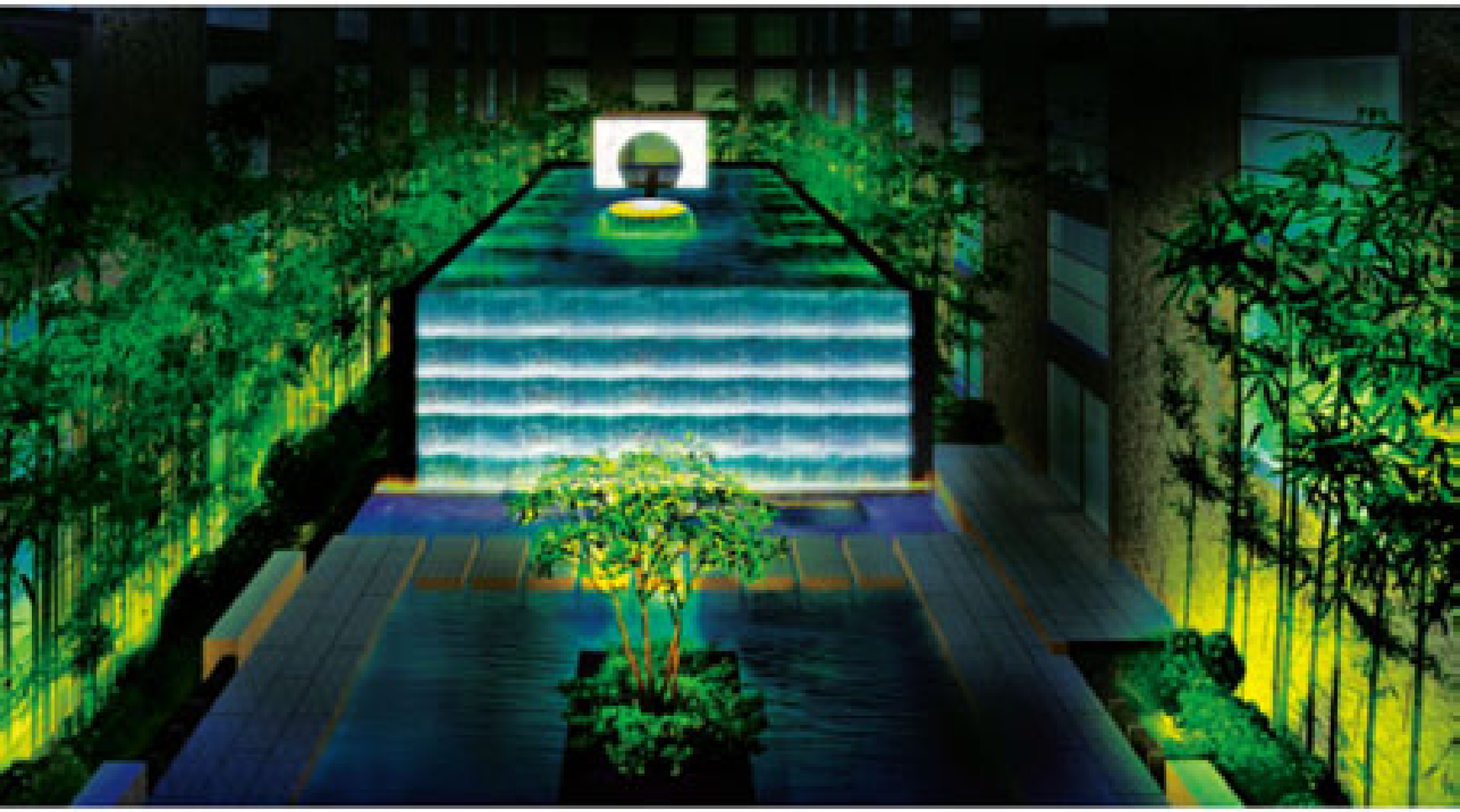
Lighting Design

照明设计

Building & Cityscape & Art
建筑·景观·艺术

凤凰空间·上海 编



Le Corbusier said Light creates ambience and feel of a place, as well as the expression of a structures Light is one of the most vital natural elements. The world, shape, size, and colour can be understood because of the light and it deeply affects people's ability to see, also ability to feel.
建筑大师勒·柯布西耶曾说“灯光，正如结构一样，赋予建筑特殊的感觉与氛围”，人类视觉架构的感知是透过光，而传递光的技术是照明，人们透过照明设计来感受光的艺术，与照明设计则是运用技术来传递光的价值。

