

Lighting for Emergency, Safety & Security

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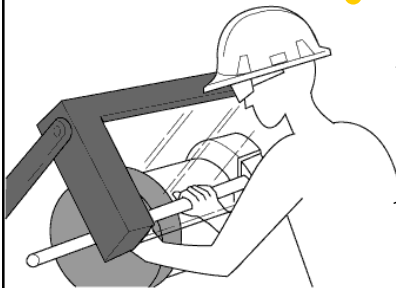
Contents

- Basic concepts
- Design requirements
- System components
- System design & operation
- Security lighting

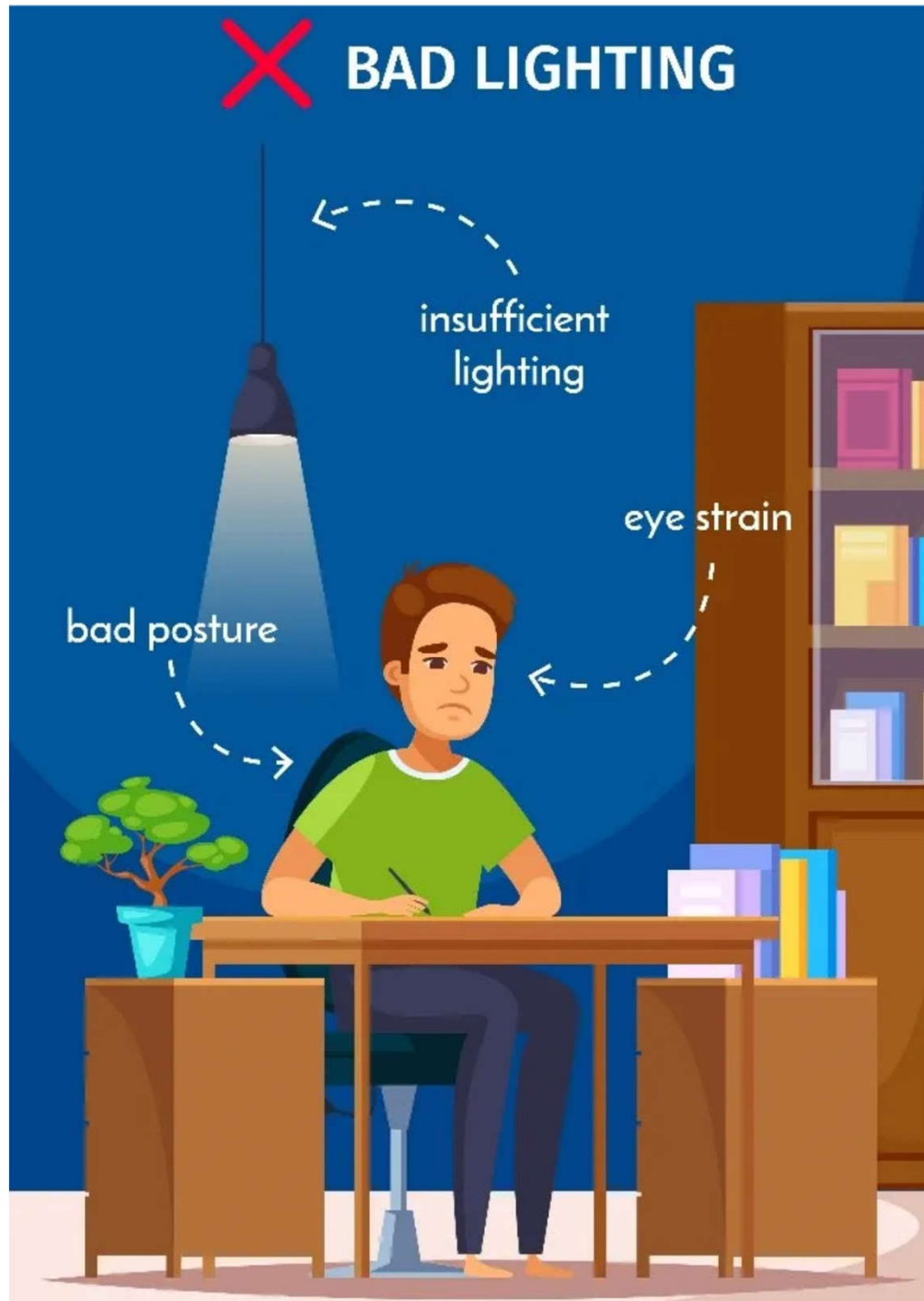


Basic concepts

- **Lighting ergonomics** 照明人體工程學
 - Appropriate lighting, without glare or shadows, can reduce eye fatigue & headaches
 - Prevent workplace incidents by increasing the visibility of moving machinery & other hazards
 - Good quality lighting also reduces the chance of incidents & injuries from “momentary blindness” (momentary low field vision due to eyes adjusting from brighter to darker, or vice-versa, surroundings)
 - Factors affecting the ability to “see” at work:
 - Time to focus on an object, the size of an object, brightness & contrast



