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Introduction to Methods for Simulating Urban Heat Islands: Subject Review

Zainab Khalid[1*] **Tamara Mutaz[2]** **Hassan Haider Abdulrazzaq Kamoona[3]**

[1]*Department of Architecture, College of Engineering, University of Baghdad, Baghdad, Iraq*

[2]*Architecture Department, College of engineering, Al-Muthanna University, Al-Muthanna, Iraq*

[3]*Construction and Projecs Department, University of Baghdad, Baghdad, Iraq*

***Corresponding author email**: zainab.khalid@coeng.uobaghdad.edu.iq;

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Abstract

Urbanization led to significant changes in the properties of the land surface. That appends additional heat loads at the city, which threaten comfort and health of people. There is unclear understanding represent of the relationship between climate indicators and the features of the early virtual urban design. The research focused on simulation capability, and the affect in urban microclimate. It is assumed that the adoption of certain scenarios and strategies to mitigate the intensity of the UHI leads to the improvement of the local climate and reduce the impact of global warming. The aim is to show on the UHI methods simulation and the programs that supporting simulation and mitigate the effect UHI. UHI reviewed has been conducted the form of many studies, it resulted that all simulation methods were pass through the follow stages: modeling, Simulation and mitigation. Most of the literature reviewed shows that there are some key criteria that have been adopted as universal urban health coverage in cities, and that the first control component is city design.

Key Words: UHI, Simulation, Local climate, Urban Simulation, Simulation programs.

1. Introduction

Urbanism researches coincides the rapid growth of cities with rapid technological advances created many challenges for urban environments managing. Cities in 21 century more pollution generate, reduce natural resources and more heat amounts than the past [1-5]. The phenomenon of UHI document by Luke Howard in 1818, and recognized and most major cities in the world recorded the presence of these islands [2, 6-10], it can be summarized as follows see Fig. 1. Urban fabrics affect the city's thermal balance. Because it absorbs solar and infrared energy, and part of it is dissipated during convection and radiation processes. Thus, the temperature of the local urban atmosphere increases [11]. Hence the (UHI) phenomenon can threaten the health and comfort of citizens [12].

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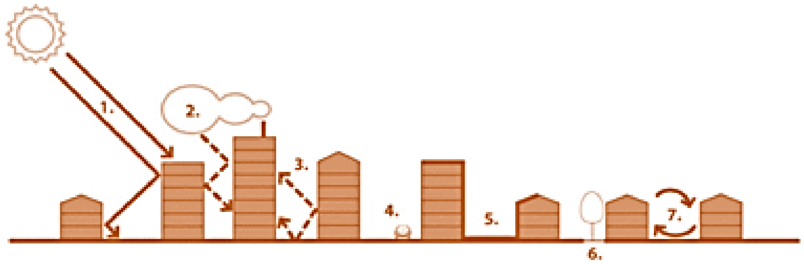

1 The low albedo materials absorption of short-wave sun radiation and trapping by multiple reflections between buildings façades and sidewalks or streets.
2 The pollution of air because materials thermal properties which store heat in the city urban, thus reducing the possibility of night cooling, and re-emits long-wave radiation to the urban environment.
3 Decreased loss of a long-wave radiate heat from street canyons, because buildings surfaces (sky obstruction), absorbed long-wave and reflected it back to the urban fabrics.
4 Combustion processes, such as traffic, space heating and industries.
5 Increased storage of heat by applying materials with large thermal admittance in buildings.
6 Reduced vegetation cover and evaporative surfaces, which pumps more heat energy .The evaporation from urban areas is decreased because of 'waterproofed surfaces' – less permeable materials, and less veg-elation compared to rural areas.
7 The Human heat transport emitted from streets, fuel combustion and metabolism is decreased by a reduction of wind speed.

Figure 1. The effect factors that cause urban heat island [3, 6 and 8 - 10].

All over the world, major cities like Toronto, Montreal, Dresden, Chicago and China are also experiencing serious effects of UHI [13] see Fig. 2.

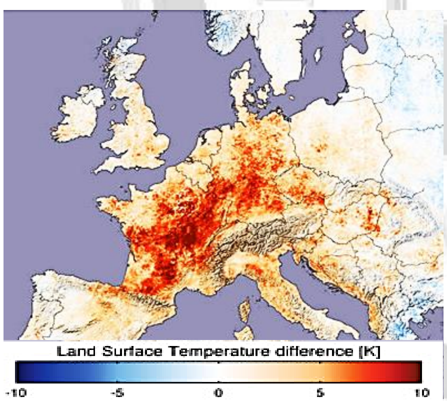

Figure (A) The central of Germany and France, UHI, surface high air temperature was responsible for (tens of thousands of deaths across Europe2003 summer) [14].