江苏人民出版社

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Preface

序言

Before people have defined the term of design, it was only known the core motivation is for satisfying human need. In recent decades, design has been defined as a process of observing human behavior and experiences, understanding the needs, and finally the problem solving. By applying the concept of design into lighting design, we can say that the lighting design came into existence because of the desire of light. The history of light can be traced back to the natural lighting from the fire to the creation of light bulb by Thomas Edison. This development demonstrates that light is always an essential element which is as significant as the air for humanity. As the progression in technology, culture, and economy, people nowadays yearn to improve life with a better quality of light. This motivation not only changes the way people live, but also lighting design, which gets a great advancement, and we believe that lighting design is no longer a single subject.

As other fields of design, lighting design has combined with the idea of user-centred design recently. This collaboration makes design idea more thoughtful and suitable for people. When mentioning the terms of "User-Centred Design" or "Universal Design" , they were originally used for industrial design which emphasised the concerning of the need from the end-users. Within a few decades, its concept has been applied to various fields, not only in design, but other non-design areas. It has become a common attitude that is conventional in most public.

Then, why do we put so much concern on lighting effect? The reason is its unique feature. Lighting is an important medium for human to perceive their environment. It not only decided whether people see an object, also how they feel about it. That is, the lighting can affect people both physically and mentally. By combining light and user-centred design, we create a lighting environment that focuses on how people feel and interact with the light. How can we make people feel better in the environment by changing the lighting effect? This is the premier consideration when developing a concept. This consideration represents that lumen is no longer the only way to evaluate lighting appropriation in a space, which means the designers should focus on the quality of light rather than the quantity, and the idea of light must be more delicate and suitable for daily life. To create environment that suits all kinds of occasions in life, for example, the illumination that helps concentration while reading, accent lighting in museum, romantic ambient light in restaurant, or a grand building at night, lighting designers gather their thoughts and feelings about the space based on their experience in light application and communicate with spatial designers, architectures, and clients continuously.

In the past few years, people have started to realise the importance of illumination for urban view and living style. They have paid more attention on lighting design, especially in Asia, such as China and South Korea, which have the maturity of LED technology in these countries. However, the fast growing in hardware also brings to light the issues, the shortage in lighting professional and education for lighting design. Lighting design can be treated as an art creation that merges both aesthetics and technology. It aims to create a harmony and assists to present the image for a space, a building, or urban landscape at day and night. Designers must have knowledge about light and understand the relationship between the light and the space in order to make an efficient lighting effect to show its value.

Regarding to the experiences, we found that lighting design is still a newborn industry in Asia. When reviewing the current situation, it is not surprising to find that most lighting designers come from different professions but lighting. Lighting design needs to take complex considerations, such as the aesthetics, space, lighting features, moreover, some engineer problems, into account at once when developing an idea and we still don't have mature educational structures and platforms which combine multiple disciplines for educating professionals in this field. Fortunately, the lighting industry has received more attention because of the anticipation on the issues of energy conservation. This fact has encouraged the collaborations of professions from government, education, research institutes, and real industry to build a credentials and comprehensive educational environment which integrated all of essential knowledge for the lighting design. From the perspective of lighting designers, we are glad to see this change since it will doubtlessly promote a great progress in industry of lighting design in future Asia.

