International Journal of Research in Civil Engineering, Architecture and Design (IJRCEAD)
Volume 9, Issue 1, January-June 2025, pp. 1-19. Article ID: IJRCEAD_09_01_001
Available online at https://iaeme.com/Home/issue/IJRCEAD?Volume=9&Issue=1
ISSN Print: 2347-8284, ISSN Online: 2347-2855
Impact Factor (2025): 13.89 (Based on Google Scholar Citation)
DOI: https://doi.org/10.34218/IJRCEAD_09_01_001

DEFINING BUILDING PERFORMANCE EFFICIENCY IN COASTAL REGIONS (THE NILE DELTA CASE STUDY)

Tamer Elgohary

Associate Professor, Department of Construction and technology Engineering,

Obour higher institute for Engineering and technology, Cairo, Egypt.

Nisreen Abdeen

Associate Professor, Central Asian University (CAU), Tashkent, Uzbekistan

ABSTRACT

The building bricks are responsible for building performance efficiency, especially in coastal regions such as the Nile delta region. In this region the weather, as a result of climate change, may have a negative effect on internal building thermal comfort and on its energy consumption. So, for this reason, we used a soft computing technique such as Design Builder in order to define the building performance efficiency of two public buildings located in the Egyptian delta as a case study. In this study we used three brick types, including red, cement, and sand bricks for each building model. For each brick type, we investigated its effect on indoor temperature, energy consumption, carbon dioxide emission, and relative humidity. By the end of this research, we found out that the sand brick is the best among the three types because it consumes less energy and creates optimum thermal comfort. Also, sand brick is an affordable construction material due to the fact that its raw material is available naturally in the surrounding *environment. On the opposite, we concluded that the cement brick is the worst type compared to the other two types and causes low efficiency for all building performance parameters.*

Keywords: Coastal region, Bricks, Building performance, The Nile delta, Carbon Dioxide emissions, Indoor temperature

Cite this Article: Tamer Elgohary, Nisreen Abdeen. Defining Building Performance Efficiency in Coastal Regions (The Nile Delta Case Study). *International Journal of Research in Civil Engineering, Architecture and Design (IJRCEAD)*, 9(1), 2025, pp. 1-19.
https://iaeme.com/Home/issue/IJRCEAD?Volume=9&Issue=1

1. INTRODUCTION

1.1 Climate change

Climate change has become a serious issue in recent years due to the extreme events that already took place all over the world due to greenhouse gas emissions, especially carbon dioxide (CO2). These extreme events turned out to be disasters in some cases, which emphasised the importance of adapting to the negative impact of climate change. The intergovernmental panel on climate change (IPCC) [1] released a report that suggested a group of climate change scenarios for each part of the world, including Egypt. The expected climate change scenarios describe the potential damage, especially for the Egyptian coastal zone and delta region. Also, many problems related to climate change will negatively affect the coastal zone, such as sea level rise, sea water intrusion, environmental pollution, land stress, economic depression, ecosystem degradation, population displacement, and the decrease in agricultural production [2].

The Nile Delta coast is 240 km from Alexandria to Port Saied, as shown in Fig. 1. [3]. This region is highly populous, with almost 1600 people per square kilometer. Also, this coast contributes a large section of the Egyptian economy. [4]. In the delta the Nile river distributes into two man branches Rosetta on the west and Damietta on the east. Also it contains most of the fertile farms that provide almost of 40% of the agriculture production in Egypt. It contributes 60% of fish catch [3]. Half of Egypt’s industrial production comes from the delta and the delta contains many of the important cities in Egypt such as Alexandria, Damietta and Ras El bar.

It has been suffering from increased severity and frequency of sand storms, dense haze and flooding.

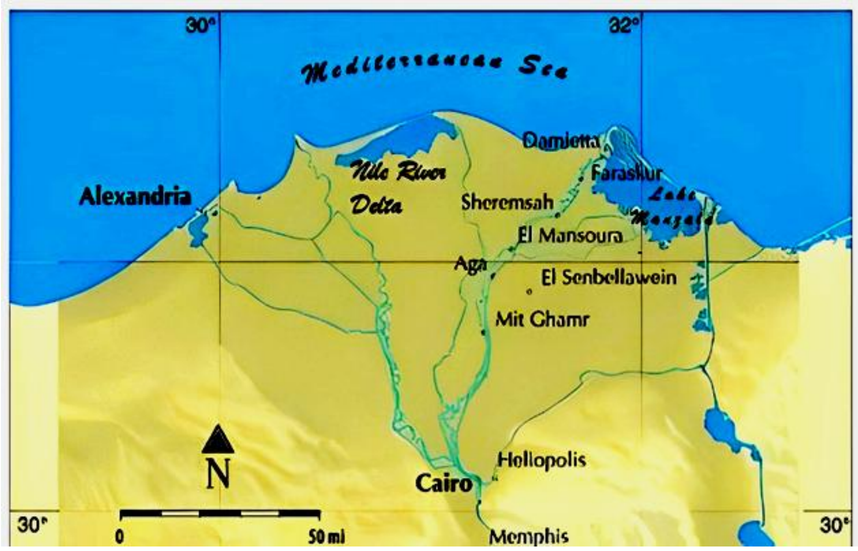

Fig 1 The Nile Delta coast [3]

These extreme events have had negative socio-economic impacts on almost all sectors. The delta contains many lakes such as lake Burullus, Lake Idku and lake Mariout also it contains many of the Egyptian irrigation network conduits such as El Esmalia and El Mahmoudia canals. The relative humidity can be measured or obtained from any nearby observatory. However, its average value in the Nile Delta central zone ranges from 58.4 to 63.36% [5] averaged over 10 years as shown in Table 1 and figure 2.

Table 1. Relative humidity and average air temperature [5].

Year 1995-2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RH%	61.51	62.24	61.84	58.40	60.26	61.79	59.60	61.48	61.72	63.95	63.36	60.46
T, °C	14.58	14.24	15.49	18.02	20.82	23.99	26.54	26.92	25.62	22.86	19.69	16.38

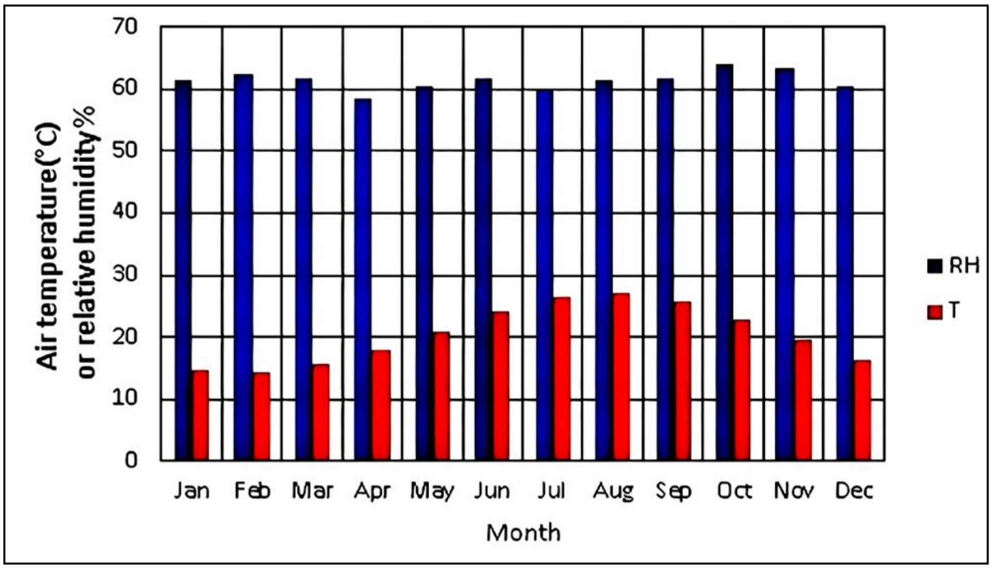

Fig. 2. The air temperature & relative humidity for Delta region [5]

