 | 7.3 | 7.6 | 5.6 | 4.1 | 4.8 | 4.6 | 8.5 | 6.2 | 5.6 | 6.3 |
| 11111 | 1998 | 4 | 6.1 | 8.1 | 7.3 | 5.8 | 6.8 | 2.8 | 3.7 | 4.3 | 5.8 | 7.4 | 7.8 | 5.9 |
| 11111 | 1999 | 8.3 | 7.5 | 7.2 | 8.4 | 5.5 | 5 | 3.9 | 3.8 | 3.8 | 5.2 | 8.3 | 7.4 | 6.2 |
| 11111 | 2000 | 6.1 | 5.8 | 8.5 | 8.5 | 5.2 | 4.6 | 5 | 4.8 | 4.6 | 5.8 | 8.3 | 8.2 | 6.3 |
| 11111 | 2001 | 7.9 | 7.2 | 8.7 | 8.6 | 6.1 | 3.5 | 4.6 | 5.1 | 4.6 | 5.6 | 6.4 | 7.2 | 6.3 |
| 11111 | 2002 | 7.4 | 8.8 | 7.8 | 8.2 | 5.6 | 2.5 | 1.8 | 4.3 | 5.5 | 6.7 | 6.6 | 6.3 | 6 |
| 11111 | 2003 | 5.2 | 7.4 | 7.2 | 8 | 7.4 | 2.1 | 5 | 5.7 | 3.7 | 4.7 | 8.3 | 5.9 | 5.9 |
| 11111 | 2004 | 5.3 | 7.6 | 7.6 | 6.5 | 7.8 | 2.9 | 3.8 | 5.6 | 2.7 | 6.6 | 7.8 | 6.7 | 6 |
| 11111 | 2005 | 6.3 | 7.9 | 7 | 8.4 | 7.8 | 3.2 | 4.1 | 3.5 | 4.8 | 4.6 | 6.6 | 7 | 6 |
| 11111 | 2006 | 5.3 | 6.1 | 7.3 | 7.8 | 6.5 | 2.2 | 4.8 | 6.2 | 5.1 | 5.1 | 6 | 5.5 | 5.7 |
| 11111 | 2007 | 5.7 | 5.7 | 8.2 | 6.4 | 7.8 | 4.7 | 3.3 | 4.9 | 3 | 5.2 | 5.7 | 5.5 | 5.6 |
| 11111 | 2008 | 4.7 | 6.6 | 5.9 | 8.5 | 7.7 | 4.2 | 3.1 | 4 | 4.4 | 5.8 | 7.9 | 3.9 | 5.6 |
| 11111 | 2009 | 5.7 | 8.7 | 7.3 | 8.3 | 6.8 | 5.9 | 4.7 | 3.9 | 4.1 | 6.2 | 6.7 | 4.8 | 6.1 |
| 11111 | 2010 | 5.7 | 6.7 | 8.3 | 7.3 | 6.7 | 3.7 | 4.9 | 4.4 | 3.8 | 5.8 | 6.2 | 6.2 | 5.9 |
| 11111 | 2011 | 4.9 | 7.5 | 7 | 6.8 | 5.5 | 3.5 | 4.1 | 2.5 | 5.1 | 6.1 | 6 | 4.4 | 5.3 |
| 11111 | 2012 | 4.6 | 7.1 | 7.6 | 7.1 | 6.2 | 2.9 | 3.9 | 3.8 | 4 | 6 | 5.6 | 3 | 5.2 |
| 11111 | 2013 | 4.5 | 7 | 7.9 | 6.5 | 3.6 | 4.8 | 4.4 | 3.3 | 3.6 | 4.5 | 7 | 4.1 | 5.2 |
| 11111 | 2014 | 4.2 | 6.3 | 8.6 | 8.6 | 6.7 | 3.3 | 3.9 | 3.2 | 4.8 | 5.8 | 5.2 | 2.8 | 5.3 |
| 11111 | 2015 | 4.4 | 5.4 | 8.5 | 6.4 | 6.4 | 4.7 | 2.5 | 3.4 | 4.2 | 6.1 | 6.2 | 4.6 | 5.3 |
| 11111 | 2016 | 5.1 | 6.2 | 7.1 | 7.4 | 5.8 | 5.5 | 3.4 | 4.8 | 4 | - | - | - | - |

**Table C3: Monthly and Yearly Average Humidity in %**

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | 70 | 66 | 69 | 69 | 80 | 87 | 86 | 87 | 86 | 83 | 76 | 76 | 77 |
| 1962 | 69 | 66 | 48 | 68 | 79 | 86 | 85 | 86 | 84 | 78 | 74 | 74 | 74 |
| 1963 | 66 | 56 | 54 | 67 | 80 | 86 | 86 | 85 | 85 | 83 | 76 | 74 | 74 |
| 1964 | 69 | 66 | 63 | 76 | 78 | 86 | 88 | 84 | 85 | 86 | 77 | 72 | 77 |
| 1965 | 69 | 62 | 56 | 68 | 78 | 87 | 86 | 87 | 86 | 79 | 76 | 78 | 76 |
| 1966 | *** | *** | *** | 65 | 71 | 86 | 85 | 87 | 85 | 82 | 74 | 76 | 79 |
| 1967 | 71 | 64 | 70 | 63 | 78 | 83 | 84 | 85 | 86 | 77 | 69 | 71 | 75 |
| 1968 | 67 | 60 | 56 | 69 | 75 | 87 | 85 | 85 | 82 | 79 | 74 | 73 | 74 |
| 1969 | 66 | 60 | 65 | 71 | 74 | 86 | 86 | 87 | 82 | 78 | 72 | 71 | 74 |
| 1970 | 70 | 61 | 62 | 71 | 75 | 85 | 86 | 85 | 85 | 84 | 74 | 71 | 75 |
| 1971 | 70 | 59 | 58 | 64 | 75 | 84 | 85 | 87 | 81 | 77 | 71 | *** | 73 |
| 1972 | 69 | 63 | 59 | 73 | 77 | 83 | 85 | 87 | 81 | 76 | 70 | 68 | 74 |
| 1973 | 63 | 62 | 62 | 74 | 84 | 86 | ** | 85 | 87 | 82 | 82 | 78 | 76 |
| 1975 | 68 | 62 | 57 | 70 | 79 | 84 | 89 | 84 | 87 | 85 | 77 | 70 | 76 |
| 1976 | 66 | 66 | 63 | 66 | 79 | 87 | 86 | 87 | 83 | 78 | 74 | 70 | 75 |
| 1977 | 66 | 66 | 68 | 81 | 82 | 88 | 87 | 83 | 84 | 78 | 78 | 73 | 77 |
| 1978 | 67 | 61 | 52 | 72 | 83 | 87 | 86 | 83 | 85 | 80 | 72 | 68 | 74 |
| 1979 | 68 | 61 | 57 | 65 | 71 | 82 | 85 | 85 | 84 | 79 | 74 | 76 | 73 |
| 1980 | 69 | 66 | 63 | 68 | 80 | 85 | 86 | 84 | 84 | 81 | 70 | 69 | 75 |
| 1981 | 70 | 67 | 65 | 76 | 78 | 80 | 88 | 83 | 83 | 70 | 66 | 71 | 74 |
| 1982 | 68 | 62 | 63 | 72 | 73 | 85 | 84 | 85 | 83 | 77 | 75 | 73 | 75 |
| 1983 | 72 | 63 | 69 | 72 | 79 | 84 | 84 | 86 | 87 | 84 | 69 | 72 | 76 |
| 1984 | 68 | 61 | 56 | 70 | 83 | 85 | 86 | 85 | 82 | 78 | 67 | 71 | 74 |
| 1985 | 70 | 59 | 69 | 73 | 78 | 84 | 85 | 83 | 83 | 74 | 70 | 69 | 74 |
| 1986 | 71 | 58 | 55 | 74 | 75 | 82 | 84 | 82 | 85 | 80 | 78 | 75 | 74 |
| 1987 | 72 | 64 | 64 | 74 | 74 | 82 | 88 | 84 | 83 | 77 | 73 | 75 | 75 |
| 1988 | 70 | 67 | 68 | 73 | 80 | 84 | 84 | 84 | 81 | 77 | 74 | 78 | 76 |
| 1989 | 68 | 63 | 58 | 67 | 77 | 81 | 84 | 79 | 85 | 81 | 73 | 72 | 74 |
| 1990 | 77 | 69 | 72 | 76 | 79 | 83 | 87 | 82 | 84 | 78 | 75 | 71 | 77 |
| 1991 | 70 | 65 | 65 | 70 | 84 | 85 | 83 | 83 | 87 | 82 | 72 | 75 | 76 |
| 1992 | 75 | 70 | 62 | 68 | 75 | 79 | 83 | 81 | 79 | 78 | 72 | 74 | 74 |
| 1993 | 72 | 68 | 61 | 69 | 79 | 82 | 84 | 84 | 83 | 81 | 78 | 74 | 76 |
| 1994 | 72 | 68 | 67 | 70 | 76 | 81 | 79 | 81 | 78 | 76 | 74 | 71 | 74 |
| 1995 | 66 | 69 | 57 | 64 | 75 | 82 | 83 | 82 | 83 | 80 | 78 | 76 | 74 |
| 1996 | 72 | 65 | 66 | 69 | 77 | 82 | 83 | 84 | 83 | 78 | 75 | 71 | 75 |
| 1997 | 69 | 64 | 65 | 74 | 76 | 81 | 85 | 83 | 86 | 77 | 74 | 79 | 76 |

