

Advertorial

What does $U_n = 1000 \text{ V d.c.}$ mean for the boxes?

When using electrical components in the range of photovoltaics there is the result of off-load voltage up to $U_{oc} = 1000 \text{ V}$ caused by series connections of several pv modules. Those pv modules work with **direct current (d.c.)**.

The above mentioned facts have to be regarded when choosing components for the generator-junction boxes as well as for active parts, i.e. surge protection devices or disconnector and for the used boxes.

The normative background for the installation of photovoltaic plants is the **IEC 60 364-7-712**. In this document the statement is issued that **protection class II** (insulation) should be used as a protection measure.

Protection class I (protective earthing) cannot be used because in case of fault the protection measure would not work due to the insufficient short-circuit current

($I_k \approx 1,1 \times I_n$). The nominal current I_n depends on the solar radiation on the pv module.

Caused by high voltage up to 1000 V the protection class III do not work either (protection low voltage up to 120 V d.c.).

=> Therefore boxes made from insulating material are a good choice (i.e. HENSEL Mi-Boxes).

For the production of generator junction boxes the **IEC 61439** has to be obtained.

In this document the test conditions are regulated.

Part 10.9.4 issues the statement that concerning boxes from insulating material the multiplier 1,5 has to be used relating to "table 8".

"Table 8" shows which insulation-test-voltage at which voltage (U_i) has to be used, i.e.

for 1000 V d.c. is classified: test voltage $U_i = 3110 \text{ V} \times 1,5 \Rightarrow 4665 \text{ V}$

for 1500 V d.c. is classified: test voltage $U_i = 3820 \text{ V} \times 1,5 \Rightarrow 5730 \text{ V}$



The HENSEL KV-, ENYSTAR- and Mi-distributors have passed the insulation test in the Hensel quality assurance with 4665 V. Therefore these distributors are suitable for the operation of $U_{oc} = 1000 \text{ V}$.



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AOTS Training in Japan

The Environmental Management Training for Malaysia was organised by The Association for Overseas Technical Scholarship (AOTS) in collaboration with TEEAM to introduce know-how for the promotion of energy efficiency in factories in the manufacturing industry in Malaysia. It was a two week programme held between 25th September 2011 to 7th October 2011 at Yokohama Kenshu Center (YKC) Yokohama, Japan for the fourth time. TEEAM only managed to recruit seven trainees for the 2011 programme due to the earlier earthquake and tsunami disaster in Japan.

The key objective of the training was to enable its trainees to gain a deeper understanding of environmental management techniques and methods, and to promote energy efficiency in their own organisations. The training programme was very well structured to cover a wide area of applications to demonstrate the opportunities for energy efficiency and energy saving methods. Some areas covered were the high efficiency equipment produced by the Japanese and used in most of their homes, office buildings and factories.

Besides classroom lectures, some technical visits and study tours were made to some Japanese plants which have energy efficiency and environmental management programme.

The training also introduced new products that would reduce energy consumption. However the most important and critical aspect to learn from this training with respect to energy saving is the culture adopted by the Japanese in their quest to continue to reduce their overall energy consumption.

Since the world oil crisis in 1973, Japan being a country fully dependent on foreign petroleum experienced a severe increase in their energy cost which affected their economy tremendously. It was after this oil crisis that the Japanese fully appreciated the importance of energy and hence led to the beginning of the energy conservation culture in Japan. The Japanese then progressively began to reduce their dependence on fuel and moved on to alternative sources of energy.

The training was an eye-opener for all the trainees. In order to effectively conserve energy, Malaysia needs an energy saving culture and to properly understand this culture. There is no better way than to observe the ways of the Japanese as they have successfully integrated the act of saving energy into their everyday life. It no longer requires additional effort to reduce energy but rather it has become norm. One can have the most efficient equipment but if it is not switched off when unused, energy is still wasted.

With such programme and exposure, Malaysians' will be more aware of the importance of energy conservation and it is hoped that we will be less dependent on oil by the time our oil reserves are depleted in the near future.

A special note of thanks to Trainees, Mr Ian Cheong and Mr Desmond Yoo for the notes and photos contribution for this article. The trainees wish to thank AOTS and TEEAM for continuously organising such programme for the good of the industry and country.



Fruitful training – After classroom lecture.



Learning trip – Trainees received first hand information during a technical visit.



Japan here we come – Seven “Ninjas” landed at Narita airport, Tokyo.



Technical visit – Visit to a PV plant.

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..... Continue AOTS Training in Japan



Interesting – A technical visit to Tokyo Electric Power Company (TEPCO).



Gigantic – Kawasaki Solar Power Generation Plant.



Lunch at Hakone Lake – Trainees savouring authentic Japanese cuisine.



Sayonara! – Group photo taken at the closing ceremony.



Guangzhou International Lighting Exhibition 2012

9th to 12th June 2012

China Import and Export Fair Complex, Guangzhou, China

The Guangzhou International Lighting Exhibition, one of the world's most comprehensive lighting industry events, is aiming to set another new record in terms of exhibition space with an expected 21 halls covering 220,000 sqm for its 17th edition this year.

Organised by Guangzhou Guangya Messe Frankfurt Co Ltd, the show provides a one-stop platform by offering the world's most dynamic trading hub for the lighting industry, supported by a highly respected fringe programme of event offering market intelligence and networking opportunities.

This year, the hall arrangement uses the following six generic product categories:

- Brand name halls featuring the world's leading lighting brands
- Technical lighting
- Decorative lighting
- Light Emitting Diode (LED) technology
- Display applications
- Accessories & electronic components

The 2012 exhibition will see the largest ever line up of seminars, forums, events and presentations with more than 100 sessions offering market intelligence and networking opportunities to professionals representing a diverse range of industry interests. Some of the popular events are:

- Lighting technology symposium
- Lighting design gallery
- Industry information & networking
- Asia LED industry summit
- China lighting distribution market summit
- Innovation in lighting symposium
- Lighting award presentation
- Product presentation



The Guangzhou International Lighting Exhibition is held concurrently with Guangzhou Electrical Building Technology which supports the growing trend of eco-friendly buildings with a special focus on electrical engineering and building, and home automation.

TEEAM intends to organise a delegation to visit the exhibition and members who are interested may contact the TEEAM Secretariat to register as trade visitors. Tel: +603-9221 4417 E-mail: teeam52@gmail.com

To find out more information about the 2012 edition of the Guangzhou International Lighting Exhibition, please visit www.light.messefrankfurt.com.cn

New Members

The following new members have been approved and accepted by the TEEAM Council (as at 29th March 2012). A warm welcome to all the new members and special appreciation is extended to those who introduced these new members. For those who are not yet members..... why wait? Join us and find out how our Association can offer our services to you.

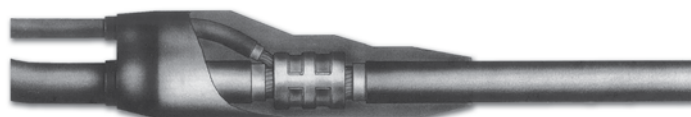
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SILQ (Malaysia) Sdn Bhd 149, Jalan Sultan Azlan Shah, Taman Perindustrian Bayan Lepas, Fasa I (FTI), Bayan Lepas, 11900 Penang. Tel: +604-646 9405 Fax: +604-643 6521 E-mail: geo.lim@silq.com Website: www.silq.com Contact Person: Mr Geo Lim Soo Siang <i>Business: Manufacturer of LED.</i>	QAV Technologies Sdn Bhd 116, Lintang Kg Jawa, Nfiz 3, Taman Perindustrian Bayan Lepas MK 12, 11900 Pulau Pinang. Tel: +604-643 8317 Fax: +604-643 8597 E-mail: johnsee@qavtech.com Website: www.qavtech.com Contact Person: Mr See Keat Siang <i>Business: Test services.</i>
Smart Cable (M) Sdn Bhd No.9, Jalan BA/3, Kawasan Perusahaan Bukit Angkat, 43000 Kajang, Selangor Darul Ehsan. Tel: +603-8737 0189, 8737 0289 Fax: +603-8737 0389 E-mail: smartcable@live.com Contact Person: Mr Yuan Zhong Ping <i>Business: Manufacturer of cables & wires.</i>	L. V. Control Sdn Bhd No.98, Jalan SS 14/1, 47500 Subang Jaya, Selangor Darul Ehsan. Tel: +603-5631 7803 Fax: +603-5636 4780 E-mail: info@lvcontrol.com.my Contact Person: Madam Lillian Lip <i>Business: Manufacturing, trading, installation of lightning protection system & electrical component.</i>
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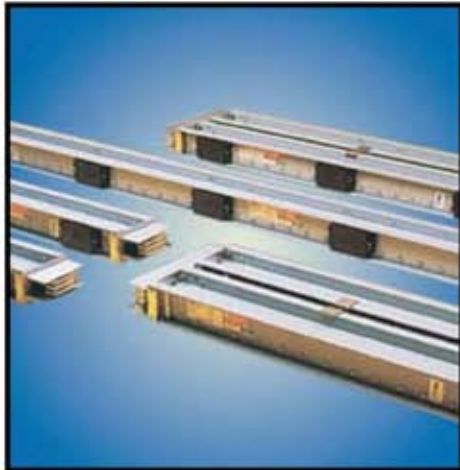
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Seminar on Light and Colour

A half day Seminar on Light and Colour was held on 22nd November 2011 at UNITEN. The seminar was organised by MyCIE (Malaysia CIE) to educate and create awareness for those involved in the lighting industries. The speaker was Mr Mervin Woo from Konica Minolta Sensing Singapore Pte Ltd. His presentation was very informative and his seminar topics included introduction to light and colour measurement and types of measuring instruments and its application. The seminar was well attended by 86 participants. They were lighting manufacturers, electrical contractors, traders, consultants and university students. The seminar ended with an interactive Q &A session and it had benefited all the participants.



Speaker – Mr Mervin Woo giving his presentation.



Good response – Participants listening attentively to the presentation.



MyCIE Chairman – Mr C T Siew delivering his welcome speech.



Building Wiring Installer Course

Introduction

The Building Wiring Installer training programme is designed for the construction personnel involved in the low voltage installation of electrical wiring and related electrical equipment. It is also a skill standard developed by the Construction Industry Development Board (CIDB) with participation of industrial experts from the public and private sectors. The 3-month course is sponsored by CIDB subject to prior approval.

Course Content

1. Fundamentals of electricity

Series and parallel circuits. Measurement units. Supply sources. Single phase and Three phase.

2. Wiring cables

Types, size, colour code, rating and applications. Conductor and insulator. Current carrying capacity and voltage drop. Types and methods of electrical wiring joint.

3. Protective devices

Fuse, miniature circuit breaker and earth leakage circuit breaker. Overload relay.

