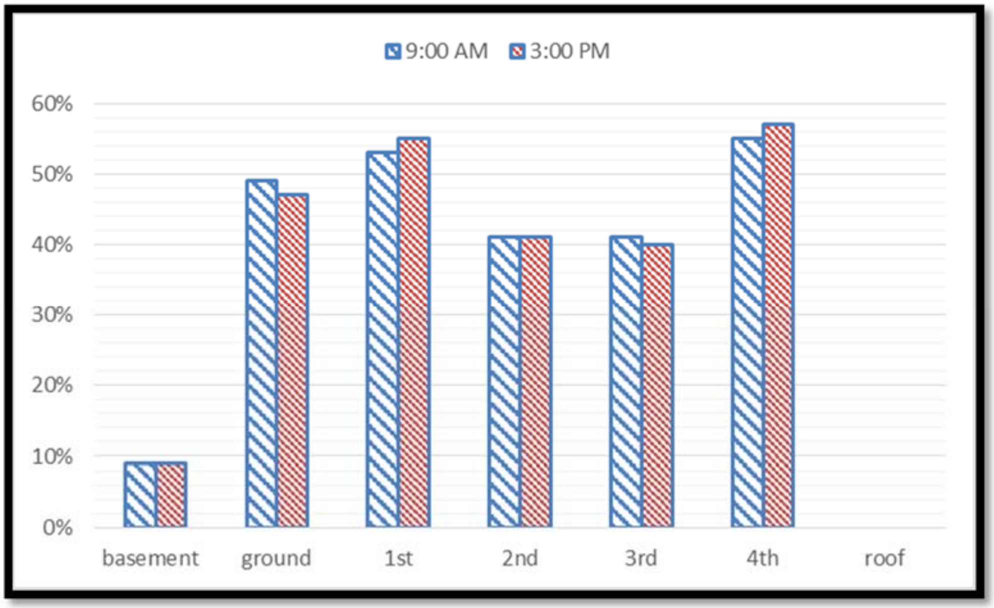

Figure 4-38: percentage of light distribution, floor analyses

4.3.5 Conclusion

Rivet helped in the study to understand the building and highlight the advantages and disadvantages in it in pure engineering view and in a way that can't be matched by any other program such as Auto Cad.

The program was very helpful in showing the mechanism of determining the natural lighting percentages in the building throw the process of utilizing it as a solution in green buildings. Using this feature, buildings A, B, and GS were analyzed giving a highly accurate results in order to determine the additional amount of artificial lighting needed.

In the survey process there were high difficulties in installing all the building components because ether it isn't available in the program families which will result in incomplete schedules and insufficient results, also there was high difficulty to install some components because of the lack of access to its position in the 3-D model.

In addition of that the program is very sensitive to the data entry which could lead to miss leading results if even a small in effective mistake was made during the model building process. For that reasons the survey schedules was made manually which was easier and less sensitivity and has more trustable results. In spite all of that the model is considered a great addition to the study and increase it engineering value.

CHAPTER FIVE

RESULTS and ANALYSES

CHAPTER FIVE
RESULTS AND ANALYSES

5.1 Introduction

This chapter presents detailed results and analyses for evaluating the three buildings of AASTMT (A, B, and GS) towards being upgraded to green building, the main focus of the research was to retrofit the effect of using the available natural lighting system, decreasing the amount of energy consumed via the electrical appliances installed and consequently their effect on the amount of greenhouse gas (GHG) released, in addition to the operating cost when green building polices have been implemented to them.

5.2 Energy consumption

5.2.1 Indoor lighting

Buildings (A, B, and GS) were designed in a way that a natural lighting illuminates most of the rooms and laboratories except for some rooms and corridors that have limited accessibility of natural lighting. Conley (2010) stated that, the greater reliance on natural lighting would reduce the amount of energy consumed, the operating cost, positively affect human health, workplace, academic performance, productivity, and reduce absenteeism by at least 20 %. According to El Din (2011), renewable energy is the best choice for securing energy demand to the next generations with clean environment.

5.2.2 Daylight Harvesting

According to the case study here in, light level detectors could be used to augment natural light with artificial light to maintain a constant lighting level within a space, while reducing energy consumption. This technique is similar to a heating control with a thermostat. Daylight harvesting assumes an area in a building, such as an office, will have a natural lighting source available during the daylight hours (Conley 2010).

5.2.3 Artificial Lights

The buildings contain a large number of artificial lighting fixtures (fluorescent lambs, fluorescent bulbs, and spot lights) that represents the main source of energy consumption which could be reduced as presented in the following sub-sections:

5.2.3.1 Outdoor lighting

For all three buildings, all the lights on the roof and the fence must be replaced with solar panel lights to eliminate their energy consumption by 100%.

5.2.3.2 Building (A)

A complete field survey was made for all the electrical systems in building (A). Recommendations and suggestions were analyzed in order to reduce both energy consumption and cost and increase the reliance on renewable resources through the adoption of green policies and LEED standards as shown in **Figure 5-**1.

1- Ground floor:

After investigating the current operating conditions for the ground floor, it is advised to reduce the lighting period in the reception area to 12 hrs/ by use high efficient electronic ballasts, reduce the number of lighting fixtures illuminated by 30 % since the area is naturally lighted yet there is over use of artificial lighting. This is recommended till 4:00 pm at which all lights could be used to get a good level of lighting in this area in the remaining lighting period.
In addition, the use of electronic lighting sensors to turn the lights on as long as this area is being occupied and switch it off five minutes after the last occupant leaves would help in reducing the amount of energy consumed by nearly 70 % and this would consequently lead to cost reduction.

Since most of the administrational rooms are well naturally lightened, the artificial lighting could be dispensed except in cases of necessity until 4:00 pm with using high efficiency electronic ballasts and using light level detectors to augment natural lighting with artificial lighting to maintain a constant lighting level within a space.
For the rooms which are poorly naturally lightened the artificial lighting will be used but along with the use of high efficient electronic ballasts and rationalizing the consumption, which will reduce the consumption again by about 70 % additionally to the cost as well.
The bathrooms and corridors near the kitchen are poorly naturally lightened and desolated most of the time; hence electronic lighting sensors can be used to turn the lights on as long as this area is in use and switched off five minutes after the last occupant leaves also using the high efficiency electronic ballasts.

This in total will reduce the consumption approximately by 80 % and the cost as well. It is also possible to reducing the number of the lighting fixtures illuminated in the cafeteria by 30% as it is naturally lightened and there is over use of artificial lighting; this is recommended till 4:00 pm when all the lights can be used to provide a good level of lighting in this area in the remaining lighting period besides using high efficiency electronic ballasts to reduce energy consumption by nearly 70 % as well as the cost.

2- Typical floors (1st-4th):

The corridors between the lecture rooms and laboratories are poorly naturally lightened and need artificial lighting source to reduce the energy consumption. Electronic lighting sensors can be used to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves also using the high efficiency electronic ballasts. This in total could reduce the consumption approximately by 50 % and the cost as well. This also could be applied in the bathrooms.

Most of the administrational rooms, lecture rooms, and laboratories are well naturally lightened, so that the artificial lighting could be dispensed except in essential cases until 4:00 pm with using high efficiency electronic ballasts. For the rooms that partially naturally lightened the artificial lighting will be used along with the natural lighting with using the high efficiency electronic ballasts and rationalization of consumption, which will reduce the consumption approximately by 80 % in addition to reducing the operating cost.

3- Stairs:

Lighting can be dispensed except when obligatory after 4:00 pm using high efficiency electronic ballasts which will reduce the consumption approximately by 80 % as well as minimizing the cost.

4- Air conditioning

The air conditioning systems should meet the compliance of the occupants with a high level of energy, cost efficiency and to be environmentally friendly. In order to get the higher performance level for the air conditioning system in buildings the compressors should be covered with a steel frame to protect it from the natural conditions.

To reduce the reliance on them, the green roof techniques could be very effective in chilling the indoor atmosphere. Additionally, using high performance insulation materials as glass mineral wool, rock mineral wool, and double glass windows will reduce the heat losses and maintain the indoor temperature with comfortable level and reduce the system operating hours. In case of applying the previous recommendations this will result in consumption reduction approximately by 50 % and reducing cost as well.

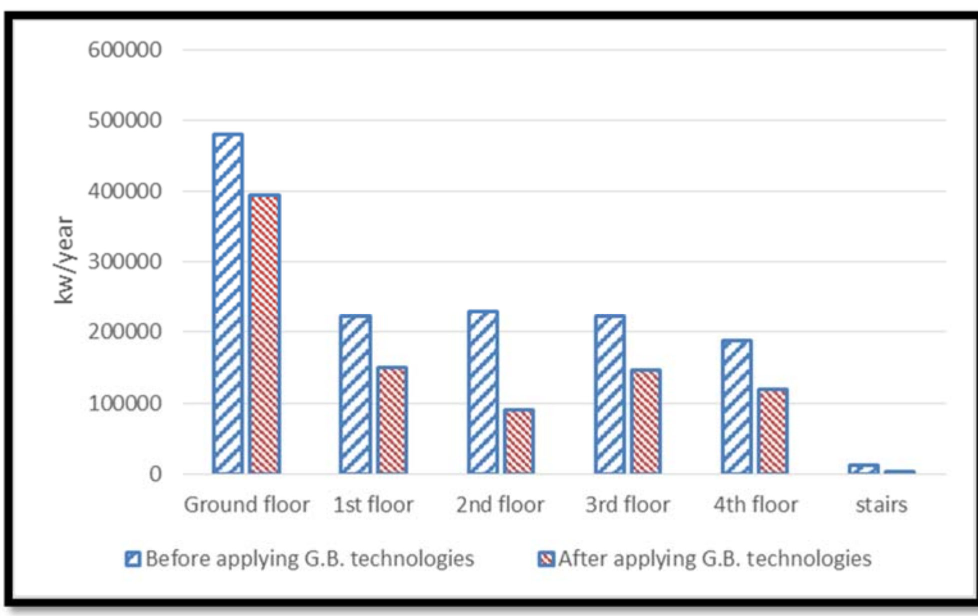

Figure 5-1 Building A: energy consumption before and after applying G.B. technologies

5.2.3.3Building (B)

A complete field survey was made for all the electrical systems in building (B). Recommendations and suggestions were analyzed in order to reduce energy consumption and cost as well and increase the reliance on renewable resources through the adoption of green policies and LEED standards as presented in **Figure 5-**2.

1- Basement:

Natural lighting in this floor is poor in general with some exceptions. The artificial lights will be the main source of lighting using the high efficient electronic ballasts to rationalize the electricity consumption. In the reception area and the corridors, electronic lighting sensors can be used to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves. All these practices aim to reduce electrical consumption and operating costs. The artificial lighting could be reduced in the drawing halls since the natural lighting level is good there, hence by using the light level detectors to augment natural light with artificial light to maintain a constant lighting level within a space. The rest of the rooms suffer from poor natural lighting; consequently they shall rely on artificial lighting. This will lead to reduction in energy consumption approximately by 50 % in addition to reducing the operating cost.

2- Ground floor:

After investigating the current operating conditions for the ground floor, it is advised to reduce the lighting period in the reception area to 10 hrs/d , use high efficiency electronic ballasts, reduce the number of lighting fixtures illuminated by 30 % since the area is naturally lightened yet there is over use of artificial lighting. This is recommended till 4:00 pm at which all lights could be used to get a good level of lighting in this area in the remaining lighting period. In addition, the use of electronic lighting sensors to turn the lights on as long as this area is being occupied and switched off five minutes after the last occupant leaves would help in reducing the amount of energy consumed by nearly 70 % and this would consequently lead to cost reduction.

Since most of the administrational rooms are well naturally lightened, the artificial lighting could be dispensed except in cases of necessity until 4:00 pm with using high efficiency electronic ballasts and using light level detectors to augment natural lighting with artificial lighting to maintain a constant lighting level within a space. For the rooms which are poorly naturally lightened the artificial lighting will be used but along with the use of high efficient electronic ballasts and rationalizing the consumption, which will reduce the consumption again by about 70 % additionally to the cost as well.

The bathrooms and corridors near the kitchen are poorly naturally lightened and desolated most of the time; hence electronic lighting sensors can be used to turn the lights on as long as this area is in use and switched off five minutes after the last occupant leaves also using the high efficiency electronic ballasts. This in total will reduce the consumption approximately by 80 % and reduce the cost as well.

It is also possible to reduce the number of the lighting fixtures illuminated in the cafeteria by 30% as it is naturally lightened since there is over use of artificial lighting; this is recommended till 4:00 pm when all the lights can be used to provide a good level of lighting in this area in the remaining lighting period besides using high efficiency electronic ballasts to reduce energy consumption by nearly 50% as well as minimizing the cost.

3- Typical floors (1st-4th):

The corridors between the lecture rooms are poorly naturally lightened and need artificial lighting source. To reduce the energy consumption electronic lighting sensors can be used to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves also using the high efficiency electronic ballasts. This in total could reduce the consumption approximately by 50 percent and the cost as well. This also could be applied in the bathrooms.