**Table C3:** Continued

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 77 | 67 | 63 | 74 | 77 | 80 | 86 | 85 | 84 | 81 | 77 | 76 | 77 |
| 1999 | 71 | 64 | 57 | 68 | 78 | 82 | 85 | 83 | 83 | 82 | 75 | 70 | 74 |
| 2000 | 71 | 60 | 62 | 73 | 77 | 79 | 79 | 80 | 80 | 80 | 72 | 68 | 73 |
| 2001 | 62 | 61 | 55 | 66 | 78 | 83 | 81 | 81 | 82 | 81 | 77 | 74 | 73 |
| 2002 | 67 | 57 | 58 | 72 | 78 | 83 | 84 | 81 | 78 | 74 | 73 | 73 | 73 |
| 2003 | 75 | 65 | 64 | 70 | 72 | 81 | 79 | 78 | 82 | 80 | 66 | 72 | 73 |
| 2004 | 73 | 60 | 62 | 72 | 67 | 81 | 81 | 78 | 85 | 74 | 69 | 70 | 72 |
| 2005 | 68 | 60 | 66 | 66 | 73 | 79 | 81 | 82 | 81 | 80 | 72 | 66 | 72 |
| 2006 | 69 | 65 | 53 | 67 | 72 | 81 | 80 | 77 | 80 | 76 | 68 | 69 | 71 |
| 2007 | 68 | 68 | 54 | 69 | 70 | 81 | 84 | 80 | 80 | 78 | 77 | 69 | 73 |
| 2008 | 69 | 61 | 67 | 64 | 70 | 80 | 83 | 81 | 81 | 77 | 69 | 79 | 73 |
| 2009 | 72 | 55 | 53 | 66 | 72 | 74 | 80 | 82 | 81 | 73 | 66 | 69 | 70 |
| 2010 | 71 | 56 | 59 | 67 | 71 | 79 | 77 | 78 | 79 | 74 | 68 | 66 | 70 |
| 2011 | 69 | 54 | 57 | 64 | 76 | 80 | 79 | 82 | 77 | 73 | 67 | 73 | 70 |
| 2012 | 66 | 52 | 57 | 69 | 70 | 77 | 79 | 78 | 79 | 71 | 68 | 77 | 70 |
| 2013 | 65 | 55 | 55 | 63 | 78 | 76 | 77 | 80 | 81 | 78 | 66 | 72 | 70 |
| 2014 | 72 | 62 | 52 | 56 | 68 | 78 | 77 | 82 | 76 | 72 | 66 | 77 | 69 |
| 2015 | 70 | 63 | 52 | 68 | 71 | 77 | 81 | 79 | 78 | 73 | 69 | 68 | 70 |
| 2016 | 68 | 63 | 59 | 72 | 74 | 75 | 82 | 77 | 82 | 74 | 73 | 72 | 72 |

Note: *** means missing data

**Table C4:** Monthly and Yearly Total Rainfall in mm (Station: Dhaka).

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | *** | 12 | 20 | 205 | 219 | 856 | 296 | 288 | 221 | 52 | 0 | 0 | **** |
| 1962 | 0 | 15 | 6 | 166 | 205 | 191 | 355 | 273 | 395 | 180 | 0 | 0 | 1786 |
| 1963 | 0 | 0 | 51 | 98 | 219 | 621 | 404 | 186 | 200 | 182 | 7 | 3 | 1971 |
| 1964 | 9 | 42 | 18 | 296 | 236 | 354 | 629 | 155 | 269 | 283 | *** | 0 | *** |
| 1965 | 0 | *** | 22 | 55 | 305 | 442 | 304 | 480 | 300 | 50 | 131 | *** | *** |
| 1966 | *** | *** | *** | 34 | 127 | 270 | 291 | 306 | 496 | 261 | 14 | 15 | **** |
| 1967 | 23 | 12 | 168 | 185 | 216 | 241 | 363 | 504 | 266 | 74 | 1 | 0 | 2053 |
| 1968 | 0 | 5 | 121 | *** | 194 | 590 | 480 | 212 | 128 | 69 | 74 | 0 | *** |
| 1969 | 0 | 1 | 65 | 86 | 95 | 249 | 198 | 540 | 201 | 103 | 2 | 0 | 1540 |
| 1970 | 16 | 8 | 23 | 45 | 192 | 276 | 496 | 280 | 200 | 427 | 32 | 0 | 1995 |
| 1971 | 3 | 28 | *** | *** | 344 | 339 | 550 | 540 | *** | 118 | *** | *** | *** |
| 1972 | 0 | 11 | 12 | 248 | 340 | 353 | 249 | 380 | *** | 105 | 0 | 0 | *** |
| 1973 | *** | 21 | 32 | 131 | 621 | 414 | *** | 238 | 348 | 128 | 64 | 86 | *** |
| 1975 | 1 | 29 | 13 | 98 | 317 | 235 | 559 | 307 | 329 | 232 | 25 | 0 | 2145 |
| 1976 | 0 | 7 | 117 | 34 | 459 | 627 | 346 | 361 | 165 | 114 | 8 | 0 | 2238 |
| 1977 | 0 | 66 | 71 | 255 | 381 | 252 | 306 | 92 | 131 | 273 | 10 | 24 | 1861 |
| 1978 | 0 | 20 | 18 | 194 | 454 | 529 | 320 | 426 | 192 | 98 | 0 | 0 | 2251 |
| 1979 | 3 | 13 | 6 | 17 | 114 | 258 | 267 | 525 | 382 | 146 | 55 | 51 | 1837 |
| 1980 | 3 | 32 | 54 | 147 | 414 | 323 | 380 | 269 | 296 | 300 | 0 | 0 | 2218 |
| 1981 | 10 | 42 | 109 | 274 | 272 | 168 | 356 | 188 | 320 | 82 | 9 | 35 | 1865 |
| 1982 | 0 | 15 | 81 | 104 | 154 | 514 | 136 | 346 | 258 | 146 | 51 | 0 | 1805 |
| 1983 | *** | 61 | 138 | 318 | 348 | 300 | 179 | 437 | 322 | 253 | *** | 18 | *** |
| 1984 | 13 | 1 | 5 | 124 | 707 | 637 | 694 | 311 | 478 | 58 | 0 | 0 | 3028 |
| 1985 | 8 | 1 | 195 | 176 | 300 | 399 | 262 | 317 | 306 | 79 | 0 | 10 | 2053 |
| 1986 | 22 | 0 | 23 | 247 | 191 | 304 | 443 | 171 | 687 | 237 | 172 | 3 | 2500 |
| 1987 | 4 | 0 | 33 | 230 | 109 | 316 | 526 | 462 | 363 | 104 | 7 | 33 | 2187 |
| 1988 | 0 | 44 | 74 | 282 | 513 | 580 | 255 | 169 | 196 | 213 | 153 | 3 | 2482 |
| 1989 | 0 | 32 | 0 | 85 | 228 | 319 | 347 | 59 | 305 | 240 | 0 | 12 | 1627 |
| 1990 | 0 | 36 | 151 | 154 | 202 | 229 | 567 | 227 | 247 | 181 | 103 | 6 | 2103 |
| 1991 | 27 | 8 | 46 | 53 | 529 | 320 | 318 | 345 | 692 | 392 | 14 | 106 | 2850 |
| 1992 | 1 | 47 | 0 | 25 | 153 | 132 | 386 | 182 | 158 | 83 | 2 | 0 | 1169 |
| 1993 | 0 | 52 | 88 | 113 | 556 | 504 | 421 | 432 | 417 | 217 | 19 | 0 | 2819 |
| 1994 | 13 | 54 | 115 | 201 | 254 | 266 | 153 | 246 | 169 | 55 | 14 | 0 | 1540 |
| 1995 | 8 | 31 | 0 | 88 | 264 | 237 | 354 | 360 | 205 | 91 | 112 | 1 | 1751 |
| 1996 | 0 | 21 | 54 | 199 | 208 | 343 | 257 | 361 | 244 | 357 | 0 | 0 | 2044 |
| 1997 | 2 | 7 | 82 | 133 | 151 | 249 | 549 | 230 | 440 | 30 | 1 | 22 | 1896 |

