

REFERENCES

- [1] J. Flynn, T. J. Spencer, O. Martyniuk, and C. Hendrick.“Interim Study of Procedures for Investigating the Effect of Light on Impression and Behavior”, in *Journal of the Illuminating Engineering Society*, 1973, pp 94-96.
- [2] D.L. Loe, K. P. Mansfield, and E. Rowlands. “Appearance of Lit Environment and Its Relevance in Lighting Design: Experimental Study”, *Lighting Research and Technology*, 1994, pp 119-133.
- [3] J. Flynn, “A Study of Subjective Responses to Low Energy and Non uniform Lighting Systems”, *Lighting Design and Applications*. 1977.7(2), pp 6-15.
- [4] H. N. McKay, “Energy optimization and quality lighting design”, *Lighting Design and Application*, Mar. 1986, pp 24-56.
- [5] P. Y. Papalambros and D. J. Wilde, “*Principles of Optimal Design*”. Cambridge University Press, Cambridge, England, 1988, pp 8-67.
- [6] J. E. Flynn, “A study of subjective responses to low energy and nonuniform lighting systems”, *Lighting Design and Application*, Feb. 1977, pp 92-103.
- [7] J.M. Henderson [University of Moratuwa, Sri Lanka] [The Calton Trust], “Lighting Bright Ideas for illumination”, [Online]. Available:http://www.lbm.gov.uk/Images/J7802_CTV049_Lighting%20Overview_AW_Print_tcm21-179778.pdf. [Accessed: Dec. 05, 2014].
- [8] Odyssey Land Development Group, “Products”, [Online]. Available:http://www.odysseygreenenergy.com/led_highIntensityDischarge_Bulbs.html. [Accessed: Dec. 07, 2014].
- [9] Mondo Arc^{arc}, “The international magazine for designers with light”,[Online]. Available:www.mondoarc.com/siteimage/scale/800/600/64820mondoarc.com/siteimage/scale/800/600/64820.png.[Accessed: Dec 12, 2014].
- [10] J. E. Flynn, C. Hendrick, T. J. Spencer, and O. Martyniuk.“A guide to methodology procedures for measuring subjective impressions in lighting”, *Journal of the IES*, Jan. 1979, pp 11-39.
- [11] R. Attalage. TA 7778SRI. Training program on energy auditing, Topic: “Basics of lighting” Sri Lanka Sustainable Energy Authority, BMICH, BauddhalokaMawatha, Colombo-07.
- [12] Mondo Arc^{arc}. “2007: when Solid-State became the future of Lighting”,[Online]. Available:http://www.mondoarc.com/technology/LED/219260/2007_when_solid_state_became_the_future_of_lighting.html. [Accessed: Dec. 12, 2014].

- [13] Lighting Industry Association Ltd, “Incandescent Lighting”, Internet:<http://energy.gov/energysaver/articlesincandescent-lighting>. [Dec. 5, 2014].
- [14] Unitarian Universalist Fellowship of Visalia, “Compact Fluorescent Light Bulbs”, Internet:<http://www.uuvisalia.org/justice/cfl.html>, [Dec. 05, 2014].
- [15] Odyssey Green & Renewable Energy ,“dischargelamp”,Internet:https://www.google.lk/search?q=Discharge+lighting&biw=1056&bih=595&source=lnms&tbo=isch&sa=X&ved=0CAYQ_AUoAWoVChMI37Owh9u-xwIVQ1mOCh0-MAW4#imgrc=eZWm8FIbyY1F8M%3A. [Dec. 05, 2014].
- [16] Installation Das Infomagazin für Elektroinstallateure in Deutschland – Oktober 2008, “The Lighting Handbook”. Internet: <http://www.zumtobel.com/PDB/teaser/EN/lichtthandbuch.pdf> [April. 18, 2015].
- [17] Engineering Resources, “Lux to watts calculation formula”. Internet:, <http://www.rapidtables.com/calc/light/lux-to-watt-calculator.htm>, [April. 20, 2015].
- [18] D.M. Berson, “Human eye sensitivity, photometric quantities”. Internet:, <http://www.ecse.rpi.edu/~schubert/Light-Emitting-Diodes-dot-org/Sample-Chapter.pdf> [April. 20, 2015].
-  University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk
- [19] M. Akgun, B. Becerir, “Journal of Textiles” “Effect of Fabric Layers on the Relationship between Fabric Constructional Parameters, Percentage, Reflectance values of polyester fabrics”. Internet:<http://www.hindawi.com/journals/jtex/2014/267530/> [April. 20, 2015].
- [20] J. Szosland, “Designing of woven fabric features by designing the phase of their structure(Kszta³towanie w³asnoœci tkanin poprzez kszta³towanie fazy ich struktury ”, ArchitekturaTekstyliów, No. 1-3, 1999.
- [21] Y. Wang and , X. Sun., “Presented at the 15th Annual Technical Conference for Composites, WHERE?, Sept. 23-27, 2000.
- [22] ILO Manual, “Why is lighting in the workplace important?”. Internet: http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/---sroport_of_spain/documents/presentation/wcms_250198.pdf [December. 28, 2015]
- [23] Z. Zupin and K. Dimitrovski, “Mechanical Properties of Fabrics from Cotton and Biodegradable Yarns Bamboo, SPF, PLA in Weft”. Internet:http://cdn.intechopen.com/pdfs/12238/InTech-mechanical_properties_of_fabrics_made_from_cotton_and_biodegradable_yarns_bamboo_spf_pla_in_weft.pdf, [June. 28, 2015].

