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Solar Powered Building with Dynamic Shading System

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Problems

Glass skyscrapers have become the trademark in the Gulf. However, buildings in the Gulf suffer from the following issues:

- Heat and glare from the Sun can warm up the exterior of the buildings to up to 90°C (CNN, 2012)
- The constant increase in price of electricity tariffs.

The International Royal Hotel (TIRH), will employ a dynamic shading system; similar to the one used in Al-Bahar Towers in Abu Dhabi. However, we will modify Al-Bahar Towers to achieve higher power efficiency using solar panels.

Solution

Geographic Location:

- Down Town Dubai is the location of TIRH.
- The façade will be free from obstacles that will block the sun.
- Solar panels will have maximum exposure to sunlight.

Structural Design and Construction of Material:

- 145 meters high.
- 40 exterior columns.
- Cylindrical (Refer to figure 1)
- Reinforced Concrete.

Mashrabiya Design and Material Used:

- 1000 shading units.
- Polytetrafluoroethylene (PTFE) mesh.
- 4x4x2 meters



Figure 1: Similar existing project (Al Bahar Towers)

Retrieved from : <http://www.ctbuh.org>

Features of the dynamic shading system:

- 1.Input:** We will place one control “Mashrabiya” per column. The control unit has a sensor that converts sunlight to digital electrical voltage. As light intensity increases, the sensor generated more electrical voltage.
- 2.Output of a single unit:** Based on the digital electrical voltage, the sensor determines the shape of the control “Mashrabiya” (Refer to figure 2)
- 3.Signal propagation:** The shape of the control “Mashrabiya” will be passed to all units in that column.

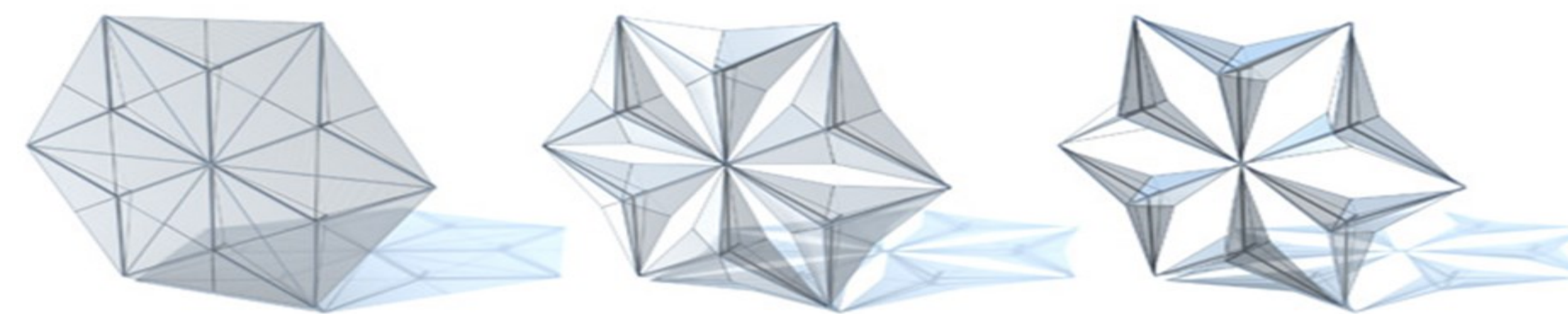


Figure 2: Six units of the “Mashrabiya”: opening stages
Retrieved from : <http://aedasresearch.com>

We will apply the following modifications that will increase the efficiency of the solar panels:

- **Mirror Reflecting:** increases the efficiency by 25% (Rahman and Khan, 2010) (Refer to figure 3).
- **Sun Tracking:** We will use a mechanical system to rotate the solar panels in the direction of the Sun (Refer to figure 4).
- **Anti-Reflection Coating:** To prevent reflection of Sun rays.
- **Using NeverWet:** Maintenance and efficiency are correlated.



Figure 3: Mirror Reflection
Retrieved from :



Figure 4: Sun Tracking
Retrieved from:

Evaluation

- Mashrabiya reduces the required cooling load from 140 kW/m² to 100 kW/m² (CTUBH,2012).
- The use of solar panels during the day allows the client to save up to 50% on electricity bills (Refer to figure 5).
- TIRH is a modern project that will increase tourism in Dubai.
- Our project face lower cost in the long run.