Most of the administrational rooms, lecture rooms, and laboratories are well naturally lightened, hence the artificial lighting can be dispensed except in cases of necessity until 4:00 pm with using high efficiency electronic ballasts.

For the rooms that partially naturally lightened the artificial lighting will be used along with the natural lighting using the high efficiency electronic ballasts and rationalization of consumption, which will reduce the consumption approximately by 70 percent and the cost as well.

4- Stairs:

As the stairs are poorly naturally lightened, the artificial lighting must be used to get an acceptable level of lighting using high efficient electronic ballasts and electronic lighting sensor for each floor to turn the lights on as long as this stair is used, and switched off five minutes after the last occupant leaves. This shall reduce the electrical consumption approximately by 30 % and the cost shall thus be reduced.

5- Air conditioning

The air conditioning systems should meet the compliance of the occupants with a high level of energy, cost efficiency and to be environmentally friendly. In order to get the higher performance level for the air conditioning system in buildings the compressors should be covered with a steel frame to protect it from the natural conditions.

To reduce the reliance on them, the green roof techniques could be very effective in chilling the indoor atmosphere. Additionally, using high performance insulation materials as glass mineral wool, rock mineral wool, and double glass windows will reduce the heat losses and maintain the indoor temperature with comfortable level and reduce the system operating hours.

In case of applying the previous recommendations this will result in consumption reduction approximately by 50 % and reducing cost as well.

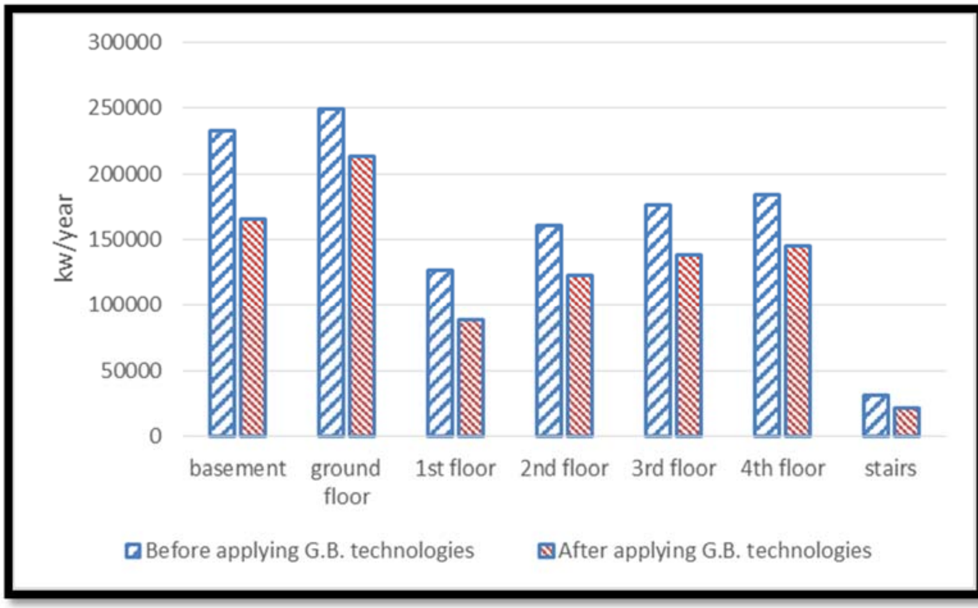

Figure 5-2 Building B: energy consumption before and after applying G.B.

5.2.3.3 Building (GS)

A complete field survey was made for all the electrical systems in building (GS). Recommendations and suggestions were analyzed in order to reduce energy consumption and cost as well and increase the reliance on renewable resources through the adoption of green policies and LEED standards as illustrated in **Figure 5-**3.

1- Basement:

Natural lighting in this floor is poor in general with some exceptions. The artificial lights would be the main source of lighting with using the high efficiency electronic ballasts to rationalize the electricity consumption. In the reception area and the corridors, electronic lighting sensors can be used to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves. All these practices aim to reduce electrical consumption and operating costs.

Reducing the number of the lighting fixtures illuminated in the cafeteria by 30% as it is naturally lightened and there is over use of artificial lighting and this is recommended till 4:00 pm when all the lights can be used to get a good level of lighting in this area in the remaining lighting period which will lead to reduction in energy consumption approximately by 50 % in addition to reducing the cost. The high efficiency electronic ballasts shall be used with all the artificial lights.

2- Ground floor:

After investigating the current operating conditions for the ground floor, it is advised to reduce the lighting period in the reception area to 10 hrs/d, use high efficiency electronic ballasts, reduce the number of lighting fixtures illuminated by 30 % sinc the area is naturally lightened yet there is over use of artificial lighting.

This is recommended till 4:00 pm at which all lights could be used to get a good level of lighting in this area in the remaining lighting period. In addition, the use of electronic lighting sensors to turn the lights on as long as this area is being occupied and switched off five minutes after the last occupant leaves would help in reducing the amount of energy consumed by nearly 70 % and this would consequently lead to cost reduction.

Since most of the administrational rooms are well naturally lightened, the artificial lighting could be dispensed except in cases of necessity until 4:00 pm with using high efficiency electronic ballasts and using light level detectors to augment natural lighting with artificial lighting to maintain a constant lighting level within a space.

For the rooms which are poorly naturally lightened the artificial lighting will be used but along with the use of high efficient electronic ballasts and rationalizing the consumption, which will reduce the consumption again by about 70 % additionally will reduce the cost as well.

The bathrooms and corridors near the kitchen are poorly naturally lightened and desolated most of the time; hence electronic lighting sensors can be used to turn the lights on as long as this area is in use and switched off five minutes after the last occupant leaves also using the high efficiency electronic ballasts. This in total will reduce the consumption approximately by 50 % and minimizing the cost.

3- Typical floors (1st-4th):

The corridors between the lecture rooms and laboratories are poorly naturally lightened and need artificial lighting source to reduce the energy consumption electronic lighting sensors can be used to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves also using the high efficient electronic ballasts.

This in total will reduce the consumption approximately by 50 % as well as the cost. This also could be applied in the bathrooms.

Most of the administrational rooms, lecture rooms, and laboratories are well naturally lightened, so that the artificial lighting can be dispensed except in cases of necessity until 4:00 pm using high efficient electronic ballasts.

For the rooms that partially naturally lightened the artificial lighting will be used along with the natural lighting using the high efficient electronic ballasts and rationalization of consumption, which could reduce the consumption approximately by 70% additionally reduce the cost as well.

In the reception area using high efficient electronic ballasts, also reducing the number of the lighting fixtures illuminated by 30 % as the area is naturally lightened and there is over use of artificial lighting and this is recommended till 4:00 pm when all the lights can be used to get a good level of lighting in this area in the remaining lighting period also using electronic lighting sensors to turn the lights on as long as this area is used and switched off five minutes after the last occupant leaves which lead to reduction in energy consumption approximately by 50 % and minimizing the cost.

4- Stairs:

As the stairs are poorly naturally lightened the artificial lighting must be used to get an acceptable level of lighting using high efficient electronic ballasts and electronic lighting sensor for each floor to turn the lights on as long as this stair is used and switched off five minutes after the last occupant leaves which will reduce the consumption approximately by 30 percent as well as the cost.

5- Air conditioning

The air conditioning systems should meet the compliance of the occupants with a high level of energy, cost efficiency and to be environmentally friendly. In order to get the higher performance level for the air conditioning system in buildings the compressors should be covered with a steel frame to protect it from the natural conditions.

To reduce the reliance on them, the green roof techniques could be very effective in chilling the indoor atmosphere. Additionally, using high performance insulation materials as glass mineral wool, rock mineral wool, and double glass windows will reduce the heat losses and maintain the indoor temperature with comfortable level and reduce the system operating hours.

In case of applying the previous recommendations this will result in consumption reduction approximately by 50 % and minimizing the cost.

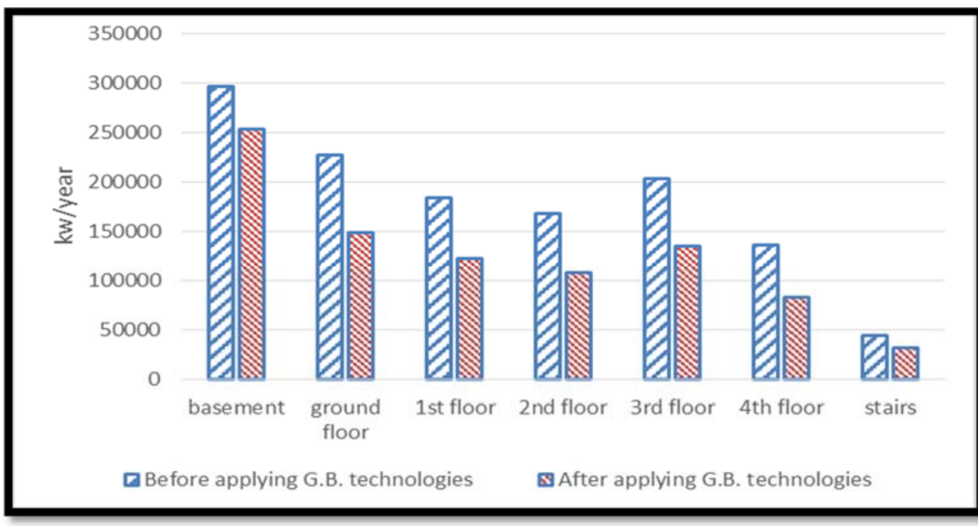

Figure 5-3 Building GS: energy consumption before and after applying G.B.

5.2.4 Comparing Amount of Energy Reduced in the Three Buildings

By comparing the field survey results and the green building recommendations it was shown that:

- The energy consumption in building A is greater than buildings B, and GS because of the absorptive capacity and area of each building.
- The amount of reduction in building A is greater than buildings B, and GS as its wide windows makes most of its rooms naturally lightened.

- Building GS is relatively better than building B in amount of energy reduced as the ground floor and typical floors in building B have lower reduction percentage than building GS.
- Through the previous results and the energy reduction percentages it is obvious that the academy could make use of adoptee green building practices to reduce the amount of energy being consumed.

Comparisons for the amount of Energy Reduced upon Applying green building technologies for buildings A – B – Gs are illustrated in **Figures 5-4** and **5-5**

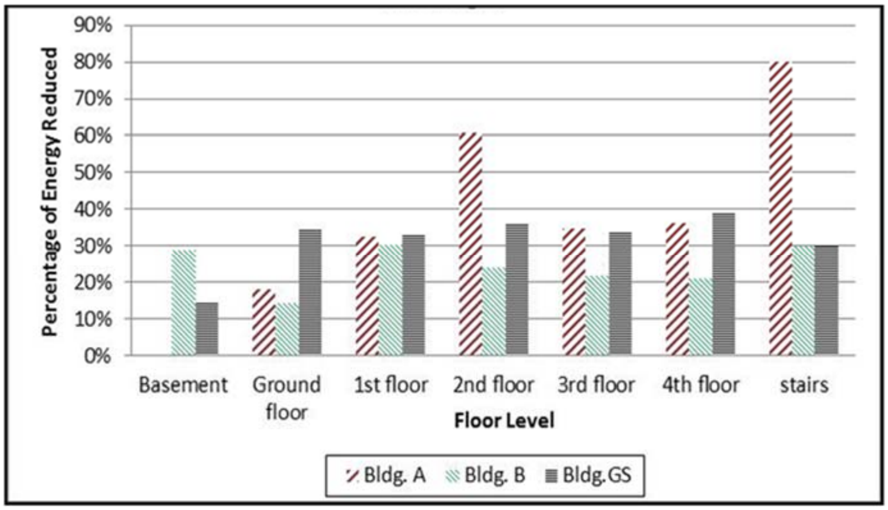

Figure 5-4 Percentage of energy reduction after applying green building technologies

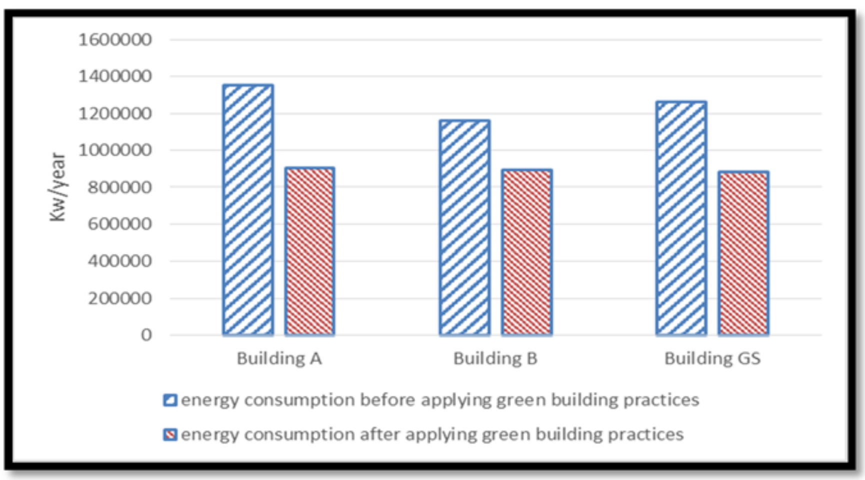

Figure 5-5 Total energy consumption before and after applying green building technologies

5.3 Greenhouse gas emissions

The study revealed that the greenhouse gas emission could be reduced by reducing the energy consumption through relating the amount of gas expressed by CO_2 and the electricity generated by the formula **1kw =1.68 lb CO_2** of (Distillate Oil). By applying this on the collected data from the field survey.

