

Conserving Energy Using Heritage Systems for Renovated Heritage Houses to Museums at Sharjah City

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Abstract: This study presents several strategies to control day light at Bait Obaid Al-Shamesi and Emirate Fine Arts Society (Annual Photography Exhibition) where both are originally heritage buildings located at Sharjah in UAE and were renovated to museums. This study is a comparison between the methods of natural lighting used in both museums before and after renovation. The lighting results were evaluated using both manual and computer-assisted ways, the manual way to assess the light using Lutron Light Meter (LM-8000A) Anemometer and the computer-assisted way was using Revit Architecture Software with Lighting Analysis Plugin. The manual readings were during day-hour time with all artificial lights on, however, software analysis was during day-hour time with all doors shut and the artificial lights were completely “off”.

Key words: Revit, light meter, green, heritage, day light, Sharjah

INTRODUCTION

Sharjah Heritage Area is the heartbeat and the pulse of the city, it reflects its history. The modern city of Sharjah was built on a rich foundation of history and tradition that dates back 6000 years with more than 20 buildings could be renovated besides another 14 museums at Sharjah city. Bait Obaid Al Shamesi and The Emirates Fine Arts Society were houses for ancient Emirati local people which were renovated to be used as museums. The architecture of this region was known for having courtyards as a main element at their houses. Courtyards could be a light source transformer besides generating a good air circular and ventilation for the building.

Bait Obaid Al Shamesi (Fig.1) (Al-Ragom, 2003) was owned by the late Obaid Bin Esa Al Shamsi and built around the year 1845. The building reflects Arabic-Islamic Architecture and simulate the absolute spirit of Sharjah in a two-story house. The house contains 16 rooms, three of which are at the upper floor. There are also parlours, extensions and stairs as well as the distinctive top ventilation-structures wind-towers “Barjeel”. After the 1997 renovation, 13 studios came up around the traditional courtyard which are rented to professional artists to practice their work constantly.

On the other hand, the Emirates Fine Arts Society (Fig. 2) (Al-Sallal *et al.*, 2013) was established as a non-profit organization in 1980. The aim was to nurture young talent and represent the artists of UAE (Gutierrez and Labaki, 2007) at local and international events as well as providing artists with media support.



Fig. 1: Bait Obaid Al-Shamesi Museum (Al-Ragom, 2003)



Fig. 2: Emirates Fine Arts Society (Annual Photography Exhibition) (Al-Sallal *et al.*, 2013)

Bait Obaid Al Shamesi and the Emirates Fine Arts Society Museums (Pindado *et al.*, 2014) are located at Al

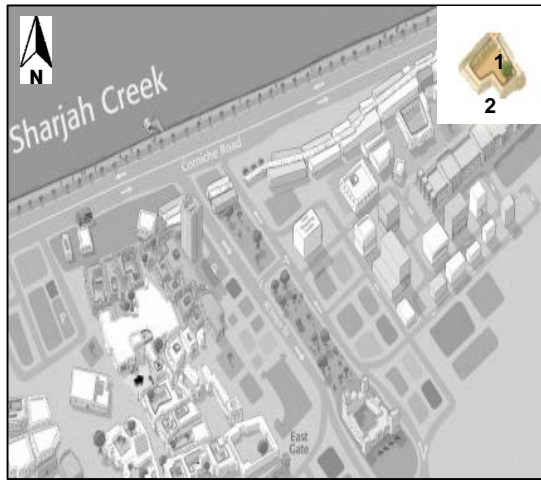


Fig. 3: Museums location at Sharjah, Bait Obaid Al Shamesi Museum, the Emirates Fine Arts Society Museum

