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The effect of developing the elements of landscape architecture in achieving Sustainability and human comfort

L. S. Al-Jezawy *, M.A. Elwazeer * and W. H. Sayed **

* Architecture department Dept., Faculty of Engineering, Mansoura University, Mansoura, Egypt
Architect, Department of Planning and Surveying, Sharjah, UAE

Abstract— over the last decade, fascination with the diagnosis of thermal comfort has increased because of environment changes and increased temperature stress in towns. The outdoor microclimate can be an important issue. There are various factors that determine the grade of outdoor Spots. On the other hand with car commuters, pedestrians are directly exposed to their immediate environment in conditions of variations of sun and shade, Changes in blowing wind quickness, and other characteristics. Thus, people Sensation of thermal comfort is greatly damaged by the local microclimate. So my objective of this search is achieving sustainable in outdoor space with measuring the temperatures, humidity and then measuring thermal human comfort from the biological and psychological aspect. And achieve the thermal human comfort in outdoor by using simulation programs.

Index Terms— Elements of architecture land scape sustainability Human comfort THE thermal human comfort in outdoor Sustainable landscaping ENVI-met simulation program PMV (Predicted Mean Vote).

1 INTRODUCTION LITERATURE REVIEW

The external environment has a significant effect on the way people live, which is determined by natural conditions, anthropogenic factors, the density of urban constructions, and the size of vegetation areas. [1]. The increasing number of buildings in a city, reduction of vegetation areas and the use of microclimate warm building and ground surface materials affect the conditions of in urban spaces, which can influence the use of outdoor space [2].

Pedestrian satisfaction level with the thermal environment is one of the important subjective indications that determine the amount of time to spend in outdoor public spaces. However, it is difficult to judge one's satisfaction level with the thermal environment as it can vary from a person to another.

Elements of landscape is one of important indicators that have direct affections of Pedestrian satisfaction level with the thermal environment, Landscape design is the holistic process of shaping the natural and built environment to create desirable places for folks to live, play and work and conditions for vegetation. [3]

It is important to us understand the concept of thermal comfort for the outdoor space design and the relationship between the effects of the environmental parameters, the objectives of urban physical configuration, social behavioral factors, as well as approaches of human thermal physiological and psychological factors [4]

-There are six key factors to human thermal comfort that should be considered for the design with microclimate, which are the environmental factors (air temperature, relative humidity, air movement, mean radiant temperature) and personal factors (clothing insulation ratio and activity or metabolic heat rate)

- Computer simulation tools are just about the most important tools available in our world. So as to construct a product and predict an outcome based on what has happened in the past or on current trends is essential to success in various fields. [5]

- ENVI-met is the main computational models that seek to replicate the major techniques in the atmosphere that influ-

ence the microclimate over a well-founded physical basis. [6]

2. THE ELEMENTS OF ARCHITECTURE LAND-SCAPE.

2.1. Land scape Definitions.

There are many variants of the definition depending on the research context.

We can defined land scape is the result of the action and interaction of natural and human factors. [7]

2.2. Landscape architecture definition.

Landscape architecture is the design of outdoor public areas, landmarks, and structures to achieve environmental, social-behavioral, or aesthetic outcomes.

The scope of the profession includes landscape design; site planning; storm water management; environmental restoration; parks and recreation planning; visual resource management ; green infrastructure planning and provision; and private estate and residence landscape master planning and design; all at varying scales of design, planning and management. [8]

2.3. Benefits of landscaping.

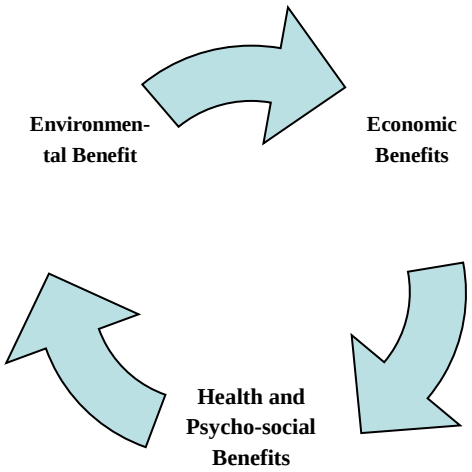


Fig. 2.1 Benefits of landscaping.

2.3.1. Environmental Benefit.

•Trees, shrubs, turf, and ground covers are filter dust particles and other pollutants out of rainwater.