GUANG Architecture Lighting Design
Alexander, C.N. Sun / President & Design Principal
Michelle, T.Y. Liu / Designer

我们想〝设计〞，最终是为问题提供一种解决的方法，谈及〝设计〞行为最核心的动力，是为满足人类的需求而产生的。同样的概念在照明设计的领域来说，所表示的也是人类因对〝光〞的需求而造就了照明设计的存在。在〝光〞的历史中，从最原始的火光到之后爱迪生发明了灯泡，显现出对人类而言，光与空气是同等重要的生命元素。发展至今，因社会、经济、整体环境的进步，人类逐渐地想要藉由设计的行为让光环境达到更进一步的提升，并且设计概念的中心思考是以〝人本为主〞。〝User-Centred Design〞、〝Universal Design〞等词汇原用于工业设计针对产品及服务，强调以最终使用者的需求出发考量，是设计的一个过程。直至今日，〝User-Centred Design〞的概念已被广泛地应用在不同领域，不仅是设计工作，更是普遍的态度与价值认同。

因此，回到照明设计，光的运用不再只是专注在亮(量）即可，而是应以更为细腻且生活化的方法来思考——〝如何让环境因为光而让人感觉更好？〞人类因光而能够看见、了解事物的样貌，也因此照明所能够影响的，不只是空间的明亮度，同时更直接地影响了观者的心理。能提高专注力的灯光、博物馆重点式照明、具有浪漫气氛的餐厅、壮观的建筑外部结构等，照明设计师凭借着使用〝光〞的经验，与空间设计师、建筑师、业主不断重复地交流及整合对环境的感受，去创造出一个最为适合的环境氛围。

在亚洲地区如中国、韩国的照明设计因LED电子工程技术集中成熟，照明设计所能够发挥的机会越来越多，同时，社会也逐渐意识到照明对都市景观、生活环境的重要性、但硬件的快速发展也暴露了照明专业人才及设计师美学素养缺乏的问题。照明设计是一门集结了人文及科技的艺术，演绎了空间、建筑、景观在日夜间调和的美感，设计者必须对光的性质和空间的关系具有足够的了解和知识，才能让其中的各项元素发挥其影响及展现其价值。

在过去的经验中我们发现的是，因照明设计需考量的元素较为复杂且跨学科领域，再加上目前学校的教育尚未有完整的课程架构能提供足够学养的环境，至今照明设计依然普遍被视为新兴。且照明设计师需要是跨领域的工作者，人才素养的培育更必须结合实际产业的环境作为教育的平台。庆幸的是，照明产业的动向也因全球节能议题的重视，渐渐地在政府、学校、研究机构、产业界专家合作之下，结合各领域与照明相关的必要专业知识，开始推动一系列能力认证及教育学程的建立。就我们照明设计师的角度来说，特别对亚洲区的照明整体产业而言，这无疑地是一个具有前瞻性及计划性的进步开端。

光拓彩通照明设计 孙启能 / 总经理及主持设计师
刘子银 / 设计师

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Overview

综述

This section will focus on the concept and types of lighting, lighting industry standard, green lighting, and so on.

本节，将围绕着照明的概念与类型、照明的行业标准、绿色照明等方面展开阐述。

一、Concept and Types of Lighting

照明的概念与种类

"Cihai" defined lighting as：measures of using the light source to illuminate the working and living place, or individual objects. Sun and sky as light source are named"natural lighting"; Man-made light source is named" artificial lighting". The primary purpose of lighting is to create a good visibility and a comfortable and enjoyable environment. There are normal lighting, emergency lighting, duty lighting, security lighting and obstruction lighting. Emergency lighting includes the spare lighting, security lighting and evacuation lighting.

《辞海》将照明定义为：利用光源照亮工作和生活场所或个别物体的措施。利用太阳和天空作为光源的称为〝天然照明〞；利用人工光源的称为〝人工照明〞。照明的首要目的是创造良好的可见度和舒适愉快的环境。

照明种类可分为：正常照明、应急照明、值班照明、警卫照明和障碍照明。其中应急照明包括备用照明、安全照明和疏散照明。

二、Basic patterns of lighting

照明的基本方式

Patterns of lighting: according to installation location or light distribution, the basic standard of the lighting. According to light distribution and lighting effects there are direct lighting and indirect lighting. According to installation location, there are general lighting(include district general lighting), local lighting and mixed lighting.