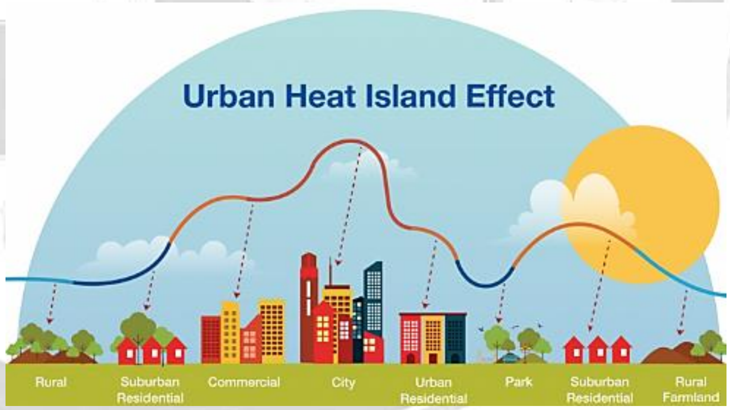

Figure (B) UHI difference in the city than urban residential, park, suburban, suburban residential, rural farmland and rural [15].

Figure 2. UHI, an increase in Earth's surface temperatures as a result of urbanism in major cities.

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The 21 century a development stand out in the use of the first simulation as a tool in studying the UHI phenomenon [1and 6]. It helps in making early decisions in the architectural and urban design process, especially in the early stages of the design process [16]. Which can enhance thermal comfort in open spaces such as courtyards, streets and patios, and increase urban design features [16]. The urban formation was simulated using the data provided by the survey and climatological maps of the weather [4]. With the systematic description of the simulation performance data, a myriad of spatial representations can be formed, as in the case of massive parametric computations or performance optimization simulations. Those complex thermodynamics, large amounts of simulated data are extracted in one simulation model. This is due to the time-varying climatic nature of the computation (8,760 hours/year). Many spatial locations (sensing points), with a large number of possible outputs. Performance dashboards have been proposed and prototyped - passive and active, these new graphs, spatial-temporal and outputs intended help to respond the passive design environment, with future low-energy city, urban and building designs [16 and 17]. Several literature related to performance, analysis, and improvement of the urban environment were presented. And the applied methodologies reviewed to create a general framework to reduce the UHI effect to improve the urban environment [18]. To improve the city's ability to mitigate urban heat island effects and enhance radiate properties; which can be increased by using highly reflective materials to roofs, walls and floors; in urban areas, the reflectivity of surfaces has been often about 0.2 [11]. Urban green spaces and green infrastructures have been checked in several studies and identified as an adaptive solution to reduce the impact of urban heat, and improve the health of citizens, by considering urban thermal comfort and its social and economic role. Activating social activities is the goal that most urban studies seek [12]. **The paper aim is highlighting the comprehensive microclimate simulation methods when used in urban design context through process, programs and experiences. First, survey climatic analysis tools were presented. Then, discussed the three phases of the UHI simulation process, emphasizing methods for assembling meteorological boundary conditions and developing open urban spaces**.

2. Material And Methods

Several literature related to performance, analysis, and optimization have been presented. The methodologies in this review applied to improve the design of the external urban environment, and reduce the UHI effect, by considering thermal comfort as an objective function that must be achieved to ensure a healthy outdoor urban environment which can Pre-tested in a virtual environment with simulation software. The work of the simulation-based technology framework is divided into three stages: modeling, simulation and Mitigation [18]. **According to the above, and to achieve the goal of the research, the research methodology was divided into the three flowing phases: UHI modeling, UHI Simulation and UHI Mitigation stages.**

2.1. UHI modeling stage

The first stage is modeling, the modeling process is defined as: simple sketches that provide drawings and direct notes about the appearance and some of the spatial characteristics of the entire building. The Surface Energy Balance (SEB) & BPS (building performance system) metrics should be able to provide this kind of guidance to support urban design, from conceptual

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design to development phases of a project within a virtual environment. The researchers suggest that the graph should connect the BPS results to the following objectives [1, 16 and 23]:

- That the annual BPS & SEB climate outcomes align with current best practices of simulation, daylight and energy modeling.
- The modeling should be spatially and geometrically separate, and linked to the environmental performance determinants of the design and spatial characteristics.