•In urban microclimates crops are useful in moderating the temperatures ramifications of infrared and solar radiation, increasing comfort levels.

• Plants help to remove organic volatile compounds from indoor air such as carbon monoxide and formaldehyde can be removed from indoor environments by plant leaves alone.

•Trees absorb the carbon dioxide that contributes to global warming, as well as other gases that contribute to urban pollution .

2.3.2. Economic Benefits.

•Landscaping can add around 14% to the resale value of any building and speed its sale.

•By evaluated, all the architectural and urban design variables, landscape amenities had the highest relationship with the occupancy of local rental properties

•Proper arrangement of landscape plant life around structures can considerably reduce both warmth loss and cold air infiltration through wall surfaces and floors during the winter months .

•A tree shading a patio air conditioner unit can increase its efficiency by as much as 10.%

2.3.3 Health and Psycho-social Benefits.

•green views and access to green spots in cities help regain attention and relieve the everyday pressures of living in poverty. Green places also contribute to a wholesome environment and foster a sense of community, making them valuable in inner-city neighborhoods particularly." [9]

2.4. Elements of architecture land scape. Definitions.

The elements of composition are the visual qualities that people see and respond to when viewing a space. Visual qualities can illicit many different emotions and feelings, and the more positive those feelings, the more likely people are to enjoy,

take pleasure and use a space. [10]

we have many elements of architecture land scape:-

1- Lighting.
2- Stone.
3- Wood.
4- Plants.
5- Water.
6- Landform.
7- Bricks.
8- Metals
9- Plastic.
10- Glass.

2.5. Landscape Design.

Landscape design like painting, sculpture, and architecture, is a kind of skill. "Design" "the planned design of elements to create a visual style"

Elements in design are form, line, texture, and color. In landscape design, additional elements of sound such as (chimes, or the sound of water in rivers, the ocean, or waterfalls) and fragrance can also be included. Design elements are arranged according to design principles. These principles include order and unity, scale and proportion, balance and harmony, and rhythm and repetition. [11]

2.6. Landscape process

The Design Process have five steps of process that include: 1) executing a site inventory and analysis, 2) determining our needs, 3) creating the functional diagrams, 4) developing the conceptual of design plans, and 5) drawing a final design plan. [12]

3. SUSTAINABLE LANDSCAPING.

A sustainable landscape is defined as a well-balanced and productive ecosystem that conserves the physical and biological techniques occurring on that landscape. [13]

3.2. Sustainable landscaping benefits.

Fig. 3.1 Sustainable landscaping benefits.

Environmental benefits:

- enhance ecosystems and protect biodiversity.
- improve air and drinking water quality
- reduce the waste products streams
- conserve and restore natural resources

Economic benefits:

- reduce operating costs.
- create, expand, and form markets for green services and product.
- improve occupant productivity.
- optimize life-cycle monetary performance.

Social benefits:

- enhance occupant comfort and health.
- heighten visual qualities.
- minimize stress on local infrastructure.
- improve the overall standard of living. [14]

3.3. Principles of sustainable landscape.

The main goals of sustainable landscape design are to conserve water and energy, reduce waste and decrease runoff.

Principle 1 - Treat Water as a Resource

A sustainable landscaping procedure is always to treat drinking water as a valuable resource. With proper design and herb selection, the need for irrigation can be eliminated or reduced.

Furthermore, rainwater harvesting can be to capture storm water on site and make use of it for irrigation.

Principle 2 - Value Your Soil

Compacted land brings about problems such as constrained plant growth, erosion, runoff, and flooding. Runoff induced by compacted soils is one of the main sources of normal water pollution.

Principle3 - Keep Existing Plants

Many homeowners want to remove all the crops from their property in order to start with a clean slate. Often this eventually ends up doing harm since it disrupts the natural functions happening in the garden.

A sustainable landscaping way is always to assess the prevailing plant materials and preserve indigenous plants. Invasive, non-native crops should be changed and removed with a far more appropriate choice.

Principle 4 - Save Material Resources.

The normal site panorama produces high levels of the structure and backyard waste products. Additionally, lots of the hardscape materials used are energy-intensive and transported hundreds or even a large number of miles.

A sustainable landscaping approach would be to reduce yard misuse by reusing and recycling development waste. [15]

4. HUMAN COMFORT.

Definition of thermal comfort.