4. Read and interpret drawings

Electrical layout diagram. Schematic diagram. Wiring circuit diagram. Electrical symbols.

5. Electrical wiring

Concealed and surface wiring. Conduit and trunking. Surface and flush mounting. Lighting and power final circuits. Consumer terminal unit. kWh meters and earthing system.

6. Installing electrical equipment and appliances

Water heater, door bell, discharge lamp, exhaust fan, distribution board, etc.

7. Use measuring and testing instrument

Voltmeter, ammeter, clamp tester, multimeter, insulation tester, earth resistance tester, etc. Principle of operations and applications.

8. Practical safety measures

Apply first aid treatment. Hazardous environment. Safe usage of tools and equipment. Report accidents on-site. Acts and regulations.

Certificate

Course participants who have achieved the skill competency requirement will be awarded with a certificate. In addition, a CIDB Green Card will also be issued.

For registration and further information, please contact the TEEAM Secretariat at:
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New Books in Our Library

Informative reference materials are available in our Library. The Library is open to members from 9:00 am to 5:45 pm, Monday to Friday.

Title : 50th Golden Souvenir Magazine, 2011 Publisher: Sarawak Electrical Association	Title : FMM Directory 2012, 43rd Edition Publisher: Federation of Malaysian Manufacturers	Title : MFPA, Voice of the industry, for the industry, Issue 2, 2011 Publisher: The Malaysia Fire Protection Association
Title : 57th MBAM Anniversary Souvenir Programme Publisher: Master Builders Association Malaysia	Title : Hong Kong Electrical Contractors' Association (HKECA Newsletter) Publisher: Hong Kong Electrical Contractors' Association	Title : MGCC Quarterly March/April 2012 Publisher: Malaysian-German Chamber of Commerce and Industry
Title : ACCCIM Bulletin, February 2012 Publisher: The Associated Chinese Chambers of Commerce and Industry of Malaysia	Title : IEEMA Journal, April 2012 Publisher: Indian Electrical and Electronics Manufacturers' Association	Title : PEMUDAH Annual Report 2011 Publisher: The Special Task Force To Facilitate Business (PEMUDAH)
Title : Asean Elenex 2011 Show Directory Publisher: Malaysian Exhibition Services Sdn Bhd	Title : IEM Journal, Feb & March 2012 Publisher: The Institute of Engineers, Malaysia	Title : Power – Gen Asia Show Guide, 2011 Publisher: PennWell
Title : Average Unit Price of Selective Materials for Civil Engineering Works, October 2011 Publisher: Department of Statistics Malaysia	Title : Info@ ILSAS, March 2011 Publisher: TNB Integrated Learning Solution Sdn Bhd	Title : Ready Reckoner for Indian and Malaysian Business on Comprehensive Economic Cooperation Agreement (CECA) between India and Malaysia Publisher: High Commission of India, Kuala Lumpur.
Title : Berita KLSCCCI, Jan-Mar 2012 Publisher: The Chinese Chamber of Commerce & Industry of Kuala Lumpur and Selangor	Title : Jurutera, No.3 March 2012 Publisher: The Institution of Engineers, Malaysia,	Title : S & Q, Standards & Quality News, Vol. 20, 2011 Publisher: SIRIM Berhad
Title : Bina Integriti, Edisi 3/2011 Publisher: CIDB (Construction Industry Development Board) Malaysia	Title : MACRA, 11th Anniversary Dinner Souvenir Programme Book, 2011 Publisher: Malaysia Air-Conditioning & Refrigeration Association (MACRA)	Title : Suara Perunding, 1st Quarter 2012 Publisher: Association of Consulting Engineers Malaysia
Title : Building Materials Cost Index for Building & Structural Works, October 2011 Publisher: Department of Statistics Malaysia	Title : Malaysia Economic Monitor, April 2012 Publisher: World Bank Office, Bangkok	Title : Tenaga Link, Vol 04/11 Publisher: Tenaga Nasional Berhad
Title : Business in Action, Jan/Feb 2012 and Mar/Apr 2012 Publisher: Federation of Malaysian Manufacturers	Title : Malaysia Energy Guide, 2011/2012 Publisher: TM Info – Media Sdn Bhd	Title : The Strategist, Vol 3, December 2011 Publisher: Asian Strategy & Leadership Institute
Title : ELECRAMA-2012 Exhibitors' Directory Publisher: Indian Electrical & Electronics Manufacturers' Association	Title : Malaysia International Trade And Industry Report 2010 Publisher: Ministry of International Trade and Industry Malaysia	Title : TNB Annual Report 2010 Publisher: Tenaga Nasional Berhad
Title : EUMCCI Review, Volume VII, January 2012 Publisher: EU-Malaysia Chamber of Commerce & Industry (EUMCCI)	Title : Master Builders Journal, MJB Volume 3, 2011 Publisher: Master Builders Association Malaysia	Title : Trademart, January/February 2012 Publisher: MATRADE
	Title : Members Directory 2011- 2012 Publisher: Master Builders Association Malaysia	



Technical Visit to MNI

16th June 2012

TEEAM is organising a technical visit to Malaysian Newsprint Industries (MNI) Sdn Bhd's newsprint plant in Temerloh-Mentakab on Saturday, 16th June 2012. The visit aims to enhance our members' knowledge on newsprint production and the power generation facility which uses bio mass from palm oil mill waste as well as the water treatment facility in MNI.

Programme

7.30 am	Assemble at TEEAM
7.45 am	Depart Kuala Lumpur. Half-way break at highway rest area
10.00 am	Arrive MNI plant. Welcome remarks/Briefing/Plant tour
1.00 pm	End with lunch
2.00 pm	Departure. Explore places of interest along the journey back
5.30 pm	Estimated time of arrival at TEEAM

MNI is now the pioneer in the most sophisticated technology in Malaysia - one ranked among the world's top newsprint production facilities, with an annual capacity of over 260,000 tonnes of newsprint production per year. Its power generation capacity is 3MW and uses bio mass from palm oil mill waste. Its water treatment plant capacity is 15,000 m³/day.

There is no registration fee charged for the visit. Number of participants is limited to 40 and acceptance will be on a first come first served basis. Please contact the TEEAM Secretariat for registration.

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Challenges and Opportunities in Electrical Industry - Part 17

This paper is prepared by Ir Chew Shee Fuee, TEEAM Vice President.

Feed In Tariff - Malaysia

Feed In Tariff (FiT) was mentioned for a long time and eventually became a reality starting 1st December 2011. The following is an extract of the news.

The Minister of Energy, Green Technology and Water Malaysia, YB Dato' Sri Peter Chin Fah Kui officially launched the office of Sustainable Energy Development Authority Malaysia (SEDA Malaysia) in Putrajaya on 22nd November 2011. SEDA Malaysia is a statutory body established under the SEDA Act 2011 (Act 726) and its primary function is to manage and administer the FiT.

Dato' Sri Peter Chin is confident the FiT will be of tremendous benefit to the Renewal Energy (RE) industry in Malaysia. The FiT has proven to be an effective policy tool around the world and Malaysia has developed and adopted the FiT mechanism to suit our local requirements having learnt numerous lessons from other countries.

Based on the National Renewable Policy and Action Plan, it is estimated Malaysia will by 2020, generate at least RM 70 billion worth of revenue for the private sector which translates to tax revenue of at least RM 1.76 billion for the government. Another economic and social benefit arising from the sector is job creation. It is estimated that Malaysia can generate at least 52,000 jobs from the construction, operation and maintenance of RE plants in the country.

The government has decided electricity consumers will contribute 1 % of the total electricity tariff bills issued by Tenaga Nasional Berhad (TNB) to the RE Fund. Nonetheless, 75 % of the TNB's customers who consume less than 300 kWh per month will be exempted from contributing to this Fund and the collection of 1 % will be effective from 1st December 2011 onwards.

With the reduction in the cost of Solar Photovoltaic (PV) modules in the world market today it has become a very attractive business proposal for Solar PV installation.

The average global PV module price has reduced from US\$4.66/W (per Watt) in 2004 to US\$2.01/W in 2010. There was a 2.8% increase in the average module price in 2008 as the global demand exceeded supply. The average selling price of modules continued its declining trend in the last couple of years due to a reduction in production costs and increased competition. The average module price dropped by 50.9% from 2008 levels

by 2010, with the increasing presence of low cost Asian producers, and the price drop was worsened by the repercussions of the global economic crisis.

The advent of new technologies and the streaming of production processes will further reduce the price of a module and improve the conversion efficiencies of a solar cell. The average selling price of a solar module will decline further and is expected to reach US\$1.49/W by 2015 as market participants will lower their module prices to maintain or improve their market share in the global modules market.

FiT Rates for Solar PV in Malaysia are as follows:

Up to and including 4KW - RM1.23 per unit

4KW to and including 24KW - RM1.20 per unit

24KW to and including 72KW - RM1.18 per unit

My personal proposal to SEDA is to reduce the FiT for Solar PV so that more KW can be achieved with quota provided per year.

Power Factor Surcharge on TNB Commercial Meters

TNB had been replacing meters for commercial premises. These new meters are reading Power Factor (PF) which was not possible before. Therefore many commercial consumers are billed with PF surcharges. This came about when TNB was also conducting their raids on meter frauds. The PF surcharge is also wrongly perceived as TNB's way of getting back from the meter frauds.

TNB therefore was forced to provide a grace period of 3 months in the case when new meters are installed. This will provide sufficient time for consumers to get PF correction in place to prevent any surcharge. TEEAM has been requested to provide the vendors information so that the public will have an easy means of getting PF correction equipment purchased and installed.

There are commercial consumers in a wide range of electricity consumption and therefore a range of PF correction equipment is needed.

In order to maintain good voltage profile, it is important to provide automatic PF correction. Any other means will solve the PF surcharge but may pose high voltage when loads are low.

TNB Discussion on Consumer Internal Wiring Faults

TNB will attend to any breakdown as reported by their residential consumers. In many cases the breakdowns are not caused by TNB on the supply end. Trippings can be caused by faulty equipment or wiring in the residential premises. TNB has been providing the additional services in solving the problems faced by their consumers. However TNB is of the opinion that these services can be provided by contractors or licenced wiremen. Therefore it is now important to get this service in place so that the public will have the contacts to get such services. It may be of interest to be able to provide a list of services with costs indicated for the benefit of the potential customers.

Ir Chew Shee Fuee B Sc (Hons) (Strathclyde), PEng, CEng, FIEM, MIEE Member, IEEE Member, 1st Grade Electrical Engineer (Competent up to above 500 kV).

Ir Chew is the Vice President (Engineering Construction and Services) of The Electrical and Electronics Association of Malaysia (TEEAM). He was TEEAM President for 2001 - 2003 and 2003 - 2005. He is the Past President of the Asean Federation of Electrical Engineering Contractors (AFEEC).