5.3.1 Building A

1. The amount of CO_2 results from the AASTMT building A electricity usage before the application of sustainability practices:

- Ground floor : 480075.8 kw/year*1.68 lb/kw = 806527.4 lb/year
- 1st floor : 221808.6 kw/year*1.68 lb/kw = 372638.4 lb/year
- 2nd floor : 229357 kw/year*1.68lb/kw = 385319.7 lb/year
- 3rd floor : 222759.6 kw/year*1.68lb/kw = 374236.1 lb/year
- 4th floor : 187400.5 kw/year*1.68lb/kw = 314832.9 lb/year
- stairs : 11923.2 kw/year*1.68lb/kw = 20030.98 lb/year

  Total = 2273586 lb/year

2. The amount of CO_2 results from the AASTMT building A electricity usage after the application of sustainability practices:

- Ground floor : 394072.9 kw/year*1.68 lb/kw = 662042.5 lb/year
- 1st floor : 150193.6 kw/year*1.68 lb/kw = 372638.4 lb/year
- 2nd floor : 229357 kw/year*1.68lb/kw = 252325.3 lb/year
- 3rd floor : 90527.95 kw/year*1.68lb/kw = 152087 lb/year
- 4th floor : 119522.4 kw/year*1.68lb/kw = 200797.6 lb/year
- stairs : 2384.64 kw/year*1.68lb/kw = 4006.195 lb/year

  Total = 1516136 lb/year

The result above shows that using the recommended practices can reduces the amount of gas emissions by 757450.1 lb/year equal to 33.31% **as shown in Table 5-1 and Figure 5-6**

Table (5-1) Building (A) Greenhouse gas emissions before and after the application of sustainability practices

	Before the application of sustainability practices	**After the application of sustainability practices**	**Percentage Reduction (%)**
floor	**Amount of CO_2 produced (lb/year)**	**Amount of CO_2 produced (lb/year)**	
ground	806527.4	662042.5	17.91
1st	372638.4	252325.3	32.28
2nd	385319.7	152087	60.52
3rd	374236.1	244877.6	34.56
4th	314832.9	200797.6	36.22
stairs	20030.98	4006.195	80
total	2273586	1516136	33.31

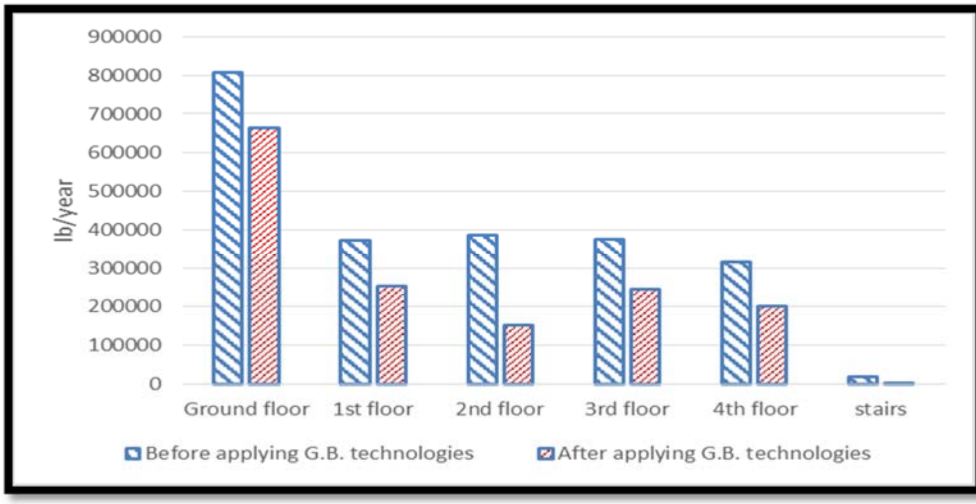

Figure 5-6 Amount of CO_2 produced in building A before and after the application of sustainability practices

5.3.2 Building B

1. The amount of Co_2 results from the AASTMT building B electricity usage before the application of sustainability practices:

- Basement : 232892.8 kw/year*1.68 lb/kw = 391259.8 lb/year
- Ground floor : 249070.6 kw/year*1.68 lb/kw = 418438.5 lb/year
- 1st floor : 126934.1 kw/year*1.68 lb/kw = 213249.3 lb/year
- 2nd floor :160802.9 kw/year*1.68lb/kw = 270148.8 lb/year
- 3rd floor : 176131.7 kw/year*1.68lb/kw = 295901.2 lb/year
- 4th floor : 183691.7 kw/year*1.68lb/kw = 308602 lb/year
- stairs : 31311.36 kw/year*1.68lb/kw = 52603.08 lb/year

Total = 1950203 lb/year

2. The amount of Co_2 results from the AASTMT building B electricity usage after the application of sustainability practices:

- Basement : 165826.2 kw/year*1.68 lb/kw = 278588 lb/year
- Ground floor : 213192.1 kw/year*1.68 lb/kw = 358162.7lb/year
- 1st floor : 88402.56 kw/year*1.68 lb/kw = 148516.3 lb/year
- 2nd floor : 122608.3 kw/year*1.68lb/kw = 205982 lb/year
- 3rd floor : 137937.1 kw/year*1.68lb/kw = 231734.4lb/year
- 4th floor : 145497.1 kw/year*1.68lb/kw = 244435.2 lb/year
- stairs : 21917.95 kw/year*1.68lb/kw = 36822.16 lb/year

Total = 1504241 lb/year

The result above shows that using the recommended practices can reduces the amount of gas emissions by 445962.1 lb/year equal to 22.86% as shown in **Table 5-2** and **Figure 5-7**

Table (5-2) Building (B) Greenhouse gas emissions before and after the application of sustainability practices

	Before the application of sustainability practices	After the application of sustainability practices	Percentage Reduction (%)
Floor	Amount of CO_2 produced (lb/year)	Amount of CO_2 produced (lb/year)	
Basement	58223.19	41456.55	28.79
Ground	62267.64	53298.02	14.40
1st	31733.52	22100.64	30.35
2nd	40200.72	30652.08	23.75
3rd	44032.92	34484.28	21.68
4th	45922.92	36374.28	20.79
stairs	7827.84	5479.488	30
total	1950203	1504241	22.86

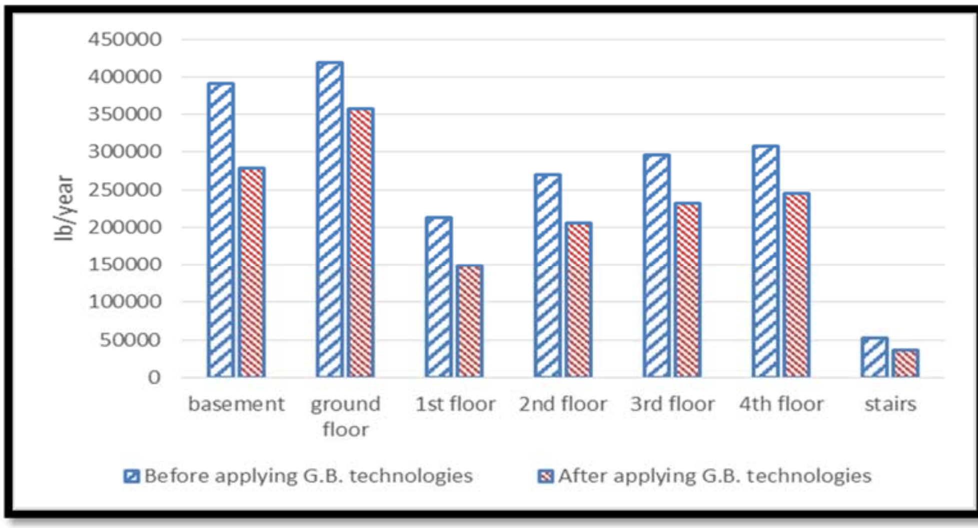

Figure 5-7 Amount of CO_2 produced in building B before and after the application of sustainability practices

5.3.3 Building GS

1. The amount of Co_2 results from the AASTMT building GS electricity usage before the application of sustainability practices:

- Basement : 296668 kw/year*1.68 lb/kw = 498402.2 lb/year
- Ground floor : 227530.9 kw/year*1.68 lb/kw = 382251.9 lb/year
- 1st floor : 183597.6 kw/year*1.68 lb/kw = 308444 lb/year
- 2nd floor :167678.4 kw/year*1.68lb/kw = 281699.7 lb/year
- 3rd floor : 203971.6 kw/year*1.68lb/kw = 342672.2 lb/year
- 4th floor : 136325.5 kw/year*1.68lb/kw = 229026.9 lb/year
- stairs : 44884.8 kw/year*1.68lb/kw = 75406.46 lb/year

  Total = 2117902.75 lb/year

2. The amount of CO_2 results from the AASTMT building GS electricity usage after the application of sustainability practices:

- Basement : 253178.5 kw/year*1.68 lb/kw = 425339.9 lb/year
- Ground floor : 148929.2 kw/year*1.68 lb/kw = 250201lb/year
- 1st floor : 123209.8 kw/year*1.68 lb/kw = 206992.4 lb/year
- 2nd floor : 107809 kw/year*1.68lb/kw = 181119.1 lb/year
- 3rd floor : 135781.8 kw/year*1.68lb/kw = 228113.4lb/year
- 4th floor : 82834.32 kw/year*1.68lb/kw = 139161.7 lb/year
- stairs : 31419.36 kw/year*1.68lb/kw = 52784.52 lb/year

  Total = 1483712 lb/year

The result above shows that using the recommended practices can reduces the amount of gas emissions by 634190.7 lb/year equal to 29.94% **as shown in Table 5-3 Figure 5-8**

Table (5-3) Greenhouse gas emissions before and after the application of sustainability practices

	Before the application of sustainability practices	**After the application of sustainability practices**	**Percentage Reduction (%)**
floor	**Amount of CO_2 produced (lb/year)**	**Amount of CO_2 produced (lb/year)**	
Basement	74166.99	63294.62	14.65
ground	56882.73	37232.3	34.54
1st	45899.4	30802.45	32.89
2nd	41919.6	26952.25	35.7
3rd	50992.89	33945.44	33.43
4th	34081.38	20708.58	39.23
stairs	11221.2	7854.84	30
total	2117902.75	1483712	29.94

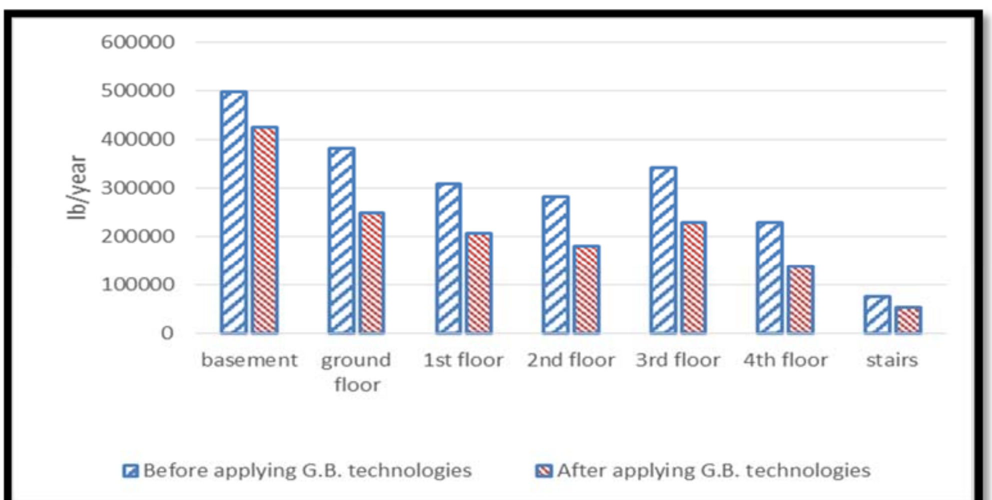

Figure 5-8 Amount of CO_2 produced in building GS before and after the application of sustainability practices

The previous results are summaries in **Table 5-4**

Table (5-4) Amount of CO_2 produced before and after the application of sustainability practices

	Before the application of sustainability practices	**After the application of sustainability practices**	**Percentage Reduction (%)**
Building	**Amount of CO_2 produced (lb/year)**	**Amount of CO_2 produced (lb/year)**	
A	2273586.336	1516136.187	33.31
B	1950202.8	1504241	22.86
GS	2117902.75	1483712.01	29.94
Total	**6341691.88**	**4504088.897**	28.97