Comfort has been defined as 'the condition of mind which expresses satisfaction with the... environment'. [16]

Thermal comfort factors in urban space.

The thermal comfort in an urban space depends on environmental factors such as air temperatures, Mean Radiant temperatures, Air velocity, relative humidity, solar occurrence and radiation exchanges, and Local characteristics of winds. Personal factors such as person's clothing CLO, activity level MET Also, effect the thermal comfort of the users. [17]

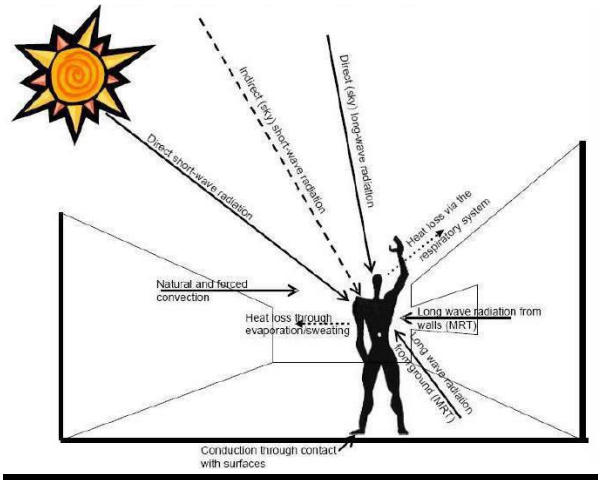


Fig. 4.1 outdoor human energy balance.

4.2. The basic factors of Human Comfort in outdoor spaces:-

The six factors affecting thermal comfort are both environmental and personal. These factors may be independent of one another. [18]

Environmental factors.

- Air temperature
- Radiant temperature
- Air velocity
- Humidity

Personal factors.

- Clothing Insulation
- Metabolic heat

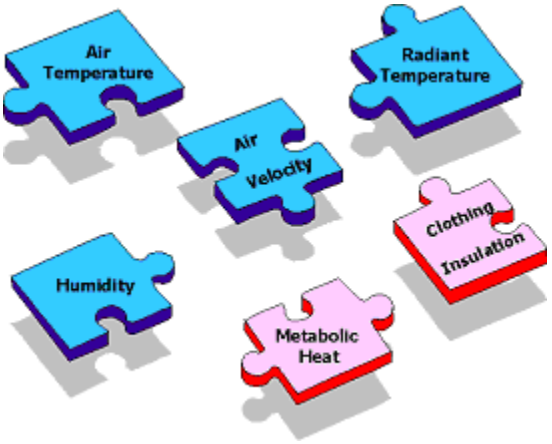


Fig. 4.2 the basic factors of Human Comfort in outdoor spaces.

5. ENVI-MET SIMULATION PROGRAM.

5.1. Definition of ENVI-met.

ENVI-met is a three-dimensional microclimate model designed to simulate the surface-plant-air interactions in urban environment with a typical resolution down to 0.5 m in space and 1- 5 sec in time. [19]

5.2. Expected PMV (Predicted Mean Vote).

Based on the following formula, the Envi-met thermometer is calculated by measuring the average expected rate (temperature, air speed, and radiation temperature, relative humidity, insulation, activities heat and humidity exchange with the human body)

-The Envi-met simulation calculates the external thermal comfort scale using the following formula:

$$PMV = [0,303(-0,036M) + 0,028 + 0.028]L.$$

Where:-

PMV: Average expected rate scale.

M: Heat generated by metabolism (W / m 2).

L: convection on the body.

The PMV is an indicator where the value of zero is the value of the thermal comfort and when the deviation there will be a thermal stress variable as Figure (5) shows the relationship between the values of thermal comfort scale. [20]

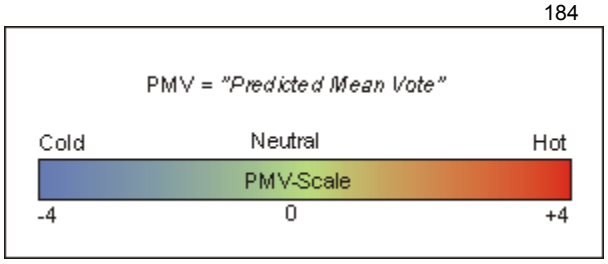


Fig. 5.1 Average expected rate scale.

