



المؤتمر العربي الثاني للأراضي

Second Arab Land
Conference

22-24 FEBRUARY 2021
CAIRO, EGYPT

Technical Session 1 [Technologies and Smart Solutions]

Enhancing Land Management, Land Development and Construction

Technologies and Smart Solutions for Unconventional Adaptive Form Generation in Office Buildings; Al-Basrah, Iraq

Manal Mandeel. E-mail : arch.manalmalik@gmail.com



Introduction

This study focused on Al-Basrah city, Iraq. Investigate how to manage the land in a better way with the rules of the city, and provides smart solutions by using technology and environment to generate an adaptive unconventional form with a responsive, efficient shading system to reduce the impact of the radiation, allowed daylight at the same time. Investigate how to see generative parametric design through the lens of nature, as provides great opportunities for architects and designers to contrive the design process more efficiently and make a complex, creative forms easily, complete unity between the building, users, and at the same time the environment.

Main Message;

Manage the land efficiently by employing technology and environment to generate an unconventional adaptive form.

Methodology

The methodology of the study includes two main parts; the first, about generating form of a tall office building based on the Biomimicry in Al-Basrah, Iraq. Mimicking the form and the performance of the Bottlebrush flower by using technology, and provide smart solutions through parametric design technique, its tools, and a software namely Rhino and its plug-in named Grasshopper. The second part is analyze the building form under the effect of the environment (sun path and the radiation) on this building by making a simulation to the generating building form in different environment conditions and compare the results before and after. The process utilizes off-the-shelf one of parametric design software namely Rhino and its plug-ins named Grasshopper and ladybug.

Office envelope Design, Al-Basrah, Iraq

Al- Basrah Case Study: Office Envelope Design

Al-Basrah is the most southern province of Iraq, located in south-eastern Iraq, its location at the Shatt Al-Arab and its vast oil reserves make it one of the economically most important province of Iraq. It has a hot desert climate, during the summer months, from June to August, Basrah is consistently one of the hottest cities on the planet, with temperatures regularly exceeding 50 °C (122 °F) and high humidity ,sometimes exceeding 90 per cent .

- The form generation of the building here is coming from the environment and nature of the geographic spot where the building in, it came from mimicking a flower named Bottlebrush its botanical name is (*Callistemon viminalis*) as shown in fig.(1)