Modeling outputs measured using several methods for evaluating temporal data [24]: Frequency, certain range and Average.

The construction model is drawn in a graphical interface, and AutoCAD or Google Sketch Up uses for this [18]. The Surface Energy Balance (SEB) is a preliminary indicator of the UHI phenomenon, Fig. 3. gives an idea of Earth's surface temperatures. A studies successfully conducted a simple SEB operation in selected areas of Kuala Lumpur, represented by modeling of building in urban areas and air mass over buildings, it indicates a sharp rise in air temperature at 12 noon, followed by a gradual decrease to a minimum of 24.9°C at 5pm [1].

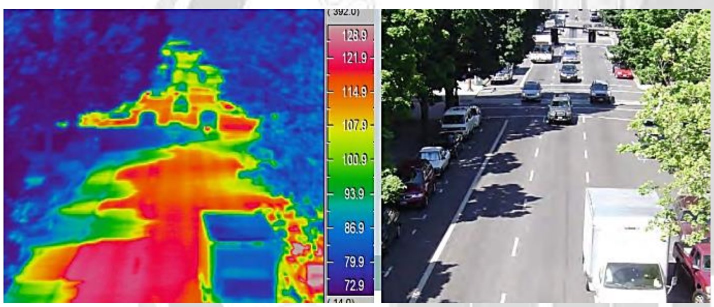

Figure (A) Street photo shows that paved surfaces higher than shaded surfaces [19]

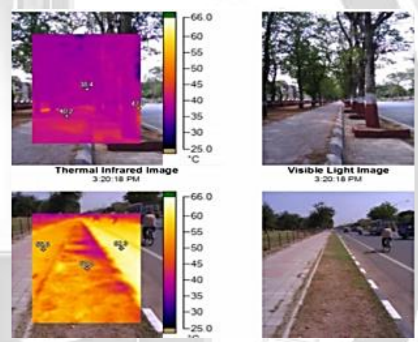

Figure (B) Infrared images show the effect of tree shade, which mitigate the solar radiant at pavements walkability [20]

Figure 3. Urbanism in major cities, an increase in Earth's surface temperatures as a result of a solar radiant.

A model of single-layer urban canopy combined with WRF/NOAH LSM was applied in Putrajaya and Malaysia (in 2012) discovered that the UHI is spatially and temporally diverse with a maximum of 3.1 °C [1 and 4]. Three methodological models can be considered, when modeling UHI, including urban surface layer, urban canopy (single or multi-layer) and urban boundary layer [16 and 22]. UHI modeling use software programs like (ENVI-MET3, SM2-U4, FVM5, etc. [21]. we can see the difference in UHI temperatures during the day in Fig. 4.

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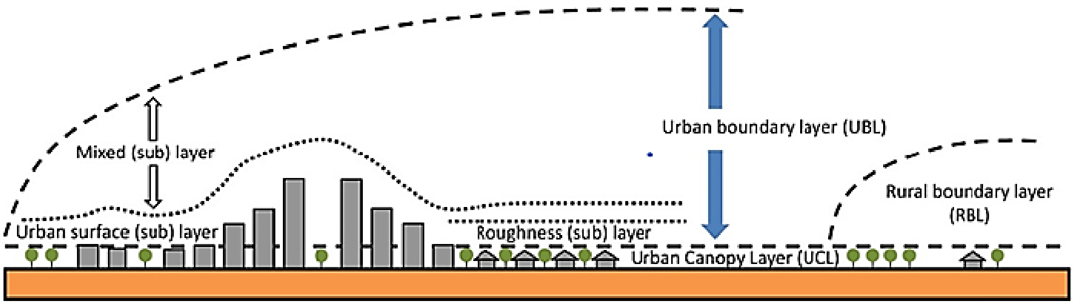

Figure (A) Urban surface layer: urban boundary and urban canopy layers [16 and 22].