1.2 Building Performance

Measuring the indoor air temperature and its difference with the outdoor temperature, wind speed, solar radiation, and relative humidity. (Belcher et al.) to achieve energy balance and study the impact of different building materials on the building envelope performance as it relates to the number of occupants and the type of building. The most accurate predictions for energy balance data are based on the validation of international agencies like ASHARE 140-2007, BESTEST, and CEN 15265, which show the prediction of thermal performance in buildings[6], [7]. The indoor air temperature in residential buildings shouldn't be more than 26 °C in summer, according to the Swedish national board of health[8], [9].The study focused on measuring building envelope performance using different building materials annually[10], to show the consumed energy in various climates, show the energy flow for buildings, the supplied energy needed, heat supply, ventilation heat loss, and estimate its building behavior for recent climate change by using design-builder simulation.

The increase in greenhouse gases (GHGs) in the environment causes great destabilization in the climate system. The research reported the temperature of different building materials in recent years and their average temperature to reduce the expected greenhouse gas emissions [11]. So, we have to know the current increase in global warming to take appropriate actions for energy use to avoid any further increase in $CO2$ emissions and mitigate climate change. Adaptation of buildings and climate change Mitigation aspects include decreasing climate change dissatisfaction, avoiding crises in the built environment, and ensuring the resilient performance of future cities. To reduce the overheating risk, passive and active measures can be applied to ensure a comfortable indoor climate. The effect of future climate change varies according to different buildings and their locations.

2. CASE OF STUDY:

2.1 Green house gases emissions

In order to overcome the negative effect of climate change scenarios in delta region[12], [13] we have to decrease or mitigate greenhouse gases emissions in buildings sector in ports and residential area in the delta region. This will be done in order to eliminate its effect on labors and resident's health by using a correct type of brick in building walls which produce the minimum CO2 emission. This will enable us to decrease climate change effect on the surrounding environment and internal atmosphere of buildings. Egypt produce almost 22.5 MT of CO2 emission from buildings sector which contribute almost 8% of its total annual CO2 emission as shown in figure 4 [14].

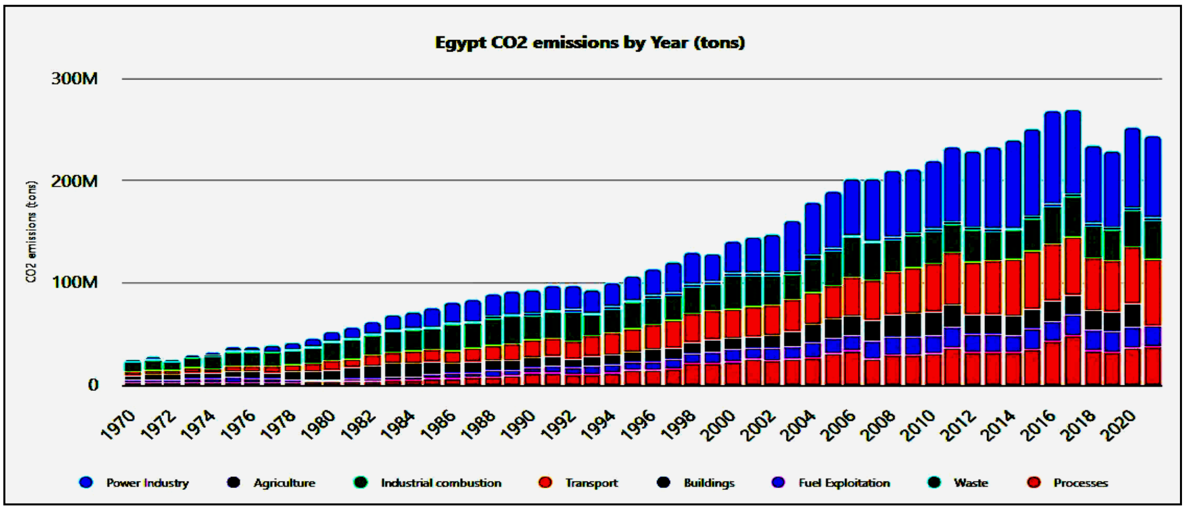

Fig3. Egypt CO2 emissions by year (Ton) [14]

2.2 Buildings materials

The study suggests implementing new strategies for building materials to be more effective and reduce the energy demands due to climate change; it will also have an effect on indoor thermal comfort performance to improve adaptation strategies and overheating control.

The three main types of brick types (building materials) that were used in this study are cement brick, red brick, and sand brick. Cement brick is made from cast concrete (e.g., Portland cement and aggregate, usually sand and fine gravel, for high-density blocks). Lower-density blocks may use industrial wastes, such as fly ash or bottom ash, as aggregate. Red brick is a type of brick that is used in bearing and non-bearing walls and can be used both internally and externally. The materials that are used in its manufacture are clay or silt, sand, and a little straw. The clay used is aqueous alumina silicate and contains impurities such as iron oxide, calcium oxide, magnesium oxide, alkali, and some organic materials. The two common types of red bricks are raw bricks and ordinary red bricks. Sand-lime brick is a product that uses lime instead of cement. It is usually a white brick made of lime and selected sands, cast in moulds, and cured[15]. The different values for U and R for the three types of bricks are shown in figure 4 [16]. It shows that U and R values for sand brick are higher than clay and cement bricks, the while U and R values for cement brick are the lowest among the three types of the bricks.

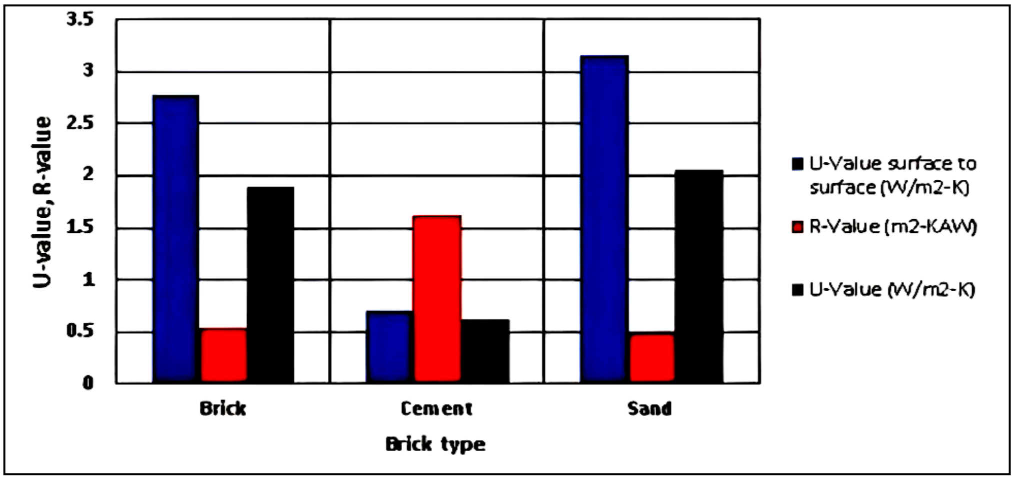

Fig 4. The U value & the R value for brick types [16]

2.3 Buildings description:

In order to investigate the possible effect of using different brick types on the building performance of residential and port buildings, we have chosen two buildings in two different places. These two places are located in two different spots in Cairo, which is located at the south of the Egyptian delta region. The first place is a building inside a river port, and the second place is a public building. The reason for choosing a building inside a port as a case study is the fact that different studies have estimated CO2 emissions from shipping activities inside any port to be around 2-3% of the total global emissions[17].