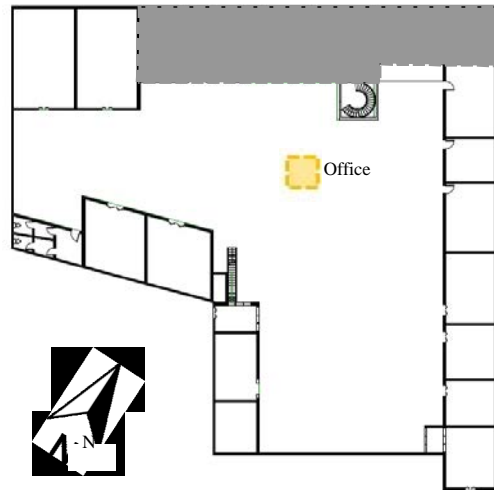


Fig. 5: Ground floor plan for Bait Obaid Al-Shamesi Museum by Revit

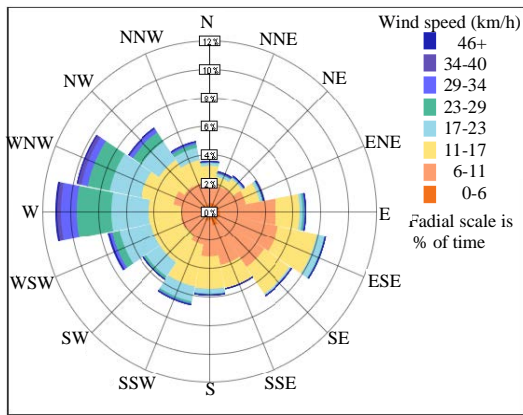


Fig. 4: Annual wind rose at Sharjah by Revit

Shuwaiheen area in Sharjah along the Corniche Road (Fig. 3) where the maximum outdoor temperature reaches 47°C and the minimum is 8°C. The wind speed distribution is shown in the annual wind rose chart (Fig. 4).

Objectives

Bait Obaid Al-Shamesi: The environmental conditions of both Bait Obaid Al-Shamesi and Emirate Fine Arts Society need to be treated. Not many functions are defined in these buildings very small areas were utilized as museums while most other functions are closed, Bait Obaid Al-Shamesi Museum is a two-story building, however, the ground floor contains offices only (Fig. 5) while the first floor got <20% as areas of exhibitions (Fig. 6).

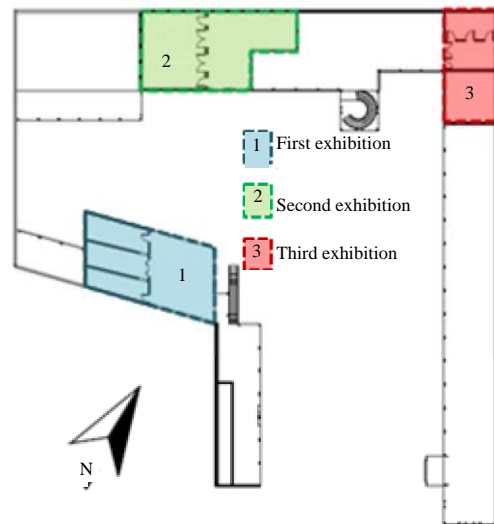


Fig. 6: First floor plan for Bait Obaid Al-Shamesi Museum by Revit

The ancient Emirati solved the issue of lighting by sense and congenital using different shapes and sizes (Stalder *et al.*, 2015) of openings (Table 1) which are used in all exhibitions. The following changes would be considered in the solution. Open the existing windows at exhibitions 1 and 3 (Fig.7). Open new windows at exhibition 2 (Fig.7).

The Emirates Fine Arts Society: The Emirate Fine Arts Society (Annual Photography Exhibition) used about 30% of the total area for the exhibition (Fig. 8 and 9) which also needs a solution for lighting to be treated to adjust the

Table 1: Windows and openings used by the ancient Emirati people to produce light for their buildings

Window type	Illuminance
	101 lx
	117 lx
	93 lx
	143 lx
	19 lx

-  1 First exhibition
-  2 Second exhibition
-  3 Third exhibition

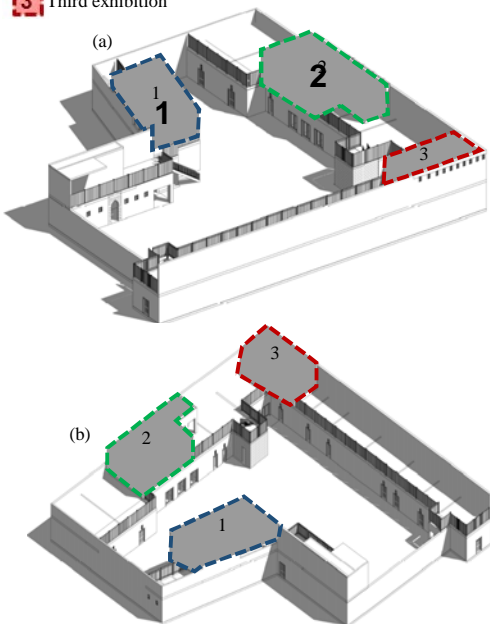





Fig. 7: Two (3D) views, exhibitions locations at Bait Obaid Al-Shamesi Museum by Revit