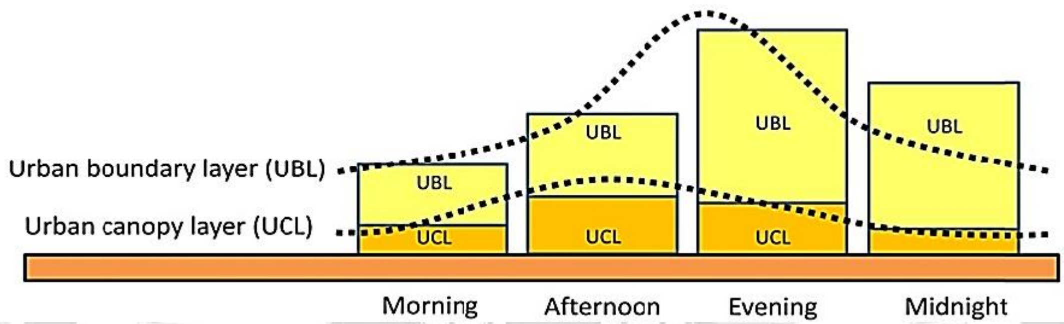

Figure (B) The difference in UHI temperatures during a day, air mass over buildings indicates a sharp rise in air temperature at 12 noon [16 and 22].

Figure 4. Urban surface layer and the difference in UHI temperatures during a day.

2.2. Urban heat island Simulation stage

The second stages comes the simulation stage; in it, the drawn model is imported into a simulator programs. The urban heating effect stems primarily from a man-made impermeable structure and surface made of manufactured materials with radioactive and varying heat properties. Asphalt and concrete store and absorbent heat during the day [4]. When study the effect of (UHI), we need to input all calculating information about the study area and outputs numerically, climate parameters and the material of sites in an Index of UHI simulator program, for some of the calculating information[20, 25 and 26], see Table 1. Below. In Addition, similar studies have demonstrated that urban design features indeed can mitigate the effect of UHI [10]. **Urban design must therefore be updated in order to accommodate non-traditional design strategies. The successful mitigation practices in other countries, especially those with similar contexts, can help in the development of future design solutions towards sustainability. The research was conducted to understand the relationship between UHI, climate, the features of the hypothetical early urban design and the human thermal performance of the open environment in a way that leads to sustainable urban integration as a result of improving the local climate**. The UHI Simulation includes topics such as: Urban Simulation, Local climate and urban design, Local climate Simulation, UHI influence, UHI

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Simulation programs, UHI Simulation programs examples, Thermal comfort and urban simulation.

Table 1. Some of the calculating index [20 and 26].

Index	Input	Index	Input
RSI	Regional Sustainability Index	WBGT	Wet-Bulb-Globe-Temperature
FA	Factor Analysis	PET	Physiological Equivalent Temperature
LISA	Local Indicator of Spatial Association	ET	Effective Temperature
UTCI	Universal Thermal Climate Index	WCT	Wind Chill temperature

2.2.1. Urban Simulation

Urban design and planning combined with the health care system [27]. A health approach in urban design can improve health care in today's societies [6 and 27]. The majority of local studies highlight the role of changes in urban materials, land use, population density, traffic, climate change, vegetation and landscape morphology. Urban design and planning factors are associated with local climate variables, which in turn, affects the energy consumption of residential units and other urban areas [5]. Many researchers have focused on UHI mitigation strategies by simulating neighborhood units, the results was the effects of some detailed urban planning and design techniques in mitigate the effects of heat islands and improves outdoor spaces and urban layers [11 and 24]. Geographical location also plays an important role in the simulation, where nature and physical spaces, terrain, mountains, hills, rivers and other water pools [21], Fig. 5. Beirut satellite image, representation grid cells of simulating units, which difference according to simulation programs.

Figure (A) Beirut satellite image, Identify the zone to be simulated. (Google Earth, 2015).

Figure (B) Grid cells grid of simulating units on TEB are conducted. [21]

Figure 5. Urban simulation, cells of simulating units

The activities and users concentration in outdoor spaces of cities. The urban microclimate is important factor in the use of public open spaces intensity [28]. **Local urban microclimates are created by means of active and passive climate control and the interrelationships between indoors and outdoors, to achieve a pre-tested quality of life for urban residents and the city's climate in a virtual environment.**

2.2.2. Local climate Simulation

The term "Local climate" was coined by German meteorologists, British meteorologists and geographers, they recognize a significant difference between rural and urban locations [29]. Others, demonstrated that city urban climate was composed of a variety of urban climate phenomena's such as air pollution or UHI are related to the urban built environment and its design [6, 29 and 30]. Including sunlight direction, daylight exposure, wind current, and local temperature. Which affects the energy consumption of urban areas and residential units [5]. In Ecological Diversity, climate Comfort and Control (among other environmental aspects) can be discussed threw a historical views [6 and 29]. As a historical challenges arising from the increasing man-made character of local climates [5, 29 and 30]. As an urban perspective, climate considers as the anthology that complement individual studies in certain sites [29].