Comparisons for the amount of GHG's emissions Reduced upon Applying green building technologies for buildings A – B – Gs are shown in **Figures 5-9** and **5-10**

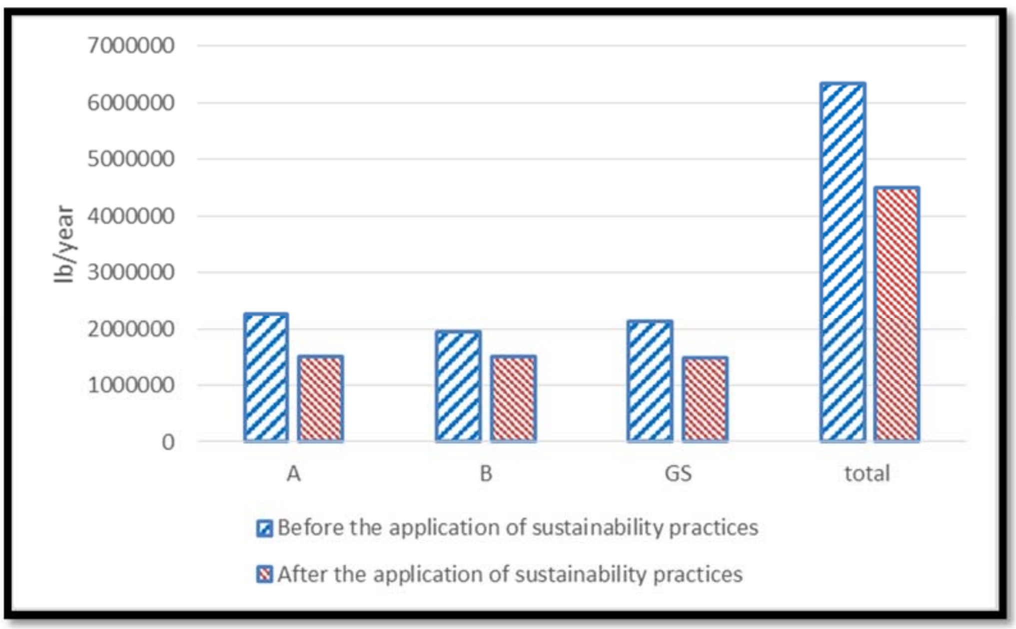

Figure 5-9 Amount of CO_2 produced before and after the application of sustainability practices

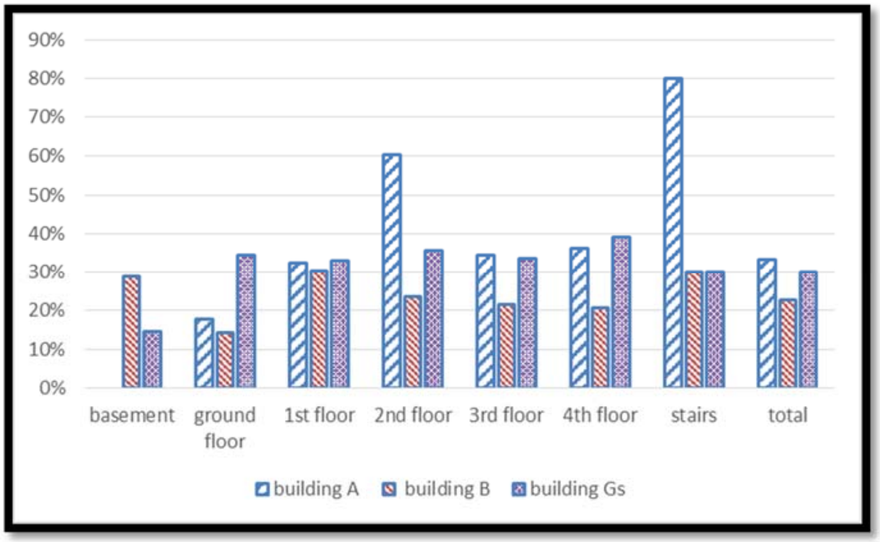

Figure 5-10 Percentage of Co_2 emissions reduction after applying green building technologies

According to the previous results it was concluded that the application of green building polices and the resulted energy reduction leads to reducing the amount of CO_2 produced by 33.31% in building A, 22.86% in building B, and 29.94% in building GS equal to 28.97% for the here buildings which emphasis on the value of adopting green building polices and the usage of renewable resources on the environment.

5.4 Operating cost

This point has been studied from many views and obtaining the amount of energy that can be reduced via using the renewable energy systems along with sustainability practices with respect to LEED standards and results are shown in **Tables 5-5** to **5-8** and **Figure 5-11** to **5-15**:

5.4.1 Building A

Table (5-5) Building (A) operating cost before and after the application of sustainability practices

	Before the application of sustainability practices		After the application of sustainability practices		
floor	**Consumption kw/year**	**Cost LE/year**	**Consumption kw/year**	**Cost LE/year**	**Reduction LE/year**
ground	480075.8	120019	394072.9	98518.24	21500.72
1st	221808.6	55452.15	150193.6	37548.41	17903.74
2nd	229357	57339.24	90527.95	22631.99	34707.25
3rd	222759.6	55689.9	145760.5	36440.12	19249.78
4th	187400.5	46850.13	119522.4	29880.59	16969.54
stairs	11923.2	2980.8	2384.64	596.16	2384.64
Total	1353325	338331.3	902462	225615	112715.5

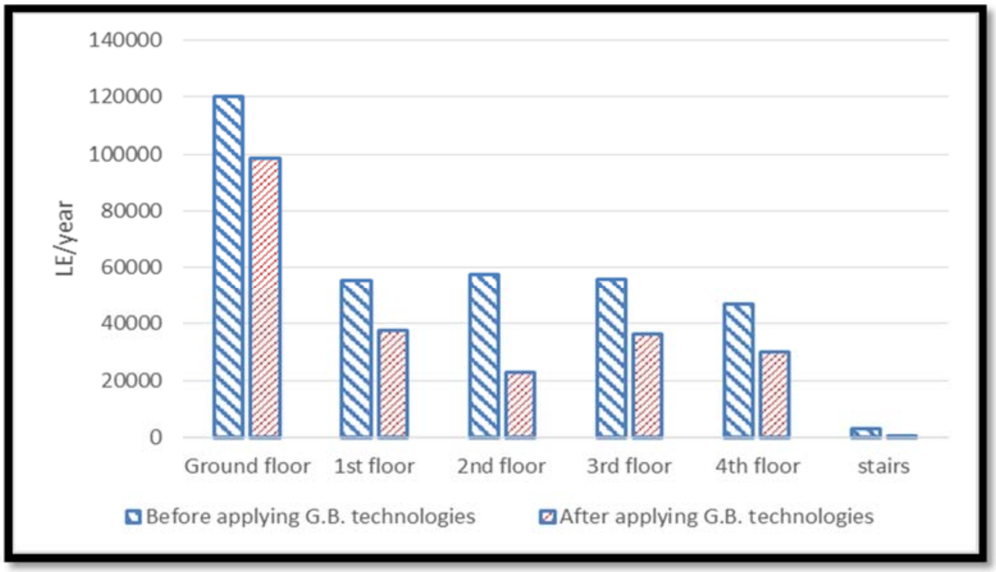

Figure 5-11 Building A: operating cost before and after the application of sustainability practices

5.4.2 Building B

Table (5-6) building B operating cost before and after the application of sustainability practices

	Before the application of sustainability practices		After the application of sustainability practices		
floor	**Consumption kw/year**	**Cost LE/year**	**Consumption kw/year**	**Cost LE/year**	**Reduction LE/year**
basement	232892.8	58223.19	165826.2	41456.55	16766.64
ground	249070.6	62267.64	213192.1	53298.02	8969.616
1st	126934.1	31733.52	88402.56	22100.64	9632.88
2nd	160802.9	40200.72	122608.3	30652.08	9548.64
3rd	176131.7	44032.92	137937.1	34484.28	9548.64
4th	183691.7	45922.92	145497.1	36374.28	9548.64
stairs	31311.36	7827.84	21917.95	5479.488	2348.352
total	1160835	290208.8	895381.4	223845.3	66363.41

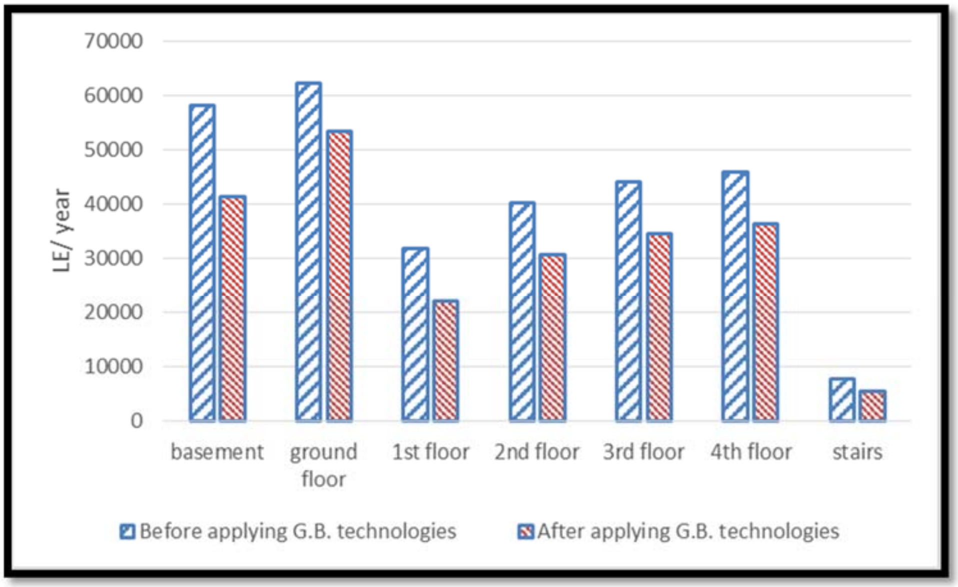

Figure 5-12 Building B operating cost before and after the application of sustainability practices

5.4.3 Building GS

Table (5-7) Building GS operating cost before and after the application of sustainability practices

	Before the application of sustainability practices		After the application of sustainability practices		
floor	**Consumption kw/year**	**Cost LE/year**	**Consumption kw/year**	**Cost LE/year**	**Reduction LE/year**
basement	296668	74166.99	253178.496	63294.62	10872.37
ground	227530.9	56882.73	148929.192	37232.3	19650.43
1st	183597.6	45899.4	123209.784	30802.45	15096.95
2nd	167678.4	41919.6	107808.984	26952.25	14967.35
3rd	203971.6	50992.89	135781.776	33945.44	17047.45
4th	136325.5	34081.38	82834.32	20708.58	13372.8
stairs	44884.8	11221.2	31419.36	7854.84	3366.36
total	1260656	315164.1	883161.912	220790.5	94373.62

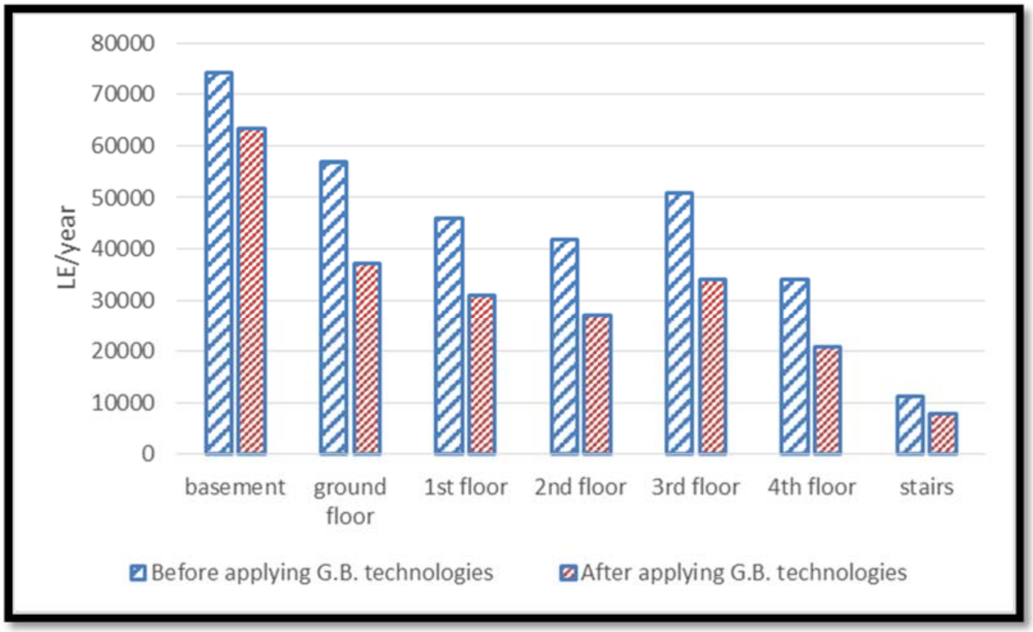

Figure 5-13 Building GS: operating cost before and after the application of sustainability practices