-  Annual exhibition
-  Office
-  Media room

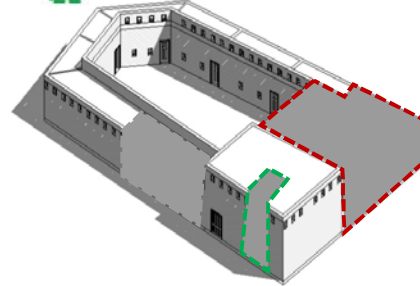


Fig. 8: Two (3D) views of the Emirates Fine Arts Society by Revit

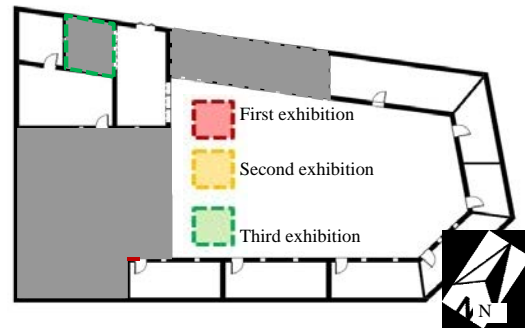


Fig. 9: Floor plan for the Emirates Fine Arts Society by Revit

level of natural lighting gradually inside exhibitions, which would add more opportunities for people to stay at these areas. The same suggested solutions for Bait Obaid Al-Shamesi Museum will be used in this museum because it also ignores the original green solutions of windows and openings.

However, instead of placing a shading device for the courtyard, this solution suggests to: change the yellowish shading device to a white one. Main windows/openings types used in this museum are shown with its illuminance results.

MATERIALS AND METHODS

Site visit: The site visit took place in 12th April 2016 at 12:00 p.m. the date and time were chosen to be in Spring were the weather at the UAE is average. When entering Bait Obaid Al-Shamesi Museum at Sharjah you will enter a small room that leads to a huge courtyard (Fig. 10). The ground floor contains multi closed unused rooms rather than the offices, no exhibitions exist at this floor (Table 2).

Table 2: Windows and openings used by the ancient emirati people to produce light for their Emirati Fine Arts society




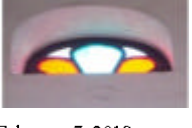
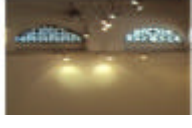
Window types	Illuminance
	01×
	1e.04 1×
	86 1×
	5 1×
February 7, 2019	
	12 1×



Fig. 10: Bait Obaid Al-Shamesi Museum view from the courtyard

The courtyard is not shaded except having one huge tree at the corner of it (Fig. 11) which make it too hot and exposed to harmful direct sun-light but it helps getting some indirect natural light to the exhibitions (Fig. 12). Staircase (Fig. 11) leads to one of the exhibitions (Fig. 12) at the first floor while the other staircase (Fig. 11) will lead to two exhibitions upstairs (Fig. 12). On the other hand when entering the Emirate