Ir Chew is the Managing Director of G H Liew Engineering (1990) Sdn Bhd and QATM Engineering Services Sdn Bhd. He graduated from the University of Strathclyde, Glasgow with a B Sc (Hons) in Electrical & Electronics Engineering. He is a Professional Engineer and is also licensed by Energy Commission as a competent engineer (without voltage limits) and a service engineer to carry out electrical testing up to a voltage of 500 kV.

Ir Chew has more than 30 years experience in electrical control and relay protection. He is also specialised in electrical site tests on power equipment, electrical fault investigation, service and maintenance of electrical switchgear and relays. His work also includes electrical supervision of substations and electrical audit. He presents lectures on electrical apparatus and the protection system. He is at present a WG representative in the development of Green Technology Road Map Phase 1. He is also a member of the National Energy Efficiency Technical Working Group. He is the Immediate Past President of IET Malaysia (Institution of Engineering & Technology) and Board Member of IET's APRB (Asian Pacific Region Board). He can be reached at E-mail: sfchew@ghliew1990.com.

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Switch on with



Suitability of LED for Road Lighting in Malaysia

Foreword

This Technical Report was developed by the Working Group on LED for Road Lighting under the authority of The Electrical and Electronics Association of Malaysia (TEEAM).

This Technical Report gives recommendations on the suitability of LED for road lighting in Malaysia with the justification based on a comprehensive techno-economic analysis of the current best available technology LED and HPSV lighting systems and with public safety in mind.

This Technical Report is the first edition and will be reviewed every 4 to 6 months depending on the development in LED technologies.

Executive Summary

This Working Group was established to study the suitability of Light Emitting Diode (LED) light source for road lighting at this moment of its technological development, in response to the call of many stakeholders in the road lighting industry who are extremely concerned that untimely rush into the use of this technology may cost the federal government, state government, local government and highway operators, dearly in providing safe road lighting and this cost will ultimately be passed back to all Malaysians in the form of direct and indirect taxes and higher toll charges. There are also concerns that there is no proper detailed cost and benefit justification and comparison with the best of existing proven technology, thus creating an unhealthy situation that is open to abuse by unscrupulous opportunists for their own benefit at the expense of the general public.

At this stage of LED development, the conclusion of this study is as follows:

	Advantage of using LED	For 3-lane dual carriageway (ME1 lighting class)	For 4-lane bi-directional carriageway (ME2 lighting class)
1) Energy saving	No	LED use 15% more power	LED use 10% more power
2) Cost saving	No	Increase initial cost by 5 times with LED products	Increase initial cost by 2 times with LED products
3) Maintenance cost over 20 years	No	12.5 times more with LED products	5 times more with LED products
4) Safety and security	No	Impact of LED on road lighting is still under deliberation. Current lighting standards have to be respected, or public safety will be compromised.	
5) Environmental impact	No	5 times more using LED products	2 times more using LED products

The result of this study can be corroborated with similar studies carried out by Kostic, M. et al. – ‘LEDs in Street and Ambient Lighting – Two case studies’ enclosed with this report as Appendix A*, and by Onaygil, S. et al titled ‘Cost Analysis of LED Luminaires in Road Lighting’ which is enclosed herewith as Appendix B*, for European climatic condition which is less taxing.

The Maintenance Factor (MF) for LED luminaire used in this study is calculated using the method presented by LacBatel, C., Sergeant, M. in their paper titled ‘Maintenance Factor Of Outdoor LED Lighting Installation’ enclosed herewith as Appendix C*. The MF value of 0.717 obtained is at best a good estimate, thus risking a possibility of more life cycle cost if this figure is on the high side. On the other hand, the MF of 0.8 in the scenario presented here for HPSV solution is well established, and maintenance budget can be easily allocated accurately to ensure that the safe lighting level is always maintained. The MF for LED and HPSV solution for the same luminaire cleaning interval is not the same. Detail on MF is on page 3 to 5 of this report. Henceforth, the initial lighting level of LED has to be higher than that of HPSV solution.

The non-professional current practice of having administrators to view visually a new lighting installation and make policy decision based on his feel is wrong and must be stopped.

It is also established herewith that the efficiency of a lighting solution does not depend solely on the efficacy of the light source alone. Other influencing parameters have to be taken into consideration and fortunately well tested software tools are already widely available to make the calculation.

Up to 9% of energy can be saved by just cleaning the luminaire every year and up to 25% of energy saving can be achieved over the lamp lifespan by using Constant Light Output (CLO) gears or controller. (CLO for HPSV is attached in Appendix D*). Finally, during period of low traffic, up to 20% energy can be saved. Just by improving on our current practice of designing, operating and maintaining a road lighting installation, a total of up to 54% energy saving can easily be achieved.

In this study, on page 11, Table 3, it is also shown that there was also a lot of improvement in the photometry of HPSV luminaires that an old installation using 400W luminaire can be replaced with current high performance 250W HPSV luminaire on a one to one basis without having to shift the position of the poles. This upgrading results in an immediate energy saving of 40%.

Zhaga which is an industry wide consortium is in the process of developing industry standard specifications for LED light engine to ensure interchangeability of light engine from different manufacturers, provide a stable design platform for luminaire makers and to future-proof light engines which can be second sourced and upgraded. As Zhaga is an industry wide consortium, standard specifications develop by Zhaga will become international standard. Luminaire in the market now are not Zhaga compliant and will be obsolete soon, thus becoming a maintenance nightmare in terms of availability of spare parts.

LED is still evolving at a fast rate even at this moment and will eventually become viable as alternative lighting solution for road lighting. For this reason, this Working Group will review the situation periodically and advise accordingly on the readiness of LED as a good viable alternative lighting solution for road lighting. Meanwhile, use of LED for road lighting must be assessed carefully to ensure lower total life cycle cost and environmental impact than the existing technology. The approach used in this study is a simple method to do so.

Background

In the last few years, Light Emitting Diode (LED) has been marketed aggressively as the light source that can replace all the lamps that are now in common use claiming that it is energy efficient, long life and green. In this time of unprecedented green movement, this has put a lot of pressure on policy makers who are obliged to reduce carbon emission and at the same time attracts opportunists out to capitalize from this huge green bandwagon. However, experience with LED products for road lighting has so far been generally negative especially the long life or reliability aspect. Technical data of LED for road lighting did not indicate that LED is any more efficient than other highly efficient lamps that are much cheaper, widely used and easily available in the market. As such, involvement of government in promoting the use of LED for road lighting using public fund without proper detailed cost and benefit justification need to be reviewed urgently.

Under such circumstances, The Electrical and Electronic Association of Malaysia (TEEAM), which is in the forefront in promoting green, is taking the initiative to study the use of LED in areas of public interest. The formation of the Working Group involving all interested parties to study the suitability of LED for road lighting is one of such initiatives.

* Editor's Note:

1. For full details on all the appendices in this technical report, please refer to the original report in the TEEAM website: www.teeam.org.my
2. The page numbers mentioned herein are those of the original report.

..... Continue Suitability of LED for Road Lighting in Malaysia

This Working Group is established to evaluate the suitability of LED light source for road lighting as this area of lighting is of immense public importance as it involves :

- (a) the safety and security of road users,
- (b) the use of public funds to provide, maintain and operate road lighting systems, and
- (c) the environmental impact to the manufacture, distribution, use and finally disposal of lighting equipments and consumables.

This Working Group is made up of members from professionals, manufacturers, operators and other stakeholders in this area of lighting and this report is open to the public to study, dissect, evaluate and comment on its accuracy and conclusion, after which, to be used as a guide/reference for evaluation of light sources for road lighting so that investment in this area of lighting is based on sound technical and financial considerations and not on loosely defined criteria such as the widely abused word “green”.

Introduction

During the recent CIE 27th Session that took place from 11th to 15th July 2011 in Sun City, South Africa, two papers on similar subject were presented. Kostic, M. et al. of the University of Belgrade presented a comprehensive techno-economic analysis of using LED for road and ambient lighting regarding efficiency, maintenance and financial aspects based on the frequently declared economic life of LED of 50,000 hours with lumen depreciation factor of 0.8 (L80), conclude that LEDs are not yet appropriate for road lighting. The full report is as shown in Appendix A*. The other paper as attached in Appendix B*, by Onagyl, S. et al. on Cost Analysis of LED Luminaires in Road Lighting based on the economic life of 30,000 and 50,000 hours for LEDs, concludes that LED Luminaires can be feasible only if it has higher efficacy and lower cost than recent situation. In other words, it is not feasible now.

This Working Group evaluates the suitability of LED light source for use in road lighting as compared to the present, widely used High Pressure Sodium Vapour (HPSV) Light source from the energy, long life and environmental impact aspects in the Malaysian situation. In making the comparisons, latest technological development in both are used to comply with the Malaysian Code of Practice (COP) for the Design of Road Lighting, MS 825, 2007. LED is basically another type of light source and compliance with the COP will ensure that the objectives of the specified lighting task, especially the safety of road users, are met. Appropriate factors are taken into consideration to allow direct comparison and where direct comparison is not possible, cost argument is used instead.

Energy comparison of HSPV and LED luminaires

The energy comparison is made with luminaires from major players in road lighting, one from US, two from Europe, one from China and compare to a HPSV luminaire made in Malaysia. The calculation is made from photometric data from the manufacturers using the Ulysse software (version 2.1) developed by Schröder specifically for road lighting simulation. In the case of the luminaire from China where photometric data is not downloadable from the website, the calculation is from their published data.

The comparisons are made for two typical types of road geometry that are very common in Malaysia, namely 3-lane dual carriageway to be lit to ME1 lighting class and 4-lane single carriageway, bi-directional traffic to be lit to ME2 lighting class. For the 3-lane dual carriageway, comparisons are made for twin central installation and opposite installation. For the 4-lane single carriageway, calculations are done for opposite, opposite staggered, and single sided installation.

The maintenance factor (MF) used in Malaysia for HPSV luminaires has been standardized at 0.8 and luminaire of IP6X are now generally used. For the purpose of this study, we assume that luminaire cleaning is done during re-lamping and these roads are generally in medium pollution category. This works out to be about 4 years or 17520 hours based on 12 hours operation per night. Figure 1 shows the lumen maintenance and survival rate of high output, 4 year HPSV lamp.

Table 1 shows the Luminaire Maintenance Factor (LMF) for an IP6X luminaire [MS 825: Part 1: 2007]. The MF for HPSV luminaire is the product of lumen output after 4 year operation and LMF at 4 years which works out to be 0.8. During this period before scheduled relamping, 8% (or average of 2% per year) of lamps MAY fail and have to be attended to immediately in order to comply with the safe lighting standard and the cost is accordingly taken into consideration in the calculation of maintenance cost. As such, the Lamp Survival Factor (LSF) for road lighting is not applicable [CIE 154: 2003].