**Table C4:** Continued

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 49 | 4 | 83 | 178 | 405 | 89 | 521 | 552 | 246 | 100 | 83 | 0 | 2310 |
| 1999 | 0 | 0 | 0 | 21 | 428 | 348 | 553 | 282 | 361 | 368 | 13 | 0 | 2374 |
| 2000 | 13 | 44 | 172 | 189 | 608 | 165 | 197 | 359 | 216 | 278 | 0 | 0 | 2241 |
| 2001 | 0 | 1 | 33 | 46 | 402 | 386 | 202 | 205 | 209 | 177 | 18 | 0 | 1679 |
| 2002 | 22 | 4 | 51 | 111 | 272 | 373 | 446 | 272 | 156 | 52 | 116 | 0 | 1875 |
| 2003 | 0 | 25 | 96 | 123 | 140 | 473 | 191 | 202 | 264 | 134 | 0 | 45 | 1693 |
| 2004 | 0 | 0 | 9 | 167 | 162 | 476 | 295 | 191 | 839 | 208 | 0 | 0 | 2347 |
| 2005 | 1 | 3 | 155 | 91 | 291 | 259 | 542 | 361 | 514 | 417 | 3 | 0 | 2637 |
| 2006 | 0 | 0 | 0 | 181 | 185 | 326 | 331 | 167 | 663 | 61 | 5 | 0 | 1919 |
| 2007 | 0 | 30 | 11 | 163 | 185 | 628 | 753 | 505 | 179 | 320 | 111 | 0 | 2885 |
| 2008 | 23 | 56 | 45 | 91 | 205 | 577 | 563 | 319 | 279 | 227 | 0 | 0 | 2385 |
| 2009 | 1 | 1 | 43 | 14 | 168 | 170 | 676 | 482 | 298 | 74 | 4 | 0 | 1931 |
| 2010 | 0 | 48 | 22 | 37 | 177 | 308 | 167 | 340 | 169 | 174 | 0 | 81 | 1523 |
| 2011 | 0 | 0 | 20 | 123 | 235 | 314 | 356 | 409 | 207 | 112 | 0 | 0 | 1776 |
| 2012 | 10 | 1 | 37 | 269 | 137 | 175 | 226 | 282 | 81 | 38 | 68 | 5 | 1329 |
| 2013 | 0 | 8 | 26 | 32 | 378 | 325 | 302 | 212 | 138 | 131 | 0 | 4 | 1556 |
| 2014 | 0 | 12 | 10 | 80 | 147 | 342 | 212 | 391 | 156 | 49 | 0 | 0 | 1399 |
| 2015 | 3 | 17 | 4 | 166 | 185 | 375 | 623 | 395 | 346 | 51 | 0 | 1 | 2166 |
| 2016 | 3 | 13 | 55 | 55 | 212 | 212 | 405 | 171 | 138 | 76 | 25 | 0 | 1365 |

Note: **** means missing data

**Table C5: Monthly and Yearly Maximum Temperature in deg. cel. of Dhaka.**

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Spt | Oct | Nov | Dec | Annual | Month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | 29.2 | 31.7 | 36.3 | 40.6 | 36.6 | 35.1 | 34.3 | 32.8 | 33.6 | 32.6 | 30.6 | 31 | 40.6 | 4 |
| 1962 | 29.3 | 31.6 | 40.6 | 39.4 | 35.9 | 35 | 35.1 | 32.7 | 33.6 | 32.5 | 31.1 | 28 | 40.6 | 3 |
| 1963 | 28.1 | 33.1 | 35.9 | 37.9 | 34.9 | 34.7 | 32.2 | 32.7 | 34.9 | 33.2 | 31.1 | 28.2 | 37.9 | 4 |
| 1964 | 29.9 | 34.7 | 36.7 | 36.7 | 36.7 | 34.9 | 32.6 | 32.8 | 34.3 | 32.9 | 30.6 | 28.3 | 36.7 | 3 |
| 1965 | 28.6 | 31.6 | 35.8 | 42 | 38.3 | 34.2 | 32.4 | 33.4 | 33.3 | 32.9 | 32.6 | 28.9 | 42 | 4 |
| 1966 | *** | *** | *** | 39.8 | 39.8 | 35.6 | 32.8 | 32.8 | 34.1 | 31.9 | 30.5 | 27.2 | *** | ** |
| 1967 | 27.2 | 33.6 | 34.9 | 37.7 | 36.1 | 35.4 | 32.8 | 33.9 | 32.7 | 33.3 | 29.9 | 28.3 | 37.7 | 4 |
| 1968 | 27.2 | 31.6 | 36.9 | 37.7 | 36.9 | 33.1 | 33.3 | 34.2 | 35.3 | 32.8 | 31.2 | 29.4 | 37.7 | 4 |
| 1969 | 28.3 | 35.1 | 35.8 | 37.2 | 37.1 | 34.2 | 32.8 | 33.3 | 34.4 | 32.8 | 32.2 | 27.8 | 37.2 | 4 |
| 1970 | 27.8 | 32.3 | 37.2 | 36.9 | 37.2 | 34.4 | 34.2 | 34.2 | 33.3 | 32.9 | 30.9 | 27.8 | 37.2 | 3 |
| 1971 | 26.7 | 31.6 | 29.7 | 32.1 | 35.3 | 32.8 | 33.3 | 32.7 | 33.8 | 32.8 | 30.2 | *** | *** | ** |
| 1972 | 30.5 | 31.7 | 36.7 | 36.8 | 36.1 | 35.2 | 35.6 | 32.4 | 34.6 | 33.8 | 31.1 | 30.9 | 36.8 | 4 |
| 1973 | 31.2 | 33.6 | 36.3 | 39.4 | 33.3 | 33.5 | **** | 32.9 | 36.7 | 33.2 | 30.6 | 26.7 | **** | ** |
| 1975 | 27.2 | 31.9 | 37.2 | 37.6 | 36.7 | 34.9 | 32.2 | 34.4 | 33.4 | 33.2 | 30.2 | 26.8 | 37.6 | 4 |
| 1976 | 29.2 | 32.8 | 37 | 38.9 | 39.8 | 33.9 | 32.4 | 32.8 | 33.9 | 33.1 | 32.4 | 28.7 | 39.8 | 5 |
| 1977 | 27.4 | 32.3 | 35.6 | 33.3 | 34.7 | 33.8 | 33.6 | 34.4 | 35 | 32.2 | 31.9 | 29.4 | 35.6 | 3 |
| 1978 | 34.2 | 33 | 36.1 | 37.2 | 35.3 | 33.3 | 32.9 | 33.8 | 33.6 | 33.4 | 32.9 | 29.8 | 37.2 | 4 |
| 1979 | 28.3 | 31.1 | 37.2 | 38.9 | 40.6 | 38.3 | 33.9 | 35.1 | 34.2 | 32.7 | 31.8 | 27.2 | 40.6 | 5 |