Comparisons for the operating cost reduced upon Applying green building technologies for buildings A – B – Gs are shown in **Table 5-8** and **Figures 5-14** and **5-15**

Table (5-8) Operating cost before and after the application of sustainability practices

	Before the application of sustainability practices		After the application of sustainability practices		
Building	**Consumption kw/year**	**Cost LE/year**	**Consumption kw/year**	**Cost LE/year**	**Reduction LE/year**
A	1353325.2	338331.3	902462.016	225615.504	112715.796
B	1160835	290208.75	895381.368	223845.342	66363.408
GS	1260656.4	315164.1	883161.912	220790.478	94373.622
Total	3774816.6	943704.15	2681005.296	670251.324	273452.826

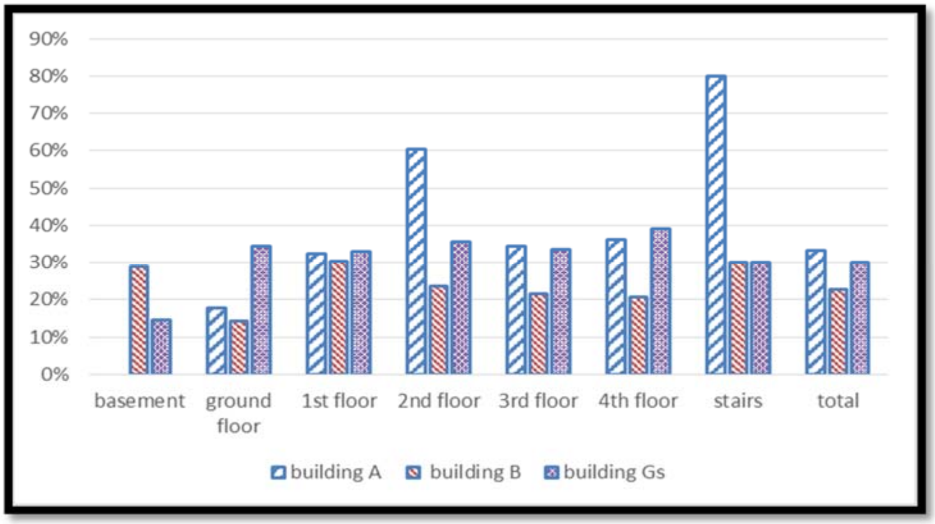

Figure 5-14 Percentage of operating cost reduction after applying green building technologies

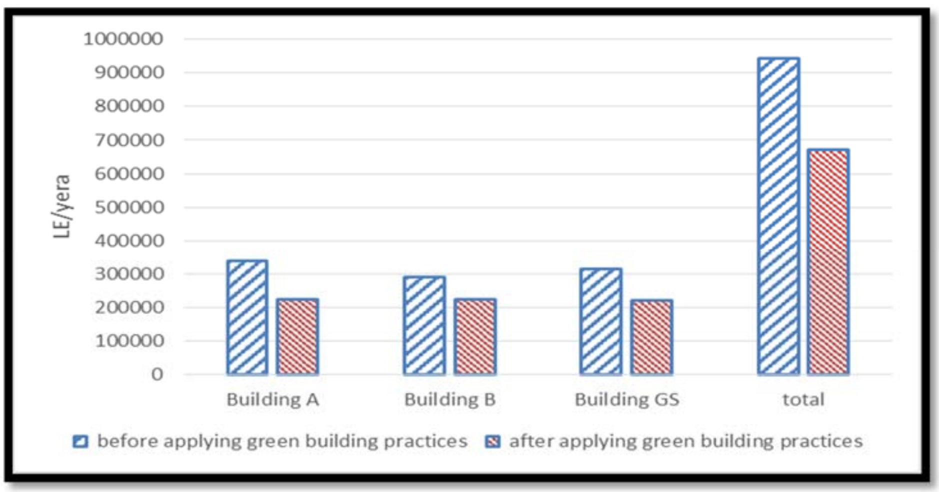

Figure 5-15 Operating cost before and after the application of sustainability practices

Based on the previous results the cost reduction in building A is 112715.796 LE/year، building B is 66363.408 LE/year، and building GS is 94373.622 LE/year totally equal to 273452.86 LE/year, which illustrate the financial benefits that can be gotten by the application of green building practices

5.5 Conclusion

The above results and analyses showed the possibility of decreasing the amount of energy consumed via the electrical appliances installed and consequently their effect on the amount of greenhouse gas (GHG) released in addition to the operating cost when green building polices are implemented to them.

CHAPTER SIX

CONCLUSION
&
RECOMMENDATIONS

CHAPTER SIX
CONCLUSION and RECOMMENDATIONS

6.1 Introduction

The main aim of this research focus on identifying green and sustainable design building features, evaluating the applicability of green features in buildings (A, B, and GS), conducting a lifecycle cost analyses associated with the implementation of each green feature, evaluating how do current policies make use of the key stakeholders in the green building system to encourage the development, and making preliminary recommendations to the stakeholders regarding the implementation and effectiveness of each green building feature at AASTMT.

The site visit, literature review, field survey, questioners and interviews, mathematical equations, BIM software-natural lighting analyses, and comparisons showed that the implement of green building techniques could enhance the operating performance level of those buildings consequently minimizing energy consumption which would directly decreasing the amount of CO_2 emissions and consequently the operating cost. Those are summarized in the following lines:

6.2 Conclusions

- The AASTMT buildings are in a good condition with respect to the environmental compatibility.

- The buildings are mostly well ventilated and naturally lightened, and the spaces within the building designed to give the occupant a comfortable atmosphere to work with.

- The financial benefits of applying green building technologies in the AASTMT buildings (A, B, GS) represents by reduce the operating cost include lower energy, and lower maintenance costs through the high efficient usage of the nonrenewable resource and the exploitation of the renewable ones.

- The energy consumption reduction in building A was from 1353325.2kw/year to 902462.016kw/year equal to 33.31% and in the reduction in greenhouse gas emissions was from 2273586.336lb/year to 1516136.187lb/year equal to 33.31 and the operating cost from 315164.1 LE/year to 220790.478LE/year equal to 94373.622 LE/year

- The energy consumption reduction in building B was from 1160835kw/year to 895381.368kw/year equal to 22.86% and in the reduction in greenhouse gas emissions was from 1950202.8lb/year to 1504241lb/year equal to 22.86% and the operating cost from 290208.75 LE/year to 223845.342LE/year equal to 66363.408 LE/year

- The energy consumption reduction in building GS was from 1260656.4kw/year to 883161.912 kw/year equal to 29.94% and in the reduction in greenhouse gas emissions was from 2117902.756lb/year to 1483712.01lb/year equal to 29.94% and the operating cost from 338331.3 LE/year to 225615.504LE/year equal to 112715.796 LE/year

- The energy consumption can be reduced noticeably from 3,145,680 kw / year to 2,234,171 kw/year, about 29% decrease.

- The application of green building practices will result in reducing operating cost by 273452.826 LE/year.

- The amount of GHG's emission decreased from 6341691.88 lb/year to 4504088.897 lb/year equal to1837602.991 lb/year about 28.97%.

- The implementation of green building practices became imperative to face the current challenges facing the world. It is mandatory for the governments to put development plans to encourage people, designers, and businessmen to adopt green building practices in their life due to the amount of environmental and economic benefits the green building provide.

6.3 Recommendations

The research could be extended to include:

- Detailed study about water quality, treatment and reuse methods.
- Analyses for waste and the proper way to reuse and recycle it.
- The degree of satisfaction of the occupants about the buildings and how they are affected by them in terms of health and productivity.
- Life cost analysis for the buildings to clarify the mount of financial benefit could be gained by adopting the sustainability practices.
- Applying the obtained results on the private universities and school in Egypt.

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APPENDIX -A

(Building A)

Field Survey Data

Table 1 (Building A Ground floor)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 100cm	274	23	6	10	8	0.184	5.52	1512.48
fluorescent bulb	216	26	4	12	6	0.156	4.68	1010.88
fluorescent bulb	151	15	8	12	10	0.15	4.5	679.5
fluorescent bulb	98	36	6	10	8	0.288	8.64	846.72
spotlight	70	40	5	9	6	0.24	4.8	336
fluorescent lamp 40cm	655	15	6	10	8	0.12	2.4	1572
fluorescent lamp 120cm	35	36	6	10	8	0.288	5.76	201.6
plasma TV 42"	12	170	6	14	12	2.04	40.8	489.6
computer	42	500	4	12	8	4	80	3360
air condition 4hp	5	2944	4	8	5	14.72	294.4	1472
air condition 5hp	1	3680	4	8	5	18.4	368	368
central A.C 25hp	2	18400	1	5	3	55.2	552	1104
ceiling air condition	9	1760	4	8	5	8.8	176	1584
air condition 1.5hp	5	1068	4	8	5	5.34	106.8	534
elevator	2	19600	2	5	3	58.8	1176	2352
router	10	7.65	24	24	24	0.1836	3.672	36.72
network	8	7.65	24	24	24	0.1836	3.672	29.376
water pump 5hp	2	3560	0	4	2	7.12	142.4	284.8
outdoor light	4	100	8	12	10	1	30	120
copy machine	11	940	1	5	3	2.82	56.4	620.4
printer	16	450	1	3	2	0.9	18	288
plastic id card printer	2	396	0	4	2	0.792	15.84	31.68
system router	1	10.5	24	24	24	0.252	7.56	7.56
fan	8	75	2	8	5	0.375	7.5	60
water boiler	5	2500	0.5	2	1	2.5	50	250
security gate	2	20	6	10	8	0.16	3.2	6.4
fingerprint reader	3	10	1	2	1.5	0.015	0.3	0.9
hand dryer	3	2300	1	3	2	4.6	92	276
speaker	8	75	0	4	3	0.225	2.25	18
projector	4	313	0	3	1	0.313	6.26	25.04
receipt Printer	2	48	6	10	8	0.384	7.68	15.36
paper shredder	3	1500	0	2	1	1.5	30	90
tiles polisher	1	750	0	3	2	1.5	15	15

Table 1 Building A Ground floor continue:

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
central telephone network	1	500	24	24	24	12	360	360
digit display screen	2	4.6	6	10	8	0.0368	0.736	1.472
camera	4	1	24	24	24	0.024	0.72	2.88
counting machine	3	60	3	12	6	0.36	7.2	21.6
air curtain	8	1500	4	6	5	7.5	150	1200
cashier machine	2	250	8	12	10	2.5	50	100
kitchen vent fan	1	300	8	12	10	3	60	60
large vent fan	4	1100	8	12	10	11	220	880
small vent fan	3	40	24	24	24	0.96	19.2	57.6
heat printer	1	60	1	4	2	0.12	2.4	2.4
shawerma grill	2	4600	0	4	3	13.8	276	552
microwave oven	1	700	0	3	2	1.4	28	28
soft drink machine	2	1275	4	8	6	7.65	153	306
display Refrigerator	1	2000	8	12	10	20	400	400
display heater	2	300	8	12	10	3	60	120
ice-cream machine	1	2000	0	3	2	4	40	40
refrigerator	11	2800	8	8	8	22.4	672	7392
double refrigerator	3	3400	8	8	8	27.2	816	2448
freezer	1	1050	8	8	8	8.4	252	252
refrigerator	3	1500	8	8	8	12	360	1080
refrigerator	1	4000	8	8	8	32	960	960
boiler	1	1800	8	14	10	18	540	540
pizza oven	1	4800	0	6	3	14.4	288	288
electric oven	2	4000	2	8	4	16	320	640
electric fryer	3	3000	3	6	4	12	240	720
juice mixer	5	2000	2	4	3	6	120	600
mixer	3	2500	0	3	2	5	100	300
grill	2	4400	3	6	4	17.6	352	704
dish washer	1	1200	3	8	4	4.8	96	96
drying oven	1	225	0	1	1	0.225	1.125	1.125
electronic scale	3	15	0	1	1	0.015	0.075	0.225
microphone	5	75	0	5	2	0.15	3	15
laptop	20	100	4	12	6	0.6	12	240
electricity socket	135	0						
								40006.318

Table2 (Building A 1st floor)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 120cm	81	36	8	16	12	0.432	8.64	699.84
fluorescent lamp 40cm	588	15	6	12	8	0.12	2.4	1411.2
air conditioner 4hp	16	2944	4	10	6	17.664	353.28	5652.48
air conditioner 2hp	14	1472	4	10	6	8.832	176.64	2472.96
computer	86	500	4	10	6	3	60	5160
printer	16	450	4	10	6	2.7	54	864
smart board	2	290	4	10	8	2.32	46.4	92.8
projector	13	313	4	10	8	2.504	50.08	651.04
air compressor	1	300	0	0	0	0	0	0
scale	2	15	0	0	0	0	0	0
electrical oven	1	4000	0	0	0	0	0	0
pump .75hp	2	500	0	0	0	0	0	0
paper shredder	1	1500	1	4	2	3	60	60
laptop	15	100	4	12	6	0.6	18	270
router	7	7.65	24	24	24	0.1836	5.508	38.556
access point	2	7.65	24	24	24	0.1836	3.672	7.344
spotlight	7	40	8	16	12	0.48	9.6	67.2
fluorescent lamp 100cm	21	23	8	16	12	0.276	5.52	115.92
central network system	1	200	24	24	24	4.8	144	144
network switch	1	7.65	24	24	24	0.1836	5.508	5.508
fluorescent bulb	40	26	8	16	12	0.312	6.24	249.6
vent fan	8	40	24	24	24	0.96	19.2	153.6
hand dryer	4	2300	1	3	2	4.6	92	368
Electricity socket	164					0	0	0
								18484.048