Office envelope Design, Al-Basrah, Iraq



Fig.1 Bottlebrush flower

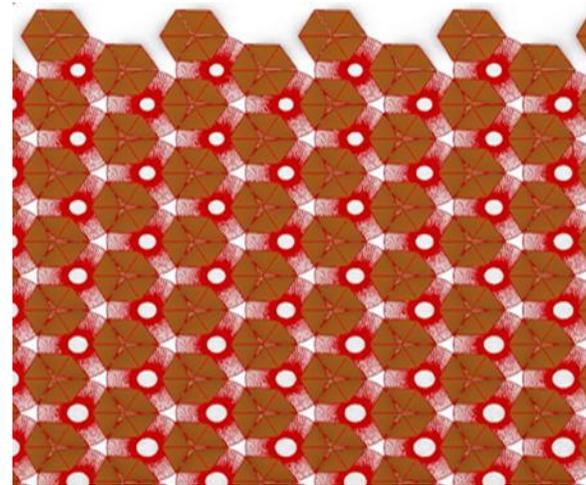


Fig.2 the pattern A

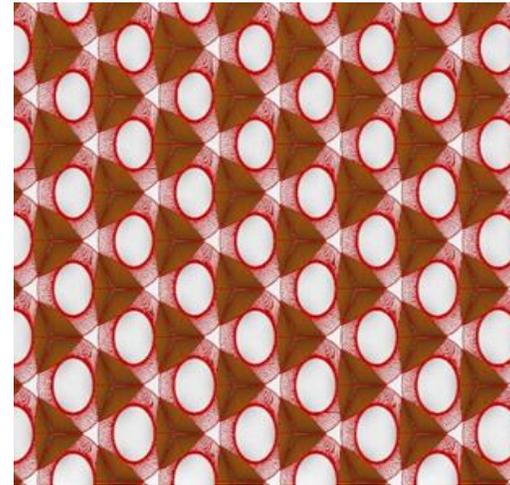


Fig.3 the pattern B

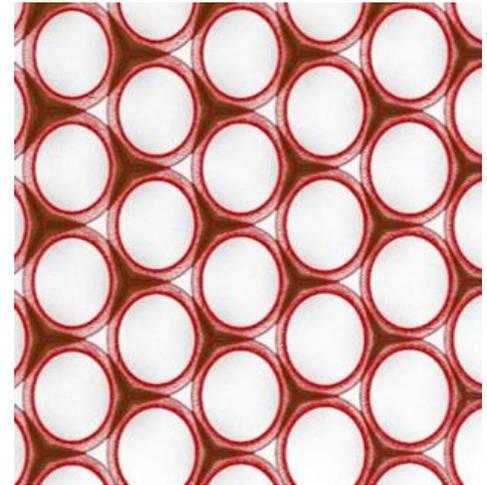


Fig.4 the pattern c

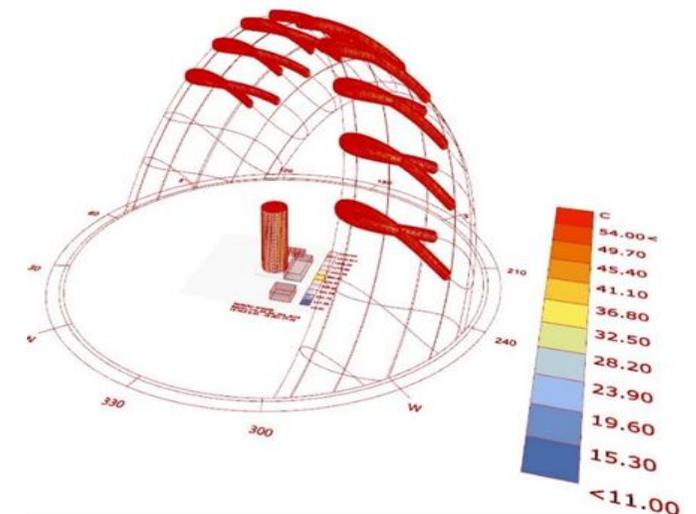
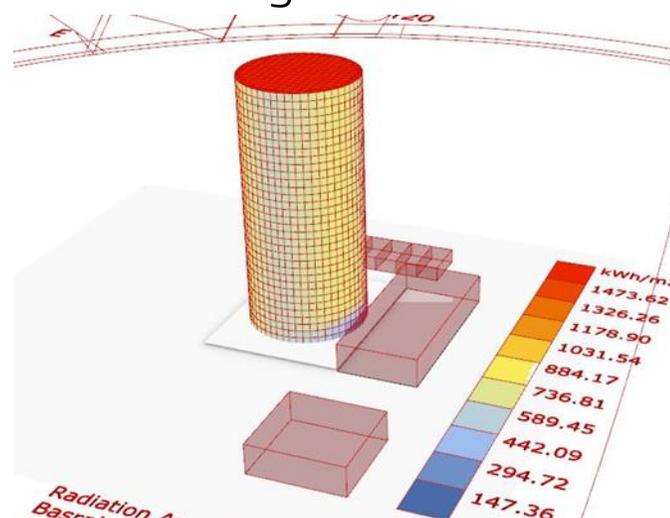
The building form contains two parts, the first part is a cylinder, came from the cylinder form of the flower itself, gathering the individual flowers forming this shape. Second one is the envelope that covered it, The envelope form is a pattern which forming from the capsules overlaps and the flower spikes in blooming time. According to the performance of this flower, it starts flowering in Spring and Summer seasons and needs full sun, this performance makes the pattern responsive to the sun open and closed according to the sun position Fig. (2,3,4)

Results

The process starts with making a simulation of the building by Using Grasshopper and ladybug plug-ins to study and analyze the effect of the environment in the building in different stages and conditions, Sun path and the radiation analysis according to Al- Basrah weather data.