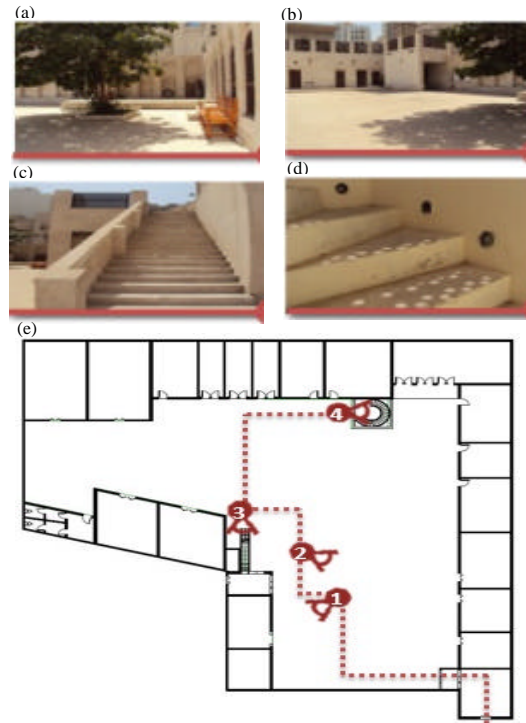


Fig. 11a-e): Bait Obaid Al-Shamesi Museum's sequence of space at ground floor

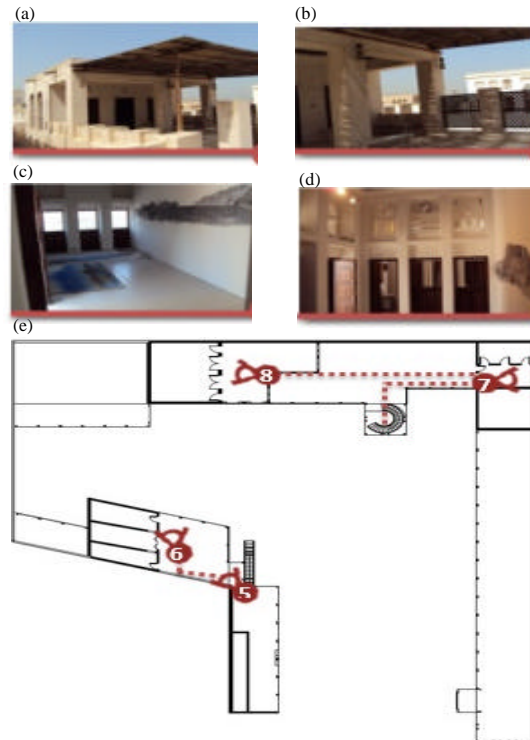


Fig. 12a-e): Bait Obaid Al-Shamesi Museum's sequence of space at first floor

Table 3: The manual simulation for illuminance at Bait Al-Shamesi Museum

Area	Illuminance (lux)
Entrance (Under shade)	1014
Courtyard (Open area)	Above 2000
Semi-Shaded courtyard (Type 1)	428
Semi-Shaded courtyard (Type 2)	1001
Room at center	185
Exhibition (1)-Natural light	215-318
Exhibition (1)-Natural light+Artificial light	383-476
Exhibition (3)-Natural light+Artificial light	221-505
Stairs (Semi-Shaded)	1214
Shaded area between buildings	943

Table 4: The manual simulation for illuminance at Emirate Fine Arts Society Museum

Area	Illuminance (lux)
Main court	414
Exhibition (Natural light)	592
Exhibition (Artificial light)	350
Very inside exhibition (No natural light)	182-185
Artificial light for photos	362
Media area (Projector)	355



Fig. 13: Emirate Fine Arts Society's yellowish courtyard

Fine Arts Society (Annual Photography Exhibition). The media room will be directly to the right side which is a closed room with very tiny windows to meet the needs of darkness for projectors presenting. The courtyard is to be at the left side and it is shaded-unlike Bait Al-Shamesi Museum's courtyard- however, the shading device is so yellowish (Fig. 13), though it solves the problem of direct sun-light but it is still affecting the aesthetic of space and doesn't feel comfortable when entering the courtyard. The annual photography exhibition is designed as two narrow corridors taking the L-Shape (Fig.14).

Illuminance measurements: As a part of the site visit, measuring illuminance manually using Anemometer (LM-8000A) was a starter to the analysis and detecting lighting problems at the museums (Table 3 and 4).