The first place is the guard house, which is located inside Tanash port. The river port of Tanash is located in Imbaba (20 km north of Cairo), and work began at the end of 2009. The capacity of the port of Tanash, in the case of full exploitation, reaches 2 million tons of grain, goods, and other bulk materials, in addition to 110,000 standard containers annually. The port covers an area of 27,500 square meters and supports its strategic location, 1.5 km from the Ring Road. The building consists of one floor, and its area is almost 9 m2, as shown in the following figure 6[18].

The second place is a public building (lecture hall) in the future university, the future university is located in fifth avenue of new Cairo as shown in figure, New Cairo is a new Egyptian city of the third generation, located in Cairo Governorate, and it is one of the largest new cities in Egypt, with an estimated area of about 85 thousand acres, consisting of several residential compounds, the largest of which is the Fifth Settlement. The city is located in the eastern arc of Cairo, east of the Ring Road, in the space confined between the Cairo-Suez Desert Road and the Cairo-Ain Sokhna road. The climate of New Cairo is desert, and due to its altitude, New Cairo enjoys a gentler atmosphere than Cairo, and it is approximately five degrees Celsius lower than it. The building consists of three floors and of area of m2 as shown in figure 7[19].

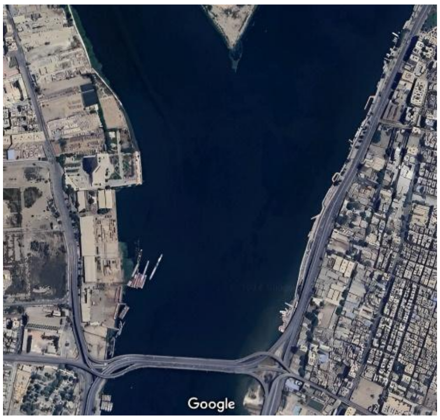

Fig 5. Site 1 map[18]

Fig 6. Site 2 map[19]

There are several programs for optimizing energy consumption in buildings, such as Design Builder software. The sustainability of building performance can be investigated by using design builder (energy plus simulation) as an advanced interface for building performance simulation based upon the industry standards. This will be acheived by showing the advanced thermal simulation per hourly timestep. The program facilitates the measuring of carbon emissions and thermal comfort,. Also it provides good terms annually, monthly, daily, hourly, and per hour intervals. On other hand the software accesses thermal mass, temperature distribution, and passive performance, as well as overheating performance. It facilitates assessing building life cycle costs, whether for cooling or heating systems. There are competing simulations as a black box approach that use using EMS routine scripting. A design builder can measure heating and cooling systems to check for design alternatives. Also, It calculates energy saved using photoelectric sensors for the lighting control system as well as measuring shading by the Louvre system. The program can investigate the effectiveness of the variation in design analysis using parametric parameters.

3. METHODOLOGY

For each of the two buildings, we created a model as shown in figures 8, 9. For each model, we used three types of bricks in their exterior and interior walls: red brick, cement brick, and sand brick. We investigated the effect of the three brick types for both models on building performance parameters. The parameters included CO_2 emission, fuel consumption, internal air temperature, operative temperature, relative humidity, and energy consumption. In order to analyze the effect of the three brick types on these parameters, we used soft computing software (Design Builder)[20]. We made this analysis for the two models in order to define the best type of brick for building performance. This means it will produce minimum CO_2 emissions and cause minimum energy consumption, as well as provide optimum thermal comfort inside the buildings. All the analysis for all the parameters for the three brick types will be achieved under the effect of recent increased air temperature. This increased air temperature resulted from climate change phenomena.