| 1980 | 28.9 | 32.2 | 37.9 | 38.9 | 35.4 | 36.7 | 32.8 | 33.6 | 33.6 | 32.5 | 31.7 | 28.9 | 38.9 | 4 |
| 1981 | 27.8 | 32.9 | 34 | 35.4 | 35 | 35.9 | 33.3 | 36.5 | 35 | 33.4 | 33.1 | 29 | 36.5 | 8 |
| 1982 | 30.1 | 30.3 | 36.1 | 37 | 38.3 | 36.6 | 34.8 | 33.2 | 34.8 | 34.4 | 32.1 | 27.2 | 38.3 | 5 |
| 1983 | 28.1 | 31.7 | 36.2 | 37.7 | 36.4 | 35.6 | 34.4 | 33.6 | 33.1 | 33.6 | 32.8 | 28.8 | 37.7 | 4 |
| 1984 | 27.2 | 33 | 38 | 37.6 | 35.8 | 35.8 | 32.5 | 35.4 | 34.5 | 34 | 31.8 | 30 | 38 | 3 |
| 1985 | 29.4 | 32.4 | 37.1 | 35.8 | 35.1 | 35 | 34.3 | 34.7 | 35 | 35.5 | 33.3 | 30.6 | 37.1 | 3 |
| 1986 | 30 | 32.3 | 39.5 | 38 | 37.2 | 36.8 | 34.5 | 36 | 34.5 | 33.9 | 33.1 | 29 | 39.5 | 3 |
| 1987 | 29.8 | 35 | 39 | 39.5 | 38 | 37 | 34.1 | 34.7 | 34.6 | 35.1 | 33 | 29.2 | 39.5 | 4 |
| 1988 | 29.2 | 32.8 | 37 | 39 | 36.2 | 36.8 | 35.2 | 34.1 | 36 | 35.1 | 33 | 29.3 | 39 | 4 |
| 1989 | 27.9 | 32.6 | 37.2 | 38.4 | 39.4 | 36.5 | 34.1 | 35.5 | 35.3 | 35.4 | 33.4 | 30 | 39.4 | 5 |
| 1990 | 28.2 | 30.4 | 34.6 | 34.5 | 35.4 | 34.2 | 32.7 | 35.3 | 34.8 | 34 | 32.8 | 28.6 | 35.4 | 5 |
| 1991 | 28 | 33 | 36.8 | 37.2 | 34.2 | 34 | 35 | 36.2 | 34.5 | 37 | 30.2 | 29.3 | 37.2 | 4 |
| 1992 | 27.4 | 28 | 36.6 | 39.2 | 36.2 | 35.8 | 33.8 | 35.2 | 35 | 34.6 | 33.5 | 27.8 | 39.2 | 4 |
| 1993 | 28.6 | 32 | 34.6 | 37 | 35 | 34.3 | 33.2 | 33.3 | 35.3 | 33.6 | 30.8 | 29.1 | 37 | 4 |
| 1994 | 29.1 | 31 | 35.2 | 37.6 | 36.1 | 34.8 | 34 | 34.1 | 35 | 34.5 | 33 | 29.8 | 37.6 | 4 |
| 1995 | 29.2 | 30.8 | 38.8 | 39 | 38 | 36.6 | 33.5 | 34.7 | 35.6 | 34.6 | 34.2 | 28.6 | 39 | 4 |
| 1996 | 29.2 | 32 | 37.6 | 38.4 | 36.5 | 35.5 | 34.1 | 35.5 | 37.5 | 35.4 | 33.7 | 30.3 | 38.4 | 4 |
| 1997 | 27.6 | 31.3 | 35.6 | 34.7 | 36.2 | 35.5 | 34.4 | 37.5 | 34 | 34 | 33.7 | 29 | 37.5 | 8 |
| 1998 | 27.3 | 30.8 | 34.8 | 35.7 | 37.5 | 35.8 | 34.1 | 34.6 | 36.2 | 35.7 | 33.6 | 30.3 | 37.5 | 5 |
| 1999 | 29.4 | 35.7 | 39.6 | 37.6 | 37.5 | 36.6 | 35.6 | 34 | 34.6 | 34.6 | 32.4 | 29.7 | 39.6 | 3 |
| 2000 | 28.7 | 28.2 | 34 | 35.1 | 36.6 | 35.2 | 35.2 | 35 | 34.4 | 34.9 | 32.5 | 27.3 | 36.6 | 5 |
| 2001 | 28 | 31.4 | 35.8 | 37.5 | 35 | 33.8 | 34 | 34 | 34.2 | 34.8 | 32 | 28.4 | 37.5 | 4 |
| 2002 | 28.2 | 33.5 | 35.5 | 34.3 | 35.4 | 34.4 | 35.2 | 34.1 | 35 | 34.2 | 32 | 29.5 | 35.5 | 3 |
| 2003 | 27.5 | 31.6 | 34 | 36.2 | 36.3 | 36.7 | 35.3 | 35.1 | 34.2 | 34 | 32.1 | 29.2 | 36.7 | 6 |
| 2004 | 27.5 | 32.8 | 35.7 | 35.2 | 38.1 | 35.2 | 34.5 | 34.6 | 34 | 34.5 | 31.1 | 29.4 | 38.1 | 5 |
| 2005 | 28.5 | 32.1 | 35.6 | 37 | 36.4 | 36.6 | 33.7 | 34 | 35.1 | 34.6 | 31.4 | 29 | 37 | 4 |
| 2006 | 28.2 | 35.9 | 38.5 | 37.1 | 36.8 | 35 | 35.6 | 35.2 | 35.7 | 34.7 | 32.6 | 30.1 | 38.5 | 3 |
| 2007 | 28.8 | 30.8 | 36.7 | 35.9 | 37.5 | 35.9 | 34.8 | 35.9 | 34.9 | 35.6 | 31.8 | 28.2 | 37.5 | 5 |
| 2008 | 29 | 30.6 | 34.6 | 36.9 | 36.7 | 35.4 | 34 | 36 | 34.8 | 34.8 | 32.3 | 29 | 36.9 | 4 |
| 2009 | 28.1 | 33.9 | 36 | 39.6 | 37.8 | 36.5 | 35.7 | 34.3 | 35.3 | 35.8 | 33.9 | 29 | 39.6 | 4 |
| 2010 | 29 | 31.2 | 37.3 | 37.9 | 36.9 | 35.8 | 35.1 | 35.1 | 34 | 35.7 | 33.2 | 29.7 | 37.9 | 4 |
| 2011 | 27.8 | 31 | 34.5 | 35.8 | 35.3 | 36 | 35.4 | 35 | 36.2 | 34.5 | 32.4 | 30 | 36.2 | 9 |
| 2012 | 28.5 | 33 | 37.3 | 37.1 | 36.2 | 36.7 | 34.3 | 34.5 | 36.5 | 34.4 | 32.4 | 28.5 | 37.3 | 3 |
| 2013 | 28.1 | 32.4 | 36 | 37 | 37.1 | 36.4 | 34.6 | 35 | 35.7 | 35.2 | 32.1 | 30.5 | 37.1 | 5 |
| 2014 | 28.5 | 30.4 | 38 | 40.2 | 38 | 37 | 35.8 | 34.4 | 34.8 | 36 | 33.8 | 29.2 | 40.2 | 4 |
| 2015 | 29.9 | 32.2 | 36.4 | 35.5 | 36.4 | 36.5 | 35.5 | 34.7 | 36.5 | 35.5 | 32.9 | 30.3 | 36.5 | 6 |
| 2016 | 27.6 | 34 | 34.8 | 39 | 37 | 36 | 34.6 | 36.1 | 34.7 | 36 | 34.5 | 31 | 39 | 4 |