2.2.3. Local climate and urban design

The city's urbanism and its climate as a result of revealing internal activities of human. Thus, the critical task of microclimate research today consists in describing and understanding the physical, man-made microclimate as a human tool, even though it appears to be a natural, immaterial physical phenomenon [29]. The local climatic in field studies revealed that features of urban tissues differ in any given part of a city. So the urban fabric accommodates and supports distinct local climatic within a set of quantitative data surrounding the design environment [31]. These climates are part of the built-up density and architecture [31]. After an orientation to assess the potential of urban spaces and identify possible design strategies for the new future environment, the importance of the human parameter and the urban microclimate must be taken into consideration [7]. The choice of local climate scale, and program support the ability to create a 3D design of environmental out door space model, based on analysis in a virtual environment rather than just individual guesswork [23]. Table 2. represent the relationship between local climate and urban design. Therefore, climate change can be addressed through careful design of urban areas in terms of materials, density, distance and orientation of buildings in order to pursue and achieve indoor and outdoor comfort [32]. Determine possible design strategies for the future environment, the potential of urban spaces for this environment is taken into consideration, with the importance of the human parameter and the urban microclimate [7]. In a hot and dry climate, higher temperatures in urban areas cause thermal discomforting [31]. **This has a negative impact on people, including less use of outdoor urban spaces and therefore less social interaction**. There is an increasing ability for designers to predict the measured climate, and to anticipate the previously unperceivable, in a virtual digital environment for the design of floors, walls and ceilings [33]; **The integration analysis of microclimate not**

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only affects in the way that urban designer think about city design, it affects how they could develop their projects is simulated as well.

Table 2. Local climate and urban design [23].

Scale	layer	Focused temperature	Focused elements	Dimension range (approximate)
Micro	Skin layer	Surface temperature	Open Space skin Building rooftops Building facades	1-10 m
Micro-local	Canopy layer	Air temperature	Open spaces between buildings Public spaces streetscapes Land cover feature classes Urban precincts	$10\text{-}10^3$ m
Local	Roughness (sub) layer	Air temperature.	Warm waves of air over tall elements of a uniform surface	$10^2\text{-}10^3$ m
Local	Inertial surface (sub) layer	Air temperature	Blended warm air over uniform surfaces	$10^2\text{-}10^3$ m
Macro	Mixed (sub) layer	Surface and air temperature	Land use classes Urban regions	$10^3\text{-}10^5$ m

2.2.4. UHI Simulation programs

New tools in experimentation and modern design have provided access to vital meteorological parameters. Among them are a variety of simulation software and plug-ins such as Dynamo and Grasshopper (with various commonly used plug-ins: Ladybug, ENVI-met, SimScale and Eddy3D among AEC products) Rhino and Revit straight [1]. The simulation results are differentiated from ventilation, thermal and daylight performance, organized into a single framework using the area (in engineering and annual area data). Once it organized within the framework, the results can be browsed and presented in a file of a variety of methods and programs [13]. Several studies deepened at ENVI-met in simulating of UHI effects [1]. Fisheye SVF simulation images search for sun gaps in the canopy layer where diffuse or direct radiation able to reach the ground. Table 3. provides a brief description some of these programs usually in use. The sky view factor (SVF) was analyzed and calculated on the basis of fisheye images using RayMan Pro program [21]. And use ENVI-met model to calculate the urban SVF canopy [18].

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Table 3. Describe some important simulation programs [1, 3, 6, 18, 23, 24 and 34].

Programs	Description
Grasshopper	Simulation program Includes components for weather data and solar radiation
Ladybug	It is an open source environment analysis plugin for Grasshopper, visual scripting.
Eddy3D	Airflow microclimate simulation plugin for Grasshopper. Powered by OpenFOAM and EPW weather files.
Radiance	One of the most widely adopted and appreciated software as a lighting modeling tool
Python	To analyze the results of ENVI-met.
ENVI-met.	It is a comprehensive computational fluid dynamics (CFD) simulation software. For local climate simulation and modeling of surface-plant-atmosphere.
RayMan	Using different output data for PET values from an ENVI-met simulation.
(RANS)	Designing wind flow using the Reynolds Averaged Navier-Stokes equations.
(IVS).	Solve radiate fluxes using an indexed field-of-view diagram.
SimScale	Software providing annual wind comfort by wind flow around urban structures.