照明方式指照明设备按其安装部位或光的分布而构成的基本制式。按光的分布和照明效果可分为直接照明和间接照明。就安装部位而言，有一般照明(包括分区一般照明)、局部照明和混合照明等。

(一) Direct lighting and indirect lighting

直接照明和间接照明

Direct lighting：Top 0～10%、Below100～90% Light distribution，Opaque reflective umbrella，e.g.Spotlight.

直接照明：上方0～10%、下方100～90%的配光，不透明反射伞，例：射灯。

Semi-direct lighting：Top10～14%、Below90～60% Light distribution，Translucent umbrella，e.g.Pendant lamp

半直接照明：上方10～14%、下方90～60%的配光，半透明伞，例：吊灯。

All diffused lighting：Top40～60%、Below60～40% Light distribution，e.g.Dome lamp.

全方位扩散照明：上方40～60%、下方60～40%的配光，例：球型灯。

Semi-indirect lighting：Top60～90%、Below40～10% Light distribution，Translucent reflective umbrella，e.g.Door lights.

半间接照明：上方60～90%、下方40～10%的配光，半透明反射伞，例：门灯。

Indirect lighting：Top90～100%、Below10～0% Light distribution，Opaque reflective umbrella，e.g.Wall lamp.

间接照明：上方90～100%、下方10～0%的配光，不透明反射伞，例：壁灯。

(二)General lighting and Local lighting

一般照明与局部照明

General lighting：Uniform lighting to illuminate the entire premises.

一般照明：为照亮整个场所的均匀照明。

Local lighting：Lighting for illuminating a specific visual working and a local setting.

局部照明：特定视觉工作用的、为照亮某个局部而设置的照明。

Mixed lighting：Consisting of general lighting and local lighting.

混合照明：由一般照明与局部照明组成的照明。

三、Lighting Industry Standards

照明的行业标准

(一)Lighting technology standards of main light source

主要光源的照明技术标准

Light source types 光源种类	Luminous efficiency 光效(Lm/W)	Color rendering index 显色指数Ra	Color temperature 色温(K)	Average life 平均寿命(h)
Incandescent light bulbs 白炽灯泡	15	100	2 800	1 000
Quartz halogen 石英卤素灯	25	100	3 000	2 000-3 000
SL light SL灯	50	87	2 700/5 000	8 000
High pressure mercury lamp 高压汞灯	50	45	3 300-4 300	6 000
Ordinary fluorescent 普通日光灯	70	70	Full series 全系列	8 000
PL type lamp PL型灯管	85	85	2 700/3 000/3 500/ 4 000/5 000/5 300	8 000-12 000

To be Continued 续前表

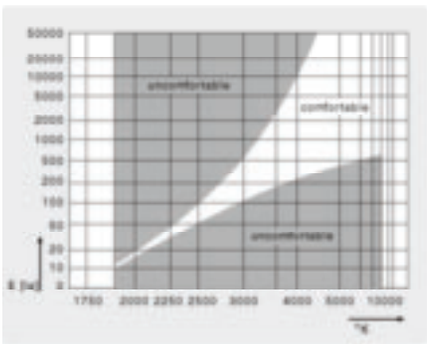
Metal halide lamps 金属卤化物灯	75-95	65-92	3 000/4 500/5 600	6 000-20 000
Pansy lamps 三基色日光灯	96	80-98	Full series 全系列	10 000
High pressure sodium lamps 高压纳灯	120	23/60/85	1 950/2 200/2 500	24 000
Low pressure sodium lamp 低压钠灯	200	44	1 700	28 000
QL lamp QL灯	70	85	3 000/4 000	80 000

(二)Lighting color temperature and the human eye kruith curve

灯光色温与人眼舒适度曲线 (Kruithof舒适性曲线)

A lower color temperature lighting system(2,700- 3,000K)between 50 to100 lx illumination can be able to offer comfortable lighting.The illumination by further increasing will cause unpleasantness.