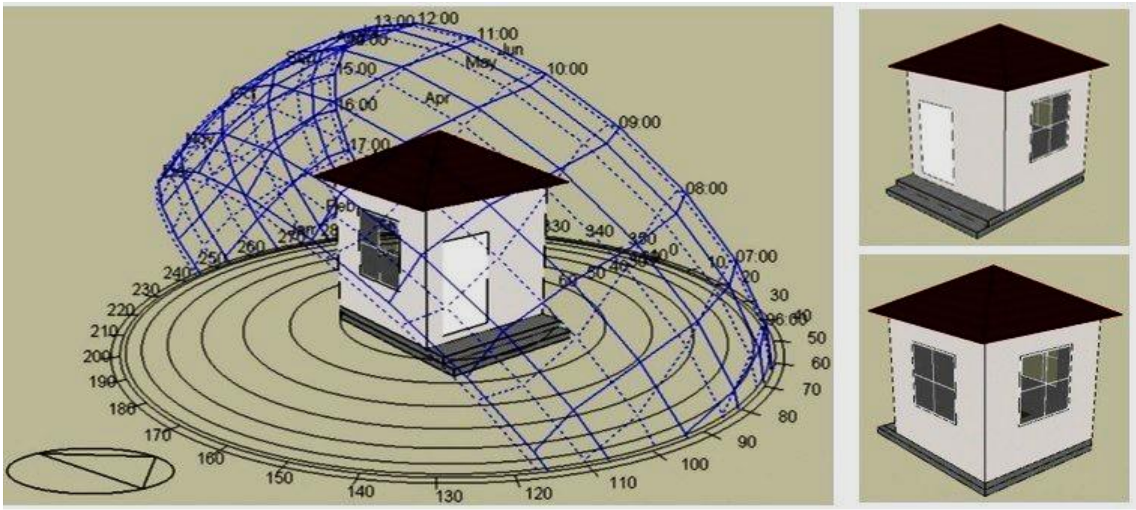

Fig 7. Model 1 for the guard house inside Tanash port

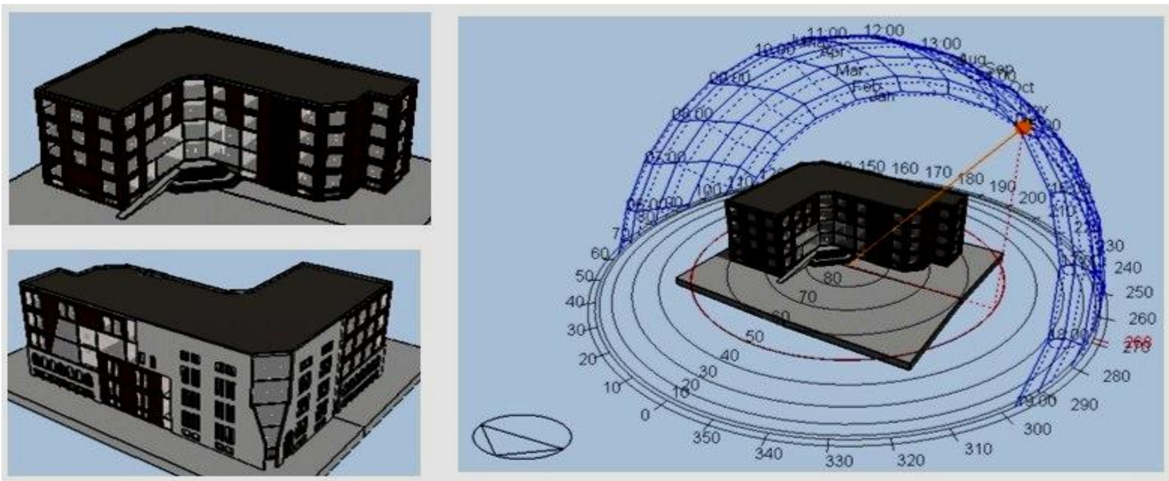

Fig 8. Model 2 for the Lecture hall building inside FUE campus

4. RESULTS ANALYSIS

The results for each case can be seen from figure 9 to figure 20. The results include CO2 emission, thermal comfort, air temperature, fuel consumption, operative air temperature, and relative humidity. The results for Model (1) can be seen from Figure 9 to Figure 14. It can be seen from figure 9, which represents CO2 emission for model 1, that its maximum values are in July and August as a result of using an air conditioner; the August values are 153.34, 148.28, and 154.31 kg per month for red brick, cement brick, and sand brick, respectively. The CO2 emission minimum values can be noticed in January; these January values are 50.41, 59.22, and

50.8 kg for the same mentioned brick cases. This is due to the fact that in this month the fuel consumption is at its minimum. The fuel consumption values for January are 110.75, 114.93, and 124.46 KWH for red brick, cement brick, and sand brick, respectively. The total CO2 emissions of building all over the year are greater for cement brick than the other two cases; its annual emission value is 1210.8 kg per year, while the emission values for both red brick and sand brick are 1148.7 and 1124.75 kg per year, respectively. Figures 10, 11, 13, and 14 represent comfort, air temperature, relative humidity, and operative temperature, respectively. Human-level comfort can be reached in any internal space if the air temperature ranges from 22 to 27 °C and the relative humidity is between 40 and 60%. In August, the air temperature will reach 28.74 °C, and the internal space relative humidity will be 48.95 % for the red brick type. While for cement brick type air, the temperature will reach 28.95 °C and the relative humidity will be 48.82 % in the same month.

Also in August, the air temperature will reach 28.82 °C and the relative humidity will be 48.75 % for the sand brick type. All the previously mentioned data will cause an operative temperature of 30.17, 30.32, and 30.27 °C for the cases of red brick, cement brick, and sand brick, respectively. All three brick types will cause discomfort for the resident in the summer (from July to August). In order to provide thermal comfort for the occupants, we have to use an air conditioner, which will increase the fuel consumption for the same period. The fuel consumption in August will reach maximum values compared to the whole year, as shown in figure 13. The operative temperature reaches its minimum values in January, the operative temperature values are 20.78, 22.11, and 20.13 °C for red brick, cement brick, and sand brick, respectively. The residents will feel a bit cold due to these low temperature values; in order to avoid this feeling of discomfort, we have to use central heating inside the building. Fuel consumption will be minimal compared to summertime consumption. The fuel consumption for the whole year will be significantly higher in the case of using cement brick than in the other two cases. Its value for cement brick will be 2034.37 KWH, while its values for both red and sand brick will reach 1953.3 and 1948.8. According to all the facts that were mentioned before, sand brick is considered to be the best choice for building rather than the other two cases.