It is calculated for traffic, building regulations and green spaces. (UWG) permits to obtain weather data sets for the three metropolitan areas by modifying existing weather data collected in the area, for use in thermal analysis and (UTCI.) 2.5 Simulation Overheating [34]. The effects of cold surfaces (on roofs, on sidewalks or as vegetation areas) are evaluated by numerical simulations using the software ENVI-met. [24]. It is a comprehensive program for simulating the local climate modeling the surface -plant- air interactions with urban environments [16]. ENVI-met. capable of simulating solar reflection, transmission, absorption and emission, wind flow around buildings, rooftop heat transfer and evaporation. And has been widely validated used in recent years [1, 3, 6 and 18]. **Grasshopper and Rhino, ENVI-met allowing precise control of urban design visualizations.**

2.2.5. Thermal comfort and urban simulation

Many efforts have been made to improve a quality of outdoor public spaces, the level of thermal comfort and a quality of indoor living (life), especially in social interaction areas, residential buildings and workplaces [36]. The perception of human thermal was based on, radiation fluxes, wind speed, air humidity, air temperature and the energy balance of individual's personal body, a physiological equivalent temperature (PET) depending on Matzarakis and Mayer 1996, Lin and Matzarakis 2008 PET studies, and the index of thermal comfort based on the Munich Model of Personnel Energy Equilibrium (MEMI), which physiologically models the human body thermal conditions in an appropriate manner [24]. Present in Table 4. [15]. RayMan software provided PET values using various output data from the ENVI-met simulation [24]. Using simulation to measure the level of thermal comfort, and improve indoor and outdoor environmental quality of the [23 and 36] Table 4. (HTCIs) also take into account the isolation of clothing and the metabolic rate of an individual, the Global Thermal Climate Index (UTCI) and [24, 37 and 38]. PET consideration of individual's metabolic rate, clothing and making it preferable to simulate a local climate [23, 24 and 37]. See Table 5.

Table 4. Ranges of (PET) [15]

PET	Thermal perception	Grade of physiological stress
	Very cold	Extreme cold stress
4°C	Cold	Strong cold stress
8°C	Cool	Moderate cold stress
13°C	Slightly cool	Slight cold stress
18°C	Comfortable	No thermal stress
23°C	Slightly warm	Slight heat stress
29°C	Warm	Moderate heat stress
35°C	Hot	Strong heat stress
41°C	Very hot	Extreme heat stress

Table 5. Different urban thermal comfort [20]

Index	Input	Scale Factor
PET	1. Dry Bulb Temp. 2. MRT 3. Wind speed 4. Relative humidity Can take 1. Metabolic Rate 2. Clothing level	<4 C – Cold Stress >41 C- Heat Stress 18-23 C- Comfort
PMV		Scale Factor
UTCI		<4 C – Cold Stress >41 C- Heat Stress 18-23 C- Comfort
SET		Scale Factor

In Malaysia, the adaptive model of thermal comfort was used in the indoor temperature simulation study to determine the comfort level of the dwelling residents with reference to the criteria of (ASHRAE 55:2013) [36]. This happens by: thermal discomfort recognizing, environmental factors focusing and environmental parameters designing which interventions in urban design [23]. **These studies help researchers and academics to understand more clearly the environment of potential thermal disturbance in different urban apartment blocks and buildings in the city.**