- [24] M. Abbasipour, “Effect of titanium dioxide on near infrared radiation reflectance of cotton fabrics”. Internet:<http://www.itc.polyu.edu.hk/ UserFiles/access/ Files /BA /FYP1314/14090/12018 989D.pdf> [May. 18, 2015].
- [25] D.D. De Miranda, “Six key factors in evaluating a fiber for suitability in weaving a sail-cloth”. Internet:<https://en.wikipedia.org/wiki/Sailcloth> [June. 28, 2015].
- [26] M .A. Collier, “Units of textile measurement”. Internet: https://en.wikipedia.org/wiki/ Units_of_textile_measurement [June. 28, 2015].
- [27] F.J. Goes, “Colors that can be produced by visible light of a single wavelength (monochromatic light) are referred to as the pure spectral colors”. Internet:http://www.manfredkaiser.com/health_effects_of_sunlight.html [December. 20, 2015].
- [28] A.R. Kelly and C.P. Huynh, “Spectral Image Formation”. Internet :<https://foundation.sofvision.stanford.edu/chapter-9-color/> [May. 18, 2015].
- [29] C. Hasnain, “how slight changes in the spacing between the ribbons allows the material to reflect different colors of light.”[Blog]. Available:<http://blogs.discoverymagazine.com/science-sushi/2015/03/13/new-technicolor-dream-material-mimicschameleonskin/#.VbkJUPmqko>
- [30] D. Heeger, “Perceived Brightness”Internet:<http://hyperphysics.phy-astr.gsu.edu/hbase/vision/bright.html>[May. 18, 2015].
- [31] M. Shanbeh, “Effect of Fibre Fineness on Color and Reflectance Value of Dyed Filament Polyester Fabrics,afterabrasionProcess”. Internet:<http://www.tekstileci.si/wpcontent/uploads/2010/11/Effects-of-Fibre-Fineness-on-Colour-and-Reflectance -Value-of-Dyed-FilamentPoly ester-Fabrics-after-Abrasion-Process. Pdf> [May. 10, 2015].
- [32] M. Hossain1 and K. S. Ahmed, “Illumination Condition and Work Efficiency in the Tropics”.Internet:http://www.comarchitect.org/wpcontent/dhaka_2013/pdf_file/Abs_Acceptd%20Abstract%2010.pdf [April. 20, 2015].