6. CASE STUDY.

In this part we will evaluate the performance of Outdoor Thermal Comfort for faculty of engineering in Assuit University by using computer simulation with Envi-met tool. **The selected case study are:** faculty of engineering in Assuit University (Egypt).

6.1. Location of assuit city.

Assuit city is located at 27°11′00″N 31°10′00″E, Assuit climate as hot it is the driest city of Egyptdesert. Asyut have the widest difference of temperatures between days and nights of any city in Egypt, with almost 16 °C (29 °F) difference. During summer the temperature can exceed 42 °C (108 °F). Yet, in winter Asyut gets below 0 °C (32 °F) temperatures during the night and frost can easily form. [21]

6.2. Research Methodology.

1- Create the form of case study site and drawing perspective layout.

2- Add database for the model such as (location, Building sign (dimensions and height of buildings, Form description, beginning of simulations (day / month / year), number of simulation hours, building materials in facades and roof...).

3- Calculate the temperature of the external air and the relative humidity and the speed of the air and its direction around and between buildings for the existing case study.

4 - Calculation of average radiation temperature MRT and

thermal comfort zone PMV for current site.

5- Start to treatment the site by change the elements of land scape materials and materials of building in facades and roof to achieve the best efficiency and thermal human comfort.

Faculty of engineering in Assuit University.

Fig. 6.1 student square area in faculty of engineering.

Fig. 6.2 location of assuit university.

Fig. 6.3 faculty of engineering zone in assuit university.

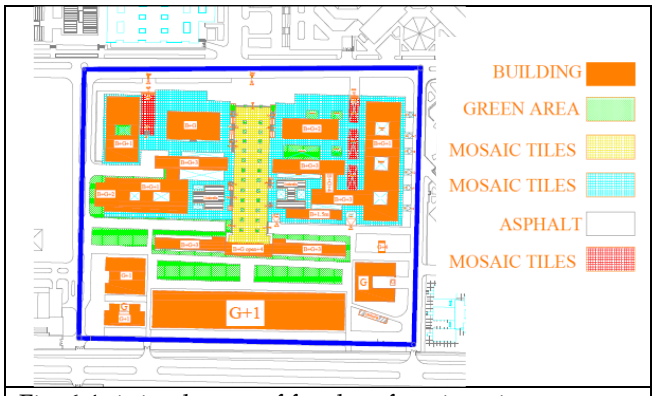
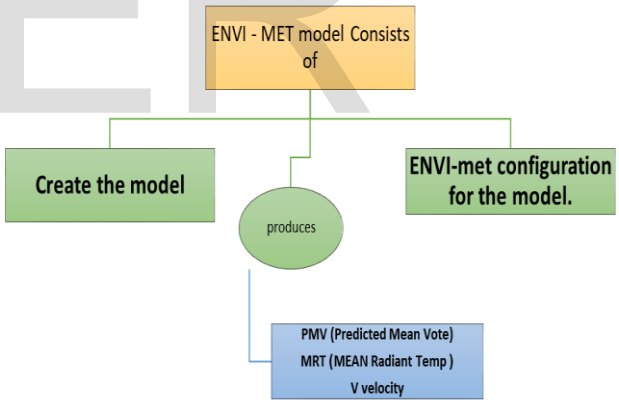


Fig. 6.4 sitting layout of faculty of engineering.

6.3. Input data of ENVI- MET program.

(The simulations has been done for (external area of the Faculty of Engineering, Assiut University) for twelve hours from 6 am until 6 pm, due to the presence of the effect of solar radiation in contrast to the night that are stable or fixed and was chosen on 21/6/2017 .The squares are divided into several spaces and Select a point in the middle of each vacuum to calculate the PMV, MRT, and air velocity.



6.3.1. Create the model for case study.

The screen of **ENVI- MET** program contains that:-

1. Determination of directions

2. Identification of the climatic region in which the project is located (longitude - latitude)

3 - Determine the scale of drawing (1: 2)

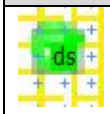
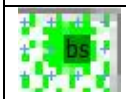
4 - Determine the dimensions of drawing in directions (x, y, Z)

a) Edit building and vegetation.