Ergonomics of lighting



Basic concepts



- Lighting & safety

- Lighting to enhance safety both indoors & outdoors



- 1. Emergency escape lighting

- Enable people to move along the path to the exit

- 2. Road lighting

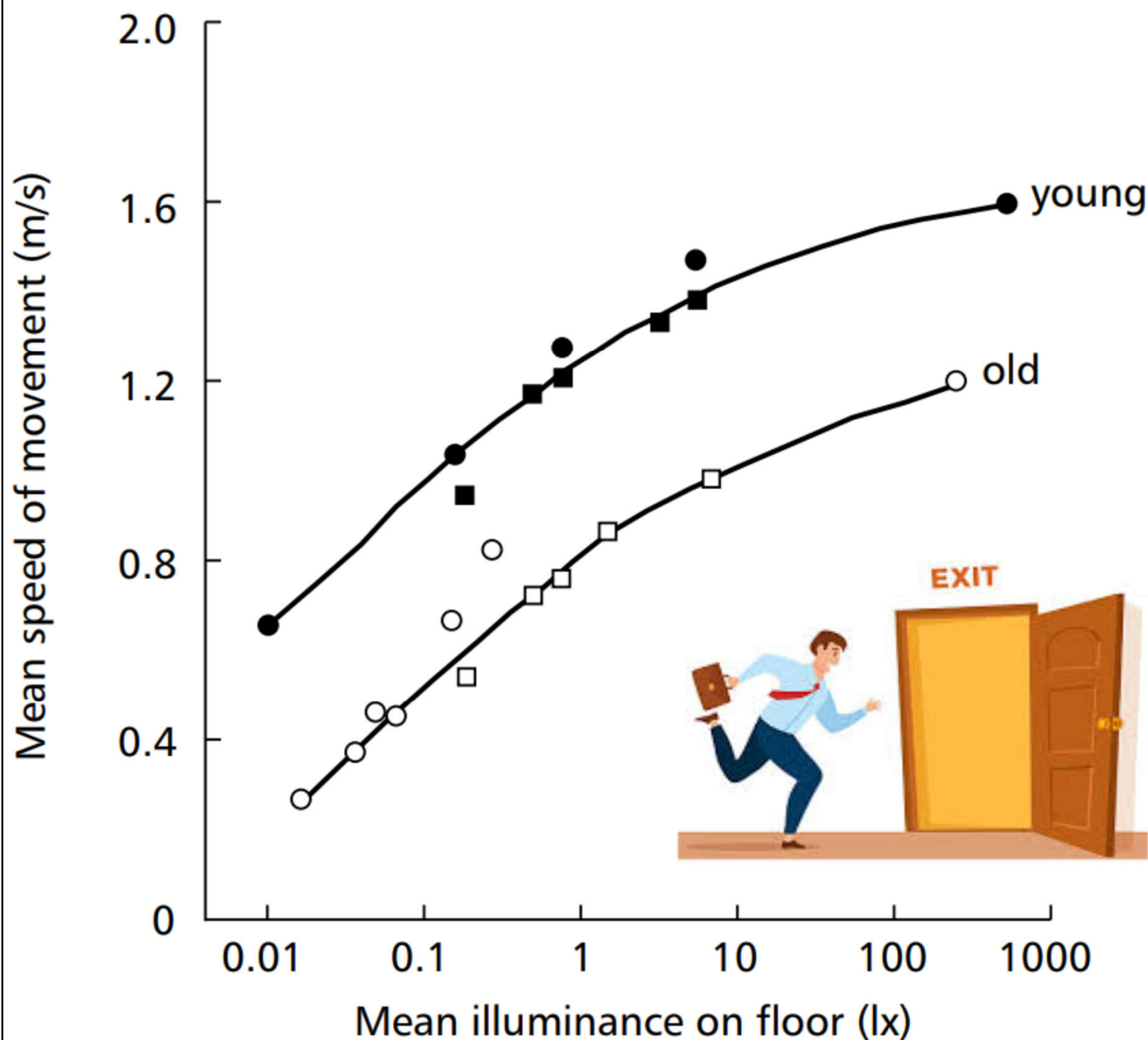


- Enhance road safety & reduce property damage
- Unlighted objects will have a low visibility after dark

- 3. Lighting & crime



- Lighting has a role to play in crime prevention
 - It facilitates surveillance by people after dark
 - It enhances community confidence & informal social control



Mean speed of movement in cluttered & furnished spaces in a clear atmosphere by young & old people, plotted against mean illuminance on the floor

Street lighting & road safety

Emma - On the Way

Good street lighting helps reduce accidents, and white light increases our sense of safety.



#BetterLighting

LIGHTING FOR SAFETY

6 OUTDOOR SPACES

www.delmarfans.com



ROADWAY
LUMINARIES

①

DRIVEWAYS
PARKING AREAS
STREETS

MOTION SENSOR
FLOODLIGHTS

② ④

DRIVEWAYS
BACKYARDS
ENTRYWAYS
CORNERS
DECKS/PATIOS
POOL AREAS

MOUNTED
LUMINARIES

③

ENTRANCES
PERIMETER

LANDSCAPE
LUMINARIES

⑤

GROUND
TREES/PLANTS
FLOWER BEDS
PATHS/TRAILS
WALKWAYS

MOTION SENSOR
RECESSED LIGHTS

⑥

PATHWAYS
DOORS
BACKYARDS

Basic concepts



- **Emergency lighting** 緊急照明



- Provided for use when the power supply to the normal lighting fails
- Plays a critical role in building safety & particularly in an evacuation scenario

- Aims (during an emergency):

- Assist occupants to leave a building
- Help protect occupants if they stay in a building during an emergency
- Help occupants to continue normal operations in the event of failure of the supply to the normal lighting