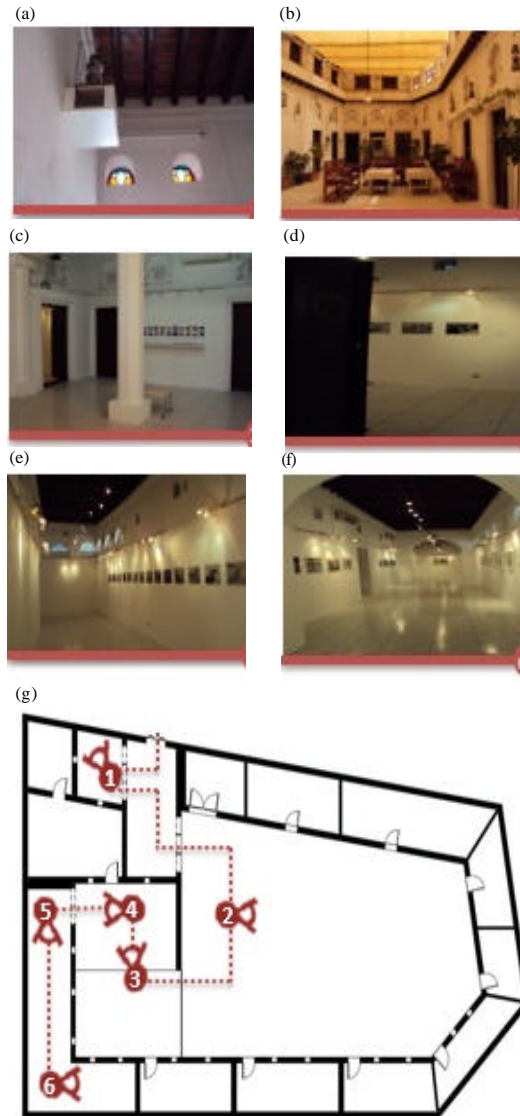


Fig. 14a-g): Emirate Fine Arts Society's sequence of space

Analysis

Windows and openings: Traditional elements should be respected even when we renovate an old building, because the people at that time relied on try and error system until they found the environment that suits the human comfort. Moreover, local people at the United Arab Emirates cares a lot about privacy and that is why they always use thick engraved and carved windows which should be considered to get an in-direct amount of natural-lighting.

The existing condition of Bait Al-Shamesi Museum shows a lack of natural lighting inside the exhibitions (Fig. 15) which would probably push the building to be an energy consuming building and none sustainable

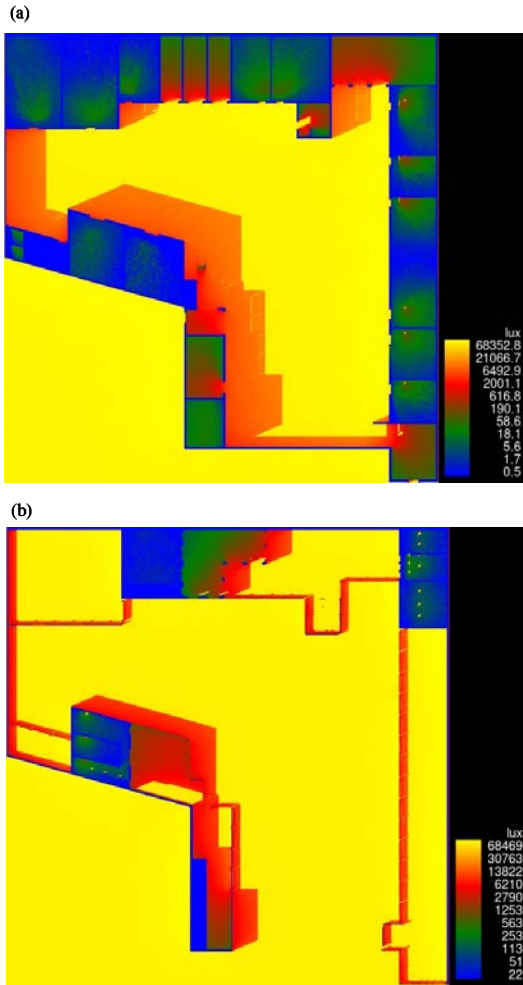


Fig. 15a, b): Illuminance levels (lux) plans of Bait Al-Shamesi Museum using ECOTECT lighting plugin for Revit Architecture 2014 at 12:00 pm, April 12, 2016. Where upper plan is the ground floor plan and the bottom one is the first-floor plan

building, besides being walking under the sun along distance to reach the staircases and go to the exhibitions at the first floor. This problem should be solved by opening the existing windows and allowing the natural light in plus adding a partial shading device above the courtyard using wooden louvers, since, most of heritage shading devices were made by wood.