Note: *** means data missing

**Table C6: Monthly Average Dry-Bulb Temperature in deg. cel. of Dhaka.**

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Index | Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep | . Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11111 | 1961 | 18.8 | 19 | 26.9 | 28.4 | 28.7 | 27.7 | 28.2 | 28.1 | 27.8 | 26.7 | 21.7 | 16.5 |
| 11111 | 1962 | 16.7 | 21 | 26.3 | 28.4 | 27.8 | 27.9 | 28.7 | 27.9 | 28.4 | 26.3 | 22 | 18.3 |
| 11111 | 1963 | 17.2 | 22.5 | 25.9 | 27.1 | 27 | 28.1 | 28.4 | 28.4 | 28.5 | 26.5 | 22.4 | 19.2 |
| 11111 | 1964 | 17.2 | 21.4 | 26.9 | 27.4 | 28.1 | 28.1 | 27.4 | 28.4 | 28.2 | 27.1 | 23.3 | 19.4 |
| 11111 | 1965 | 18.4 | 20.6 | 24.7 | 28.2 | 28.9 | 28 | 27.7 | 27.6 | 27.7 | 26.7 | 23 | 19.4 |
| 11111 | 1966 | **** | **** | **** | 29.4 | 30 | 28 | 28.4 | 28.1 | 27.7 | 25.7 | 23.7 | 19 |
| 11111 | 1967 | 18.6 | 22 | 24.1 | 27.4 | 28.7 | 28.5 | 28.4 | 28.1 | 27.5 | 26.3 | 21.7 | 19.5 |
| 11111 | 1968 | 18 | 20.9 | 25.7 | 27.9 | 28.3 | 27.2 | 28.3 | 28.4 | 28.8 | 26.6 | 23.3 | 19 |
| 11111 | 1969 | 17.9 | 21.6 | 26.4 | 28.2 | 29.3 | 28.3 | 28.4 | 27.6 | 28.6 | 26.8 | 23.1 | 19.4 |
| 11111 | 1970 | 18 | 21.8 | 26 | 28.5 | 29.5 | 28.5 | 28.4 | 28.4 | 28.1 | 26.5 | 22.9 | 18.8 |
| 11111 | 1971 | 18.5 | 20.9 | 22.2 | 27.9 | 28.2 | 28.3 | 28.2 | 27.3 | 28.6 | 27.6 | 23.6 | **** |
| 11111 | 1972 | 18.4 | 19 | 26.2 | 27.2 | 29.3 | 28.6 | 28.6 | 27.6 | 28.5 | 27 | 23.5 | 19.7 |
| 11111 | 1973 | 19 | 22.7 | 25.1 | 29 | 27 | 28.3 | **** | 28.2 | 27.8 | 26.9 | 22.8 | 19 |
| 11111 | 1975 | 18.3 | 21.6 | 26.3 | 28.8 | 28.2 | 28.6 | 27.3 | 28.3 | 27.5 | 27.2 | 22.4 | 18.3 |
| 11111 | 1976 | 18.8 | 21.9 | 26.7 | 28.6 | 27.6 | 27.6 | 27.9 | 27.6 | 28.2 | 26.7 | 24.4 | 18.5 |
| 11111 | 1977 | 17.7 | 21.1 | 27 | 26 | 26.7 | 27.4 | 28.1 | 28.7 | 28.4 | 26.7 | 24.3 | 19.5 |
| 11111 | 1978 | 17.7 | 21.1 | 25.6 | 27.1 | 27.1 | 27.9 | 28.1 | 28.8 | 28 | 27.5 | 23.9 | 19.2 |
| 11111 | 1979 | 19 | 20.4 | 26.1 | 29 | 30.3 | 29 | 28.7 | 28.6 | 28.3 | 27.3 | 25.3 | 19.5 |
| 11111 | 1980 | 18 | 21.2 | 26.5 | 30.1 | 27.7 | 28.5 | 28.4 | 28.7 | 28.5 | 26.7 | 23.7 | 20.7 |
| 11111 | 1981 | 19.3 | 21.5 | 24.8 | 26.5 | 27.8 | 29.4 | 28.1 | 29.2 | 28.5 | 27.9 | 24 | 19.7 |
| 11111 | 1982 | 19.5 | 21.4 | 25 | 27.2 | 29.5 | 28.2 | 28.9 | 28.2 | 28.6 | 27.1 | 22.3 | 19 |
| 11111 | 1983 | 18 | 20.3 | 25.7 | 27.1 | 27.8 | 29.1 | 29 | 28.4 | 28.2 | 26.9 | 24.5 | 19.3 |
| 11111 | 1984 | 18.5 | 20.7 | 27.2 | 28.8 | 27.8 | 28.2 | 28.2 | 28.4 | 28.1 | 28.1 | 23.6 | 20 |
| 11111 | 1985 | 19.7 | 22.1 | 27.5 | 28.5 | 27.9 | 28.7 | 27.9 | 28.9 | 28.3 | 27.7 | 23.7 | 20.8 |
| 11111 | 1986 | 19.4 | 22.3 | 27.3 | 27.5 | 28.3 | 29.4 | 28.5 | 29.3 | 27.7 | 26.7 | 24 | 20.4 |
| 11111 | 1987 | 19.1 | 22.7 | 26.3 | 27.9 | 29.7 | 29.9 | 28.3 | 28.9 | 29 | 27.9 | 24.6 | 20.6 |
| 11111 | 1988 | 19.8 | 22.7 | 26.1 | 29 | 28.7 | 28.5 | 28.8 | 29 | 29.5 | 27.8 | 24.5 | 21 |
| 11111 | 1989 | 17.7 | 21.8 | 26.5 | 29.7 | 29.5 | 29.1 | 28.8 | 29.6 | 28.4 | 27.5 | 23.9 | 19.2 |
| 11111 | 1990 | 19.3 | 22.3 | 23.9 | 27.2 | 28.3 | 29.2 | 28.2 | 29.2 | 28.5 | 26.6 | 25.3 | 20.9 |
| 11111 | 1991 | 18.8 | 23.1 | 26.9 | 28.7 | 27.4 | 28.4 | 29.1 | 28.9 | 27.9 | 27.3 | 23.4 | 19.6 |
| 11111 | 1992 | 18.5 | 20.6 | 27.1 | 29.8 | 28.5 | 29.5 | 28.5 | 28.9 | 28.8 | 27.4 | 23.7 | 18.5 |
| 11111 | 1993 | 17.8 | 22.4 | 24.7 | 27.6 | 27.4 | 28.7 | 28.6 | 28.4 | 28.3 | 27.2 | 23.7 | 19.8 |
| 11111 | 1994 | 19.1 | 20.3 | 26.3 | 27.9 | 29.1 | 29 | 29.2 | 29 | 28.8 | 27.3 | 23.5 | 19 |
| 11111 | 1995 | 17.7 | 21.2 | 26.1 | 29.9 | 30.1 | 29.3 | 28.6 | 29.1 | 28.6 | 27.6 | 23.9 | 19 |
| 11111 | 1996 | 18.3 | 22 | 27.4 | 28.9 | 29.6 | 28.3 | 28.9 | 28.3 | 29.1 | 26.9 | 23.4 | 19.7 |
| 11111 | 1997 | 17.6 | 20.8 | 26.7 | 25.9 | 28.9 | 29 | 28.7 | 29.2 | 27.9 | 26.5 | 24 | 19 |
| 11111 | 1998 | 17.1 | 21.7 | 24.4 | 27.4 | 29.1 | 30.7 | 28.8 | 28.9 | 28.7 | 28.5 | 25 | 20.4 |
| 11111 | 1999 | 18.8 | 23.3 | 27.7 | 30.6 | 28.6 | 29 | 28.5 | 28.5 | 28.2 | 27.6 | 23.8 | 20.9 |
| 11111 | 2000 | 18.7 | 20.8 | 25.5 | 27.9 | 28 | 29.1 | 29 | 29.1 | 28.6 | 27.5 | 24.5 | 20.1 |
| 11111 | 2001 | 18.4 | 22.6 | 26.6 | 29.1 | 27.7 | 28 | 28.8 | 29.5 | 28.7 | 27.6 | 24.5 | 19.8 |
| 11111 | 2002 | 19.7 | 22.6 | 26.2 | 27.6 | 27.8 | 28.3 | 28.5 | 28.6 | 28.9 | 27.4 | 24 | 20.3 |
| 11111 | 2003 | 16.2 | 22.1 | 24.4 | 28.9 | 29.5 | 28.4 | 29.3 | 29.4 | 28.5 | 27.8 | 24 | 20.5 |
| 11111 | 2004 | 18.2 | 21.8 | 27.1 | 27.8 | 30.4 | 28.5 | 28.6 | 29.1 | 27.7 | 26.9 | 23.4 | 21 |
| 11111 | 2005 | 19 | 23.4 | 26.9 | 29 | 28.6 | 29.7 | 28.6 | 29 | 28.9 | 27 | 23.9 | 20.9 |
| 11111 | 2006 | 18.9 | 24.9 | 27.4 | 28.6 | 29.1 | 29.1 | 29.2 | 29.1 | 28.5 | 27.9 | 24.3 | 20.6 |
| 11111 | 2007 | 18 | 21.5 | 25.4 | 28.1 | 30 | 28.7 | 28.2 | 29.1 | 28.7 | 27.1 | 23.9 | 19.8 |
| 11111 | 2008 | 19 | 20.3 | 26.6 | 29.2 | 29.3 | 28.7 | 28.5 | 28.8 | 28.9 | 27.1 | 23.7 | 20.4 |
| 11111 | 2009 | 19.7 | 23.3 | 27 | 30.1 | 29.1 | 30.2 | 29 | 28.9 | 28.8 | 27.6 | 24.6 | 20 |
| 11111 | 2010 | 17.6 | 22.3 | 28.2 | 30.4 | 29.7 | 29.3 | 29.7 | 29.5 | 28.9 | 28.3 | 24.9 | 20.1 |
| 11111 | 2011 | 17.3 | 22.5 | 26.4 | 28 | 28.4 | 29.1 | 29.2 | 28.5 | 29.1 | 28.1 | 23.9 | 19.3 |
| 11111 | 2012 | 18.9 | 22.1 | 27.1 | 28.1 | 30.1 | 29.7 | 29.1 | 29.2 | 29 | 27.9 | 23.5 | 18.4 |
| 11111 | 2013 | 17.6 | 22.8 | 27.5 | 29 | 28 | 30.1 | 29.3 | 28.7 | 28.9 | 27.2 | 23.8 | 20.2 |
| 11111 | 2014 | 18.3 | 21 | 26.5 | 30.7 | 30.2 | 29.6 | 29.5 | 28.8 | 29.2 | 27.7 | 24.3 | 19 |
| 11111 | 2015 | 19.1 | 22.4 | 26.3 | 27.9 | 29.7 | 29.3 | 28.4 | 29.2 | 29 | 27.7 | 24.5 | 20.4 |
| 11111 | 2016 | 18.9 | 24 | 27.3 | 30.4 | 28.5 | 29.9 | 28.8 | 29.6 | 29 | 28.6 | 24.2 | 21.6 |

## Table C7: Daily Monthly Max. & Mean Maximum Temperature

Bangladesh Meteorological Department,Climate Division, Agargaon, Dhaka-1207.