- The analysis period starts from day 15 March to 15 October at time (8 a.m.to 5 p.m.), the radiation analysis of the building without an envelope as is shown Fig.5 the lowest value of the radiation is 147.36 kWh/m² and the highest is 1473.62 kWh/m². And the temperature is from 15.30 C to 54 C.

Fig.5 (left) The radiation analysis
Fig.6 (Right) the temperature
and sun path



Office envelope Design, Al-Basrah, Iraq

- The radiation analysis after applying the envelope to the building from day 15 March to 15 October at the time (8 a.m.to 5 p.m.) as shown in fig. (7) the lowest value of the radiation is 147.36 kWh/m² and the highest value is 1473.62 kWh/m². With the same temperatures .

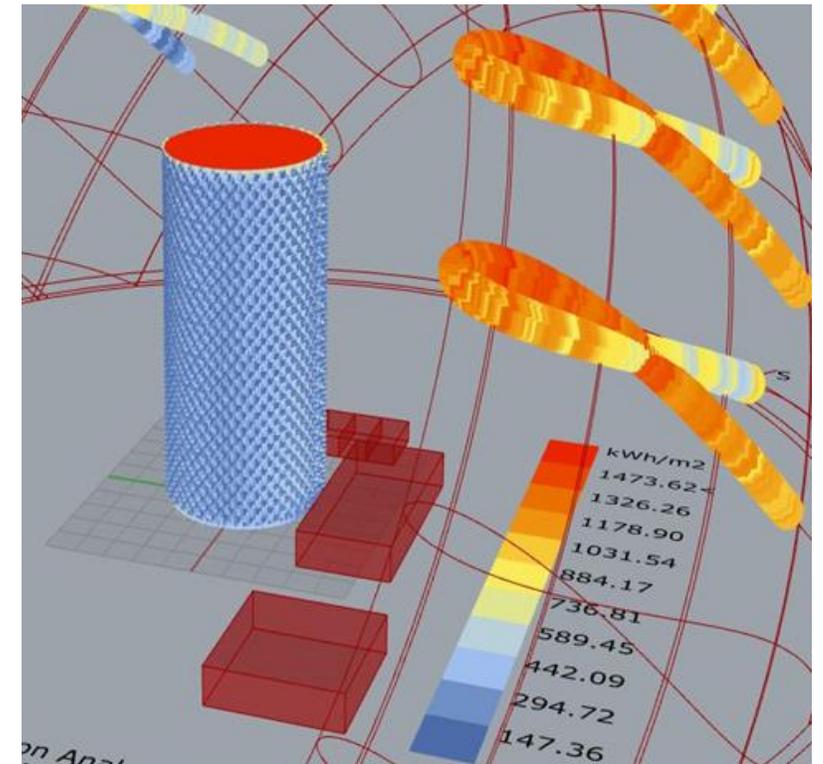


Fig. 7 the radiation analysis after applying the envelope

Discussion

The radiation analysis as shown in fig.(5) is between (147.36 – 884.17 kWh/m²) before applying the envelope, while after applying the envelope it is becoming between (147.36 – 589.45 kWh/m²) as shown in Fig. (7) This means that it has becoming less than the first case. Besides that in the hot, humid climate the circular shape is the optimum geometric shape (receiving the lowest amounts of annual total radiation) among all high-rise building shapes. So the effect of the radiation on the building is reduced.

Conclusions and Main Recommendations

In this study, it was concluded that by using technology through the use of parametric design, taking into account nature and the environment, it is possible to obtain an unconventional office building adapted to the surrounding environment and reduce the effect of the radiation which helps to reduced cooling and lighting loads in the building, and keep pace with future architectural development, at the same time manage the land better, taking into account the standards and conditions of Al-Basrah city.

Main Recommendations;

- Use the technology to provide smart and unconventional solutions to manage the land efficiently by using this technique in the design process.
- Considering the nature and the environment in the design process.

THANK YOU FOR THE ATTENTION!