Figure 1. Lamp lumen maintenance and survival rate
(Philips SON-T PIA PLUS)

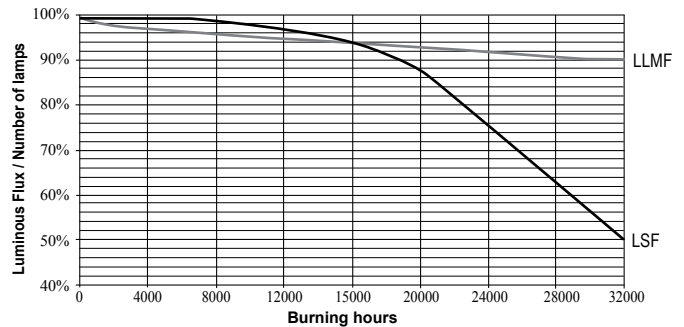


Table 1. Luminaire maintenance factor (MS 825: Part 1: 2007)

Cleaning interval months	Luminaire maintenance factor								
	IP2X minimum ^a			IP5X minimum ^a			IP6X minimum ^a		
	High pollution ^b	Medium pollution ^c	Low pollution ^d	High pollution ^b	Medium pollution ^c	Low pollution ^d	High pollution ^b	Medium pollution ^c	Low pollution ^d
12	0.53	0.62	0.82	0.89	0.90	0.92	0.91	0.92	0.93
18	0.48	0.58	0.80	0.87	0.88	0.91	0.90	0.91	0.92
24	0.45	0.56	0.79	0.84	0.86	0.90	0.88	0.89	0.91
36	0.42	0.53	0.78	0.76	0.82	0.88	0.83	0.87	0.90

a Ingress protection code number of lamp housing; see BS EN 60529.

b High pollution generally occurs in the centre of large urban areas and heavy industrial areas

c Medium pollution generally occurs in semi-urban, residential and light industrial areas.

d Low pollution generally occurs in rural areas.

The construction of LED luminaire is different from that of a HPSV luminaire and the MF has to consider other depreciating factors. For this, we shall use the tool to calculate MF for LED as presented by Lac-Batel, C. and Sergeant, M., Lighting Application Specialists of Philips Lighting, during the 27th CIE Session. Their paper is as shown in Appendix C*. The MF for a LED luminaire with PMMA lens, driven at 350mA, in our average ambient temperature of 28°C, with same cleaning interval of 4 years in medium pollution environment works out to be 0.717. The calculation is given below.

Calculation of maintenance factor for LED street lighting installation:

The maintenance factor for LED street lighting installation is derived based on the methodology and data presented in Appendix C.

i) Lamp Lumen Maintenance Factor (LLMF):

$$LLMF = \text{Lumen depreciation for } 25^{\circ}\text{C ambient temperature} \times \text{Lumen depreciation for driving current of 350mA} \times \text{Relative initial flux at } 28^{\circ}\text{C}$$

$$LLMF = (0.936) \times (0.934) \times (0.992)$$

$$LLMF = 0.867$$

ii) Luminaire Maintenance Factor (LMF):

$$LMF = \text{Luminaire depreciation factor for medium pollution environment \& cleaning intervals of 4 years} \times \text{Aging of PMMA optical lenses}$$

$$LMF = (0.841) \times (0.983)$$

$$LMF = 0.827$$

iii) MF = LLMF (0.867) x LMF (0.827)

$$MF = 0.717$$

From the foregoing explanation, the MF for HPSV based on 4 year cleaning cycle and re-lamping is 0.8 and for LED is 0.717. Table 2a shows the comparison for a 3-lane dual carriageway, lit to ME1 lighting class, twin central installation and Table 2b shows that of the same highway with opposite installation. Table 2c shows comparison for a 4-lane single carriageway, 2 lanes per traffic direction, lit to ME2 lighting class, with opposite installation, Table 2d for opposite staggered installation and Table 2e for single sided installation. The simulation is optimized for energy efficiency.

..... Continue Suitability of LED for Road Lighting in Malaysia

Table 2a. Comparison for ME1 lighting class – Twin central installation

Road Details								
1) Carriageway		Dual carriageway						
2) Road width		3 x 3.65m / carriageway						
3) Median		2m						
4) Road surface		R3 ; Qo = 0.07						
Installation Details								
1) Lighting system		LED				HPSV		
2) Luminaire type		USA	Europe-1	Europe-2	China	Malaysia		
3) Lamp power	(W)	204	-	215	-	150	250	400
4) System wattage (α)	(W)	237	256	228	275	176	285	450
5) Total luminous flux (lamp)	(klm)	15.6	29.9	23.4	23.0	17.5	33.2	56.5
6) Luminaire efficiency	(%)	100.0	82.8	72.0	-	81.0	80.5	82.4
7) Luminaire efficacy	(lm/W)	65.8	96.7	73.9	-	80.5	93.8	103.5
8) Lamp colour temperature	(K)	4000	4000	4250	-	2000	2000	2000
9) Pole arrangement		Twin central				Twin central		
10) Mounting height	(m)	12	12	12	12	12	12	15
11) Pole spacing (β)	(m)	21	34	26	29	26	40	69
12) Setback of pole	(m)	1	1	1	1	1	1	1
13) Overhang	(m)	1	0	1	-1	2	-1	2
14) Arm length	(m)	2	1	2	0	3	0	3
15) Arm inclination		0°	5°	0°	5°	5°	5°	5°
16) Maintenance factor		0.717	0.717	0.717	0.717	0.8	0.8	0.8
Lighting Performance								
1) Lighting criteria								
Required level								
a) Average luminance	Lave ≥ 2cd/m ²	2.00	2.01	2.04	2.00	2.00	2.01	2.07
b) Overall uniformity	Uo ≥ 40%	44.4	43.2	44.2	40	42.2	41.7	41.1
c) Longitudinal uniformity	UL ≥ 70%	85.9	77.3	88.8	90.0	86.6	79.4	72.5
d) Threshold increment	TI ≤ 10%	4.1	6.9	8.9	10	8.8	9.9	10.0
e) Surround ratio	SR ≥ 0.5	0.5	0.5	0.5	0.9	0.5	0.6	0.6
2) Limitation factor		Lave	Lave	Lave	Lave	Lave	Lave	TI
Power Consumption								
1) Energy used per unit area { = α / (3 x 3.65 x β) }		(W/m ²)						
		1.03	0.69	0.80	0.87	0.62	0.65	0.60
2) Energy efficiency (benchmark against HPS)		(%)						
		-71.67	-15.00	-33.33	-45.00	-3.33	-8.33	0.00
3) Energy consumption per hour / km		(kWh)						
		22.57	15.06	17.54	18.97	13.54	14.25	13.04
4) Energy consumption per year / km		(KWh)						
		98,863	65,958	76,818	83,069	59,298	62,415	57,130

Note: 1) In the case where luminaire is measured using total flux method, the luminaire efficiency is given as 100% with the total lumen output of luminaire equal to the lamp luminous flux quoted above.

Table 2b. Comparison for ME1 lighting class – Opposite installation

Road Details							
1) Carriageway		Dual carriageway					
2) Road width		3 x 3.65m / carriageway					
3) Median		2m					
4) Road surface		R3 ; Qo = 0.07					
Installation Details							
1) Lighting system		LED			HPSV		
2) Luminaire type		USA	Europe-1	Europe-2	Malaysia		
3) Lamp power	(W)	204	-	215	150	250	400
4) System wattage (α)	(W)	237	256	228	176	285	450
5) Total luminous flux (lamp)	(klm)	15.6	29.9	23.4	17.5	33.2	56.5
6) Luminaire efficiency	(%)	100.0	82.6	71.2	81.0	82.7	83.6
7) Luminaire efficacy	(lm/W)	65.8	96.5	73.1	80.5	96.3	105.0
8) Lamp colour temperature	(K)	4000	4000	4250	2000	2000	2000
9) Pole arrangement		Opposite			Opposite		
10) Mounting height	(m)	10	10	12	12	12	15
11) Pole spacing (β)	(m)	20	34	27	24	40	64
12) Setback of pole	(m)	1	1	1	1	1	1
13) Overhang	(m)	1	1	2	2	2	2
14) Arm length	(m)	2	2	3	3	3	3
15) Arm inclination		5°	5°	5°	5°	5°	5°
16) Maintenance factor		0.717	0.717	0.717	0.8	0.8	0.8
Lighting Performance							
1) Lighting criteria	Required level						
a) Average luminance	Lave ≥ 2cd/m ²	2.02	2.03	2.02	2.01	2.04	2.02
b) Overall uniformity	Uo ≥ 40%	66.7	60.4	50.2	54.0	43.6	40.7
c) Longitudinal uniformity	UL ≥ 70%	82.7	75.2	88.4	86.1	71.5	75.4
d) Threshold increment	Ti ≤ 10%	7.1	9.6	8.1	9.9	8.3	9.4
e) Surround ratio	SR ≥ 0.5	0.5	0.5	0.5	0.6	0.6	0.6
2) Limitation factor	Lave	Lave	Lave	Lave	Lave	Lave	Lave
Power Consumption							
1) Energy used per unit area { = α / (3 x 3.65 x β) }	(W/m ²)	1.08	0.69	0.77	0.67	0.65	0.64
2) Energy efficiency (benchmark against HPS)	(%)	-68.75	-7.81	-20.31	-4.69	-1.56	0.00
3) Energy consumption per hour / km	(kWh)	23.70	15.06	16.89	14.67	14.25	14.06
4) Energy consumption per year / km	(kWh)	103,806	65,958	73,973	64,240	62,415	61,594

Note: 1) In the case where luminaire is measured using total flux method, the luminaire efficiency is given as 100% with the total lumen output of luminaire equal to the lamp luminous flux quoted above.