- The model is drawn on a scale (1: 2) and the heights shown

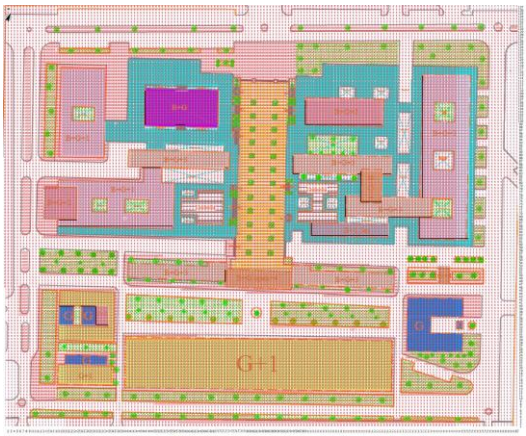
on the drawing are (1, 5, 5, 7, 9, 11, 13 AD) and in fact (3, 10, 14, 18, 22, 26 AD).

A) Trees and plant.

Color	Symbols	Classifation
	ds	Tree 10m dense ,distinct crown layers
	Bs	Tree 20m dense ,distinct crown layers

b) Edit soil and floors.

Color	Symbols	Classifation
	0	Default use soil
	kk	Brick road (red stone)
	s	Asphalt road



c) Set up points in the middle of the space.

We put the Optional points in the model (in the middle of space) at a height of 1.6 m (average normal human length) that act as receptors for recording climatic data resulting from simulations.

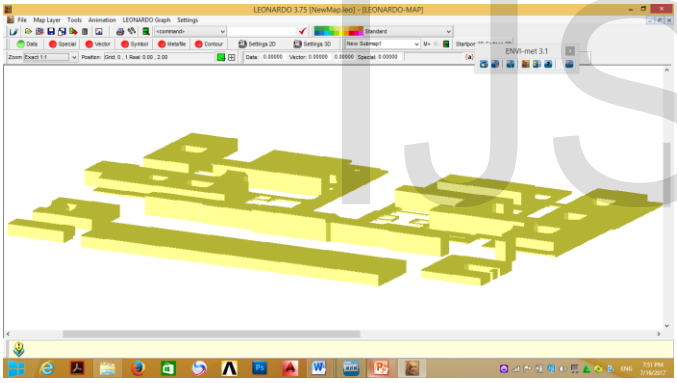
6.3.2. ENVI-met configuration editor for the model.

Input data	Value
Name for Simulation	Asyut 10-7-2017
Start Simulation at Day (DD.MM.YYYY)	21.06.2017
Start Simulation at Time (HH:MM:SS)	06:00:00
Total Simulation Time in Hours	1.00 hour
Save Model State each [min]	60 min
Wind Speed in 10 m ab. Ground [m/s]	3.6m/s
Wind Direction (0:N..90:E..180:S..270:W..)	20
Roughness Length z0 at Reference Point	0.1
Initial Temperature Atmosphere [K]	293[K]
Specific Humidity in 2500 m [g Water/kg air]	7 g Water/kg air
Relative Humidity in 2m [%]	44%

6.3.3. ENVI-met configuration editor Building properties.

Input data for Building	Value
Inside Temperature [K]	293 K
Heat Transmission Walls [W/m²K]	2.4 W/m²K
Heat Transmission Roofs [W/m²K]	1.8 W/m²K
Albedo Walls	0.5
Albedo Roofs	0.5
Input data for human	**Value**
Walking Speed (m/s)	0.3 m/s
Energy-Exchange (Col. 2 M/A)	116 Col. 2 M/A
Mech. Factor =	0.0
Heat transfer resistance cloths	0.5

6.3.4 .3D model drawing.



6.4. Output data of ENVI- MET program.

The index of thermal comfort (PMV) start to comes out of the limits of thermal comfort from 11 am to 4 pm, and reached

The value of the index of thermal comfort at 1 pm up to 1.64 this means that the rate of feeling of thermal comfort in the vacuum has decreased, especially at midday at 1:00 pm

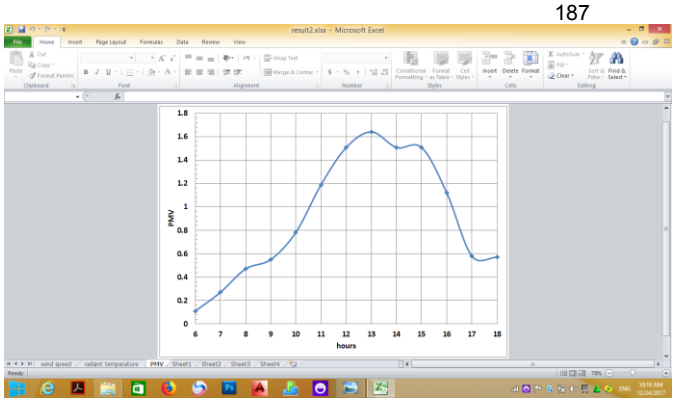


Fig. 6.5 shows the values of the thermal comfort index (PMV) for daylight hours from 6 am to 6 pm.