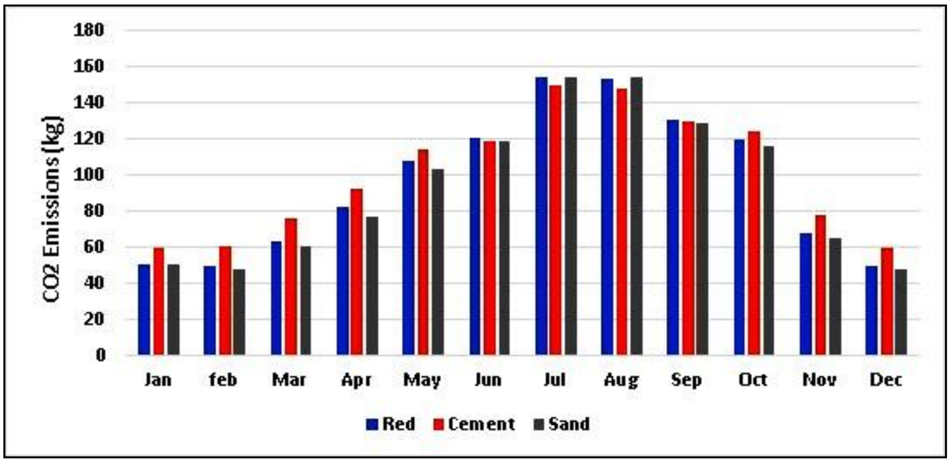

Fig 9. The CO2 emissions per year in (Kg) for model 1

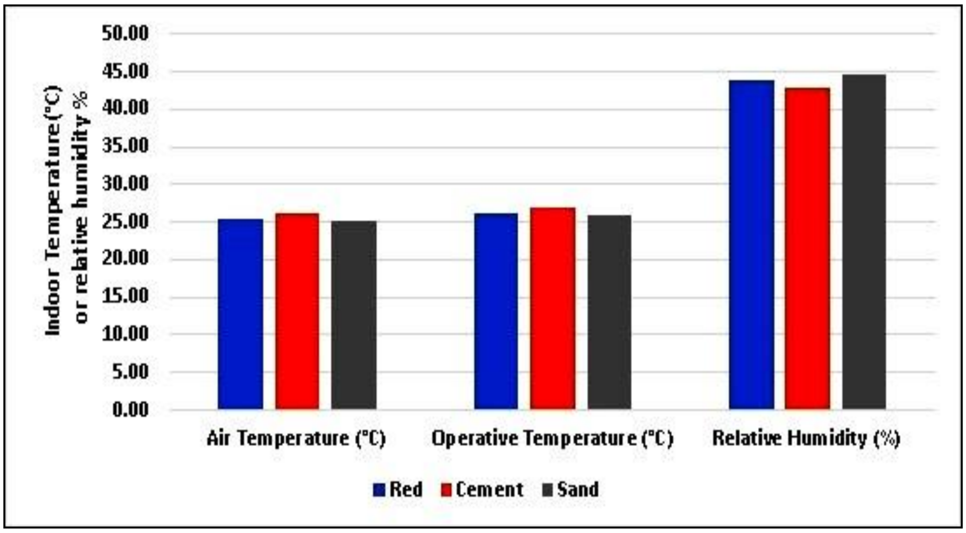

Fig 10. The comfort for model 1

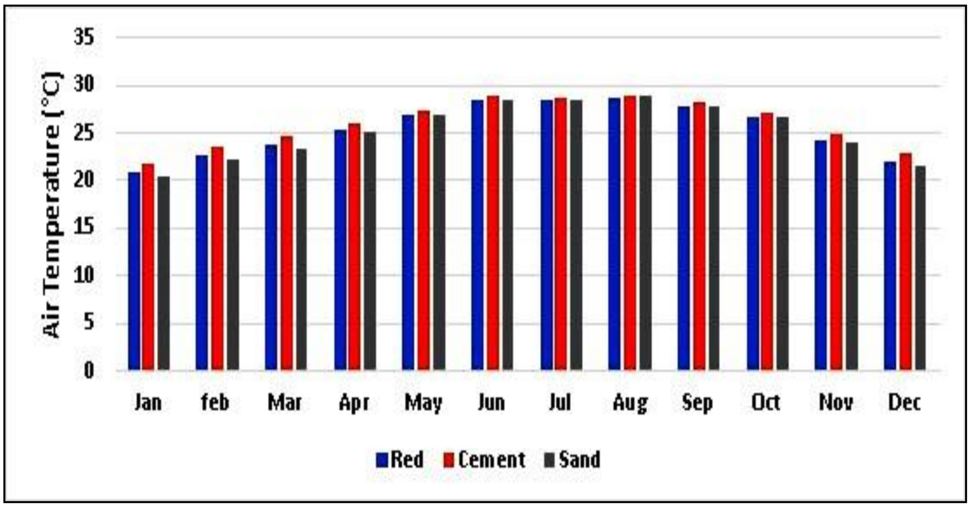

Fig 11. The air temperature (°C) for model 1

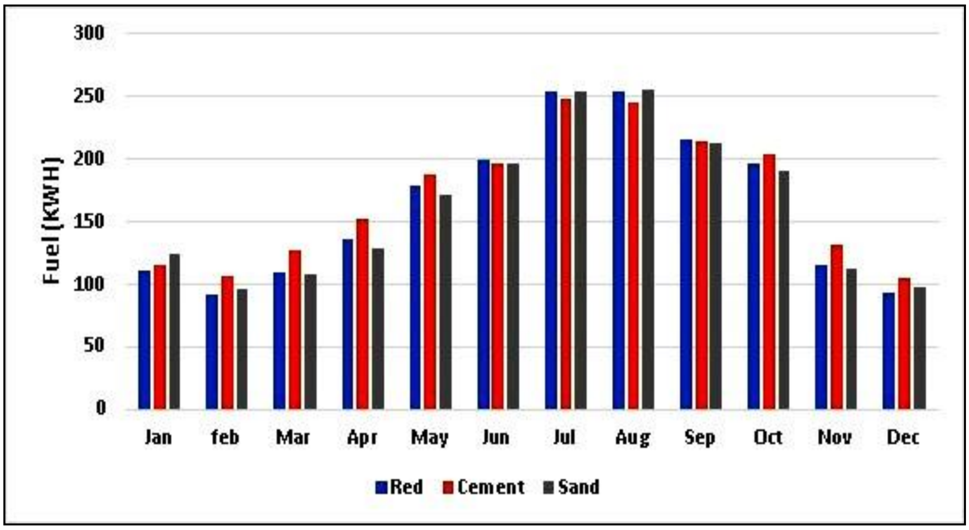

Fig 12. The fuel consumption (KWH) for model 1

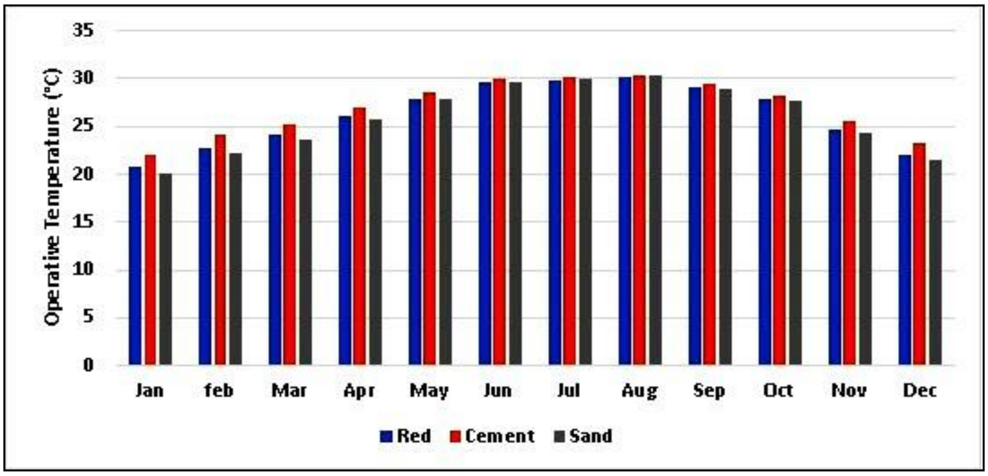

Fig 13. The Operative air temperature (°C) for model 1

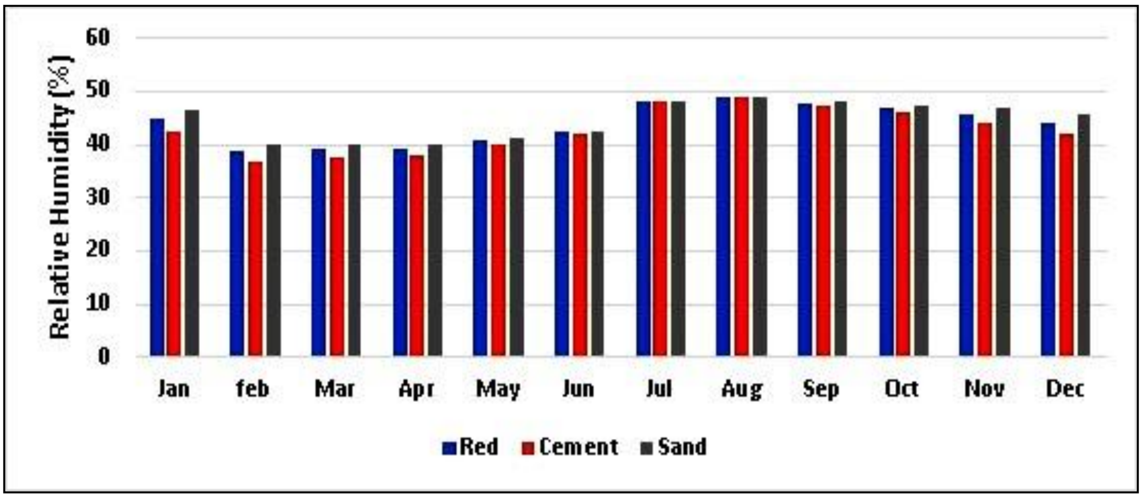

Fig 14. The relative humidity (%) for model 1

The results for Model (2) can be seen from Figure 15 to Figure 20. Regarding Figure 15, which represents CO_2 emission for Model 2, for the three brick types, we can see that the C02 production of red bricks is 368948.5 kg per year, while the C02 production of cement bricks is 376383.5 kg per year, which makes it the worst type of building brick because it produces a higher value of carbon dioxide emission. On the other hand, sand brick is considered to be the most efficient type among all brick types because its C02 production is the minimum with a value of 366719 kg per year. Figures 16.17.19.20 show that for red bricks, the operative temperature ranges from 20 °C in January to 34.15 °C in August, while the relative humidity ranges from 41% to 58% all over the year for the same type, while for sand bricks, the indoor temperature ranges from 19.9 °C in January to 33.77 °C in August, and it ranges from 20.68 °C in January to 35.68 °C in August for cement brick. According to this, the research concluded that cement bricks have the highest heat transfer and the lowest building performance efficiency among all other building materials. Regarding figure 18, the energy plus output is 614 MWH per year for the red brick type. It reaches 624 MWH per year for the cement brick and 611 MWH per year for the sand brick. Due to this fact, the cement type has the highest building operation cost because of its highest fuel consumption.