Table 2c. Comparison for ME2 lighting class – Opposite installation

Road Details									
1) Carriageway		Single carriageway							
2) Road width		4 x 3.65m (2 lanes per traffic direction)							
3) Median		-							
4) Road surface		R3 ; Qo = 0.07							
Installation Details									
1) Lighting system		LED				HPSV			
2) Luminaire type		USA	Europe-1	Europe-2	China	Malaysia			
3) Lamp power	(W)	204	-	211	-	150	250	400	
4) System wattage (α)	(W)	237	180	224	245	176	285	450	
5) Total luminous flux (lamp)	(klm)	16.0	19.5	22.9	20.5	17.5	33.2	56.5	
6) Luminaire efficiency	(%)	100.0	85.9	72.1	-	84.2	82.4	83.6	
7) Luminaire efficacy	(lm/W)	67.5	93.1	73.7	-	83.7	96.0	105.0	
8) Lamp colour temperature	(K)	4000	4000	4250	-	2000	2000	2000	
9) Pole arrangement		Opposite				Opposite			
10) Mounting height	(m)	12	12	12	12	15	15	15	
11) Pole spacing (β)	(m)	37	45	44	35	46	59	54	
12) Setback of pole	(m)	1	1	1	1	1	1	1	
13) Overhang	(m)	1	-1	-1	-1	2	1	2	
14) Arm length	(m)	2	0	0	0	3	2	3	
15) Arm inclination		5°	0°	0°	5°	5°	5°	5°	
16) Maintenance factor		0.717	0.717	0.717	0.717	0.8	0.8	0.8	
Lighting Performance									
1) Lighting criteria		Required level							
a) Average luminance	Lave≥1.5cd/m ²	1.52	1.50	1.52	2.2	1.50	1.50	2.98	
b) Overall uniformity	Uo ≥ 40%	53.0	61.8	56.7	60.0	44.5	51.3	49.5	
c) Longitudinal uniformity	UL ≥ 70%	72.5	75.7	71.4	90	73.9	71.5	74.6	
d) Threshold increment	Ti ≤ 10%	6.2	9.9	10.0	10.0	9.8	10.0	10.0	
e) Surround ratio	SR ≥ 0.5	0.5	0.7	0.5	0.7	0.5	0.7	0.6	
2) Limitation factor		Lave	Lave,TI	Lave,TI	TI	Lave	Lave,TI	TI	
Power Consumption									
1) Energy used per unit area (= α / (2 x 3.65 x β))		(W/m ²)	0.88	0.55	0.70	0.96	0.52	0.66	1.14
2) Energy efficiency (benchmark against HPS)		(%)	-69.23	-5.77	-34.62	-84.62	0.00	-26.92	-119.23
3) Energy consumption per hour / km		(kWh)	12.81	8.00	10.18	14.00	7.65	9.66	16.67
4) Energy consumption per year / km		(kWh)	56,111	35,040	44,596	61,320	33,517	42,315	73,000

Note: 1) In the case where luminaire is measured using total flux method, the luminaire efficiency is given as 100% with the total lumen output of luminaire equal to the lamp luminous flux quoted above.

Table 2d. Comparison for ME2 lighting class – Opposite staggered installation

Road Details								
1) Carriageway		Single carriageway						
2) Road width		4 x 3.65m (2 lanes per traffic direction)						
3) Median		-						
4) Road surface		R3 ; Qo = 0.07						
Installation Details								
1) Lighting system		LED				HPSV		
2) Luminaire type		USA	Europe-1	Europe-2	Malaysia			
3) Lamp power		(W)	204	-	211	150	250	400
4) System wattage (α)		(W)	237	192	224	176	285	450
5) Total luminous flux (lamp)		(klm)	15.6	16.8	22.9	17.5	33.2	56.5
6) Luminaire efficiency		(%)	100.0	88.8	72.0	82.0	81.0	83.6
7) Luminaire efficacy		(lm/W)	65.8	77.7	73.6	81.5	94.4	105.0
8) Lamp colour temperature		(K)	4000	4000	4250	2000	2000	2000
9) Pole arrangement			Opposite Staggered			Opposite Staggered		
10) Mounting height		(m)	12	12	12	12	15	15
11) Pole spacing (β)		(m)	39	44	50	48	76	84
12) Setback of pole		(m)	1	1	1	1	1	1
13) Overhang		(m)	2	1	2	2	1	2
14) Arm length		(m)	3	2	3	3	2	3
15) Arm inclination			0°	5°	0°	5°	5°	5°
16) Maintenance factor			0.717	0.717	0.717	0.8	0.8	0.8
Lighting Performance								
1) Lighting criteria		Required level						
a) Average luminance		Lave≥1.5cd/m ²	1.53	1.50	1.55	1.50	1.51	2.13
b) Overall uniformity		Uo ≥ 40%	51.2	49.7	41.8	41.3	41.8	40.1
c) Longitudinal uniformity		UL ≥ 70%	71.1	83.2	70.0	78.3	77.3	71.1
d) Threshold increment		Ti ≤ 10%	5.4	6.9	9.7	9.7	9.8	10.0
e) Surround ratio		SR ≥ 0.5	0.5	0.5	0.5	0.5	0.5	0.6
2) Limitation factor		Lave	Lave	Lave	UL	Lave	Lave	Uo,UL,Ti
Power Consumption								
1) Energy used per unit area (= α / (2 x 3.65 x β))		(W/m ²)	0.83	0.60	0.61	0.50	0.51	0.73
2) Energy efficiency (benchmark against HPS)		(%)	-66.00	-20.00	-22.00	0.00	-2.00	-46.00
3) Energy consumption per hour / km		(kWh)	12.15	8.73	8.96	7.33	7.50	10.71
4) Energy consumption per year / km		(kWh)	53,234	38,225	39,245	32,120	32,850	46,929

Note: 1) In the case where luminaire is measured using total flux method, the luminaire efficiency is given as 100% with the total lumen output of luminaire equal to the lamp luminous flux quoted above.

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*Cable Lug
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*Cable Link
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*Cable Link
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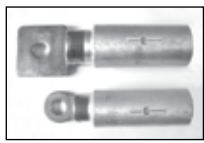
*MV Cable Lug &
Link (Up To 33KV)*



Aluminium Lug



*2-Hole & Long
Barrel Lug*



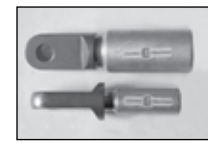
*Bimetal Lug
(IEC 1238-1)*



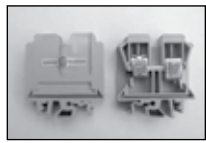
Bimetal Link



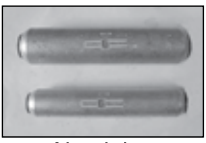
*Mccb Bimetal Lug
(For MCCB)*



*STP
Bimetal Lug*



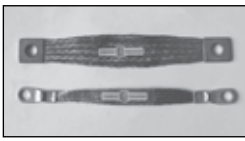
Terminal Block



*Aluminium
Ferrule*



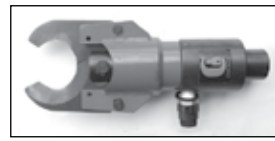
'C' Clamp



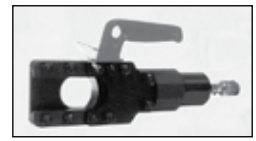
Flexible Braid



*Outdoor Cable Lug
(Solder Sealed)*



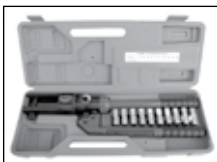
*CC-630 Cable Cutter
(Non-Armoured)*



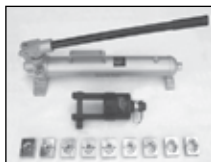
*S-100H
Cable Cutter*



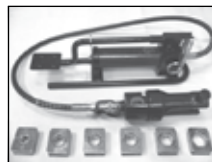
*CP-120
Crimping Tool*



*CP-240
Crimping Tool*



*CP-400
Crimping Tool*



*CP-630
Crimping Tool*



*HC-115
Hole Cutter*



Hand Crimping Tool



Hand Cable Cutter



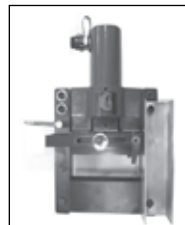
*CH-240
Indent Tool*



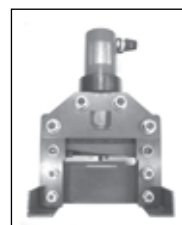
*CH-630
Indent Tool*



*CP-1000
Crimping Head*



*BB-150
Bar Bender*



*BC-150
Bar Cutter*



*CH-60
Hole Puncher*



*PM-1000
Electric Pump*

Table 2e. Comparison for ME2 lighting class – Single sided installation

Road Details		Single carriageway				
1) Carriageway		Single carriageway				
2) Road width		4 x 3.65m (2 lanes per traffic direction)				
3) Median		-				
4) Road surface		R3; Qo = 0.07				
Installation Details		LED			HPSV	
1) Lighting system		LED			HPSV	
2) Luminaire type		USA	Europe-1	Europe-2	Malaysia	
3) Lamp power	(W)	204	-	215	250	400
4) System wattage (α)	(W)	237	257	228	285	450
5) Total luminous flux (lamp)	(klm)	15.6	29.9	23.4	33.2	56.5
6) Luminaire efficiency	(%)	100.0	82.3	71.2	81.2	83.6
7) Luminaire efficacy	(lm/W)	65.8	95.7	73.1	94.6	105.0
8) Lamp colour temperature	(K)	4000	4000	4250	2000	2000
9) Pole arrangement		Single sided			Single sided	
10) Mounting height	(m)	12	12	12	15	15
11) Pole spacing (β)	(m)	17	32	24	35	52
12) Setback of pole	(m)	1	1	1	1	1
13) Overhang	(m)	2	1	2	2	2
14) Arm length	(m)	3	2	3	3	3
15) Arm inclination		5°	5°	0°	10°	5°
16) Maintenance factor		0.717	0.717	0.717	0.8	0.8
Lighting Performance						
1) Lighting criteria	Required level					
a) Average luminance	Lave ≥ 1.5cd/m ²	1.56	1.50	1.52	1.52	1.50
b) Overall uniformity	Uo ≥ 40%	45.4	44.0	42.5	44.1	43.1
c) Longitudinal uniformity	UL ≥ 70%	89.0	79.9	88.2	81.3	71.1
d) Threshold increment	TI ≤ 10%	5.7	9.8	9.6	9.2	9.3
e) Surround ratio	SR ≥ 0.5	0.5	0.5	0.5	0.5	0.6
2) Limitation factor		Lave	Lave	Lave	Lave	Lave
Power Consumption						
1) Energy used per unit area (= α/(4 x 3.65 x β))	(W/m ²)	0.95	0.55	0.65	0.56	0.59
2) Energy efficiency (benchmark against HPS)	(%)	-69.64	1.79	-16.07	0.00	-5.36
3) Energy consumption per hour / km	(kWh)	13.94	8.03	9.50	8.14	8.65
4) Energy consumption per year / km	(kWh)	61,062	35,177	41,610	35,666	37,904

Note: 1) In the case where luminaire is measured using total flux method, the luminaire efficiency is given as 100% with the total lumen output of luminaire equal to the lamp luminous flux quoted above.

Finally, a comparison of retrofitting an existing lighting installation made in 1995 on a heavily used 3-lane dual carriageway highway in the Klang valley that uses 400W HPSV luminaires designed in the 1960s mounted on 12m mast and spaced 50m apart, to meet M1 lighting class of CIE 115-1995, following in the format of CIE 30.2. Table 3 shows the result of replacing the existing 400W luminaire with new generation of HPSV luminaire and the best LED luminaire determined in earlier comparisons.