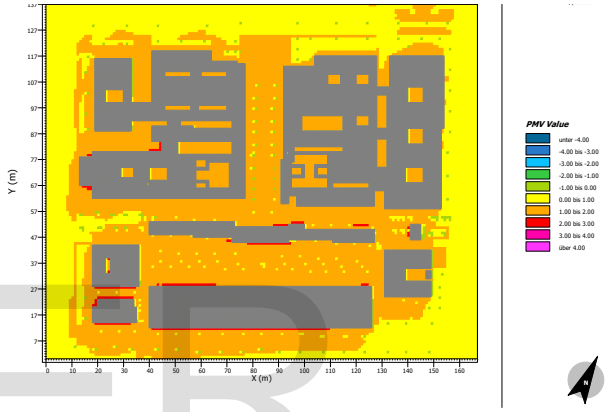


Fig. 6.6 A map of the values of thermal comfort (PMV) at 11 am on21 June for outdoor spaces of the Faculty of Engineering, Assiut University.

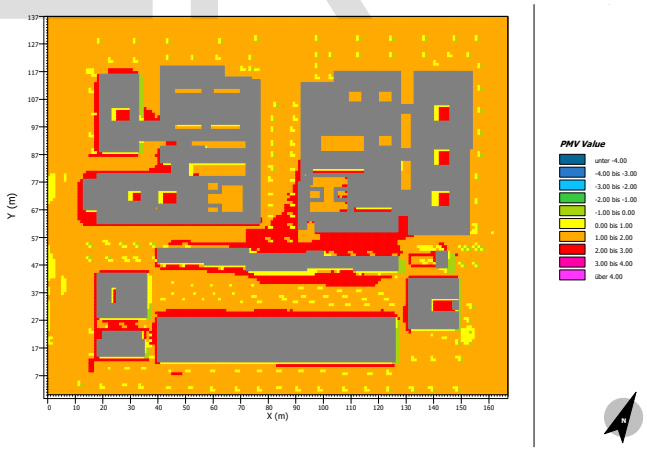


Fig. 6.7 Amap of the values of thermal comfort (PMV) at 12 am on 21 June for outdoor spaces of the Faculty of Engineering, Assiut University.

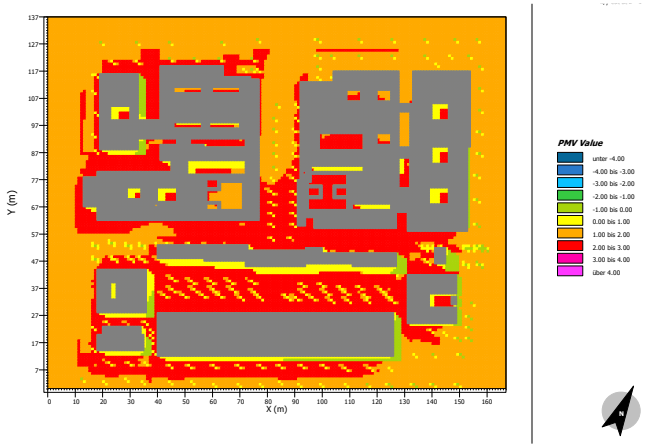


Fig. 6.8 A map of the values of thermal comfort (PMV) at 13 pm on 21 June for outdoor spaces of the Faculty of Engineering, Assiut University.