Regarding CO_2 emissions in January, it is the lowest, using the three materials relevant to the number of occupants, while the highest value is in July. In relation to measuring thermal comfort indoors, the relative humidity is highest in sand, then gradually increases in red bricks and cement; on the other hand, the operative temperature is higher than the air temperature in cement. Cement has the highest energy consumption throughout the year, rather than sand and red bricks. The cement bricks are the worst in average temperature inside the room, and in energy consumption, sand bricks are the best choice as there is no void ratio. The relation between internal temperature and humidity is vice versa, where the highest temperature has the lowest humidity in cement bricks.The privilege of sand bricks is that they have the lowest CO_2 when compared to cement, so sand bricks are the best choice as a sustainable constructive material, but they are also the most expensive in price due to their fabrication processes. The better the wall insulation, the lower the U value (heat transfer) and the higher the R value (heat resistance flow). A concrete brick will develop a thermal envelope in any building because it has a high thermal mass and will retain heat in the summer, releasing it long into the night. In winter, the same wall is likely to remain cold and absorb the heat from your house.

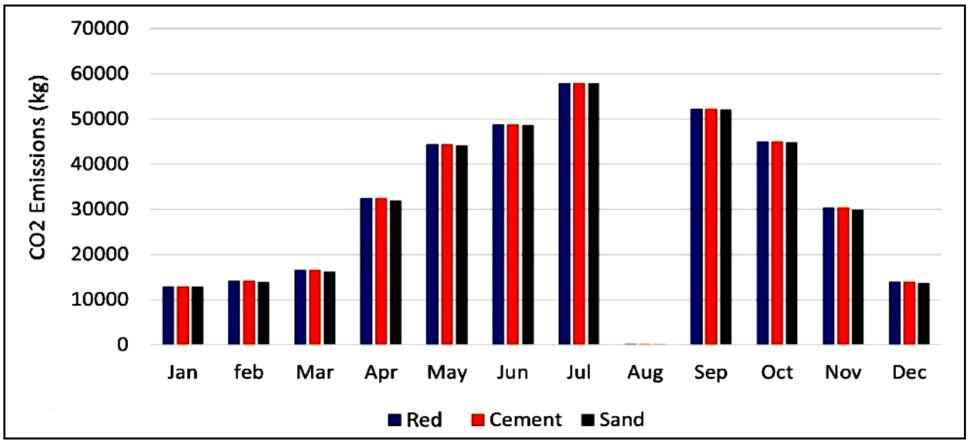

Fig 15. The CO2 emissions per year in (Kg) for model 2

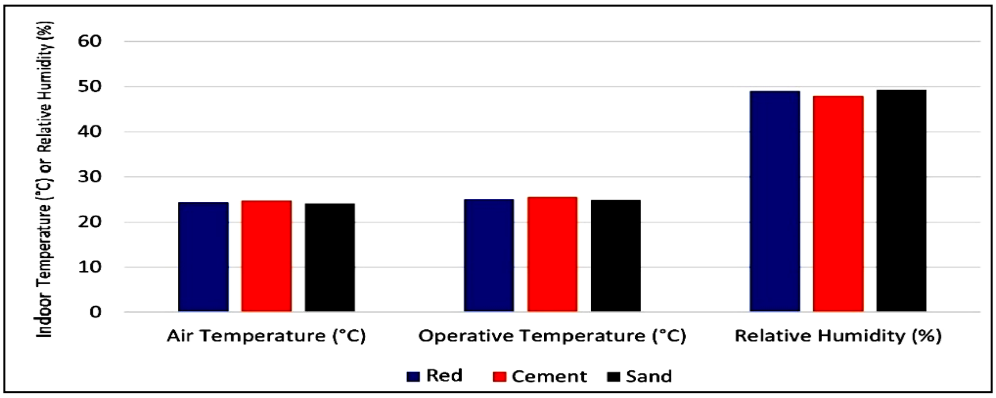

Fig 16. The comfort for model 2