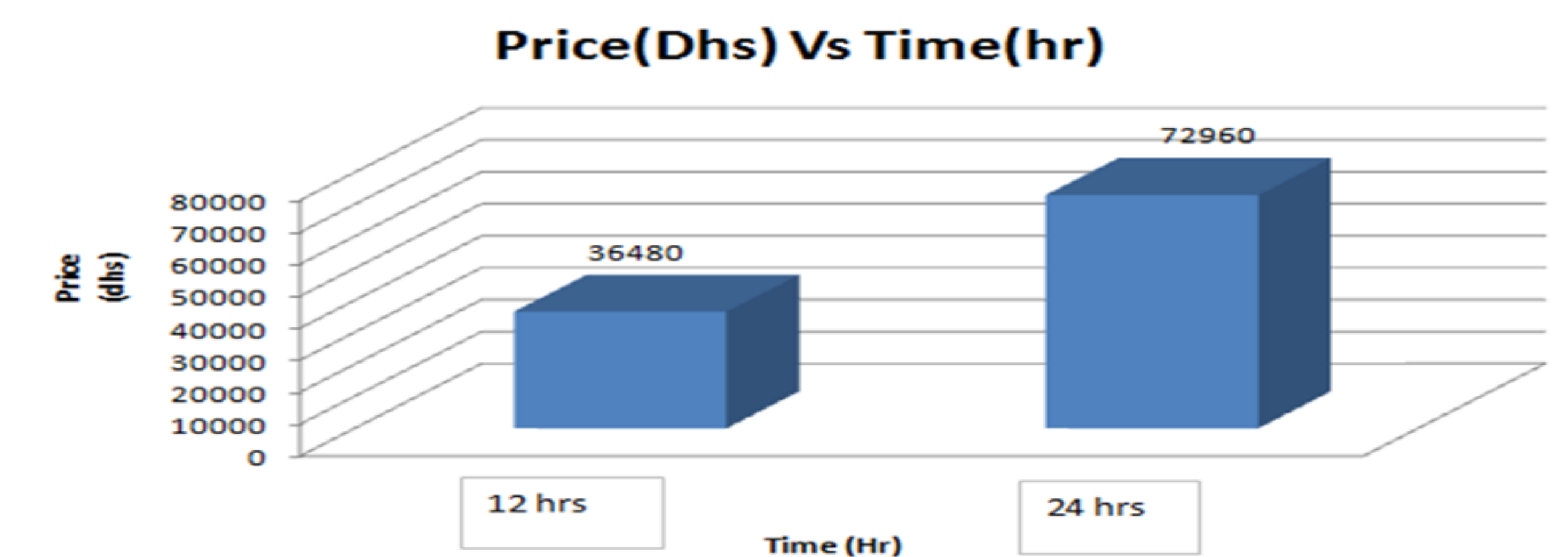


Figure 5: Price vs Time

Conclusion

TIRH is an efficient project that reduces the cost of electricity bills. Moreover, the shading system protects the façade of the building from the glaring sun and provides a comfortable surrounding for the residence of the hotel. Last but not least, TIRH will become a unique trademark of Dubai.

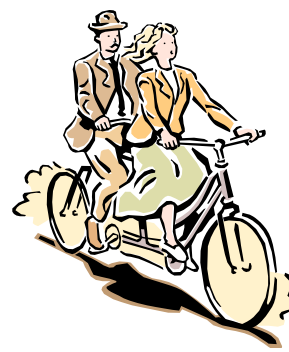
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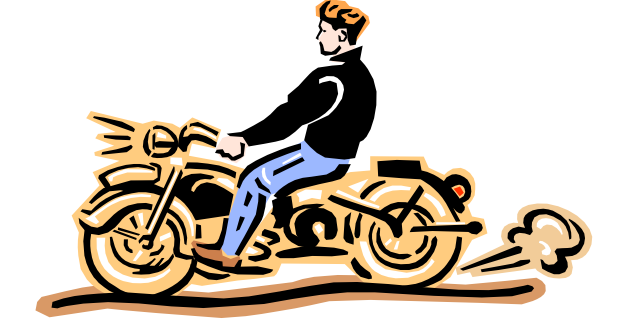
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