色温较低的照明系统(2 700- 3 000K)在50至100 lx的照度下能提供舒适的照明，而如果照度进一步提高，将会令人感到不快。



(三)National illumination standards comparison

各国照度标准比较

National illumination standards values are classified according to 0.5、1、3、5、10、15、20、30、50、75、100、150、 200、300、500、750、1,000、1,500、2,000、3,000、 5,000lx， lx is the unit of illumination. National illumination standards are different from each other; the following below is a detailed comparison.

照度标准值按0.5、1、3、5、10、15、20、30、50、75、100、150、 200、300、500、750、1 000、1 500、2 000、3 000 、5 000lx 分级， 以lx(勒克斯)为照度单位。各国照度标准不尽相同，以下做一个详细比较。

1. National Civil illumination standards

各国民用建筑照度标准

This chapter discusses the civil illumination standard, including public buildings, refers to office buildings, commercial buildings, tourism buildings, science, education buildings, transportation buildings and residential buildings illumination standards.

本章论述的民用建筑照度标准包括公共建筑即办公建筑、商业建筑、旅游建筑、科教文卫建筑以及交通运输建筑和居住建筑的照度标准。

(1)Illumination standards of office building domestic and abroad

办公建筑国内外照度标准

Illumination values standard comparison of office building illumination standards (unit: lx)

办公建筑国内外照度标准值对比(单位: lx)

Room or Site 房间或场所	China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2000	Japan日本 JISZ9100-1979	Germany德国 DIN5035-1990	sia俄罗斯 CHNII23-05-95
General office 普通办公室	300 500	500	500	300~750	300 500	300
High-grade office 高档办公室						

To be Continued 续前表

Meeting room Anteroom reception 会议室、接待室、前台	300	500 300 (Anteroom 接待)	300 500 (Important 重要)	300~750 200~500 (Anteroom 接待)	300	200 300 (Reception 前台)
Business hall营业厅	300	——	300 500 (Writing 书写)	750~1 500	——	——
Design Room 设计室	500	750	750	750~1 500	750	500
Files, copy, mail room 文件整理、复印、发行室	300	300	100	300~750	——	400
Material, document room 资料、档案室	200	200	——	150~300	——	75

(2)Illumination standards of commercial building domestic and abroad

商业建筑国内外照度标准

Because of different service objects, goods grade, and decoration requirements, illumination is also varied，each country has its own features.

鉴于各类商店服务对象的不同，商品档次不同，装饰要求不同，对照度的要求也不同，各国均有自己的特点。

Illumination values standard comparison of the commercial buildings domestic and abroad (unit: lx)

商业建筑国内外照度标准值对比(单位: lx)

Room or site 房间或场所	China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2000	Japan日本 JISZ9100-1979	Germany德国 DIN5035-1990	Russia俄罗斯 CHNII23-05-95
General business hall 一般商业营业厅	300 500	300(Small 小) 500(Big 大)	300	500~750	300	300
High-end business hall 高档商业营业厅						
General supermarket hall 一般超市营业厅	300 500	——	500	750~1 000 (the city 市内) 300~750 (the outskirts 郊外)	——	400
High-end supermarket hall 高档超市营业厅						
Cashier收款台	500	500	——	750~1 000	500	——

(3)Illumination standards of hotel building domestic and abroad

旅馆建筑国内外照度标准

Illumination values standard comparison of hotel building illumination domestic and abroad(unit: lx)

旅馆建筑国内外照度标准值对比(单位: lx)

Room or site 房间或场所	China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2000	Japan日本 JISZ9100-1979	Germany德国 DIN5035-199	Russia俄罗斯 CHNII23-05-95