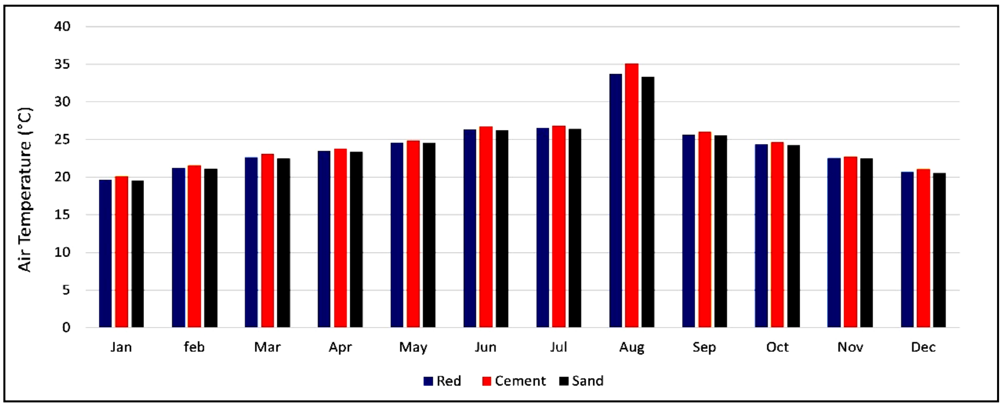

Fig 17. The air temperature (°C) for model 2

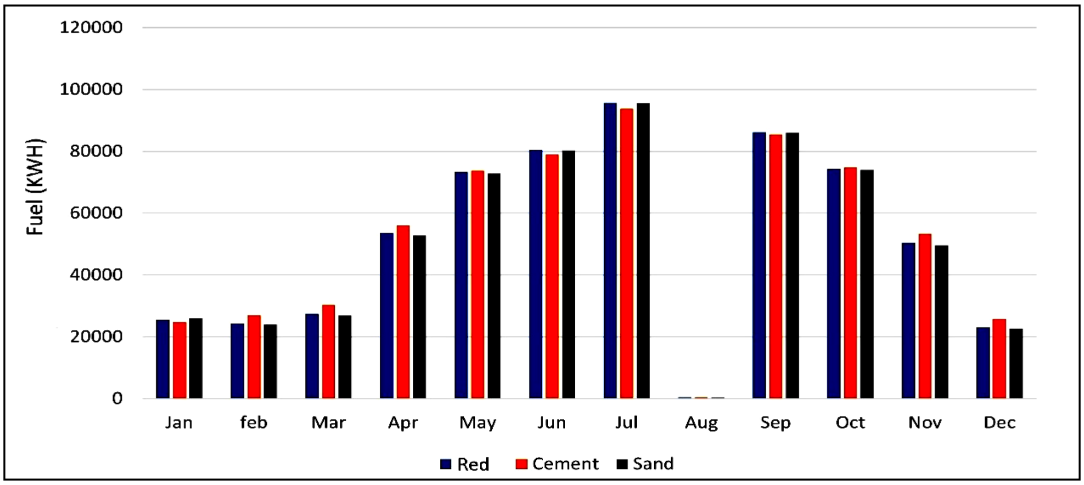

Fig 18. The fuel consumption (KWH) for model 2

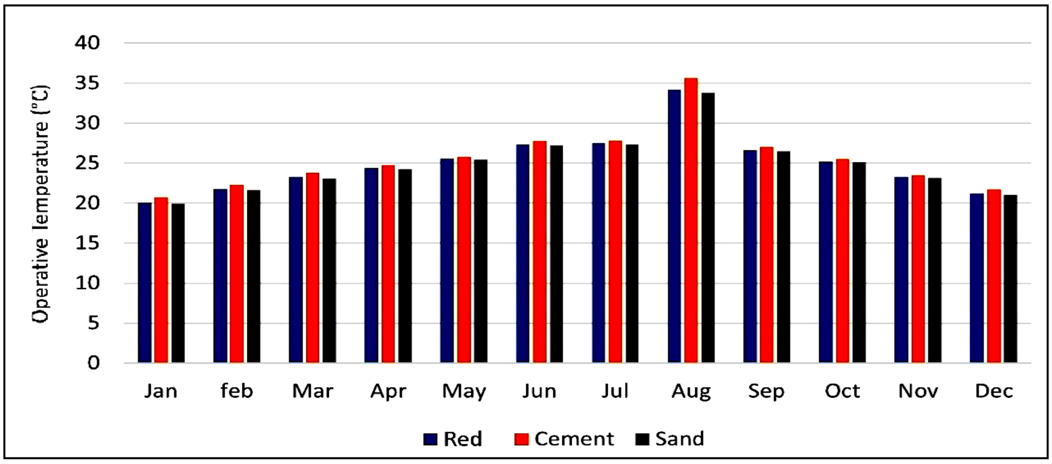

Fig 19. The Operative air temperature (°C) for model 2

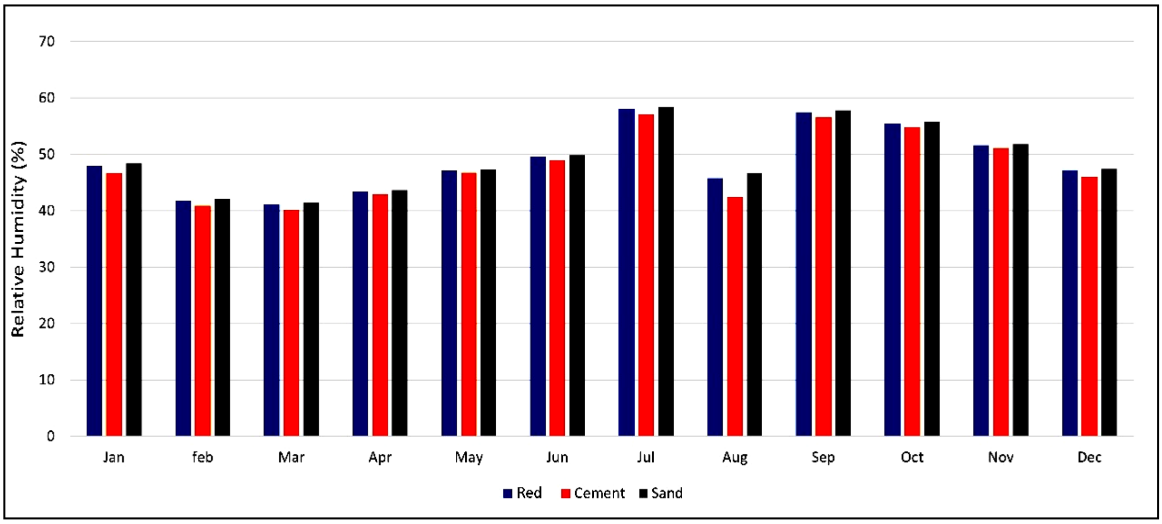

Fig 20. The relative humidity (%) for model 2

Regrading figures 21 and 22, which show the total operation cost for the two buildings we can find that it will have maximum values for the case of cement brick; its values for models 1 and 2 are 2339.526 and 717672.6 Egyptian pound (EGP) per year for the case of using cement brick, while its minimum values for models 1 and 2 are 2241.143 and 703045.9 Egyptian pound (EGP) per year for the case of using sand bricks.

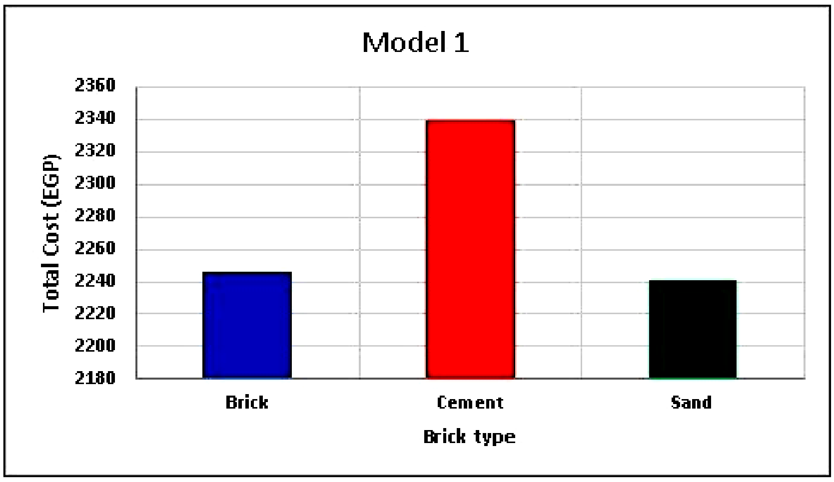

Fig 21. The operation cost for building 1 in EGP

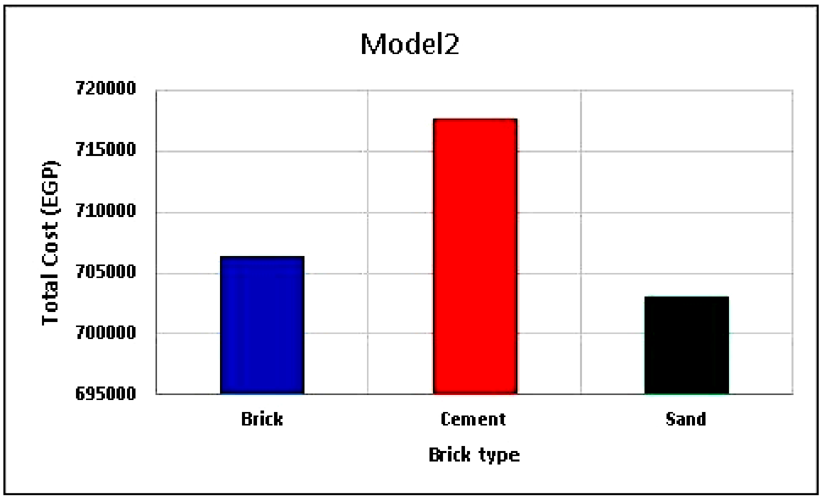

Fig 22. The operation cost for building 2 in EGP

5. CONCLUSIONS

t the end we can conclude that climate change will have negative impacts on building performance in the Egyptian delta region, especially in the coastal zone. The negative impact will affect many building aspects such as CO_2 emissions, internal temperature, thermal comfort energy consumption, relative humidity, and building operation costs. The degree of negative impact will vary depending on the brick type used in interior and exterior walls. In this research, we used three brick types, which are red brick, cement brick, and sand brick, in two buildings.