Table3 (Building A 2nd floor)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Uasge (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 120cm	81	36	8	16	12	0.432	8.64	699.84
fluorescent lamp 40cm	488	15	6	12	8	0.12	2.4	1171.2
air conditioner 4hp	22	2944	4	10	6	17.664	353.28	7772.16
air conditioner 2hp	15	1472	4	10	6	8.832	176.64	2649.6
computer	71	500	4	10	6	3	60	4260
projector	8	313	4	10	8	2.504	50.08	400.64
copy machine	1	940	4	8	5	4.7	94	94
printer	10	450	4	10	6	2.7	54	540
Electricity socket	129					0	0	0
water boiler	2	2500	0	3	1	2.5	50	100
function generator	10	15	0	0	0	0	0	0
large power supply	7	0	0	0	0	0	0	0
small power supply	4	0	0	0	0	0	0	0
oscilloscope	11	600	0	0	0	0	0	0
router	1	7.65	24	24	24	0.1836	5.508	5.508
computer simens	11	0	0	0	0	0	0	0
plc	11	0	0	0	0	0	0	0
semtich panel	11	0	0	0	0	0	0	0
01 device	11	0	0	0	0	0	0	0
pump .5hp	11	350	0	0	0	0	0	0
compressor	2	712	0	0	0	0	0	0
access point	2	7.65	24	24	24	0.1836	5.508	11.016
spot light	139	40	6	12	8	0.32	6.4	889.6
fluorescent bulb	32	26	6	12	8	0.208	4.16	133.12
fluorescent lamp 90cm	105	23	6	12	8	0.184	3.68	386.4
								19113.084

Table4 (Building A 3rd floor)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 120cm	81	36	8	16	12	0.432	8.64	699.84
fluorescent lamp 90cm	159	23	6	10	8	0.184	3.68	585.12
fluorescent lamp 40cm	552	15	6	10	8	0.12	2.4	1324.8
air condition 4hp	15	2944	4	10	6	17.664	353.28	5299.2
air condition 2hp	15	1472	4	10	6	8.832	176.64	2649.6
computer	65	500	4	10	6	3	60	3900
printer	29	450	4	10	6	2.7	54	1566
laptop	15	100	4	12	6	0.6	12	180
projector	7	313	4	10	8	2.504	50.08	350.56
router	1	7.65	24	24	24	0.1836	5.508	5.508
water boiler	6	2500	0	3	1	2.5	50	300
scanner	1	450	4	10	6	2.7	54	54
oscilloscope	21	600	0	0	0	0	0	0
function generator	13	15	0	0	0	0	0	0
AC power supply	21	0	0	0	0	0	0	0
network switch	1	7.65	24	24	24	0.1836	5.508	5.508
resistance tester	1	0	0	0	0	0	0	0
power generator	8	0	0	0	0	0	0	0
Spectrum analyzer	1	1	0	0	0	0	0	0
paper shredder	1	1500	1	3	2	3	60	60
copy machine	1	940	2	6	3	2.82	56.4	56.4
DC power supply	2	0	0	0	0	0	0	0
computer simens	11	0	0	0	0	0	0	0
plc	11	0	0	0	0	0	0	0
semtich panel	11	0	0	0	0	0	0	0
01 device	11	0	0	0	0	0	0	0
pump .5hp	11	350	0	0	0	0	0	0
electricity socket	156					0	0	0
								17036.536

Table 5 (Building A 4th floor)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 120cm	81	36	8	16	12	0.432	8.64	699.84
fluorescent lamp 90cm	132	23	6	10	8	0.184	3.68	485.76
fluorescent lamp 40cm	360	15	6	10	8	0.12	2.4	864
air condition 4hp	13	2944	4	10	6	17.664	353.28	4592.64
air condition 2hp	17	1472	4	10	6	8.832	176.64	3002.88
computer	65	500	4	10	6	3	60	3900
printer	5	450	4	10	6	2.7	54	270
projector	9	313	4	10	8	2.504	50.08	450.72
network switch	1	7.65	24	24	24	0.1836	5.508	5.508
laptop	30	100	4	8	6	0.6	12	360
access point	2	7.65	24	24	24	0.1836	55.08	110.16
fluorescent bulb	35	26	6	10	8	0.208	4.16	145.6
spotlight	114	40	6	10	8	0.32	6.4	729.6
electricity socket	115					0	0	0
								15616.708

Table6 (Building A roof)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent lamp 90cm	24	23	6	10	8	0.184	3.68	88.32
outdoor light	9	100	8	12	10	1	30	270
air condition 4hp	1	2944	4	10	6	17.664	353.28	353.28
air condition 2hp	3	1472	4	10	6	8.832	176.64	529.92
fan	3	75	4	10	6	0.45	9	27
microphone	1	75	3	1	2	0.15	3	3
speaker	2	75	3	1	2	0.15	3	6
								1277.52

Table7 (Building A stair)

Type	Quantity	Power (watt)	min usage(hr)	max usage(hr)	actual usage(hr)	Usage (kw/d)	Usage (kw/month)	total usage (kw/month)
fluorescent bulb	90	26	8	16	12	0.312	6.24	561.6
spotlight	45	40	8	16	12	0.48	9.6	432
								993.6

Table8 (Building A Ground floor)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent lamp 100cm	23	1512.48	453.744
fluorescent bulb	26	1010.88	303.264
fluorescent bulb	15	679.5	203.85
fluorescent bulb	36	846.72	254.016
spotlight	40	336	100.8
fluorescent lamp 40cm	15	1572	471.6
fluorescent lamp 120cm	36	201.6	100.8
plasma TV 42"	170	489.6	244.8
computer	500	3360	3360
air condition 4hp	2944	1472	736
air condition 5hp	3680	368	184
central A.C 25hp	18400	1104	552
ceiling air condition	1760	1584	792
air condition 1.5hp	1068	534	267
elevator	19600	2352	2352
router	7.65	36.72	36.72
network	7.65	29.376	29.376
water pump 5hp	3560	284.8	284.8
outdoor light	100	120	0
copy machine	940	620.4	620.4
printer	450	288	288
plastic id card printer	396	31.68	31.68
system router	10.5	7.56	7.56
fan	75	60	60
water boiler	2500	250	250
security gate	20	6.4	6.4
fingerprint reader	10	0.9	0.9

Table 8 Building A Ground floor continue:

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
hand dryer	2300	276	276
speaker	75	18	18
projector	313	25.04	25.04
receipt Printer	48	15.36	15.36
paper shredder	1500	90	90
tiles polisher	750	15	15
central telephone network	500	360	360
digit display screen	4.6	1.472	1.472
camera	1	2.88	2.88
counting machine	60	21.6	21.6
air curtain	9100	1200	1200
cashier machine	250	100	100
kitchen vent fan	300	60	60
large vent fan	1100	880	880
small vent fan	40	57.6	57.6
heat printer	60	2.4	2.4
shawerma grill	4600	552	552
microwave oven	700	28	28
soft drink machine	1275	306	306
display Refrigerator	2000	400	400
display heater	300	120	120
ice-cream machine	2000	40	40
refrigerator	2800	7392	7392
double refrigerator	3400	2448	2448
freezer	1050	252	252
refrigerator	1500	1080	1080
refrigerator	4000	960	960
boiler	1800	540	540
pizza oven	4800	288	288
electric oven	4000	640	640
electric fryer	3000	720	720
juice mixer	2000	600	600
mixer	2500	300	300
grill	4400	704	704
dish washer	1200	96	96
drying oven	225	1.125	1.125
electronic scale	15	0.225	0.225

Table 8 Building A Ground floor continue:

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
microphone	75	15	15
laptop	100	240	240
electricity socket	0	0	0
		40006.318	32839.412

Table 9 (Building A 1st floor)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent lamp 120cm	36	1411.2	282.24
fluorescent lamp 40cm	15	5652.48	1130.496
air conditioner 4hp	2944	2472.96	1236.48
air conditioner 2hp	1472	5160	2580
computer	500	864	864
printer	450	92.8	92.8
smart board	290	651.04	651.04
projector	313	0	0
air compressor	300	0	0
scale	15	0	0
electrical oven	4000	0	0
pump .75hp	500	60	60
paper shredder	1500	270	270
laptop	100	38.556	38.556
router	7.65	7.344	7.344
access point	7.65	67.2	67.2
spotlight	40	115.92	57.96
fluorescent lamp 100cm	23	144	72
central network system	200	5.508	5.508
network switch	7.65	249.6	249.6
fluorescent bulb	26	153.6	76.8
vent fan	40	368	368
hand dryer	2300	0	0
Electricity socket		0	0
total		17784.208	8110.024

Table 10 (Building A 2nd floor)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent lamp 120cm	36	1171.2	234.24
fluorescent lamp 40cm	15	7772.16	1554.432
air conditioner 4hp	2944	2649.6	1324.8
air conditioner 2hp	1472	4260	2130
computer	500	400.64	400.64
projector	313	94	94
copy machine	940	540	540
printer	450	0	0
Electricity socket		100	100
water boiler	2500	0	0
function generator	15	0	0
large power supply	0	0	0
small power supply	0	0	0
oscilloscope	600	5.508	5.508
router	7.65	0	0
computer simens	0	0	0
plc	0	0	0
semtich panel	0	0	0
01 device	0	0	0
pump .5hp	350	0	0
compressor	712	11.016	11.016
access point	7.65	889.6	889.6
spot light	40	133.12	66.56
fluorescent bulb	26	386.4	193.2
fluorescent lamp 100cm	23	0	0
total		18413.244	7543.996

Table 11 (Building A 3rd floor)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent lamp 120cm	36	699.84	139.968
fluorescent lamp 100cm	23	585.12	292.56
fluorescent lamp 40cm	15	1324.8	264.96
fluorescent bulb	26	183.04	91.52
spot light	40	876.8	438.4
air condition 4hp	2944	5299.2	2649.6
air condition 2hp	1472	2649.6	1324.8
computer	500	3900	3900

Table 11 Building A 3rd floor continue:

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
printer	450	1566	1566
laptop	100	180	180
projector	313	350.56	350.56
router	7.65	22.032	22.032
water boiler	2500	300	300
water cooler	550	396	396
plasma TV 42"	170	54.4	54.4
scanner	450	54	54
oscilloscope	600	0	0
function generator	15	0	0
AC power supply	0	0	0
network switch	7.65	5.508	5.508
resistance tester	0	0	0
power generator	0	0	0
Spectrum analyzer	1	0	0
paper shredder	1500	60	60
copy machine	940	56.4	56.4
DC power supply	0	0	0
computer simens	0	0	0
plc	0	0	0
semtich panel	0	0	0
01 device	0	0	0
pump .5hp	350	0	0
electricity socket		0	0
total		18563.3	12146.708

Table12 (Building A 4th floor)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent lamp 120cm	36	699.84	139.968
fluorescent lamp 100cm	23	485.76	242.88
fluorescent lamp 40cm	15	864	172.8
air condition 4hp	2944	4592.64	2296.32
air condition 2hp	1472	3002.88	1501.44
computer	500	3900	3900
printer	450	270	270
projector	313	450.72	450.72
network switch	7.65	5.508	5.508

Table 12 Building A 4th floor continue:

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
laptop	100	360	360
access point	7.65	110.16	110.16
fluorescent bulb	26	145.6	145.6
spotlight	40	729.6	364.8
electricity socket		0	0
total		15616.708	9960.196

Table 13 (Building A Stairs)

Type	Power(watt)	high usage(kw/month)	low usage(kw/month)
fluorescent bulb	26	561.6	112.32
spotlight	40	432	86.4
total		993.6	198.72

Table 14 (Building A Total)

	Before applying G.B. technologies		After applying G.B. technologies		
floor	usage (kw/month)	usage (kw/year)	usage (kw/month)	usage (kw/year)	Reduction (%)
Ground floor	40,006.32	480075.84	32839.412	394072.944	17.91%
1st floor	18484.05	221808.6	12516.136	150193.632	32.28%
2nd floor	19113.08	229356.96	7543.996	90527.952	60.52%
3rd floor	18563.3	222759.6	12146.708	145760.496	34.56%
4th floor	15616.71	187400.52	9960.196	119522.352	36.22%
stairs	993.6	11923.2	198.72	2384.64	80%
total	112777.1	1353325.2	75205.168	902462.016	33.31%