| **Year** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** | **2016** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 1 | 27.6 | 28 | 32.1 | 27 | 37 | 32.8 | 33.2 | 33.6 | 33.4 | 34 | 34 | 29.6 |
| 2 | 27 | 28.6 | 32.4 | 28 | 33 | 35.4 | 32.2 | 33.8 | 32.8 | 32.3 | 34.1 | 29.6 |
| 3 | 25.8 | 27.8 | 33 | 31.5 | 32.4 | 36 | 31.3 | 34.4 | 32.6 | 34 | 34.5 | 29.5 |
| 4 | 26.5 | 26.6 | 33.5 | 33.4 | 33.6 | 35 | 30.8 | 35 | 32.5 | 35.4 | 28.5 | 30.4 |
| 5 | 25.8 | 26.7 | 33.4 | 31.2 | 35.2 | 34.6 | 28.5 | 33.3 | 32.5 | 32.8 | 25 | 29.6 |
| 6 | 26 | 26.8 | 33.6 | 34.5 | 35 | 32.5 | 28.8 | 31.8 | 31.4 | 30.4 | 24.2 | 29.6 |
| 7 | 26.6 | 28.4 | 33 | 35.2 | 31.6 | 32.9 | 33.6 | 32.6 | 32.8 | 31.8 | 27.4 | 30.7 |
| 8 | 26.8 | 29.1 | 32.7 | 36 | 34 | 34 | 34.1 | 33.3 | 33.6 | 32.6 | 30.2 | 31 |
| 9 | 25.2 | 27.5 | 34.5 | 34.8 | 35.6 | 31.5 | 33.5 | 31.6 | 34.4 | 33 | 31.2 | 28.4 |
| 10 | 24.4 | 28 | 34.4 | 36 | 35.7 | 35 | 33 | 28.8 | 34.2 | 33.5 | 30.7 | 28.8 |
| 11 | 25.1 | 27.9 | 34.5 | 36.6 | 36.4 | 34.3 | 33.4 | 32.6 | 32.8 | 30.2 | 29.5 | 28.2 |
| 12 | 24.5 | 29.5 | 34.2 | 37 | 36 | 29.5 | 33.4 | 33.8 | 32.5 | 31.4 | 30.1 | 27.9 |
| 13 | 24.1 | 29 | 31.2 | 36.8 | 33.1 | 31.2 | 33.5 | 33.5 | 29.2 | 33 | 30.8 | 25.8 |
| 14 | 25.4 | 28.6 | 31.6 | 36.2 | 34 | 32.6 | 34.5 | 33.4 | 32.6 | 32.4 | 30.6 | 25.7 |
| 15 | 26 | 30.6 | 32.6 | 35.6 | 34.7 | 32.8 | 33.2 | 34.8 | 34.2 | 33.5 | 29.8 | 26.3 |
| 16 | 26.6 | 31.5 | 32.4 | 34.6 | 35 | 34.2 | 29.5 | 33.8 | 33.8 | 34.4 | 30.4 | 26.8 |
| 17 | 26.7 | 31 | 33.5 | 35.4 | 35.4 | 33.7 | 32.5 | 31 | 34.7 | 34.7 | 30.6 | 26.7 |
| 18 | 25.7 | 32.2 | 33.8 | 33.8 | 32.8 | 34.8 | 31 | 32.6 | 34.2 | 34.6 | 30 | 26.8 |
| 19 | 25.4 | 33.6 | 31 | 36 | 30.6 | 34 | 31.5 | 34.8 | 29.7 | 34.7 | 29.8 | 26 |
| 20 | 22.8 | 34 | 32 | 35.9 | 28.8 | 35.3 | 32 | 33.6 | 31.1 | 36 | 29 | 26.8 |
| 21 | 22.7 | 34 | 34.8 | 35.5 | 26.2 | 34.7 | 31.9 | 29.6 | 31.8 | 35.8 | 28.5 | 25.8 |
| 22 | 20 | 31.4 | 34.2 | 36.4 | 32.8 | 33.2 | 30.8 | 32.2 | 32.7 | 33.6 | 28.5 | 27.5 |
| 23 | 20.8 | 31 | 34 | 36.4 | 35 | 33.8 | 31.1 | 33.2 | 34 | 33.2 | 28.5 | 28.5 |
| 24 | 22 | 26.4 | 34.5 | 39 | 35 | 34.6 | 32.2 | 34.6 | 32.2 | 32.5 | 29.5 | 28 |
| 25 | 23.1 | 30.4 | 34.6 | 37 | 34.1 | 35.7 | 31.8 | 36.1 | 34.1 | 34 | 29.2 | 28.2 |
| 26 | 22.1 | 31.2 | 34.7 | 36.6 | 34.6 | 35.2 | 30.7 | 33.2 | 33.2 | 33.8 | 28.4 | 27.5 |
| 27 | 25 | 31.2 | 33.2 | 36.8 | 33.2 | 35 | 33.5 | 35.4 | 34.4 | 30.2 | 28.5 | 26.5 |
| 28 | 25.8 | 31.3 | 29.2 | 36.5 | 29 | 34.6 | 33.6 | 32.2 | 30.3 | 30.5 | 28.8 | 25.8 |
| 29 | 25.2 | 31.9 | 33.6 | 37.4 | 34.2 | 34.8 | 31.8 | 34.2 | 34.1 | 31.5 | 28.5 | 25.8 |
| 30 | 24.4 | ** | 33.8 | 37 | 35.5 | 34.2 | 33.5 | 35.3 | 34.4 | 32.5 | 29.2 | 26.5 |
| 31 | 26 | ** | 30.5 | ** | 34.7 | ** | 34.6 | 33.7 | ** | 33 | ** | 26.2 |
| Max. | 27.6 | 34 | 34.8 | 39 | 37 | 36 | 34.6 | 36.1 | 34.7 | 36 | 34.5 | 31 |
| Mean | 24.9 | 29.8 | 33.1 | 35.1 | 33.7 | 33.9 | 32.2 | 33.3 | 32.9 | 33.1 | 29.6 | 27.8 |

Note: **** means missing data

## Table C8: Daily Monthly Min. & Mean Minimum Temperature

Bangladesh Meteorological Department, Climate Division, Agargaon, Dhaka-1207.

| Year | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mo** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 1 | 14.8 | 18.1 | 19.9 | 18.2 | 28 | 25.2 | 28 | 25.4 | 27.7 | 25.8 | 25.4 | 18.8 |
| 2 | 14.2 | 16.8 | 21.4 | 20.6 | 21.3 | 25.8 | 27 | 26.8 | 27.4 | 27.2 | 25.2 | 18.8 |
| 3 | 14.8 | 17.6 | 21 | 24.4 | 22 | 28 | 26.6 | 27.2 | 26.1 | 26.8 | 25.6 | 19 |
| 4 | 15.4 | 17 | 23.4 | 25 | 23.6 | 27.8 | 25.5 | 28 | 27.4 | 27.5 | 26 | 19.6 |
| 5 | 15.3 | 14.4 | 22 | 26.4 | 25.5 | 28 | 26.3 | 28 | 26.2 | 26.6 | 23.4 | 18.4 |
| 6 | 15.8 | 13.3 | 23.2 | 26.7 | 25.4 | 28 | 25.1 | 26.8 | 27 | 26.5 | 19.3 | 17.7 |
| 7 | 14.6 | 13.6 | 19.5 | 27.1 | 24.2 | 27.8 | 26 | 27 | 26.4 | 26.2 | 22.4 | 16.4 |
| 8 | 14.4 | 15.6 | 22.5 | 27 | 22.8 | 23.9 | 27.3 | 27 | 26.4 | 26.4 | 20.6 | 15.5 |
| 9 | 17 | 18.6 | 22.5 | 26.8 | 26.3 | 26 | 28 | 26.8 | 27.5 | 26.4 | 20.4 | 17 |
| 10 | 17.5 | 19.5 | 25 | 27.1 | 25.5 | 26.5 | 27.3 | 25.2 | 27.5 | 26.6 | 20.8 | 16 |
| 11 | 12.5 | 17.5 | 25 | 26.8 | 26.1 | 29.2 | 27.4 | 26.1 | 27.7 | 25.8 | 19.4 | 16.2 |
| 12 | 13.4 | 19.5 | 24.6 | 27.3 | 27.3 | 22.8 | 26.8 | 27 | 26.8 | 24.2 | 19.3 | 15.8 |
| 13 | 13.6 | 19.2 | 24.4 | 27.5 | 22.4 | 22.9 | 27.5 | 28 | 25.4 | 24 | 19.9 | 14.9 |
| 14 | 14.2 | 18.8 | 21 | 27.7 | 22.6 | 25.9 | 27.4 | 27.2 | 25.3 | 24.8 | 21.5 | 15.5 |
| 15 | 14 | 19.6 | 20.7 | 27.8 | 26.8 | 26.8 | 27.9 | 27.8 | 26.6 | 24.5 | 18.9 | 15.8 |
| 16 | 14.9 | 20.3 | 23 | 27.8 | 27 | 27.6 | 26 | 27.3 | 27.2 | 25.6 | 20 | 16.4 |
| 17 | 13.4 | 19.5 | 21.5 | 28.4 | 28.4 | 28 | 26.4 | 26.3 | 27.2 | 25.9 | 20.2 | 15.8 |
| 18 | 13 | 19.5 | 19.5 | 28 | 26.9 | 26.5 | 25 | 27.5 | 26.8 | 26.8 | 18.8 | 17.2 |
| 19 | 14.4 | 21.8 | 20.3 | 27.5 | 24 | 27 | 26.4 | 26.6 | 27 | 26.2 | 18 | 17.8 |
| 20 | 16.7 | 22.4 | 23.4 | 27.8 | 24 | 27.6 | 26.8 | 27.8 | 26.1 | 25.5 | 18.2 | 18.2 |
| 21 | 15.8 | 23 | 24.6 | 28 | 23.8 | 27.6 | 27.8 | 28.8 | 26.1 | 25.5 | 18.6 | 16.8 |
| 22 | 14.8 | 23.3 | 25.5 | 28.2 | 23.6 | 27 | 27.2 | 24 | 26.6 | 23.6 | 17.6 | 16.8 |
| 23 | 13.2 | 20.5 | 24.6 | 28.7 | 26.7 | 27.2 | 25.3 | 25.5 | 25.6 | 22.8 | 17.7 | 17 |
| 24 | 11.4 | 20 | 20.8 | 28.4 | 27.6 | 28 | 25.3 | 27.3 | 26.8 | 24 | 18 | 17.3 |
| 25 | 11.5 | 20.5 | 21.4 | 28 | 24.2 | 28 | 25.5 | 28.8 | 26 | 23.8 | 18.3 | 18 |
| 26 | 10.2 | 20 | 23.6 | 28.4 | 22.2 | 26.8 | 25.2 | 24.4 | 25.8 | 24.5 | 18.8 | 18.5 |
| 27 | 10 | 22.4 | 24.8 | 28.2 | 23 | 27.9 | 25.2 | 27.4 | 25.8 | 24.2 | 18.6 | 17.5 |
| 28 | 14.4 | 20.6 | 25.5 | 28.2 | 24.9 | 29 | 27.5 | 25.1 | 27.5 | 24 | 18.5 | 16.4 |
| 29 | 14 | 20.5 | 20.8 | 27 | 24.6 | 29 | 27.2 | 24.9 | 26.5 | 24.5 | 18.8 | 16.4 |
| 30 | 13.4 | **** | 21.5 | 28.4 | 25.8 | 28.8 | 26.8 | 27.9 | 26.1 | 23.8 | 18.6 | 16.6 |
| 31 | 16.1 | **** | 22.5 | **** | 25.4 | **** | 24.5 | 28.2 | **** | 23.8 | **** | 15 |
| Min. | 10 | 13.3 | 19.5 | 18.2 | 21.3 | 22.8 | 24.5 | 24 | 25.3 | 22.8 | 17.6 | 14.9 |
| Mean | 14.2 | 19.1 | 22.6 | 26.9 | 24.9 | 27 | 26.5 | 26.8 | 26.6 | 25.3 | 20.2 | 17 |