For all what was mentioned before, we can conclude that cement brick is the worst brick type because it has the highest CO2 emissions and the lowest building performance. Red brick cannot be considered sustainable according to Egyptian regulations because its fabrication raw material causes land degradation and deterioration of the cultivated land, which is expected to suffer from possible climate change negative effects. On the other hand, cement brick is also not a sustainable material because it cannot be recycled and has harmful effects on the surrounding environment. The best type among the three types is the sand brick because it has the lowest CO2 emissions all year. Sand brick is also considered a sustainable brick due to the fact that 90% of its raw material is sand, which can be found all over Egypt. Sand brick can be recycled easily and returned in the form of natural material to the surrounding environment.

The total operation cost for the two buildings will have maximum values for the case of cement brick, which will range from 2339.526 to 717672.6 Egyptian pound per year, while its minimum values will range from 2241.143 to 703045.9 Egyptian pound per year for the case of sand brick. At the end, the best brick type for any public or port building in the Egyptian delta is sand brick. This will help us decrease CO2 emissions in order to mitigate climate change, and at the same time, it will enhance building performance by decreasing energy consumption and operative temperature in order to provide thermal comfort.

ACKNOWLEDGEMENTS

We would like to express my gratitude to all the people who guided me throughout this research. Also we would like to thank Eng.Ahmed Mostafa who provided information that greatly assisted the research.

REFERENCES

[1] IPCC, (2023). Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647

[2] Soliman, M. (2016) (Adaptation Measures for Nile Delta Coastal Area Under Climate Change report) Coastal Research Institute, NWRC, Ministry of Water Resource and Irrigation, Egypt.

[3] Wikipedia Contributors. (2019, January 23). Nile Delta. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Nile_Delta.

[4] Iskander, M. (2013). wave climate and coastal structures in the Nile delta coast of Egypt, Emirates Journal for Engineering Research.

[5] Zaki, A., & Swelam, A. (2017, January). First Report, Climatology of Nile Delta, Egypt. Ministry of agriculture and land reclamation. https://mel.cgiar.org/reporting/download/hash/Yk09YJJ9.

[6] JUDKOFF, R., & NEYMARK, J. (2013). Twenty Years On!: Updating The Iea Bestest Building Thermal Fabric Test Cases For Ashrae Standard 140. Building Simulation Conference Proceedings. https://doi.org/10.26868/25222708.2013.1049.

[7] ASHRAE. 4 Dec. 2008, pp. 1–9. 140-2007 Errata Sheet , ERRATA SHEET FOR ANSI/ASHRAE STANDARD 140-2007 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs .

[8] unkel, Sara & Kontonasiou, Eleni & Arcipowska, Aleksandra & Mariottini, Francesco & Atanasiu, Bogdan. (2015). Indoor air quality, thermal comfort and daylight. Analysis of residential buildings regulations in eight EU member states.

[9] Aljabri, S., & Kassab, S. (2022). Evaluation of Overheating Risks and Passive Cooling Measures in Low Energy Swedish Dwellings (Master thesis in Energy-efficient and Environmental Buildings). Faculty of Engineering | Lund University.https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=9086025&fileOId=9086035.

[10] Homod, R. Z., Almusaed, A., Almssad, A., Jaafar, M. K., Goodarzi, M., & Sahari, K. S. M. (2021). Effect of different building envelope materials on thermal comfort and air-conditioning energy savings: A case study in Basra city, Iraq. Journal of Energy Storage, 34, 101975. https://doi.org/10.1016/j.est.2020.101975.

[11] Rheude, F., & Röder, H. (2022). Estimating the use of materials and their GHG emissions in the German building sector. Cleaner Environmental Systems, 7, 100095. https://doi.org/10.1016/j.cesys.2022.100095.

[12] Jungudo, M. M. (2022). The Impact of Climate Change in Egypt. International Journal of Research, Vol. 9 Issue 03 m pp: 274-290. https://www.academia.edu/75099688/THE_IMPACT_OF_CLIMATE_CHANGE_IN_EGYPT.

[13] Enhancing Climate Change Adaptation in North Coast and Nile Delta in Egypt | United Nations Development Programme. (2023). UNDP. https://www.undp.org/egypt/projects/enhancing-climate-change-adaptation-north-coast-and-nile-delta-egypt.

[14] https://www.worldometers.info/co2-emissions/egypt-co2-emissions/

[15] Achal, V., & Chin, C. S. (2021a). Building materials for sustainable and ecological environment. Springer.

[16] R-values of Insulation and Other Building Materials - Archtoolbox. (2022, February 27). Www.archtoolbox.com. https://www.archtoolbox.com/r-values/

[17] Winnes, H., Styhre, L., & Fridell, E. (2015). Reducing GHG emissions from ships in port areas. Research in Transportation Business & Management, 17, 73–82. https://doi.org/10.1016/j.rtbm.2015.10.008.

[18] https://www.google.com/maps/place/Imbabah,+Al+Munirah,+Imbaba,+Giza+Governorate/@30.0875368,31.2219256,1278m/data=!3m1!1e3!4m6!3m5!1s0x1458410bf577e239:0x17a577479ec6487e!8m2!3d30.0815975!4d31.1950354!16zL20v.

[19] https://www.google.com/maps/place/Future+University+in+Egypt/@30.0271539,31.4891508,639m/data=!3m2!1e3!4b1!4m6!3m5!1s0x145840c63cc84ef7:0x39d27f605898ea20!8m2!3d30.0271539!4d31.4917257!16s%2Fm%2F04cs17s?entry=ttu.

[20] Gavotsis, E., & Moncaster, A. (2015). Improved Embodied Energy and Carbon Accounting: Recommendations for Industry and Policy. Athens Journal of Technology & Engineering, 2(1), 9–24. https://doi.org/10.30958/ajte.2-1-1

Citation: Tamer Elgohary, Nisreen Abdeen. Defining Building Performance Efficiency in Coastal Regions (The Nile Delta Case Study). International Journal of Research in Civil Engineering, Architecture and Design (IJRCEAD), 9(1), 2025, pp. 1-19.

Abstract Link: https://iaeme.com/Home/article_id/IJRCEAD_09_01_001

Article Link:
https://iaeme.com/MasterAdmin/Journal_uploads/IJRCEAD/VOLUME_9_ISSUE_1/IJRCEAD_09_01_001.pdf

✉ editor@iaeme.com