The existing condition of Emirate Fine Arts Society shows a natural lighting catastrophe where the natural lighting is almost not integrated at all in the whole building (Fig. 16) though the building has several original windows but they are closed, moreover, the courtyard

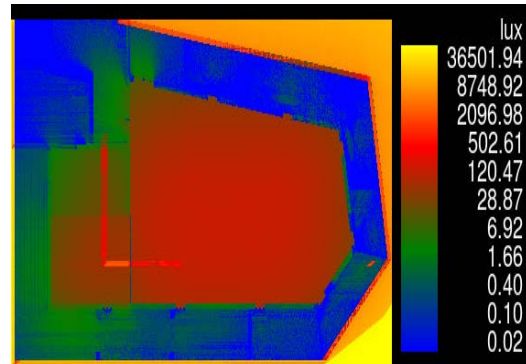


Fig. 16: Illuminance levels (lux) plan of Emirate Fine Arts Society Museum using ECOTECT lighting plugin for Revit Architecture 2014 at 12:00 pm, April 12, 2016

which usually would be a good natural lighting distributor is shaded with a yellowish fabric which prevents light from entering. This problem can be easily solved by replacing this fabric with a wooden louver shading device which will respect the heritage value of the building and solve the lighting problem besides allowing some direct light to get distributed via. the courtyard to the rest of the building.

RESULTS AND DISCUSSION

Results of analysis: After entering the data of the location for both Bait Obaid Al-Shamesi and Emirate Fine Arts Society Museums to Revit Software (Table 5) and by adding the suggested solution of opening the original windows at both buildings and adding the wooden louver for Bait Al-Shamesi Museum and replacing the fabric shading device at Emirate Fine Arts Society Museum, the lighting inside the Bait Al-Shamesi Museum improved as shown in Fig. 17. The light enters through the exterior ancient windows directly to the exhibitions and through the wooden louver shading device to the courtyard and to the exhibitions.

The Emirate Fine Arts Society Museum solution is shown at (Fig.18) where the annual photography exhibition is finally merged with light and the courtyard's fabric shading device is replaced with the wooden louvers (Fig.19).

The second goal of this study was achieved after applying solutions to both cases which was reducing energy consuming at the museums. As shown in Fig. 20 for the Shamesi Museum where (Case 1) represents the

Table 5: The input of location and area for both museums using Revit Architecture 2014 Software

Location	25.3622283935547, 55.3884201049805
Weather station	13.4467
Outdoor temperature	Max: 47°C/min: 8°C
Floor area	483 m ²
Exterior wall area	454 m ²
Average lighting power	9.69 W/m ²

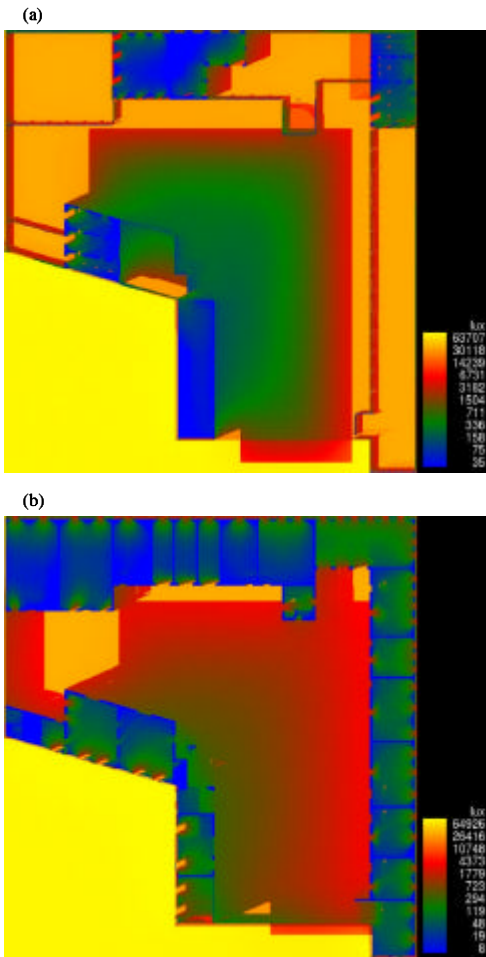


Fig. 17a, b): Illuminance levels (lux) solution plans of Bait Al-Shamesi Museum using ECOTECH lighting plugin for Revit Architecture 2014 at 12:00 pm, April 12. Where top one is the ground floor plan and the bottom one is the first-floor plan

existing case and (Case 2) represents the case after solution where the building used to consume 94% and after treatment it decreased to 44%. The same goal was achieved with the Emirate Fine Arts Society Museum shown on (Fig. 21) where (Case 1) represents the existing case and (Case 2) represents the same