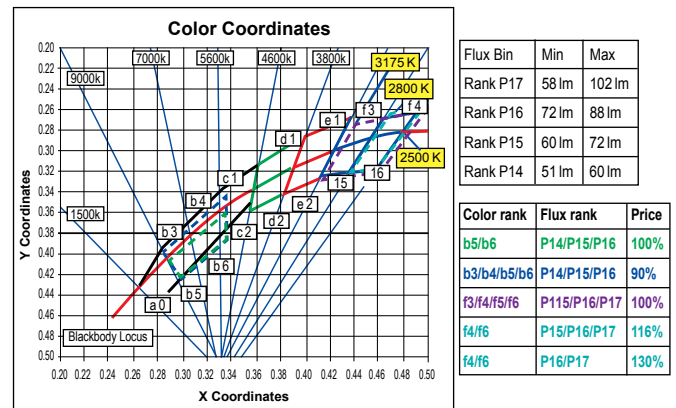
Table 3. Comparison of retrofitting an existing installation

Road Details		Dual carriageway	
1) Carriageway		Dual carriageway	
2) Road width		3 x 3.65m / carriageway	
3) Median		0.5m	
4) Road surface		R3; Qo = 0.07	
Installation Details		HPSV	LED
1) Lighting system		HPSV	LED
2) Luminaire type		Malaysia	Europe-1
3) Lamp power	(W)	250	-
4) System wattage	(W)	285	256.4
5) Total luminous flux (lamp)	(klm)	33.2	29.9
6) Luminaire efficiency	(%)	82.5	82.3
7) Luminaire efficacy	(lm/W)	96.1	96.0
8) Lamp colour temperature	(K)	2000	4000
9) Pole arrangement		Twin central	
10) Mounting height	(m)	12	12
11) Pole spacing	(m)	50	50
12) Setback of pole	(m)	0.25	0.25
13) Overhang	(m)	-0.25	-0.25
14) Arm length	(m)	0	0
15) Arm inclination		5°	5°
16) Maintenance factor		0.8	0.8
Lighting Performance			
1) Lighting criteria	Required level		
a) Average luminance	Lave ≥ 2cd/m ²	2.03	1.58
b) Overall uniformity	Uo ≥ 40%	41.2	46.6
c) Longitudinal uniformity	UL ≥ 70%	71.7	81.1
d) Threshold increment	TI ≤ 10% (15%)	9.8	8.3
e) Surround ratio	SR ≥ 0.5	0.5	0.6

Analysis of result

- The luminaire efficacy for the 4 LED luminaire used in this study ranges from 65.8-96.7 lm/W instead of the 140-150 lm/W that we often heard. The reasons are:
- LEDs are grown on a wafer substrate and then diced into tiny little LED chips. Unfortunately, every chip from the same wafer has different properties and hence need to be tested and sorted into bins according to colour, flux and forward voltage. Figure 2 shows an example of effect of bin and its price. Luminaire efficacy is therefore dependent on the combination of bins used in its manufacture. The lesser the number of bins used, the higher the performance and the higher the cost. The luminaire with the lowest luminaire efficacy could have used LEDs from more bins while that of higher efficacy uses LEDs from lesser number of bins.

Figure 2. Example of binning and price



- The other factor affecting the luminaire efficacy is the driver efficiency as the luminaire system efficacy is a product of lamp/LED efficacy and driver efficiency.
- Optical efficiency and thermal efficiency, which are usually reflected in the luminaire efficiency, have a direct impact on the LED luminaire system efficacy. Luminaire with good thermal management and better optics generally give a better efficiency.

ii) The luminaire efficacy (row 7 under the 'Installation Details' of Table 2) for different luminaire layout is different. The highest luminaire efficacy does not necessarily result in the most energy efficient solution. For example, the luminaire efficacy of the most energy efficient solution for opposite installation for LED, ME1 lighting class, is 96.5lm/W while that for ME2 lighting class is 93.1lm/W. Similarly, for HPSV system, ME2 lighting class, opposite staggered layout, the photometry with 150W giving luminaire efficacy of only 81.5lm/W is 2% more efficient than the photometry using a 250W lamp giving a luminaire efficacy that is 16% more at 94.4lm/W.

Comparing the Europe 1 and 2 LED luminaire for twin central, ME1 lighting class, the difference in luminaire efficacy is 31% but the energy used per square meter is only 16%. For opposite installation, ME1 lighting class, the difference is 32% and 12% respectively. Herein, the photometry of Europe 2 LED luminaire is much better than that of Europe 1 for these two applications.

From the above observation, the photometry or light utilisation of the luminaire also has a big influence on the energy usage in road lighting. It is therefore, erroneous to conclude that high lamp efficacy or luminaire efficacy alone will result in a more energy efficient road lighting.

iii) For 3-lane dual carriageway where luminaire lay-out is limited to either central median or opposite installation, the HPSV luminaire is more energy efficient by 8% for opposite installation and 15% for central median installation as compared to the best LED luminaire available after August 2011 in Europe.

- iv) For the 4-lane carriageway, the most energy efficient lay-out for LED luminaire can either be single sided using a luminaire with luminaire efficacy of 95.7lm/W (Table 2e) or opposite using a luminaire with luminaire efficacy of 93.1lm/W (Table 2c), where energy used is 0.55 watt per meter square. The best for HPSV is opposite staggered using 0.5 watt per meter square (Table 2d), which is 10 % better than that achieved by best LED luminaire.
- v) As the MF of LED is 0.717, the initial lighting level will be nearly 40% higher than the required level, or 2.8cd/m² for LED system compared to 2.5cd/m² for HPSV for ME1 lighting class. Energy utilisation can be improved by increasing the MF and this is possible by cleaning the luminaire yearly because the luminaire depreciation is 8% in the first year. Figure 3 shows the system light output as a function of lighting hours for one year and four year cleaning cycle for HPSV luminaire. With one year cleaning cycle, the MF can be increased to 0.85 resulting in another saving of 6.25% energy. On the other hand, MF of 0.717 seems to be the optimum for LED luminaire. From Figure 4, for MF of 0.8, the system output of LED luminaire will be insufficient to meet the specified lighting level by 28,000 lighting hours even after cleaning. The economic lifespan of LED luminaire will be reduced to about 20,000 hours or about 4.5 years if MF is change to 0.8. In this case LED lifespan is not much better than HPSV and the cost of maintenance will be much higher given the current cost of LED, LED module and LED luminaire. From here, it can be observed that the often quoted long lifespan of LED is irrelevant without considering how it is used.

Figure 3. Light output as a function of lighting hours – HPSV luminaire

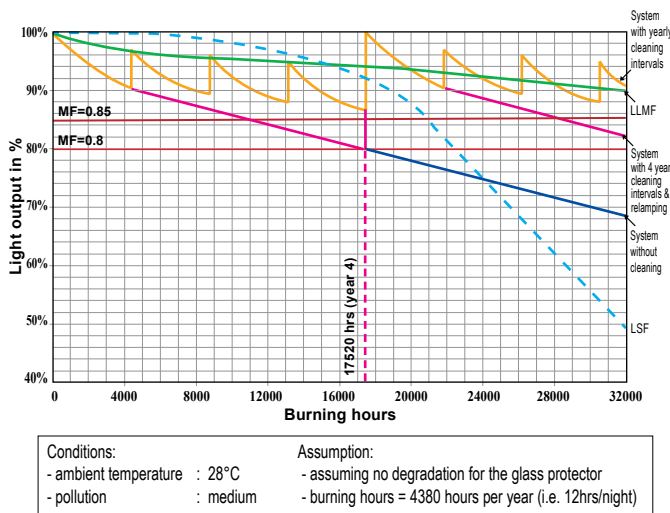
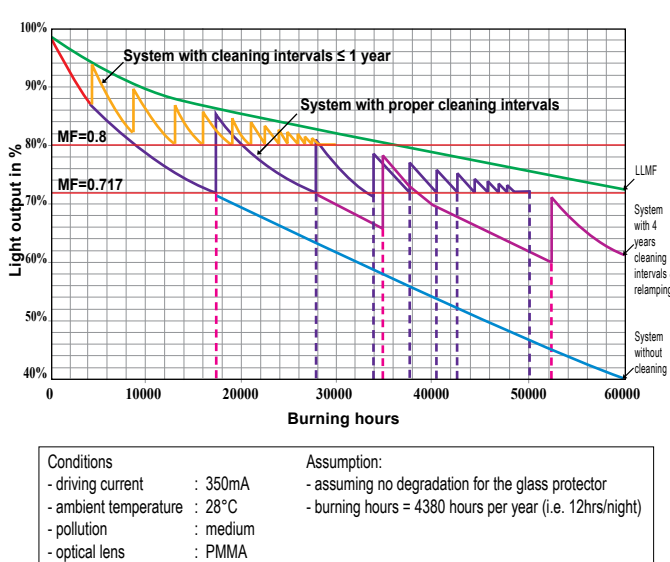


Figure 4. Light output as a function of lighting hours – LED luminaire



- vi) From Figure 4, in order to ensure that the safe lighting level is maintained the cleaning interval for LED luminaire shortens progressively with operating hours thus presenting additional challenges in maintenance and budget planning.
- vii) It is very important to note that the MF presented in this study is for LED operated at 350mA with PMMA lens and glass cover. From Appendix C*, the MF will be lower if LED is operated at more than 350mA, made worst with lens made of Polycarbonate material and Polycarbonate cover.
- viii) Table 3 shows old 400W HPSV luminaire can be replaced with new generation of 250W HPSV luminaire on a one to one basis thus saving 40% energy directly. It is not possible to do the same with the best LED luminaire available now and with MF of 0.8 as the maintained lighting level is only 1.58cd/m². This comparison again reinforces that it is inaccurate to compare luminaire for luminaire without considering the way the luminaire is to be used.

Initial cost for best energy efficient solution

For ME1 lighting class, the best energy efficient solution for LED luminaire is the same for both twin central and opposite layout using 0.69 W/m² while that for HPSV is twin central layout using 0.60 W/m². Hence, initial cost is calculated for twin central layout (Table 4).

For ME2 lighting class, the best energy option for LED luminaire is for opposite or single-sided layout using 0.55 W/m² energy while that for HPSV is for opposite staggered using 0.5 W/m². The initial cost calculation for ME2 lighting class is based on the more cost efficient and therefore less environmental impact, single-sided installation for LED luminaire and staggered for HPSV luminaire (Table 4).