Note: **** means missing data

## Table C9: Monthly Prevailing Wind Speed and Direction of Dhaka.

Bangladesh Meteorological Department,Climate Division, Agargaon, Dhaka-1207.

| Year | Jan. | | Feb. | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Sep. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** |
| 1961 | 2.9 | NW | 3.1 | N | 5.6 | SW | 5.1 | SW | 7.6 | S | 6.4 | SE | 8 | SE | 7.7 | SE | 6.1 | SE | 3.4 | N | 2.9 | NW | 3.6 | NW |
| 1962 | 4.6 | NW | 4.1 | NW | 5 | W | 8.4 | S | 5.3 | S | 5.8 | SE | 6.4 | SE | 5.2 | SE | 7.6 | SE | 2.3 | N | 2.3 | NW | 3.7 | N |
| 1963 | 2.6 | NW | 3.7 | N | 4.1 | SW | 4.8 | S | 5.2 | S | 5.7 | S | 5.9 | SE | 4.4 | S | 4.7 | SE | 6.1 | NE | 2.8 | N | 3.4 | N |
| 1964 | 3.2 | N | 3.4 | S | 5.3 | S | 8.3 | S | 4.8 | SE | 5.3 | SE | 4.5 | SW | 5.7 | SE | 6 | SE | 5 | SE | 4.1 | N | 3.6 | N |
| 1965 | 3.6 | N | 4 | N | 5.4 | NW | 6.7 | S | 6.3 | S | 5.2 | SE | 5.8 | SE | 5.7 | S | 4.6 | S | 3.3 | NE | 3.7 | NW | 3.3 | NW |
| 1966 | **** | *** | 0 | CLM | 0 | CLM | 8.5 | S | 5.8 | S | 9.1 | S | 5.3 | SE | 4.5 | S | 3.8 | SE | 6.3 | NE | 3 | N | 2.8 | N |
| 1967 | 3.3 | NW | 3.2 | SW | 3.9 | SW | 6.5 | S | 6.6 | S | 5.2 | SE | 4.9 | SE | 5 | SE | 4.5 | SE | 2 | N | 3.4 | N | 2.6 | N |
| 1968 | 3.1 | NW | 3 | W | 4.4 | S | 5.4 | S | 4.8 | S | 4.1 | SE | 4.6 | SE | 4.5 | SE | 3.7 | S | 2.9 | NW | 3.2 | NW | 3 | NW |
| 1969 | 3.4 | NW | 2.9 | SW | 4.8 | SW | 5.1 | S | 4.1 | S | 4.5 | S | 5 | SE | 4.4 | S | 5.6 | SE | 3 | N | 2.4 | NW | 2.9 | NW |
| 1970 | 3.3 | NW | 3.1 | NW | 5 | SW | 5.8 | S | 6.4 | S | 4.7 | SE | 4.4 | S | 4.5 | SE | 3.6 | S | 3.6 | NW | 3.5 | N | 2.9 | NW |
| 1971 | 3.3 | N | 3.4 | NW | 3.5 | SW | 3.5 | SE | 3 | S | 4.8 | SE | 4.9 | SE | 4.3 | SE | 3.8 | S | 3.8 | SE | 2.5 | N | **** | *** |
| 1972 | 3 | NW | 3.3 | NW | 5.5 | S | 6 | S | 6 | S | 4.4 | SE | 7.2 | SE | 4.8 | SE | 3.4 | SE | 4.5 | NW | 3.1 | NW | 3.1 | NW |
| 1973 | 2.9 | NW | 3.3 | NW | 3.5 | SE | 4.8 | S | 4.5 | SE | 3.3 | S * | *** | *** | 4 | SE | 3.8 | SE | 2.2 | N | 6.5 | E | 3 | N |
| 1975 | 2.8 | NW | 3.5 | NW | 4.2 | S | 6.5 | S | 5.1 | S | 3.8 | S | 3.8 | S | 4.7 | SE | 3.7 | SE | 3.4 | SE | 2.8 | E | 2.6 | NW |
| 1976 | 2.8 | NW | 3.8 | SW | 5.5 | S | 5.8 | S | 5 | S | 5.1 | S | 5.4 | SE | 5 | SE | 4.5 | SE | 2.9 | S | 2.9 | NW | 2 | N |
| 1977 | 2.9 | NW | 3.8 | SW | 4.6 | S | 7.5 | S | 5.6 | S | 5.6 | SE | 4.4 | S | 5.6 | SE | 5.3 | SE | 4.2 | E | 3.8 | SW | 2.2 | N |
| 1978 | 3.4 | NW | 4.3 | NW | 5.5 | NW | 4.7 | S | 5 | E | 5.2 | S | 4.1 | S | 5.5 | SE | 3 | S | 4 | N | 3.1 | SW | 3.7 | N |
| 1979 | 3.2 | NW | 3 | NW | 5 | SW | 4.3 | S | 4.8 | S | 4.5 | S | 3.9 | S | 5.5 | SE | 3.2 | S | 3.7 | S | 5.2 | N | 3.4 | NW |
| 1980 | 2.7 | NW | 2.9 | S | 5.2 | SW | 7.4 | S | 4.7 | S | 4 | SE | 4.5 | SE | 3.6 | S | 4.2 | SE | 5.9 | S | 2 | N | 2.6 | NW |

