**Explaining the Design Process of the LAGI 2019, Abu Dhabi**

The sun traverses a certain path through a given day in a given year, and this circulation and motion pattern is mapped by a graphic designation called SUNPATH. Designers have made a variety of uses. With the help of this graph, you will see a new application.

If we consider the orbit of the sun throughout the day as a mirror and rotate it 180 degrees, this circuit is at the opposite point to the vertex. The resulting image takes the direction of the sun. All of the features of the Sunpath chart namely, months, days, and hours for a specific area with specific latitude, can be moved on a page that has been interconnected from a central point. Now, at the same central point, we put a conical volume, despite the sunlight throughout the day, the shadows of this cone fall on the plate. This reflected shadow on the plate with the information of the Sunpath can be traced and studied. That is, at a certain moment you can see the moon, day and hour of this shadow. In this way, we have been able to find a calendar and solar clock in which the cone-shaped shadow is the counterpoint of this clock. Now, if we want to change the shape and form of the plate (the plate that crossed the Sunpath chart from the central point), then the graph information should also be transmitted correctly on the new plate For example, a flat plate or a cylindrical form (the reasons for choosing these forms will be explained below).The design team has used a geometric approach to achieve such a plan, which is described step by step:

1. To offset the solar clock plate inwards, around the center point and the center cone.

2. To connect the index points of the plates together (hour, day and month information).

3. To pass a new plate with the desired form (here flat and cylinder) through the two previous plates and extract their shared seasons.

 4. To detect the points of contact with the new plate and accurately transfer the information of those points on this plate.Thus the solar clock and calendar are extracted to new forms.

 Reasons for choosing a cylinder and flat form:

Cylindrical form: when drafting the goals of the design team, the creation of a solar generator was also considered. In the process of studies of solar generators, Solar Concentrated Power was considered as generators with high efficiency and high energy production. In these generators, the concave mirror plates are used to receive solar energy. On the other hand, the solar clock designed for the present project needs a form that has enough readability. So to achieve these two goals, the cylindrical shape was chosen. The form close to the theme of the contest is the design of the artistic element of Masdar city and the symbol of solar energy.

Flat form: The creation of a lively urban atmosphere was another purpose of design. This urban space should provide a platform for various activities i.e. special platforms such as architectural and urban studies. One of the drawbacks of urban design is the lack of proper use of the shadow of buildings, trees etc. in the atmosphere. The possibility of calculating the direction and size of an object's shadow for use in warm days can be a good guide for designing with different purposes(For example, shadowing trees on the bench in the hottest days of the year). Therefore, the use of a flat plate provides the main purpose of the design. It also creates an area for human presence on the site of the element, and provides a suitable place for studying and calculating the length of the shadow of objects in that area. It is easy to study and observe how the central cone shadows in a certain day and month in what direction and length of the Earth, or the maximum length of the shadow of the objects on what day and in what month falls on the earth every year.

For the inner surface, a glass with a very high reflection has been selected to focus on sunlight in the generator. For the outer surface, matte colored films are suggested for three reasons: 1. to darken the bottom of the reflective interior glass in order to increase its efficiency. 2. For readability of the clock, it is necessary to have a hand shade that does not have this property. 3. The color of these films shows the degree and intensity of solar energy on the conveyor. This study chart can be extracted in different regions with specific latitude and can be formulated as a design guide.

The main challenge for the design team was the connection between the solar generator and solar clock in the element. Since for the calculation of the amount of energy received by different buildings of a building in different seasons and months of the year the Solar Conveyor is used on the Sunpath plate; therefore, in this design, these two plates have been modeled on the cylinder volume of the generator. Solar conveyer has been designed as a colored sheet of glass and Sunpath plate in a line of metal. When the observer stands in the elemental area, he sees the amount of solar energy received (through the conveyer) at a specific time (via the Sunpath chart). This smart integration featured another interesting and exciting achievement, showing the efficiency of the solar generator in different hours and months. Thus, the highest generation of generator power is produced in days of the year that is in the red zone, on the contrary, the days in the blue range are the lowest generation of generator power. The amount of energy received by the sun at a specific hour, day and month with a BTU unit is visible and can be studied.

It needs to be explained that the design and calculation of this project required daily temperature data, and since the climatic records received from the competition organizer were not sufficient in this area, the information from another region was used with different latitudes. The ultimate goal was to provide a method which can be calculated, designed and utilized for all parts of the world. Certainly, with the more accurate and complete data of the climate of this city, the calculations can easily be modified and generalized. Ultimately, the element will retain its shape and form with all its details. The design team was working on a final design that has two important features:

1. Inventing and developing a new approach to Solar Energy: designing a calendar and Solar hour, designing a solar generator.

2. Symbolic and then artistic beauty of the design, which is unique to the city of Masdar in Abu Dhabi: The physical and distinctive features of the citizens were chosen in a form of Arabic men with a special cover, which had a good fit with the innovative elements. For the central element of the design, which plays the role of a clock hand of the sun, the architectural symbol of the country, Burj Khalifa , was used.