Since the costs of design, transformer stations, feeder pillars, cables etc. are practically equal in both cases, only poles, brackets, luminaires and lamps and their installation were compared (Kostic, Djokic, Pojatar, 2009).

Table 4. Initial cost comparison

		ME1 Lighting Class		ME2 Lighting Class	
		LED	HPSV(400W)	LED	HPSV (150W)
a) Pole height	(m)	12	15	12	12
b) Spacing	(m)	34	69	32	48
c) Pole arrangement		Twin central	Twin central	Single-sided	Opposite staggered
d) No. of pole / km		30	15	31	42
e) No. of luminaire / km		60	30	31	42
f) Cost of pole + installation	(RM)	1500	3000	1500	1500
g) Cost of luminaire + installation	(RM)	6000	1300	6000	1200
Total Initial Cost	(RM)	405,0008	4,000	232,500	113,400

For an energy optimised lighting solution, the LED system cost roughly RM320,000.00 per km more for ME1 lighting class and RM120,000.00 more per km for ME2 lighting class.

Lifespan and Maintenance cost comparison of HPSV and LED luminaire

For road lighting, the lifespan of lamp is when the system light output cannot be economically maintained to ensure that the specified lighting class is met. As demonstrated in Figure 3 and 4, the lifespan is also dependent on the MF used under the circumstances. In the case of LED luminaire, if MF of 0.717 is used, the economical lifespan can be stretched to about 42,000 hours but with 5 cleaning scheduled as shown in Figure 4. If energy efficiency takes priority, then a higher MF of 0.8 may be used, but the economical lifespan is shortened to about 20,000 lighting hours or 4.5 years. If MF of 0.8 is used, then the lifespan of LED luminaire is not any better than HPSV lamp. And then the whole luminaire will have to be changed. This

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the often quoted and emphasized long lifespan of LED is meaningless or irrelevant without considering under what circumstances it is used. In the case of HPSV luminaire, only the lamp has to be changed and luminaire cleaned every 4 years if we used a MF of 0.8. During this period, an 8% lamp outage may be expected. The luminaire life span of 20 years can be expected. (Luminaires installed on the Penang Bridge were changed after more than 22 years with some are still in use). Table 5 shows the cost comparison for a 20 year period for the most energy efficient LED luminaire with HPSV luminaire. To make it simple, current rates are used.

Table 5. Maintenance cost per kilometer over 20 years (most energy efficient)

Descriptions	3-lane dual carriageway		4-lane single carriageway	
	LED	HPSV	LED (single sided)	HPSV (staggered)
No. of luminaire / km	58	30	31	42
No. of cleaning over 20 years	10	4	10	4
Total cleaning cost over 20 years (RM50 each)	29,000	6,000	15,500	8,400
Relamping over 20 years (times)	-	4	-	4
Cost of relamping (RM / each)	-	200	-	200
Total relamping cost over 20 years	-	24,000	-	33,600
Unscheduled relamping (8%)	-	2.4	-	3.36
Total unscheduled relamping over 20 years	-	12	-	16.8
Unscheduled relamping cost (RM / each)	-	400	-	400
Total unscheduled relamping cost over 20 years	-	4,800	-	6,720
Luminaire change over 20 years	58	-	31	-
Cost of luminaire	7000	-	7000	-
Labour to change	300	-	300	-
Total luminaire cost	423,400	-	226,300	-
Driver maintenance over 20 years (17.5%, assuming 0.2% failure per 1000 hours when operated at component tc)	10.16	5.26	5.43	7.36
Cost of driver / control gear (RM / each)	700	100	700	100
Labour to change	300	300	300	300
Total driver maintenance cost	10,160	2,104	5,430	2,944
Maintenance cost over 20 years	462,560	36,904	247,230	51,664

Note:

At the time of preparing this report, there is no standardisation of LED or LED module whereby the LED or LED module can be replaced irrespective of make or brand of luminaire. LED chip development is also transforming rapidly and it is unlikely that the LEDs or LED modules made 10 years in the future can be used to replace LED module used in today's LED luminaire.

The total maintenance cost per kilometer over 20 years of LED is more than 12.5 times that of HPSV for 3-lane dual carriageway and about 5 times for 4-lane single carriageway. Even if LED luminaire were to cost half in ten years' time (possible??) the maintenance cost is still nearly 6.5 times and 2.5 times that of HPSV.

Environmental impact

A very detailed environmental impact assessment titled "Preparatory Studies for Eco-design Requirements of EuPs" was carried out by the European Union and the Final Report completed in January 2007. Detail assessment on the energy using products (EuPs) for road lighting was carried out for the production phase, distribution phase, use phase and end of life (disposal) phase and conclude that focus should be on energy efficiency in order to reduce environmental impact (Chapter 4 and 5 of Final Report). (The Final Report has 344 pages and can be downloaded at http://www.eup4light.net/assets/pdffiles/Final/VITOEuPStreetLighting_Final.pdf). However, this study covers luminaire using High Intensity Discharge (HID) lamps whereby a lifespan of 30 years has been well established.

It is also well established that more resources used will cause more environmental impact and will be reflected in the cost of the product, installation, operation, maintenance and finally disposal.

In the case of road lighting, we have established that comparisons should be based on per unit length of road to be lit to the required

lighting class. Our assessment here will accordingly be based on a per km basis, whereby the initial cost covers resources used to produce, distribute and install the luminaire, the use phase covers the energy used per km, the maintenance cost covers the maintenance per km over 20 years and the disposal cost for the disposal phase of the luminaire.

Generally, 5% of material used in the production of a luminaire goes to the landfill at the end of life, 90% of plastics incinerated, 9% recycled, 95% of metal and glass recycled, 90% of Hg captured in processing of waste lamp [EuP Final Report].

Looking at the current construction of LED and HPSV luminaire, and in the absence of detailed data, we assume that environmental impact for both type of luminaire complete with gear and lamp is the same, or difference is negligible during disposal. Therefore, the environmental impact will be the direct ratio of the number of luminaire to be disposed. As demonstrated earlier, the lifespan of current generation LED luminaire is about half that of HPSV luminaire. Table 6 shows environmental impact of LED and HPSV system for the best energy efficient solution for the current Best Available Technology (BAT) LED and HPSV lighting system.

Table 6. Environmental impact of LED and HPSV system

		ME1 Lighting Class	ME2 Lighting Class		
Description		LED	HPSV (400W)	LED	HPSV (150W)
Production, distribution & installation phase					
a) Total initial cost	(RM)	405,000	84,000	232,500	113,400
b) Environmental impact ratio during production, distribution & installation phase (benchmark against HPS)		4.82	1	2.05	1
Use phase (operation & maintenance)					
a) Energy consumption per year / km	(kWh)	65,958	57,130	35,177	32,120
Environmental impact ratio (benchmark against HPS)		1.15	1	1.10	1
b) Maintenance cost over 20 years	(RM)	462,560	36,904	247,230	51,664
Environmental impact ratio (benchmark against HPS)		12.53	1	4.79	1
c) Environmental impact ratio during use phase (benchmark against HPS)		6.84	1	2.95	1
Disposal phase					
a) No. of luminaire / km	(nos.)	60	30	31	42
b) No. of luminaire to be disposed over 20 years	(nos.)	120	30	62	42
c) Environmental impact ratio during disposal phase (benchmark against HPS)		4	1	1.48	1
Total environmental impact ratio (benchmark against HPS)		5.22	1	2.16	1

Total environmental impact of LED system is more than 5 times that of HPSV for ME1 lighting class (3-lane dual carriageway) and more than 2 times for ME2 lighting class (4-lane single carriageway).

Recommendations

- The maintenance factor used in this exercise is based on a 4 year cleaning cycle. The energy usage can be reduced by about 9% if cleaning is done every year. We therefore recommend that the Government make it a national policy to clean the road luminaire every year so that road lighting design will in future be based on yearly cleaning interval.
- The light depreciation rate of LED is currently derived using the IESNA TM21 lumen maintenance model and there is no validated model to predict or derive the lumen depreciation rate of LED package used in a module where there are many other complex influencing parameters. For example, it is widely recognized that the LED characteristics are strongly temperature dependent. The same LED when used in different luminaire with different thermal management could have different lifespan and lumen maintenance. The maintenance factor (MF) derived in this study is at most a good estimate. If it is on the conservative side, the economic

..... Continue Suitability of LED for Road Lighting in Malaysia

environmental impact could have been lower as the lighting level will be above the safe level for a longer period of time. However, there remains the risk that it is too optimistic thus risking the possibility that the safe lighting level could not be maintained. The economic and environmental impact in this scenario will thus be higher. Hence, it is recommended that the LED luminaire be tested for the light depreciation rate instead of a vague estimation based on the data of LED package.

iii) It is erroneous to conclude that high lamp efficacy or luminaire efficacy alone will result in a more energy efficient road lighting as the photometry or light utilisation of the luminaire (which is also dependent on the geometrical layout) and the maintenance practice (which in turn depends on the luminaire specification and the pollution category) have also a big influence on the energy usage in road lighting. As energy usage is of prime concern, we recommend that the energy used per square meter of road surface to be lit to a specified lighting class be the main specification and bidders are allowed to offer an energy efficient and lowest life cycle cost lighting solution rather than the current practice of specifying the type of lighting system, lamp power and pole height resulting in uncertain lighting quality and poor energy efficiency.

iv) Zhaga consortium is developing standard specifications for the interfaces of LED light engines to enable interchangeability between products made by diverse manufacturers. As this consortium is an industry wide cooperation, their standard specifications will eventually be the industry standard and become international. As such, we recommend the LED luminaire are made to comply with Zhaga standard specifications for use in an ambient temperature of 35 degree centigrade or more and humidity of not less than 90%.

v) With the inclusion of MF in the design of road lighting, the initial lighting level will be higher by the factor of 1/MF. Energy can further be saved by varying the power to the lamp to compensate for the MF during the life of the lamp thus providing a Constant Light Output (CLO) to the lit area. A saving of up to 25% for HPSV is possible with the additional benefit in increasing lamp life of up to 100%. CLO can also be applied to LED. We therefore recommend that CLO to be considered if the benefit outweighs its total life cycle cost.

vi) The specified lighting class is to provide safe lighting level for peak traffic condition which is generally at the early part of the night and about an hour before dawn. During period of low traffic, the lighting level can be dimmed to the appropriate level thus saving up to 20% energy use per night. Hence, dimming should be considered if the savings is substantially more than the life cycle cost of the dimming equipments.

vii) LEDs of higher colour temperature generally give a higher efficacy as compared to LEDs of lower colour temperature. Nonetheless,

using LEDs of higher colour temperature in road lighting may incur potential hazard to road users especially during mist or rainy conditions as the contrast of the view may be reduced if LEDs of higher colour temperature (whiter) are used. Hence, we recommend that only LEDs with colour temperature lower than 3500K be used in road lighting for the time being while research is carried out to study this potential safety hazard.