- [33] Canadian Centre for Occupational Health & Safety, “The Importance of Workplace Lighting”. Internet:<http://www.safety.com/articles/importance-workplace-lighting> [April. 20, 2015].
- [34] T.T. Schaeffer, “Effects of Light on Materials in Collections: Data on Photoflash and Related Sources”. Internet:http://www.getty.edu/conservation/publications_resources/pdf_publications/effects_light.html. [April. 20, 2015].
- [35] G. Yaoyuneyong, “Effects of Illuminants and Retail Environments on Color of Textiles Fabric”. Internet:[http://diginole.lib.fsu.edu/cgi/viewcontent.cgi? article =5209&context=etd](http://diginole.lib.fsu.edu/cgi/viewcontent.cgi?article=5209&context=etd)[April. 20, 2015].
- [36] I. Ashdown, “Photometry and Radiometry”. Internet:<http://www.helios32.com/Measuring % 20Light.pdf> [April. 20, 2015].
- [37] A. Joseph, “The basics of radiometry”. Internet:http://www.coe.montana.edu/ee/jshaw/classes/eosystems/f09/classresources/ee482_f09_radiometryoverview_2pp.pdf[April.20, 2015].
- [38] S.M.F. Kabir and M.I. Iqbal, “Optimization of parameters of cotton fabric whiteness”. Internet:<http://www.eujournal.org/index.php/esj/article/view/4898> [April. 20, 2015].
- [39] F. Figucia,  University of Moratuwa, Sri Lanka, Electronic Theses & Dissertations www.lib.mrt.ac.lk, “Energy Absorption of Kevlar (trade name) Fabrics under Ballistic Impact”. Internet:[http://www.researchgate.net/publication/235099696_Energy_Absorption_of_Kevlar_\(trade_name\)_Fabrics_under_Ballistic_Impact](http://www.researchgate.net/publication/235099696_Energy_Absorption_of_Kevlar_(trade_name)_Fabrics_under_Ballistic_Impact)[April.20, 2015].
- [40] J.C.Hiba, “Temperature, Ventilation, Noise and Lighting”. Internet: <http://betterwork.com/cambodia/wp-content/uploads/2013/05/Chapter-4-Temperature-Ventilation-Night-and-Lighting-OSH-manual.pdf> [April. 20, 2015].
- [41] International Dark-Sky Association, “Some Issues in Low Light Level Vision”. Internet :[http://merc.dreamsites.com:8080/revize/repository/lumecon/ docs/Dark_Skies_Information_Sheet.pdf](http://merc.dreamsites.com:8080/revize/repository/lumecon/docs/Dark_Skies_Information_Sheet.pdf) [April. 20, 2015].
- [42] The Health and Safety Executive, “Lighting at Work”. Internet: http://www.qub.ac.uk/safetyreps/sr_webpages/safety_downloads/HSG38Lightingatwork.pdf [April. 20, 2015].
- [43] F. William, “Light in Design – An Application Guide”. Internet:http://www.iar.unicamp.br/lab/luz/ld/Arquitetural/manuais/lighting_design_an_application_guide_ies_cp_2_10.pdf[April. 20, 2015].

- [44] A.V. Oppenheim and G. C. Verghese, “Power Spectral Density”.Internet:
http://ocw.mit.edu/courses/electrical-engineering-andcomputer-science/6-011-introduction-to-communication-control-and-signal-processing-spring2010/readings/MIT6_011S10_chap10.pdf [April. 20, 2015].
- [45] H. K. Kaynak1 and O. Babaarslan, “Polyester Microfilament Woven Fabrics”. Internet:<http://cdn.intechopen.com/pdfs/36905.pdf> [April. 20, 2015].
- [46] Z. Zupin and K. Dimitrovski, “Data Base System on the Fabric Structural Design and Mechanical Property of Woven Fabric”. Internet:<http://cdn.intechopen.com/pdfs-wm/12245.pdf> [April. 20, 2015].
- [47] B. Lambert, “Absorption and Transmission of light and the Beer-Lambert Law”. Internet:<http://www.physics.uoguelph.ca/~pgarrett/teaching/PHY-1070/lecture-21.pdf> [April. 20, 2015].
- [48] K. Mellendorf and V. Calder, (November 2010) “Absorption (electromagnetic radiation)”.Internet:[https://en.wikipedia.org/wiki/Absorption_\(electromagnetic_radiation\)](https://en.wikipedia.org/wiki/Absorption_(electromagnetic_radiation)) [April. 20, 2015].
- [49] R. Nave, “AbsorptionCoefficient”.Internet:<http://www.pveducation.org/vcdrom/pn-junction/absorption-coefficient> [April. 20, 2015].



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APPENDIX A: Sensitivity function change

$\lambda(\mu\text{m})$	$V\lambda$
0.39	0.0022
0.4	0.0093
0.41	0.0348
0.42	0.0966
0.43	0.1998
0.44	0.3281
0.45	0.455
0.46	0.5672
0.47	0.6756
0.48	0.793
0.49	0.9043
0.5	0.9817
0.51	0.9966
0.52	0.9352
0.53	0.811
0.54	0.6497
0.55	0.4808
0.56	0.3288
0.57	0.2076
0.58	0.1112
0.59	0.0655
0.6	0.0332
0.61	0.0159
0.62	0.0074
0.63	0.0033
0.64	0.0015
0.65	0.0007
0.66	0.0003
0.67	0.0001
0.68	0.0001
0.69	0
0.7	0
0.71	0
0.72	0
0.73	0
0.74	0
0.75	0
0.76	0
0.77	0



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APPENDIX B:Questionnaire

Relationship among fabric types, fabric colours and illuminance level in garment industry for energy saving and eye fatigue

Name of the Factory -.....