Natural lighting analyses results

Table (15): Lighting Analyses Room Schedule, Building A, Whole Building Results – 9am.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	9am threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Ground Floor	Ground Floor	1	22 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	2	22 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	3	41 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	4	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	5	9 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	6	36 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	7	129 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	8	35 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	9	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	10	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	11	27 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	12	189 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	13	17 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	14	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	15	40 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	16	62 m²	Yes	No	0	0 m²	0	0 m²	100	62 m²
Ground Floor	Ground Floor	17	65 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	18	14 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	19	19 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	20	639 m²	Yes	No	77	490 m²	0	0 m²	23	149 m²
Ground Floor	Ground Floor	21	132 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	22	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	23	8 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	24	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	25	10 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	26	4 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	27	7 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²

Table (15): Lighting Analyses Room Schedule, Building A, Whole Building Results – 9am continue.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	9am threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Ground Floor	Ground Floor	28	18 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	29	274 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	30	395 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	31	162 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	32	46 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
First Floor	First Floor	33	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
First Floor	First Floor	34	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
First Floor	First Floor	35	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
First Floor	First Floor	36	5 m²	Yes	No	0	0 m²	0	0 m²	100	5 m²
First Floor	First Floor	37	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
First Floor	First Floor	38	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
First Floor	First Floor	39	70 m²	Yes	No	59	41 m²	0	0 m²	41	29 m²
First Floor	First Floor	40	70 m²	Yes	No	55	38 m²	0	0 m²	45	31 m²
First Floor	First Floor	41	70 m²	Yes	No	55	38 m²	0	0 m²	45	31 m²
First Floor	First Floor	42	69 m²	Yes	No	59	40 m²	0	0 m²	41	29 m²
First Floor	First Floor	43	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	44	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	45	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	46	114 m²	Yes	No	2	3 m²	0	0 m²	98	111 m²
First Floor	First Floor	47	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
First Floor	First Floor	48	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
First Floor	First Floor	49	62 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
First Floor	First Floor	50	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
First Floor	First Floor	51	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
First Floor	First Floor	52	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
First Floor	First Floor	53	43 m²	Yes	No	100	43 m²	0	0 m²	0	0 m²
First Floor	First Floor	54	99 m²	Yes	No	42	42 m²	0	0 m²	58	57 m²
First Floor	First Floor	55	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
First Floor	First Floor	56	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
First Floor	First Floor	57	14 m²	Yes	No	33	5 m²	0	0 m²	67	9 m²
First Floor	First Floor	58	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
First Floor	First Floor	59	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
First Floor	First Floor	60	25 m²	Yes	No	18	4 m²	0	0 m²	82	20 m²

Table (15): Lighting Analyses Room Schedule, Building A, Whole Building Results – 9am continue.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	9am threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
First Floor	First Floor	61	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
First Floor	First Floor	62	240 m²	Yes	No	82	196 m²	0	0 m²	18	44 m²
First Floor	First Floor	63	821 m²	Yes	No	24	193 m²	2	14 m²	75	614 m²
second Floor	second Floor	64	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
second Floor	second Floor	65	712 m²	Yes	No	17	124 m²	1	7 m²	82	581 m²
second Floor	second Floor	66	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
second Floor	second Floor	67	9 m²	Yes	No	0	0 m²	0	0 m²	100	9 m²
second Floor	second Floor	68	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
second Floor	second Floor	69	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
second Floor	second Floor	70	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
second Floor	second Floor	71	72 m²	Yes	No	52	37 m²	0	0 m²	48	34 m²
second Floor	second Floor	72	70 m²	Yes	No	60	42 m²	0	0 m²	40	28 m²
second Floor	second Floor	73	70 m²	Yes	No	65	45 m²	0	0 m²	35	24 m²
second Floor	second Floor	74	44 m²	Yes	No	25	11 m²	0	0 m²	75	33 m²
second Floor	second Floor	75	70 m²	Yes	No	0	0 m²	0	0 m²	100	70 m²
second Floor	second Floor	76	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	77	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	78	70 m²	Yes	No	44	31 m²	0	0 m²	56	39 m²
second Floor	second Floor	79	69 m²	Yes	No	50	34 m²	0	0 m²	50	34 m²
second Floor	second Floor	80	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	81	33 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
second Floor	second Floor	82	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
second Floor	second Floor	83	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
second Floor	second Floor	84	62 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
second Floor	second Floor	85	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
second Floor	second Floor	86	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
second Floor	second Floor	87	99 m²	Yes	No	35	34 m²	0	0 m²	65	65 m²
second Floor	second Floor	88	14 m²	Yes	No	67	9 m²	0	0 m²	33	5 m²
second Floor	second Floor	89	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
second Floor	second Floor	90	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
second Floor	second Floor	91	24 m²	Yes	No	25	6 m²	0	0 m²	75	18 m²
second Floor	second Floor	92	240 m²	Yes	No	85	205 m²	0	0 m²	15	35 m²
second Floor	second Floor	93	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
second Floor	second Floor	94	43 m²	Yes	No	100	43 m²	0	0 m²	0	0 m²

Table (15): Lighting Analyses Room Schedule, Building A, Whole Building Results – 9am continue.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	9am threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
second Floor	second Floor	95	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
second Floor	second Floor	96	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
second Floor	second Floor	97	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	98	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
Third Floor	Third Floor	99	750 m²	Yes	No	16	121 m²	1	7 m²	83	621 m²
Third Floor	Third Floor	100	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Third Floor	Third Floor	101	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Third Floor	Third Floor	102	5 m²	Yes	No	0	0 m²	0	0 m²	100	5 m²
Third Floor	Third Floor	103	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Third Floor	Third Floor	104	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Third Floor	Third Floor	105	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Third Floor	Third Floor	106	66 m²	Yes	No	36	24 m²	0	0 m²	64	42 m²
Third Floor	Third Floor	107	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Third Floor	Third Floor	108	68 m²	Yes	No	40	27 m²	0	0 m²	60	41 m²
Third Floor	Third Floor	109	66 m²	Yes	No	32	21 m²	0	0 m²	68	45 m²
Third Floor	Third Floor	110	68 m²	Yes	No	70	48 m²	0	0 m²	30	20 m²
Third Floor	Third Floor	111	67 m²	Yes	No	100	67 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	112	67 m²	Yes	No	70	47 m²	0	0 m²	30	20 m²
Third Floor	Third Floor	113	70 m²	Yes	No	70	49 m²	0	0 m²	30	21 m²
Third Floor	Third Floor	114	44 m²	Yes	No	60	26 m²	0	0 m²	40	18 m²
Third Floor	Third Floor	115	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	116	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	117	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	118	43 m²	Yes	No	100	43 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	119	99 m²	Yes	No	18	18 m²	0	0 m²	82	81 m²
Third Floor	Third Floor	120	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
Third Floor	Third Floor	121	14 m²	Yes	No	25	3 m²	0	0 m²	75	10 m²
Third Floor	Third Floor	122	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Third Floor	Third Floor	123	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Third Floor	Third Floor	124	25 m²	Yes	No	17	4 m²	0	0 m²	83	20 m²
Third Floor	Third Floor	125	243 m²	Yes	No	68	164 m²	0	0 m²	32	79 m²
Third Floor	Third Floor	126	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
Fourth Floor	Fourth Floor	127	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
Fourth Floor	Fourth Floor	128	901 m²	Yes	No	47	421 m²	1	7 m²	53	474 m²

Table (15): Lighting Analyses Room Schedule, Building A, Whole Building Results – 9am continue.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	9am threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Fourth Floor	Fourth Floor	129	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Fourth Floor	Fourth Floor	130	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Fourth Floor	Fourth Floor	131	9 m²	Yes	No	0	0 m²	0	0 m²	100	9 m²
Fourth Floor	Fourth Floor	132	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Fourth Floor	Fourth Floor	133	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Fourth Floor	Fourth Floor	134	44 m²	Yes	No	80	35 m²	20	9 m²	0	0 m²
Fourth Floor	Fourth Floor	135	70 m²	Yes	No	85	59 m²	0	0 m²	15	10 m²
Fourth Floor	Fourth Floor	136	67 m²	Yes	No	70	47 m²	0	0 m²	30	20 m²
Fourth Floor	Fourth Floor	137	67 m²	Yes	No	100	67 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	138	68 m²	Yes	No	40	27 m²	0	0 m²	60	41 m²
Fourth Floor	Fourth Floor	139	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Fourth Floor	Fourth Floor	140	66 m²	Yes	No	36	24 m²	0	0 m²	64	42 m²
Fourth Floor	Fourth Floor	141	66 m²	Yes	No	40	27 m²	0	0 m²	60	40 m²
Fourth Floor	Fourth Floor	142	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	143	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	144	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
Fourth Floor	Fourth Floor	145	95 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	146	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
Fourth Floor	Fourth Floor	147	14 m²	Yes	No	50	7 m²	0	0 m²	50	7 m²
Fourth Floor	Fourth Floor	148	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Fourth Floor	Fourth Floor	149	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Fourth Floor	Fourth Floor	150	25 m²	Yes	No	17	4 m²	0	0 m²	83	20 m²
Fourth Floor	Fourth Floor	151	282 m²	Yes	No	13	36 m²	86	243 m²	1	3 m²
Fourth Floor	Fourth Floor	152	141 m²	Yes	No	12	17 m²	0	0 m²	88	124 m²
Fourth Floor	Fourth Floor	153	59 m²	Yes	No	0	0 m²	0	0 m²	100	59 m²
Fourth Floor	Fourth Floor	154	68 m²	Yes	No	0	0 m²	0	0 m²	100	68 m²
Roof	Roof	155	105 m²	Yes	No	0	0 m²	0	0 m²	100	105 m²

Table (16): Lighting Analyses Room Schedule, Building A, Whole Building Results – 3pm.

Level	Name	Number	Area	Include In Daylighting	Automated Shades	3pm threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Ground Floor	Ground Floor	1	22 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	2	22 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	3	41 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	4	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	5	9 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	6	36 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	7	129 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	8	35 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	9	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	10	13 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	11	27 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	12	189 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	13	17 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	14	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	15	40 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	16	62 m²	Yes	No	0	0 m²	0	0 m²	100	62 m²
Ground Floor	Ground Floor	17	65 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	18	14 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	19	19 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	20	639 m²	Yes	No	77	490 m²	0	0 m²	23	149 m²
Ground Floor	Ground Floor	21	132 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	22	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	23	8 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	24	23 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	25	10 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	26	4 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	27	7 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	28	18 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	29	274 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	30	395 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²

Table (16): Lighting Analyses Room Schedule, Building A, Whole Building Results_ 3pm continue:

Level	Name	Number	Area	Include In Daylighting	Automated Shades	3pm threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Ground Floor	Ground Floor	31	162 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Ground Floor	Ground Floor	32	46 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
First Floor	First Floor	33	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
First Floor	First Floor	34	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
First Floor	First Floor	35	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
First Floor	First Floor	36	5 m²	Yes	No	0	0 m²	0	0 m²	100	5 m²
First Floor	First Floor	37	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
First Floor	First Floor	38	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
First Floor	First Floor	39	70 m²	Yes	No	57	40 m²	0	0 m²	43	30 m²
First Floor	First Floor	40	70 m²	Yes	No	59	41 m²	0	0 m²	41	28 m²
First Floor	First Floor	41	70 m²	Yes	No	58	40 m²	0	0 m²	43	30 m²
First Floor	First Floor	42	69 m²	Yes	No	59	40 m²	0	0 m²	41	29 m²
First Floor	First Floor	43	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	44	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	45	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
First Floor	First Floor	46	114 m²	Yes	No	5	5 m²	0	0 m²	95	109 m²
First Floor	First Floor	47	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
First Floor	First Floor	48	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
First Floor	First Floor	49	62 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
First Floor	First Floor	50	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
First Floor	First Floor	51	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
First Floor	First Floor	52	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
First Floor	First Floor	53	43 m²	Yes	No	78	33 m²	22	9 m²	0	0 m²
First Floor	First Floor	54	99 m²	Yes	No	40	40 m²	0	0 m²	60	59 m²
First Floor	First Floor	55	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
First Floor	First Floor	56	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
First Floor	First Floor	57	14 m²	Yes	No	33	5 m²	0	0 m²	67	9 m²
First Floor	First Floor	58	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
First Floor	First Floor	59	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
First Floor	First Floor	60	25 m²	Yes	No	18	4 m²	0	0 m²	82	20 m²
First Floor	First Floor	61	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
First Floor	First Floor	62	240 m²	Yes	No	88	210 m²	12	28 m²	1	2 m²
First Floor	First Floor	63	821 m²	Yes	No	22	179 m²	0	0 m²	78	642 m²
second Floor	second Floor	64	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²

Table (16): Lighting Analyses Room Schedule, Building A, Whole Building Results –3pm continue:

Level	Name	Number	Area	Include In Daylighting	Automated Shades	3pm threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
second Floor	second Floor	65	712 m²	Yes	No	16	114 m²	0	0 m²	84	598 m²
second Floor	second Floor	66	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
second Floor	second Floor	67	9 m²	Yes	No	0	0 m²	0	0 m²	100	9 m²
second Floor	second Floor	68	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
second Floor	second Floor	69	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
second Floor	second Floor	70	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
second Floor	second Floor	71	72 m²	Yes	No	52	37 m²	0	0 m²	48	34 m²
second Floor	second Floor	72	70 m²	Yes	No	60	42 m²	0	0 m²	40	28 m²
second Floor	second Floor	73	70 m²	Yes	No	60	42 m²	0	0 m²	40	28 m²
second Floor	second Floor	74	44 m²	Yes	No	25	11 m²	0	0 m²	75	33 m²
second Floor	second Floor	75	70 m²	Yes	No	31	22 m²	0	0 m²	69	48 m²
second Floor	second Floor	76	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	77	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	78	70 m²	Yes	No	48	33 m²	0	0 m²	52	36 m²
second Floor	second Floor	79	69 m²	Yes	No	60	41 m²	0	0 m²	40	28 m²
second Floor	second Floor	80	67 m²	Yes	No	0	0 m²	0	0 m²	100	67 m²
second Floor	second Floor	81	33 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
second Floor	second Floor	82	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
second Floor	second Floor	83	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
second Floor	second Floor	84	62 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
second Floor	second Floor	85	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
second Floor	second Floor	86	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
second Floor	second Floor	87	99 m²	Yes	No	35	34 m²	0	0 m²	65	65 m²
second Floor	second Floor	88	14 m²	Yes	No	67	9 m²	0	0 m²	33	5 m²
second Floor	second Floor	89	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
second Floor	second Floor	90	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
second Floor	second Floor	91	24 m²	Yes	No	25	6 m²	0	0 m²	75	18 m²
second Floor	second Floor	92	240 m²	Yes	No	90	215 m²	10	25 m²	0	0 m²
second Floor	second Floor	93	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
second Floor	second Floor	94	43 m²	Yes	No	88	37 m²	13	5 m²	0	0 m²
second Floor	second Floor	95	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
second Floor	second Floor	96	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
second Floor	second Floor	97	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	98	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²

Table (16): Lighting Analyses Room Schedule, Building A, Whole Building Results –3pm continue:

Level	Name	Number	Area	Include In Daylighting	Automated Shades	3pm threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Third Floor	Third Floor	99	750 m²	Yes	No	13	96 m²	0	0 m²	87	653 m²
Third Floor	Third Floor	100	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Third Floor	Third Floor	103	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Third Floor	Third Floor	104	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Third Floor	Third Floor	105	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Third Floor	Third Floor	106	66 m²	Yes	No	36	24 m²	0	0 m²	64	42 m²
Third Floor	Third Floor	107	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Third Floor	Third Floor	108	68 m²	Yes	No	40	27 m²	0	0 m²	60	41 m²
Third Floor	Third Floor	109	66 m²	Yes	No	36	24 m²	0	0 m²	64	42 m²
Third Floor	Third Floor	110	68 m²	Yes	No	50	34 m²	0	0 m²	50	34 m²
Third Floor	Third Floor	111	67 m²	Yes	No	94	63 m²	0	0 m²	6	4 m²
Third Floor	Third Floor	112	67 m²	Yes	No	70	47 m²	0	0 m²	30	20 m²
Third Floor	Third Floor	113	70 m²	Yes	No	100	70 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	114	44 m²	Yes	No	80	35 m²	20	9 m²	0	0 m²
Third Floor	Third Floor	115	40 m²	Yes	No	100	40 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	116	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	117	20 m²	Yes	No	100	20 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	118	43 m²	Yes	No	100	43 m²	0	0 m²	0	0 m²
Third Floor	Third Floor	119	99 m²	Yes	No	18	18 m²	0	0 m²	82	81 m²
Third Floor	Third Floor	120	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
Third Floor	Third Floor	121	14 m²	Yes	No	25	3 m²	0	0 m²	75	10 m²
Third Floor	Third Floor	122	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Third Floor	Third Floor	123	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Third Floor	Third Floor	124	25 m²	Yes	No	17	4 m²	0	0 m²	83	20 m²
Third Floor	Third Floor	125	243 m²	Yes	No	82	198 m²	10	24 m²	8	21 m²
Third Floor	Third Floor	126	10 m²	Yes	No	0	0 m²	0	0 m²	100	10 m²
Fourth Floor	Fourth Floor	127	25 m²	Yes	No	0	0 m²	0	0 m²	100	25 m²
Fourth Floor	Fourth Floor	128	901 m²	Yes	No	45	407 m²	1	13 m²	53	481 m²
Fourth Floor	Fourth Floor	129	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Fourth Floor	Fourth Floor	130	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Fourth Floor	Fourth Floor	131	9 m²	Yes	No	0	0 m²	0	0 m²	100	9 m²
Fourth Floor	Fourth Floor	132	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Fourth Floor	Fourth Floor	133	20 m²	Yes	No	0	0 m²	0	0 m²	100	20 m²
Fourth Floor	Fourth Floor	134	44 m²	Yes	No	100	44 m²	0	0 m²	0	0 m²

Table (16): Lighting Analyses Room Schedule, Building A, Whole Building Results–3pm continue:

Level	Name	Number	Area	Include In Daylighting	Automated Shades	3pm threshold results					
						within threshold		above threshold		below threshold	
						%	Area	%	Area	%	Area
Fourth Floor	Fourth Floor	135	70 m²	Yes	No	100	70 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	137	67 m²	Yes	No	100	67 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	138	68 m²	Yes	No	40	27 m²	0	0 m²	60	41 m²
Fourth Floor	Fourth Floor	139	66 m²	Yes	No	40	26 m²	0	0 m²	60	40 m²
Fourth Floor	Fourth Floor	140	66 m²	Yes	No	32	21 m²	0	0 m²	68	45 m²
Fourth Floor	Fourth Floor	141	66 m²	Yes	No	40	27 m²	0	0 m²	60	40 m²
Fourth Floor	Fourth Floor	142	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	143	15 m²	Yes	No	100	15 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	144	12 m²	Yes	No	0	0 m²	0	0 m²	100	12 m²
Fourth Floor	Fourth Floor	145	95 m²	Yes	No	0	0 m²	0	0 m²	0	0 m²
Fourth Floor	Fourth Floor	146	13 m²	Yes	No	0	0 m²	0	0 m²	100	13 m²
Fourth Floor	Fourth Floor	147	14 m²	Yes	No	25	3 m²	0	0 m²	75	10 m²
Fourth Floor	Fourth Floor	148	8 m²	Yes	No	0	0 m²	0	0 m²	100	8 m²
Fourth Floor	Fourth Floor	149	4 m²	Yes	No	0	0 m²	0	0 m²	100	4 m²
Fourth Floor	Fourth Floor	150	25 m²	Yes	No	17	4 m²	0	0 m²	83	20 m²
Fourth Floor	Fourth Floor	151	282 m²	Yes	No	3	10 m²	95	269 m²	1	3 m²
Fourth Floor	Fourth Floor	152	141 m²	Yes	No	7	10 m²	0	0 m²	93	131 m²
Fourth Floor	Fourth Floor	153	59 m²	Yes	No	0	0 m²	0	0 m²	100	59 m²
Fourth Floor	Fourth Floor	154	68 m²	Yes	No	0	0 m²	0	0 m²	100	68 m²
Roof	Roof	155	105 m²	Yes	No	0	0 m²	0	0 m²	100	105 m²

Revit Photos

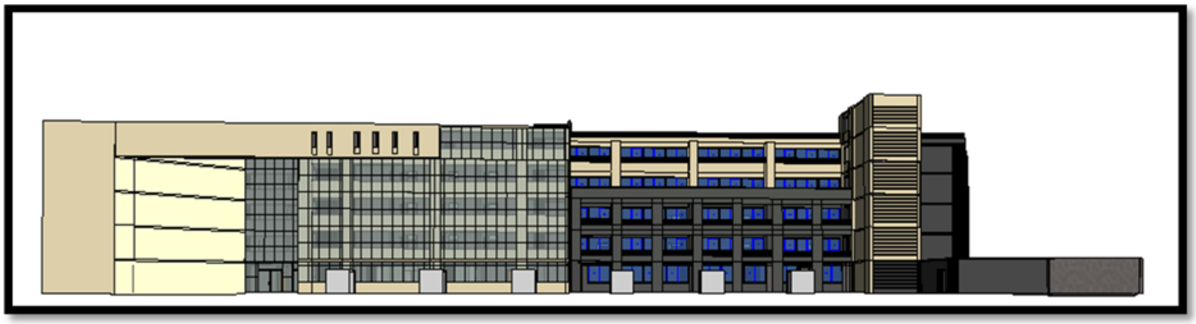

Photo 1: building (A) Front side

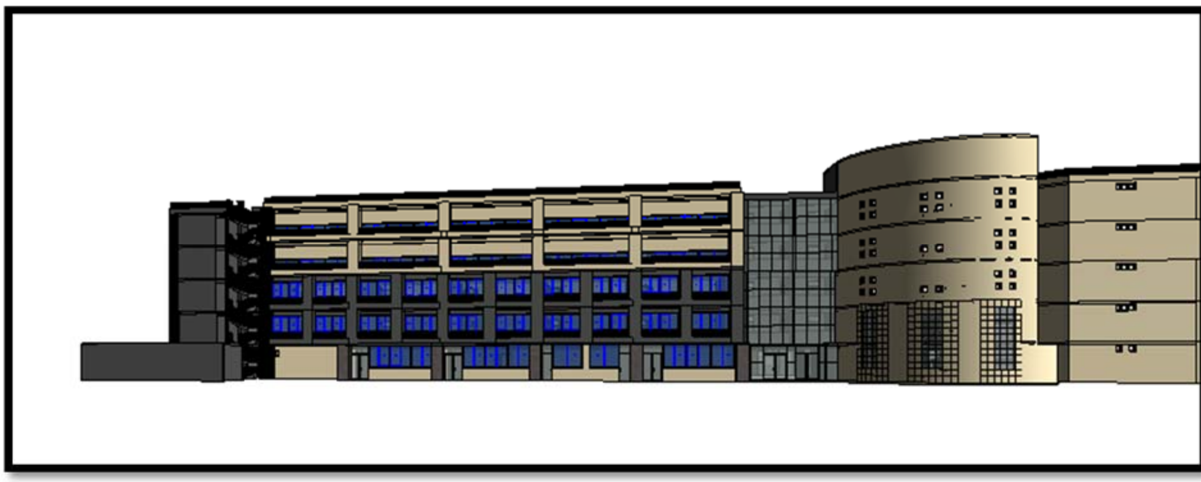

Photo 2: building (A) Back side

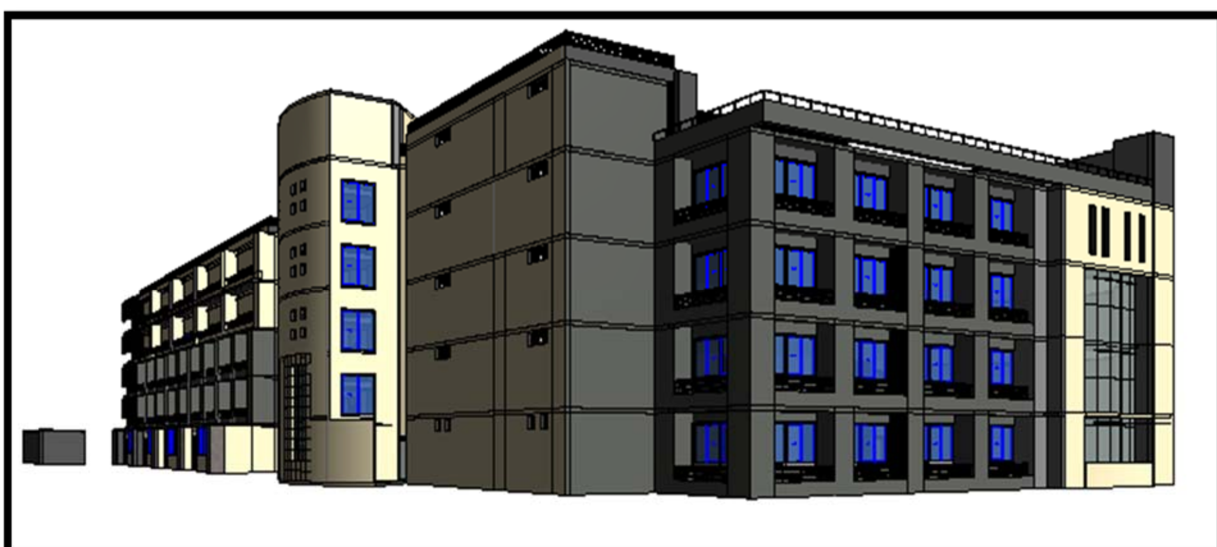

Photo 3: building (A) North Side view