2.3. Urban heat island mitigation stage

In the Mitigation stage, a mitigation tool such as GenOpt is used or conventional algorithms such as Particle Swarm Optimization, Genetic Algorithm or Mat Lab are used by considering appropriate convergence criteria. The convergence criteria may be the iteration time or it may be the specification and size of the building envelope component [15]. The aim of mitigation studies help urban designers to design healthy, usable and comfortable public spaces to human well-being [26, 31, 39 and 40]. The mitigating needs a multidisciplinary subject of landscape, urban planning, architecture, building materials, etc. [24]. Studies of UHI mitigation enhancing the feeling of climatic and thermal comfort in urban and park areas for city dwellers [1, 26, 39 and 40]. Based on the simulation of accurate meteorological parameters, the PET can be adopted with the aim of improving urban thermal comfort [3]. In addition, comparing strategies that mitigate surface radiation and thermal radiant energy, direct sunlight …etc. are important in urban thermal comfort [24]. A model for calculating albedos was developed based on changes in solar locations, 3D urban structures and the effects of multiple reflections and shading which took into account urban composition [41]. The tree width factor (TVF) was used to evaluate the trees shading ability, to promote sustainable urban development in many hot regions [24]. In a Shah Alam simulating study, simulating three different solution of three shades in and identifying their density and maturity involves maintaining the garden's microclimate by reducing the temperature of air (maximum 0.2°C), average radiation temperature (maximum 15.8°C). Thus, maintaining wind flow and increasing relative humidity [1]. Other study in Canadian cities showed that increasing albedo surface could be reduced cooling energy use 20% - 40%, by using the urban canopy model in combination with the ENVI-met to calculate the interaction of the urban environment and buildings. Whiteness enhancement results cause reduce temperature of air of 0.4 - 1.3°C with a reduction 3-25% of cooling energy use in Tokyo [11]. By combining plants with sidewalks and reflective surfaces together, this solution will reduce

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temperature of air of 0.8°C during midnight of the summer hot days [12]. For more mitigation solutions in mega cities see Fig. 10. **This is consistent with the literature that has often demonstrated that increased urban surfaces with low-reflective materials, lack, water bodies, trees and vegetation in urban settings contribute to an increase in the urban heat burden and consequently an increase in UHI formation.**

Figure 6. Urban heat island mitigation solutions [8]

3. Result And Discussion

Urban designers and Architects work with graphic data to make smarter urban design decisions [16]. Numerical parameters, ecological urban design, usually relates to climate patterns in environmental research [26, 39 and 40]. UHI reviewed has been conducted the form of many studies, it resulted that all simulation methods were pass through the follow stages: modeling, Simulation and mitigation. Most of the literature reviewed shows that there are some key criteria that have been adopted as universal urban health coverage in cities, and that the first control component is city design [6]. Discussed according to the context of the research as follows:

AS an Urban heat island modeling

It is the first stage of the simulation method, where the air mass above buildings and buildings are modeled. Numerical simulation has been used as a viable tool in the study of the UHI phenomenon, and need to know urban surface, boundary and urban canopy layer. Its programs include Energy Plus, Python scripts and meteorological limits to measure air pressure, energy use characteristics or information or any output at the level of a modeled area, thus simulating the local climate. Surface Energy Balance (SEB) & BPS (building performance system) metrics are used as graphic guidelines to better support urban, neighborhood and building designs, starting with the conceptualization, design and development stages of the project within a virtual environment.

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AS an Urban heat island Simulation

Amounts of information produce in a single model of simulation. As in performance improvement simulations, and calculations [16]. Grasshopper, Ladybug, Eddy3D, Radiance, Python, ENVI-met. , RayMan, (RANS), Energy Plus, Design Builder, Open Studio, SktechUp, (IVS) and SimScale considered as the most important and usually in use programs, and have a special plug-ins with Google. UHI intensity and improving urban heat, can be simulated in a virtual environment and different climatic backgrounds are proposed with respect to the design [6]. Surface effects (on roofs, sidewalks or vegetation areas) are evaluated by simulation software.

AS an Urban heat island mitigation

The results indicate that the impact of UHI can be reduced through urban interventions, green spaces and high-albedo building materials to influence the mean radiant temperature [22]. The studies related to the improvement of urban warming that were discussed in the research a paragraphs have proven that the process of mitigation depends directly on the following [2]:

1. Surface: The surface material, the ability of a city to reflect radiation [6].
2. Vegetation: Several studies improve the effect of green spaces and vegetation on air temperature reducing.
3. Water: Cooling affects water sprinkler systems and water ponds in urban open spaces. Table 6. showing many cities solutions to UHI mitigation.
4. Mixing more than one solution.

Table 6. Urban heat island mitigation.