- 1) What is your daily responsible duty in the factory?

.....

- 2) Are you satisfied with the intensity of light to perform your duty well in your section?

.....

- 3) Have you ever worked in any other garment factory?

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- 4) If you have worked somewhere else, what can you say about the intensity of light in the present and previous factories?

.....

.....

- 5) Explain your answer for question no4) above.

.....

.....

.....

- 6) Do you agree with the fact that the intensity of light should be changed according to the type and colour of the fabric?

.....

- 7) Do you agree with the fact that the intensity of light should be increased for dark colours?

.....

8) Do you agree with the fact that the intensity of light should be increased for light colours?

.....

9) Is it good to have a spot light?

.....

10) Is the bulb too closer to you?.

.....

11) Is it good to have an upper light?

.....



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APPENDIX C: Questionnaire responses

	No	1	0	0		0	0	1	Yes	1	0	0	No	0	1	0	Yes	1	0	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0		Yes	1	0	0	No	0	1	0	Yes	0	1	0	No	0	1	0	Yes	1	0	0
	Yes	1	0	0	Yes	1	0	0		0	0	1	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	Yes	1	0	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	Yes	1	0	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	Yes	1	0	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	Yes	1	0	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
	No	0	1	0	Yes	1	0	0	Yes	1	0	0	No	0	1	0	No	0	1	0	No	0	1	0	Yes	1	0	0
QTY	293	197	25		494	0	21		470	0	45		0	482	33		60	403	52		0	515	0		463	0	52	
%	57	38	5		96	0	4		91	0	9		0	94	6		12	78	10		0	100	0		90	0	10	



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APPENDIX D: Available illuminance levels in factories

Name of factory	illuminance level (lx)
I	1000
II	1000
III	750
IV	650
V	800



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APPENDIX E: Fabric density testing report

Material Content (Face)	Primary Weight (g/M³)	Fabric Width (M)	Yarn Count (Nec)	Density (Warp/Weft)	Yarn Type
100% Polyester	72.00	53.00	50dx50d	158x120	DTYxDTY
100% Polyester	72.00	53.00	50dx50d	158x120	DTYxDTY
100% Nylon	99.00	57.00	70D/48FX50D/96F*2PLY	121X110	FD Nylon Woolly X FD Nylon Textured
100% Polyester	140.00	56.00	75D X 75D	224 X 110	WP: P.MEMORY 75D FILAMENT WT: P.75D FILAMENT YARN
100% Nylon	51.00	57.00	30D/24FX30D/24F	193X157	SD Nylon Filament X SD Nylon Filament
100% Nylon	46.00	58.00	40D/10FX40D/10F	125X113	SD Nylon Filament X SDnylon Filament
100% Nylon	45.00	58.00	40D/10F X 40D/10F	125 X 113	SD FILAMENT

100% Nylon	45.00	60.00	40D/10F	120 X120	SD Nylon Filament x SD Nylon Filament
100% Polyester	85.00	60.00	55D/192FX55D/192F	186X125	
100% Polyester	85.00	60.00	55D/192FX55D/192F	186X125	SD Polyester Woolly X SD Polyester Woolly
100% Cotton	230.00	56.00	20 X 20	96 X 92	Combed X Combed
98% Polyester, 2% Elastane	176.00	55.00	SP30/1 x 150D/144 40DOP + 150D/144	115X 85	Polyester Spun x Polyester + Elastane + Polyester
100% Polyester	137.00	55.00	75D/72F X 160D/72F	142 X 72	FD POLYESTER DTY X FD POLYESTER ATY
100% Nylon	35.00	57.00	15d/5f x 15d/5f + 40d/34f	233 X 164	Nylon Textured Yarn
100% Cotton	175.00	55.00	2/30 X 2/30	54 X 52	Combed X Combed