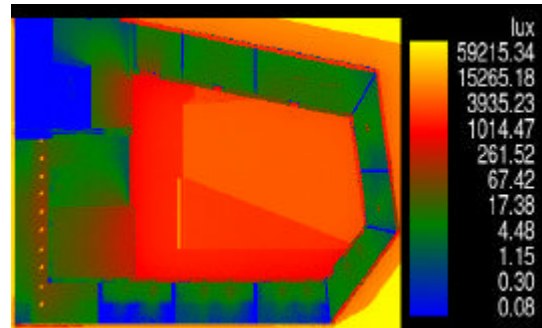


Fig. 18: Illuminance levels (lux) solution plans of Emirate Fine Arts Society Museum using ECOTECH lighting plugin for Revit Architecture 2014 at 12:00 pm, April 12. Where top one is the ground floor plan and the bottom one is the first-floor plan



Fig. 19: Wooden louver example (Gutierrez and Labaki, 2007)

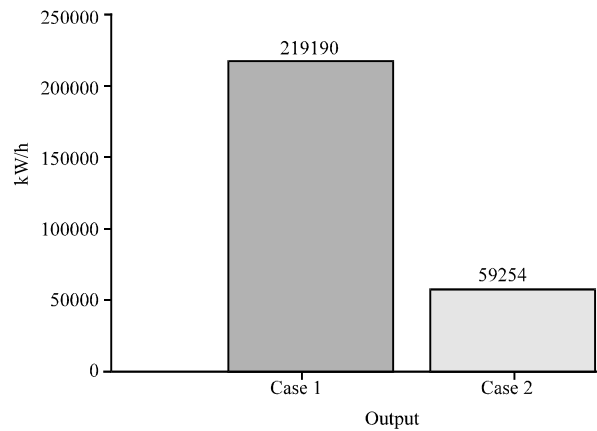


Fig. 20: Output comparison between the annual energy use/cost before and after solution for Bait Obaid Al-Shamesi Museum. Using Revit Architecture 2014 Software, energy analysis plugin

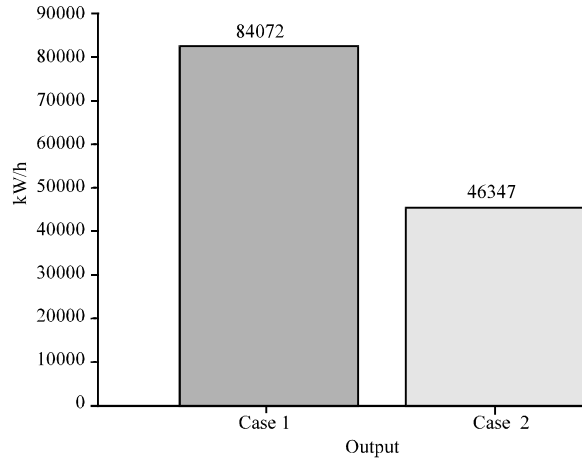


Fig. 21: Output comparison between the annual energy use/cost before and after solution for the Emirate Fine Arts Society Museum. Using Revit Architecture 2014 Software, energy analysis plugin

case after solution where the building used to consume 96% and after treatment it decreased to 25%.

CONCLUSION

Results showed that natural lighting can be integrated in better ways at renovated museums and proved that the natural ancient study deserves to stay applied at the

renovated ancient buildings as they serve the human nature. This study presented a summary of the current state of the lighting design at both Bait Obaid Al-Shamesi Museum and The Emirate Fine Arts Society Museum and displayed a solution for shading devices by using wood and suggested to re-open the existing windows as a solution for the lack of natural lighting problem at exhibitions.

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