Solution no.	Mitigation solutions
Solution 1	Increasing the Albedo of Building Materials
Solution 2	Using Green Roof like Chicago, Dresden
Solution 3	Using Cool Roof
Solution 4	Increasing Wind Speed
Solution 5	Reducing Anthropogenic Heat
Solution 6	Placing Vegetation on Buildings like Toronto ,Montreal
Solution 7	Sponge land like China

4. Conclusions and Recommendations

Urban island simulation methods are among the most important methods that have been adopted in climatic and environmental research. Which aims to improve the city's climate reality and reduce pollution and waste of energy that is spent in cooling operations in the summer. To avoid this, some mitigation mechanisms and strategies are used, and they are pre-tested to obtain the best scenario for improvement within a set of calculator programs. Ladybug and ENVI-met are the best ones. Simulation methods start with initial operations represented by modeling the place or a specific urban area. The programs for measuring surface and urban heat are selected

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within the limits of atmospheric conditions according to ASHRAE 55 (2013) standards for that elected urban area, whether it is external or internal. . The process of modeling and determining the spatial spot is followed by the process of determining the time period chosen to conduct the simulation, which was the hottest day of the year. To do this, many relevant data must be entered, which must be simulated, such as urban spatial design, generated heat islands. Thermal comfort required, meteorological limits to simulate the local urban climate. The operations of virtual visualization, photography, preparation and measurements, in addition to determining the climatic priorities and the degree of thermal comfort required. The second stage begins, which is the simulation process in a virtual environment prepared for that according to the type of simulation program selected. ENVI-met and Grasshopper very suitable for environmental simulation studies and most efficient programs. Climate simulations produce a wealth of numerical accurate data for the reality of the simulated urban climate. Followed by the preparation of optimization scenarios to mitigate the effects of UHI or urban greenhouses. The simulation results most be checked to make site measurements and calibrate between the hypothetical temperatures and the real temperature of the same location to reduce errors and deviations in the simulation results. Then, feedback is made to the simulation, which is not practical in the realistic climatic environment, and it is the most important characteristic of urban island simulation methods. It resorts to optimization scenarios to mitigate the effects of heat islands, leading to smarter, healthier and more environmentally responsive urban designs. It has been clarified that the most important mitigation scenarios that have been adopted and proven to be efficient are the application of surface whiteness to building materials and urban design. Greening and the use of natural plants and trees. Using water spray techniques, ponds, fountains and artificial lakes, to soften the climate. And the misleading use of roofs and screens made of natural materials does not increase the heat burden and reduce the exposure of roofs to solar radiation. The above scenarios have been approved worldwide and combined with each other to obtain the best results and reduce the warming effects; however, it is little used locally, because the research orientation and local studies are few. Therefore, the research recommends moving towards digital simulation methods in order to mitigate the climate and create healthy artificial microclimates in which numerical and virtual urban design has an active role.

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مقدمة لطرق محاكاة جزر الحرارة الحضرية: مقال مراجعة

زينب خالد احمد١ *، تمارة معتز٢، حسن حيدر عبد الرزاق كمونة٣

١قسم هندسة العمارة، كلية الهندسة، جامعة بغداد، بغداد، العراق

٢قسم هندسة العمارة، كلية الهندسة، جامعة المثنى، المثنى، العراق

٣قسم الاعمار والمشاريع، جامعة بغداد، بغداد، العراق

* Corresponding author email: zainab.khalid@coeng.uobaghdad.edu.iq

الخلاصة

أدى التحضر إلى تغييرات كبيرة في خصائص سطح الأرض. صاحب هذه التغيرات زيادة الأحمال الحرارية في المدينة والذي يؤدي الى مخاطر عديدة تؤثرعلى راحة الناس وصحتهم. ولعدم وجود فهم واضح للعلاقة بين مؤشرات المناخ وخصائص التصميم الحضري الافتراضي المبكر. ركز البحث على قدرة المحاكاة والتأثير في المناخ المحلي الحضري. وافترض أن اعتماد بعض السيناريوهات والاستراتيجيات للتخفيف من حدة UHI يؤدي إلى تحسين المناخ المحلي وتقليل تأثير ظاهرة الاحتباس الحراري. الهدف هو إظهار محاكاة طرق UHI والبرامج التي تدعم المحاكاة وتقلل من تأثير جزيرة الحرارة. وقد تم مراجعة العديد من دراسات UHI ، ونتج عن ذلك أن جميع طرق المحاكاة مرت بالمراحل التالية: النمذجة والمحاكاة والتخفيف. وتُظهر معظم المؤلفات التي تمت مراجعتها أن هناك بعض المعايير الرئيسية التي تم تبنيها كتغطية صحية حضرية شاملة في المدن ، وأن عنصر التحكم الأول هو تصميم المدينة.

الكلمات الدالة:– جزيرة الحرارة الحضرية، المحاكاة، المناخ المحلي، المحاكاة الحضرية، برامج المحاكاة.

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