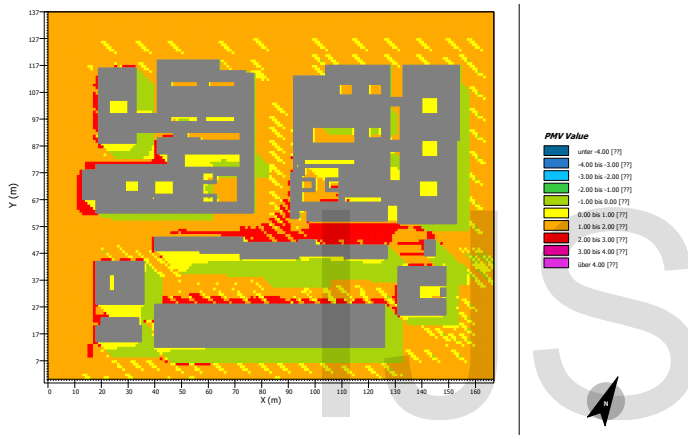


Fig. 6.9 A map of the values of thermal comfort (PMV) at 15 pm on21 June for outdoor spaces of the Faculty of Engineering, Assiut University.

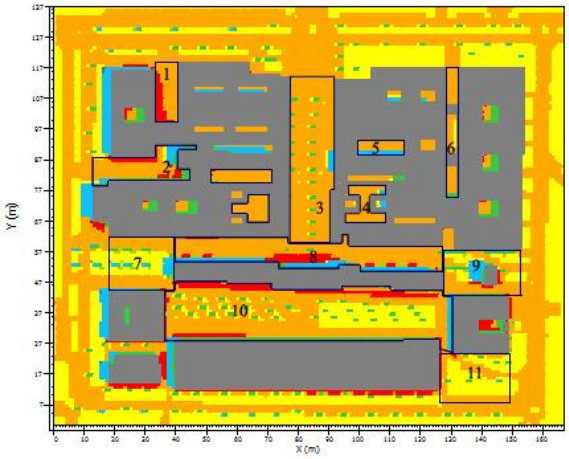


Fig. 6.10 Amap of the values of thermal comfort (PMV) for all selected points in the middle of the space.

6.4.1. The simulation result.

Through simulation results to find the thermal comfort index and compare the results of PMV to all selected space point.

1- We find a high thermal comfort index for the spaces from (10 am to 3 pm).

2- we find that values of PMV for space (1, 2, 3, 4, 6, 7, 8, 10 and 11) are Convergel from) 10 am to 3 pm) Where the average values of thermal comfort for the previous spaces range from) 1.04: 1.8).

3- We find that the values of PMV for space (9)is the higher Up to 2.38 from (1pm to 3 pm) space and the lowest PMV value is 0.56 from (2pm to 3 pm) at (5) space.

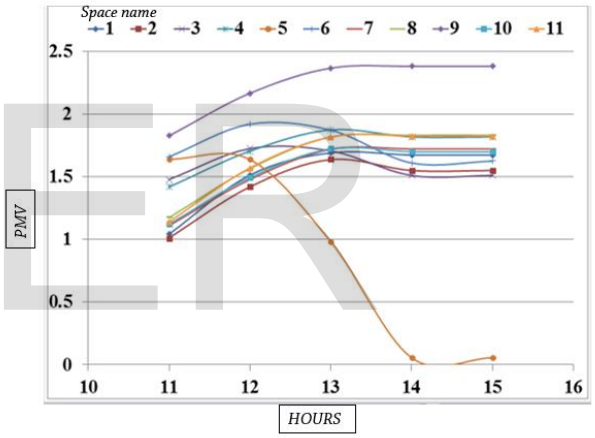


Fig. 6.11 shows the values of the thermal comfort index (PMV) in selected middle point in space from (10 am to 3 pm).

7 CONCLUSIONS

1-By assessing the thermal comfort of the outdoor space in the Faculty of Engineering, Assuit University, we find that the site needs to develop the element of landscape by increase the green spaces in the outer space to reduce the temperature in the daytime.

2-The use of climbing plants and pesticides in the bitter gusts and sitting students places. To increase the shading and relaxation of thermal loads which increases the visual and physiological comfort of users.

3-The use of water elements in the main entrance of the College of Engineering entrance (water pools and fountains).

4-The use of flooring and walkways is preferred for materials with high absorption capacity for solar radiation to provide thermal comfort.

5-Elements of landscapes playing an important role in achieving thermal comfort and lowering temperatures in the daytime in addition to achieving physiological comfort.

6-The development of an aesthetically pleasing landscape is prerequisite to a sustainable environment and it is pivotal to productive human employment, recreation, social and economic integration.

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