**Table C9:** Continued

| Year | Jan. | | Feb | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Sep. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir | Spd | Dir |
| 1981 | 3.3 | NW | 3.5 | N | 5.1 | S | 4.9 | S | 4.3 | SE | 3.8 | S | 4.1 | S | 2.7 | S | 3.7 | S | 3.2 | NW | 2.9 | NW | 2.7 | N |
| 1982 | 2.8 | NW | 3.3 | NW | 2.8 | NE | 6.3 | S | 5.8 | S | 4.8 | S | 4.7 | S | 4.9 | SE | 4 | S | 2.2 | N | 2.3 | N | 2.9 | N |
| 1983 | 3.3 | NW | 5.2 | S | 6.1 | S | 5.1 | S | 3.7 | S | 4.7 | S | 4.7 | S | 4.8 | SE | 4.2 | S | 3.9 | SE | 2.9 | N | 3.6 | E |
| 1984 | 3.9 | NW | 3.3 | NW | 4.1 | SW | 5.7 | S | 4.2 | S | 5 | SE | 4.1 | S | 4.7 | SE | 3.6 | SW | 3.5 | SE | 2.6 | E | 2.9 | NW |
| 1985 | 2.5 | NW | 4.1 | SW | 4.9 | S | 4.6 | S | 4.3 | S | 4 | S | 3.5 | S | 5 | SE | 3.3 | SE | 7.4 | SE | 3 | E | 3.1 | W |
| 1986 | 2.3 | NW | 3 | W | 4.7 | S | 5.9 | S | 3.5 | S | 3.4 | S | 4.2 | S | 3.9 | S | 5.7 | SE | 2.6 | S | 2 | NW | 3 | NW |
| 1987 | 3.2 | NW | 3.3 | NW | 4.4 | S | 5.3 | S | 4.9 | S | 4.4 | S | 4.2 | S | 4 | S | 3.6 | S | 3.4 | E | 2.7 | E | 2.4 | N |
| 1988 | 2.5 | N | 3 | NW | 4.9 | S | 5.3 | S | 6.2 | S | 4.2 | S | 4.4 | S | 4.4 | S | 3.8 | SW | 3.6 | N | 2.4 | N | 2.8 | N |
| 1989 | 3.5 | N | 4.5 | SW | 3.5 | W | 6.4 | S | 6.1 | S | 4.9 | S | 4.2 | S | 3.7 | S | 4.3 | SE | 3.6 | SE | 2.6 | N | 2.9 | N |
| 1990 | 2.6 | NW | 3.5 | NE | 6.3 | S | 6.5 | S | 3.8 | S | 4.8 | S | 4.4 | S | 4.2 | S | 4.7 | S | 7.5 | SE | 2.6 | E | 3 | N |
| 1991 | 3.2 | N | 4 | N | 3.3 | SW | 4.6 | S | 6.2 | S | 3.9 | S | 4.5 | S | 4 | S | 4.3 | S | 3.1 | S | 2.3 | N | 4.2 | N |
| 1992 | 3.7 | N | 4.2 | E | 4.7 | W | 5.8 | S | 4.4 | S | 4.1 | S | 3.9 | S | 5.2 | SE | 3.6 | S | 3.8 | E | 2.5 | N | 2.8 | N |
| 1993 | 3 | W | 3.7 | S | 4.6 | S | 3.5 | S | 3.7 | S | 3.9 | S | 3.4 | S | 3.4 | SE | 3.1 | SE | 3.6 | SE | 2.5 | NE | 2.7 | N |
| 1994 | 3.2 | NW | 3 | NW | 4.4 | S | 3.9 | S | 4 | S | 4.2 | SE | 3.8 | SE | 3.8 | SE | 3.7 | SE | 2.6 | SW | 2.1 | N | 2.2 | N |
| 1995 | 2.8 | NW | 2.6 | W | 2.9 | NW | 3.1 | S | 3.4 | S | 3.7 | S | 3.8 | SE | 3.9 | SE | 3.7 | SE | 2.4 | NE | 2.3 | NE | 2.2 | W |
| 1996 | 2.3 | NW | 2.7 | W | 3 | SW | 2.9 | S | 2.7 | S | 2.6 | SE | 2 | S | 1.8 | S | 1.5 | S | 3.3 | E | 1.4 | N | 1.4 | NW |
| 1997 | 1.5 | NW | 1.8 | W | 2.4 | W | 2.3 | S | 2.2 | S | 2.4 | S | 2.2 | SE | 2.9 | SE | 2 | S | 1.4 | NW | 2 | N | 1.7 | N |
| 1998 | 1.5 | NW | 1.7 | NW | 2.7 | W | 2.5 | S | 3.1 | S | 2.8 | S | 2 | S | 1.9 | S | 2.1 | SE | 2.7 | SE | 3.6 | NE | 2 | NW |
| 1999 | 2.1 | NW | 2.2 | NW | 2.2 | S | 2.5 | S | 2.5 | S | 2.5 | S | 2.6 | SE | 2.3 | SE | 1.9 | SE | 2.4 | SE | 1.6 | N | 1.7 | N |
| 2000 | 1.6 | N | 2 | N | 2.3 | S | 3.3 | S | 2.6 | S | 2.5 | S | 2.4 | S | 2.4 | S | 2.2 | S | 3.3 | NE | 1.5 | N | 1.6 | N |
| 2001 | 2.2 | NW | 1.8 | NE | 3.6 | S | 4.1 | S | 3.4 | S | 3.2 | S | 3.9 | S | 2.5 | S | 3 | S | 2.6 | S | 1.7 | N | 2 | N |
| 2002 | 2.5 | N | 2.5 | NW | 3.9 | S | 4.1 | S | 3.5 | S | 2.8 | S | 2.7 | S | 2.8 | S | 3 | SE | 2 | N | 6.5 | NE | 2.4 | N |
| 2003 | 3.1 | NW | 3.5 | N | 3.8 | S | 5.1 | S | 4.9 | S | 4.1 | SE | 4.1 | S | 4.3 | SE | 4.3 | SE | 3.3 | NE | 2.8 | N | 3.1 | W |

**Table C9:** Continued

| | Jan. | | Feb. | | Mar. | | Apr. | | May | | Jun. | | Jul. | | Aug. | | Sep. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** | **Spd** | **Dir** |
| 2004 | 3.5 | W | 3.9 | W | 5.6 | S | 5.9 | S | 5.5 | S | 3.6 | S | 4.3 | SE | 4.1 | SE | 6.3 | E | 4.2 | SE | 3.2 | W | 3.3 | NNW |
| 2005 | 4.1 | NNW | 4.3 | W | 4.6 | S | 4.5 | S | 4.4 | S | 4.4 | SE | 4.6 | SE | 3.5 | S | 4.6 | SE | 4.8 | SE | 3.4 | NW | 3.7 | NNW |
| 2006 | 3 | N | 3.6 | S | 5 | NNW | 3.8 | S | 3.8 | S | 2.1 | S | 2.2 | SE | 4.5 | SE | 5.4 | SE | 2.3 | N | 2.1 | NW | 2.4 | NW |
| 2007 | 2.9 | NW | 3.1 | NW | 4.2 | NW | 3.8 | S | 3.5 | S | 3.1 | S | 3.1 | S | 3.1 | S | 3.2 | S | 4.1 | NE | 5.5 | NE | 2.9 | NW |
| 2008 | 3.6 | N | 3.2 | N | 3.8 | S | 3.4 | S | 3.4 | S | 3.3 | S | 3.4 | S | 2.8 | S | 2.8 | S | 9.6 | NE | 2.5 | NE | 3.3 | W |
| 2009 | 3.3 | W | 4.1 | W | 4 | W | 4.1 | S | 3.8 | S | 3.1 | S | 4.3 | SE | 2.8 | S | 4.2 | SE | 2.3 | E | 2.8 | N | 2.4 | NW |
| 2010 | 2.9 | NW | 3.3 | W | 3.8 | S | 4.1 | S | 3.7 | S | 3 | S | 2.4 | S | 2.2 | S | 2.6 | SE | 2 | NE | 2.9 | N | 2.4 | N |
| 2011 | 2.2 | W | 2.4 | W | 3.8 | S | 2.4 | S | 3 | S | 2.7 | SE | 2.4 | SE | 2.4 | SE | 2.6 | SE | 2 | NW | 2.3 | W | 2.1 | NW |
| 2012 | 2.4 | W | 3 | W | 2.5 | S | 2.6 | S | 2.5 | S | 3 | S | 2.7 | SE | 2.5 | SE | 2.2 | E | 2 | S | 2.2 | W | 2.3 | W |
| 2013 | 2.3 | W | 2.2 | W | 2.6 | W | 2.8 | S | 3.2 | E | 2.3 | S | 2.7 | SE | 2.7 | SE | 2.2 | S | 2.9 | SE | 2.1 | N | 2.3 | W |
| 2014 | 2.5 | W | 2.5 | W | 2.4 | NW | 2.2 | S | 2.8 | S | 2.1 | S | 2.4 | SE | 2.4 | SE | 2.1 | SE | 2.1 | W | 2.1 | W | 2.2 | W |
| 2015 | 2.2 | W | 2.4 | W | 2.2 | W | 2.5 | S | 2.3 | S | 2.6 | S | 2.4 | E | 2.7 | S | 3 | SE | 1.9 | S | 2.5 | N | 2.1 | W |
| 2016 | 2.7 | W | 2.6 | W | 2.3 | S | 3 | S | 3.6 | S | 2.4 | S | 2.3 | S | 2.8 | E | 2.1 | S | 2 | W | 2.5 | NE | 2 | W |