To be Continued 续前表

Guest house 客房	Generally activity area 一般活动区	75	——	100	100~150	——	100
	Bedside 床头	150		——	——		——
	Desk 写字台	300		300	300~750		——
	Bathroom 卫生间	150		300	100~200		——
Chinese Restaurant 中餐厅		200	200	——	200~300	200	——
Western restaurants, bars, cafes 西餐厅、酒吧间、咖啡厅		100	——	——	——	——	——
Multi-function hall 多功能厅		300	200	500	200~500	200	200
Hall, the service desk and Lounge 门厅、总服务台、休息厅		300 200	300	100 300 (Reading 阅读处)	100~200	——	——
Rooms layer Corridor 客房层走廊		50	100	50	75~100	——	——
Kitchen 厨房		200	——	200~500	——	500	200
Laundry 洗衣房		200	——	——	100~200	——	200

(4)Illumination standards of school building domestic and abroad

学校建筑国内外照度标准

Illumination values standard comparison of school building domestic and abroad (unit: lx)

学校建筑国内外照度标准值对比(单位: lx)

Room or site 房间或场所	China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2001	Japan日本 JISZ9110-1979	Germany德国 DIN5035-1990	Russia俄罗斯 CHNII 23-05-95
Classroom 教室	300	300 500 (Evening schools, adult education 夜校、成人教育)	500	200~750	300~500	300
Laboratory 实验室	300	500	500	200~750	500	300
The art room 美术教室	500	500~750	500	——	500	——

To be Continued 续前表

Multimedia classrooms 多媒体教室	300	500	——	——	500	400
Classroom blackboard 教室黑板	500	500	——	——	——	500

(5)Illumination standards of library building domestic and abroad

图书馆建筑国内外照度标准

Illumination values standard comparison of library building domestic and abroad (unit: lx)

图书馆建筑国内外照度标准值对比(单位: lx)

Room or site 房间或场所		China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2001	Russia俄罗斯 CHNII23-05-95
Reading room 阅览室	General library 一般图书馆	300	500	300	300 (General—般)
	National, provincial and other important libraries 国家、省市及其它重要图书馆	500			
Older reading, rare books, Maps reading room 老年阅览室、珍善本、舆图阅览室		500	——	300	——
Directory Hall (room), showroom 目录厅(室)、陈列室		300	200 (Personal Bookshelf 个人书架)	300 (Reading shelf 阅读架)	200
Stacks 书库		50	200 (Bookshelf 书架)	50 (Fixed 固定设备)	75
Workplace 工作间		300	——	——	200

(6)Illumination standards of museum building showroom exhibits domestic and abroad

博物馆建筑陈列室展品国内外照度标准

Illumination value standard comparison of museum building showroom exhibits domestic and abroad (unit: lx)

博物馆建筑陈列室展品国内外照度标准值对比(单位: lx)

Category类别	China中国 GB 50034-2004	USA美国 IESNA-2000	Japan日本 JISZ9110-1979	UK英国 GIBS-1984	Russia俄罗斯 CHNII 23-05-95
Exhibits particularly sensitive to light 对光特别敏感的展品	50	——	75~150	50	50~75
Exhibits sensitive to light 对光敏感的展品	150	——	300~750	150	150
Exhibits not sensitive to light 对光不敏感的展品	300	——	750~1 500	——	200~500

(7)Illumination standards of exhibition hall domestic and abroad

展览馆展厅国内外照度标准

Illumination standards value comparison of exhibition hall domestic and abroad (unit: lx)

展览馆展厅国内外照度标准值对比(单位: lx)

Category类别		China中国 GB 50034-2004	USA美国 IESNA-2000	Japan日本 JISZ9110-1979	Russia俄罗斯 CHNII 23-05-95
Exhibition Hall 展厅	General 一般	200	100	200~500	200
	High-end 高档	300			

(8)Illumination standards of theater and cinema building domestic and abroad

影剧院建筑国内外照度标准

Illumination value standard comparison of theater and cinema building domestic and abroad (unit: lx)

影剧院建筑国内外照度标准值对比(单位: lx)

