5.3 Conclusion

When considering the subject of lighting of National archives building in Sri Lanka a different concept have been adopted. Hence by the introduction of new lighting design, following object have been realized.

01. Comfortable reading environments in map reading and public reading areas by achieving recommended LUX levels. And ensured recommended LUX levels to the other areas.

02. Low UV emission environment for repositories that help to protect the valuable articles for future generation. By maintaining the low LUX level in repositories, Number of fittings was reduced. Light fittings with covered florescent tube futher reduce the effect of UV emission.

03. Repository area lit only on when required. All the day time keep switch off

04. LED lights were introduced for Tape storage area. To maintaine low UV environment in that area and Zero heat emission from LED fittings that will help to keep the room temperature at 12-15 ^{0}C. Hence long life of audio tape can be ensured.

05. Sound and micro film unit and Audio recording, editing area need low temperature levels and Electronic ballast type fitting minimize the heat adding to the areas.

06. The amount of electricity needed for lighting the building decreased due to the introduction of T5 florescent fittings and day light to the building. The estimated saving to be around 34%.

07. Compared to the magnetic ballast fittings, electronic ballast fittings emit less heat hence air condition cooling load has reduced in the building.

08. A T5 fitting requires low current compared to the T8 magnetic ballast fitting. Hence during the circuit wiring, number of fittings per circuit can be increased while maintaining same wire size.

09. Electronic ballast has high power factor compared to the magnetic ballast, so new system improves the system power factor.

10. According to net present value method the investment for new system could be recovered within 6 years.

11. Wiring system has to be changed to enable easy switching of day light area light fittings.

    According to the suggestions I made during my project period, CECB design engineers decided to do some modifications to their original design and agreed to introduce T5 type fittings in their latest version of the lighting design.

5.4 Further Development of the Design

In order to fine tune the proposed lighting design following actions can be taken

01. Introduce indirect lighting for repositories to further minimize the UV emission.

02. Introduce the occupancy sensors for repositories, computer area, office area, acquisition area and wash rooms.

03. Introduce day light sensor for switching light fittings automatically according to the Illumination levels.

04. Use of LED light fittings are expensive, however it is good for air conditioned environments because LED does not emit heat to the system. Such as repository areas need extremely low temperature levels

05. LED light does not emit UV and heat to the system hence it is good for repositories, audio tape storages, sound, microfilm, audio recording and editing areas. If the budget allows, that will be a good option.

06. LED consumes less electricity compared to the florescent tubes and CFLs therefore use of LED type light fitting reduce the energy cost significantly

07. National Achieves building is a very important building in Sri Lanka and established with the prime objective of preserving important documents. Hence low UV emission and low temperature environment is very important not only to repositories tape storages, sound, microfilm area and also to the entire building.

5.5 Cost Benefit Analyze

The Net Present Value Method									
Year	-	1	2	3	4	5	6	7	8
Cost of Investment	(851,875.00)								
Energy Saving Benefit		204,386.39	204,386.39	204,386.39	204,386.39	204,386.39	204,386.39	204,386.39	204,386.39
Cost of Operation and Maintenance (15%)		(30,657.96)	(30,657.96)	(30,657.96)	(30,657.96)	(30,657.96)	(30,657.96)	(30,657.96)	(30,657.96)
Net Cash Flow		173,728.43	173,728.43	173,728.43	173,728.43	173,728.43	173,728.43	173,728.43	173,728.43
Discount Factor (10 %)	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47
Present Value	(851,875.00)	157,934.94	143,577.22	130,524.74	118,658.86	107,871.69	98,065.17	89,150.15	81,045.60
Net Present Value	74,953.36								

Table 5.2 Proposed design vs old design

The Net Present Value Method									
Year	-	1	2	3	4	5	6	7	8
Cost of Investment	(851,875.00)								
Energy Saving Benefit		246,329.16	246,329.16	246,329.16	246,329.16	246,329.16	246,329.16	246,329.16	246,329.16
Cost of Operation and Maintenance (15%)		(36,949.37)	(36,949.37)	(36,949.37)	(36,949.37)	(36,949.37)	(36,949.37)	(36,949.37)	(36,949.37)
Net Cash Flow		209,379.79	209,379.79	209,379.79	209,379.79	209,379.79	209,379.79	209,379.79	209,379.79
Discount Factor (10 %)	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47
Present Value	(851,875.00)	190,345.26	173,041.15	157,310.13	143,009.21	130,008.37	118,189.43	107,444.94	97,677.22
Net Present Value	265,150.71								

Table 5.3 Proposed design with day light vs old design

References

[1] Tejinder Singh and Arvind Dhingra , “Energy efficient lighting a way to conserve energy”, International journal of Energy, Issue 1 ,Volume 3 , 2009. PP.1-7.

[2] Tejinder Singh and Arvind Dhingra, “Energy conservation with energy efficient lighting”, WSEAS Transactions on environment and development ,Issue 10, Volume 5, October 2009.pp 630 – 638

[3] Energy efficiency guide for industry in Asia-http://www.energyefficiencyasia.org/docs/ee_modules/Chapter-Lighting.pdf PP 2-40

[4] Tommy Goven,Energy savings through improved design and engineering,AB fagerhult,asogatn,Stockholm,Sweden-Volume 1 ,1997

[5] Mark kavlen and James benya ,”Lighting design basics” , Jhorn wiley and sons ,inc,USA- Volume 1,1995 . PP 235-280

[6] Guidelines on Energy efficient equipment T5 floresent lamp ,Electical and Mechnical service department, Causeay bay, Hong Kong.

[7] IR martin and kwok tin , “T5 lamps and luminaries” , Electical and Mechnical service department, Causeay bay, Hong Kong.

[8] Darinz Heim ,Piotr Klemm and Eliza Szczepanska , Guidelines for internal daylight design,Technical university of Lodz, porland 2006.

[9] Lighting design guide , www.arktech-uk.co.uk/page11.html

[10] Gregg D. Ander ,"Day lighting" http://www.wbdg.org/resources/daylighting.php

[11] "Conservation lighting for museums and galleries" http://www.theatrearts.biz/conservationpage.html

[12] www. Osram .com,

[13] "Technical lighting design guide" The society of light and lighting ,wwwcibse.org

[14] lighting –artificial and daylighting , Energy efficiency building design guidelines for bostwana, revision 1 september 2007,

[15] A.C.Barr and C.C.Amick , fundamentals of lighting cost analysis , Day brite lighting inc,New York.

[16] UV radiation from florescent lamps, NEMA lighting system division document may 1999 .rossly , VA

[17] P.Balachandra, and B Suochankara Rreddy , Technology portfolio analysis for lighting. Indira Gandhi institute of development research center,Mumbai, may 2007.

[18] "Code of Practice for Energy Efficiency of Lighting Installations", 2007 Edition, EMSD.

[19] "Code of Practice for Energy Efficiency of Electrical Installations", 1998 Edition, EMSD..

[20] By Tay Hooi Seng , Good lighting practices– indoor lighting –Schneider Electic, Singapore,2007

[21] “A guide to energy efficient and cost effective lighting” Sustainable energy authority of Ireland , www.seai.ie.

[22] Enrgy Efficency requirements for ballast for florescent lighting - CELMA Belgium

[23] Parag Shrma , V.K.Jaiswal and H.C. Kandpal ,Ultra Violet radiation emitted by compact florescent lamps , Journal of Metrology society of India, Volume 23, no 23, 2009 PP 183-191

List of Appendices