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70% Polynsic Modal, 30% Polyester	157.00	56.00	(MODAL30'S+P150/48)X(MODAL30`S+MODAL30` S/2)	115 X 58	MODALXPOLYESTER FILAMENT
100% Cotton	160.00	55.00	20 X 20	66 X 62	Combed x Combed
70% Cotton, 30% Viscose	112.00	56.00	40 X 40	100 X 80	Compact X Compact
100% Nylon	260.00	58.00	(210D/48Fx2+N70D/68F) x (N/F210D/48Fx2+N/F70- D/68f)	54 X 35	Nylon Filament
100% Polyester	292.00	53.00	75DX75D 104	292.00	SD DTY x SD DTY
100% Polyester	137.00	55.00	75D/72F x 160D/72F	142 X 72	FD Polyester DTY x FD Polyester ATY
93.0% Polyester, 7.0% Elastane	280.00	53.00	(75D/72f+40D)x(300D/144 f+75D/72f+40D)	156 X168	(semidull DTY+OP) X (cantonicDTY+semidull DTY+OP)
100% Nylon	136.00	57.00	320T	70X90	

100% Polyester	43.00	55.00	NE20/24FD*NE20/24FD	239X188	
89% Polyester, 9% Rayon, 2.0% Elastane	357.00	56.00	300DX28/2+40D	104 X 80	
100% Polyester	60.00	58.00	68X68	117X85	
100% Polyester	70.00	59.00	68x68	117X85	
100% Nylon	35.00	57.00	150/50X150/50f + 40d/34f	233X164	Nylon Textured Yarn
95% Polyester, 5% Elastane	182.00	57.00	30/1 X 30/1 +70d	112 X 76	spun poly X spun poly + Lycra
100% Nylon	114.00	57.00	70D/48FX160D/96F	115X65	FD Nylon Filament X FD Nylon Textured
100% Polyester	70.00	56.00	50D/72FX50D/72F	167X129	

100% Polyester	228.00	58.00	POLY 600d/144 F x POLY 600d/144 F	44 X 28	SD Polyester X SD Polyester DTY
100% Polyurethane	0.00	0.00			
100% Nylon	250.00	58.00	420D	66/41	
100% Nylon	175.00	58.00	FILAMENT N/420D(SP) X N/420D(SD)	58 X 38	400D/72F SD X 400D/72F SD
100% Nylon	240.00	58.00		64 X 40	SD NYLON FILAMENT X SD NYLON FILAMENT
100% Nylon	111.00	55.00	70D(48F) x 120D(96F)	166 X 98	FD FLAMENT x FD ATY
100% Nylon	112.00	57.00	70D (48F) X 120D (96F)	163 X 95	FD FLAMENT X FD ATY
100% Nylon	113.00	58.00	70D/34F x 110D/96F	168 X 101	FD Filament Nylon x FD ATY Nylon

100% Nylon	113.00	56.00	70D(48F)x120D(96F)	161 X 98	FD FLAMENT x FD ATY
100% Polyester	228.00	58.00	POLY 600d/144 F x POLY 600d/144 F	44 X 28	SD Polyester X SD Polyester DTY
80% Polyester, 20% Polyurethane	320.00	52.00			
100% Cotton	90.00	55.00	40 Slub X 40 Slub	72 X 72	Combed X Combed
100% Nylon	230.00	58.00	200D/34f X 200D/34f	65TX55T	210DX210D
100% Nylon	79.00	53.00	15d/5f+40d/34f x 15d/5f+40d/34f	208 X 156	SD Nylon wooly + Bright Nylon filament x SD Nylon wooly + Bright Nylon filament
100% Nylon	86.00	55.00	N15/5 SD DT N50/48 SD FIL X N15/5 SD DTY50/48 SD FIL	250 X 174	Nylon Filmaent SD DTY X Nylon Filmaent SD DTY
100% Nylon	96.00	56.00	N15DxN15D		Filament

100% Polyester	180.00	57.00	150d/144f x 175d/144f	142 X 84	Poly DTY x Poly DTY
74% Cotton, 26% Polyester	255.00	57.00	10XT300	84X46	Open End
100% Polyester	228.00	58.00	POLY 600d/144 F x POLY 600d/144 F	44 X 28	SD Polyester X SD Polyester DTY
85% Modacrylic, 15% Polyester	790.00	58.00	acrylic 3dx76mm, acrylic 3dx51mm, acrylic 3dx38mm, polyester dty <small>150dx36f</small>		



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