Room or Site 房间或场所		China中国 GB 50034-2004	CIE S 008/E-2001	USA美国 IESNA-2000	Japan日本 JIS Z9100-1979	Russia俄罗斯 CHNII23-05-95
the Entrance hall 门厅		200	100	——	300~750	500
Audience Hall 观众厅	Cinema 影院	100	200	100	150~300	75
	Theater 剧院	200				300~500
Audience' Lounge 观众休息厅	Cinema 影院	150	——	——	150~300	150
	Theater 剧院	200				——
Rehearsal Hall 排演厅		300	300	——	——	
the Dressing room 化妆室	General activities area 一般活动区	150	——	——	300~750	——
	dresser 化妆台	500				

(9)Illumination standards of sports building domestic and abroad

体育建筑照度国内外照度标准

Lighting is a very important aspect in the construction of the modern multi-functional stadium, it meets not only the requirements of various sports competitions on the site of illumination, but also controls light and color, glare to reach a certain international standards. Auditorium and other area lighting are required to adapt to different needs of various environments, achieve different lighting effects.

在现代化多功能体育场馆的建设中，照明是十分重要的一个环节，它不仅要满足各类体育比赛对场地的照度要求，而且对照度、光色、眩光都要达到一定的国际标准。对于观众席及其他区域照明则要求能适应不同环境的不同需求，达到不同的照明效果。

Illumination value standards comparison of sports building domestic and abroad (unit: lx)

体育建筑照度国内外照度标准值对比(单位: lx)

Category 类别	CIE No 83-1989	USA美国 IESNA-2000	Japan日本 JISZ 9110-1979
Stadium 体育场	500~750~100(A) 750~100~140(B) 1 000~140(C)	1 000~1 500	750~1 500(Formal正式) 300~750(General一般)
Gym 体育馆		1 500~2 000	750~1 500(Formal正式) 300~750(General一般)
Swimming pool 游泳馆		300~750	750~1 500(Formal正式) 300~750(General一般)
Note : CIE standards (A)、(B) and (C)are TV broadcasting of illumination values of three group competition games. 注 : CIE标准的(A)、(B)和(C)为三组比赛项目的彩电转播照度值。			

Each country sports building illumination standards are varied, China has more detailed regulations, which provides a variety of sports illumination value standard, and develops different illumination of the TV broadcast and Non-TV broadcast standards, as follows:

各国对于体育建筑的照度标准各不相同，中国则做了更为详尽的规定，规定了各种运动项目所对应的照度标准值，并制定了无彩电转播和有彩电转播的不同照度标准，具体情况如下：

Illumination value standards of sports building without TV broadcast (unit: lx)

无彩电转播的体育建筑照度标准值 (中国GB 50034-2004)

Sports运动项目	Reference surface 参考平面	Illumination value Standards 照度值标准(Lx)	
		Training 训练	Competition 比赛
Basketball, Volleyball, Badminton,Tennis, Handball, track and field (indoor) gymnastics, rhythmic gymnastics, techniques, martial 篮球、排球、羽毛球、网球、手球、田径和(室内)体操、艺术体操、技巧、武术	Ground 地面	300	750
Baseball, softball 棒球、垒球	Ground 地面	——	750
Bowling 保龄球	Bottle area 瓶置区	300	500
Weight lifting 举重	Stage 台面	200	750
Fencing 击剑	Stage 台面	500	750
Judo, Chinese wrestling and international wrestling 柔道、中国摔跤、国际摔跤	Ground 地面	500	1 000
Boxing 拳击	Stage 台面	500	2 000
Table tennis 乒乓球	Stage 台面	750	1 000
Swimming, fin swimming, diving, water polo 游泳、蹼泳、跳水、水球	Water surface 水面	300	750
Synchronized swimming 花样游泳	Water surface 水面	500	750
Ice hockey, speed skating, figure skating 冰球、速度滑冰、花样滑冰	Ice surface 冰面	300	1 500
The game of go, Chinese chess, international chess 围棋、中国象棋、国际象棋	Stage 台面	300	750
Bridge 桥牌	Stage 桌面	300	500
Shooting 射击	Target vertical surface 靶心垂直面	1 000	1 500
	Ground地面	300	500
Football, hockey 足球、曲棍球	Ground 地面	——	300~750
the Auditorium 观众席	Seating surface 座位面	——	100