Conclusion

LED innovation and development continue to move forward in a furious pace and can now be offered as a viable alternative lighting solution in many areas of lighting. However, for road lighting, even with the latest Best Available Technology LED luminaire, there is no advantage over the most energy efficient solution using the most efficient HPSV system at this moment. The conclusion is summarised in the following table.

	Advantage of using LED	For 3-lane dual carriageway (ME1 lighting class)	For 4-lane bi-directional carriageway (ME2 lighting class)
1) Energy saving	No	LED use 15% more power	LED use 10% more power
2) Cost saving	No	Increase initial cost by 5 times with LED products	Increase initial cost by 2 times with LED products
3) Maintenance cost over 20 years	No	12.5 times more with LED products	5 times more with LED products
4) Safety and security	No	Impact of LED on road lighting is still under deliberation. Current lighting standards have to be respected, or public safety will be compromised.	
5) Environmental impact	No	5 times more using LED products	2 times more using LED products

The economic and environmental impact of LED luminaire for road lighting may be substantially reduced when interchangeability of LED light engine between different manufacturers through industry wide product standard specification, currently undertaken by Zhaga consortium, is finalised and implemented. Coupled with more mature level of innovation and development, LED will become a viable alternative lighting solution for road lighting in the near future.

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Members of the Working Group on LED for Road Lighting comprised stakeholders from professionals, lighting manufacturers, consultants, engineers, government authorities and users.



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Upcoming Event

The Year of the Water Dragon

4th February 2012 to 3rd February 2013*

(Extracted from China Press Coverage January 2012 Issue)

The last Year of the Dragon, which occurred in 2000, was fraught with fear. There was great anxiety about the collapse of our technological world, the Y2K bug and other millennial prophecies that turned out to be more hype than bite. After twelve years, the Year of the Dragon is again the subject of controversy and trepidation. This time it's about the ancient South American Mayan Calendar and the alleged 2012 Armageddon prophecy, made famous by the jaw-dropping blockbuster '2012'.

The Chinese Dragon

Indeed, anything about dragon is nothing short of significance. However, unlike the often wicked, fire-breathing dragons of Western mythology, the Chinese dragon symbolizes auspiciousness, potent and benevolent power.

According to a Taoist belief, the dragon has 117 scales, of which 81 scales are infused with yang energy and 36 scales with yin energy to reflect a dragon's personality. All Chinese Dragons bear this scale pattern except the great Heavenly Dragon which has all yang energy. The Dragons lay an egg at a time and it takes 1,000 years to hatch and another 1,500 years for it to be full-grown. It is considered to be made of nine entities – head of the camel, eyes of a demon, ears of a cow, horns of a stag, neck of a snake, belly of a clam, claws of an eagle, soles of a tiger and the scales of carp. It is also considered highly versatile with the ability to change size and colours and also take to the skies or the waters with equal dexterity.

Symbol of Imperialism

According to Chinese legends, the earliest Emperors, Yan Di and Huang Di, were closely related to Chinese Dragon. At the end of his reign, the first legendary Emperor, Huang Di, was said to have been immortalized into a dragon that resembled his emblem, and ascended to Heaven. The other legendary Emperor, Huang Di's brother, Yan Di was born by his mother's telepathy with a mythic dragon.

Since Huang Di and Yan Di were considered by the Chinese as the founders of Chinese



civilization, thereafter the Chinese went on to associate themselves as "Long De Chuan Ren", meaning the "descendants of the dragon".

This legend also contributed towards the use of the Chinese dragon as a symbol of imperial power. The dragon, especially yellow or golden dragons with five claws on each foot, was a symbol for the emperor in many Chinese dynasties. The imperial throne was called the Dragon Throne. During the late Qing Dynasty, the dragon was even adopted as the national flag. The dragon is featured in the carvings on the steps of imperial palaces and tombs, such as the Forbidden City in Beijing.

Ruler of Wind and Water

Since time immemorial, the Chinese dragons have been strongly associated with wind and water, with its influence greatly felt and observed among the populace in ancient China.

They are believed to be the rulers of moving bodies of wind and water, such as rivers or seas, and can also manifest themselves as water spouts (tornado or twister over water). As a matter of fact, cyclones or tornadoes are generally known in Chinese as 'Long Juan Feng', meaning 'Dragon Twisting Wind'.

In the capacity as the ruler of wind and water, the dragon king, whose palace is often built underwater, is depicted as a humanoid dressed in a king's costume, but with a dragon head.

Chinese dragons are divided into Heavenly Dragons, Earthly Dragons and Dragons in water. The most well-known dragons are the Four Sea Dragon Kings governing the watery world east, south, west, north of China, in charge of creating clouds and rains for the world.

In ancient times, many Chinese villages (especially those close to rivers and seas) had temples dedicated to their local "dragon kings". In times of drought or flood, it was customary for the local gentry and government officials to lead the community in offering sacrifices and conducting other religious rites to appease the dragon, either to ask for rain or its cessation.

Auspicious & Powerful

Dragon is undoubtedly the most auspicious animal in the Chinese cultures and customs. It is often related to the Tiger, which equals in strength, power and wit, as exemplified in the much-welcome Chinese fengshui configuration of 'Green Dragon and White Tiger', or 'The Battle of Dragon and Tiger', which describes an epic battle between two giants.

The Dragon which often represents the masculine gender is also often matched with its female counterpart, the Phoenix, another mystical animal of the Chinese folklore. Their joint presence in various forms, such as wedding candles and cakes, dinner invitation cards and house decoration, are thus mandatory for traditional Chinese wedding functions, while a twin of boy and girl is aptly known as a Twin of Dragon and Phoenix. In the same vein, excellent and outstanding people are often literarily compared to the dragon while incapable people without achievements are associated with lowly creatures such as rat and snake. The Chinese proverb 'Hoping one's son will become a dragon' is a common blessing among Chinese parents for their children, while the saying 'A dragon-riding son-in-law' is self-evident. Such positivism about dragon should therefore see a marked increase in newborns in the Chinese families in 2012 worldwide.

Fortune Prediction

Despite its auspicious implication and contrary to general perception, the Year of



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Furutec Electrical Sdn Bhd	1	Stantric Sdn Bhd	54
Fuseline Electric & Engineering Sdn Bhd	56	Striker Electric Sdn Bhd	58
Industrial Automation Sdn Bhd	48, 86	Success Electronics & Transformer Manufacturer Sdn Bhd	70, 71
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Kuasa Jati Sdn Bhd	30	Sun Power Automation Sdn Bhd	IFC, 74, 75
Letrik Binattech Jaya Sdn Bhd	94	Syarikat See Wide Letrik Sdn Bhd	40
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PCO Lite Electrical Sdn Bhd	26		
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..... Continue The Year of the Water Dragon

the Dragon is never a warranty of prosperity, as it is merely a symbol in the Chinese horoscope.

As a matter of fact, well-known Malaysian fortune advisor Master Xu Yi Zi, predicts significant ups and downs in the overall outlook of the world, including the political scene in Malaysia. Last year (2010), he had predicted severe epidemic in Europe and major earthquake/tsunami in the North, which happened to be true.

For 2012, he said the flu will make a comeback, especially to Southeast Asia, and a lot more rainfall would be expected, prompting the outbreak of water-related diseases.

On the business front, he said short term speculative activities should be avoided, but added that the worry of bubbling effect on the property sector is quite unfounded.

Another well-known Malaysian fortune advisor Master Zhu Shu Ling said the Water Dragon would bring beneficial effect to things related to the water element (which includes

insurance, finance, trading, entertainment, marine industry, seafood, etc) and wood element (which include health industry, animal farming, print and electronic media, travel, cultural sector, etc).



The sectors which are adversely affected include the fire and earth elements, which comprise petroleum and natural gas, building and construction, landed properties, mining, etc.

On a personal note, everyone should be more careful about their foods and health as the Water Dragon is unfavourable to our digestive system, and attention should be paid to the North East direction which is the main source of evil winds. Placing some lucky charms or auspicious objects in the West direction would help usher in the positive energy. Overall, the worst affected people belonging to the signs of Dragon, Dog, Rabbit and Sheep, while the better ones include the Roosters, Monkeys, Boars and Snakes.

The Water Dragon

The fact that 2012 is a Water year is extremely

important because Water nourishes the Dragon's fixed element, Wood, giving this Dragon a big advantage over the rest of the breed when it comes to bringing good luck and accomplishment.

More often than not, the Chinese Dragon years also tend to magnify both success and failure. So while they can mark huge achievement, disasters can be equally immense. In this respect, the Year of the Fire Dragon (1917, 1976, and 2036) typically wreaks the most havoc, while the Year of the Water Dragon (1992, 1952 and 2012) is noted for its calm, visionary intelligence, and wisdom.

**Note: According to the Chinese Zodiac Calendar, the Year of the Water Dragon begins from 4th February 2012 (also known as 'Li Chun' Day) and ends on 3rd February 2013. Many people, including some of the Chinese themselves, have mistaken that the Zodiac Year begins with the first day of the Chinese New Year, which is different and based on the common Chinese Solunar Calendar which takes into account the movements of both the moon and sun. As such, any baby born after the Chinese New Year and before 3rd February 2012 is still a Rabbit person.*

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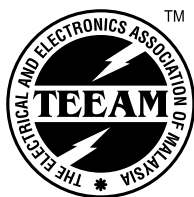
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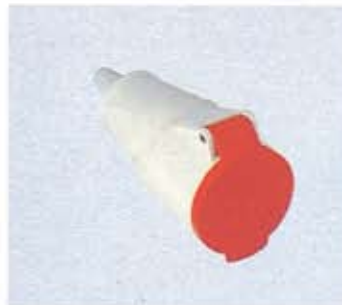
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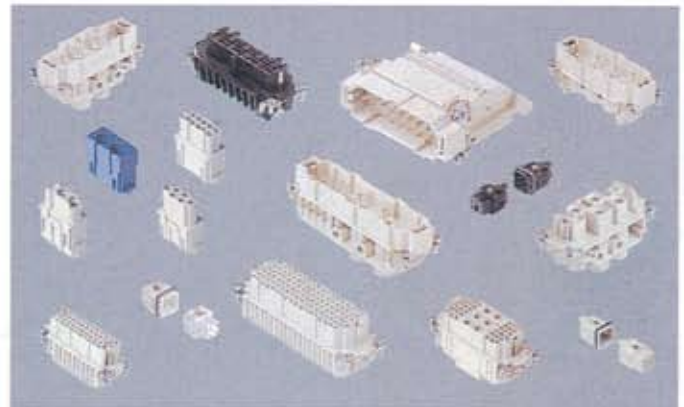
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