Types of emergency lighting (*may be combined into a single system)

Supply failure (either total or local)

Emergency
escape lighting

Immediate total
evacuation of the
premises

Emergency safety lighting

Depending on the risk and the system, the occupants might be allowed to stay in the premises in the event of failure of the supply to the normal lighting until:

- a) there is only 1 h duration left in the emergency lighting system; or
- b) the system allows occupants to be directed or escorted to a low risk location; or
- c) the risk is minimal, e.g. if there is adequate daylight in the building

Standby
lighting

Normal activities
can continue but
additional
precautions are
needed to meet
escape or safety
requirements



Basic concepts

- Emergency escape lighting
 - Provide illumination for the safety of people leaving a location or attempting to terminate a potentially dangerous process before doing so
- Emergency safety lighting
 - Provide illumination for the safety of people staying in a premises when the supply to the normal lighting fails (* new idea in risk management)
- Standby lighting
 - Enable normal activities to continue substantially unchanged



Basic concepts

- **Emergency lighting** should be an integrated part of the building lighting
 - Ensure that people can orientate themselves & find their way confidently & safely through a building to a place of safety
 - People, even in familiar buildings, may become frightened & disorientated during an emergency
 - The occupants' reaction times, speed of adaptation, chance of panicking & ability to walk in a straight line may be different (e.g. users have disabilities or have taken alcohol or drugs)

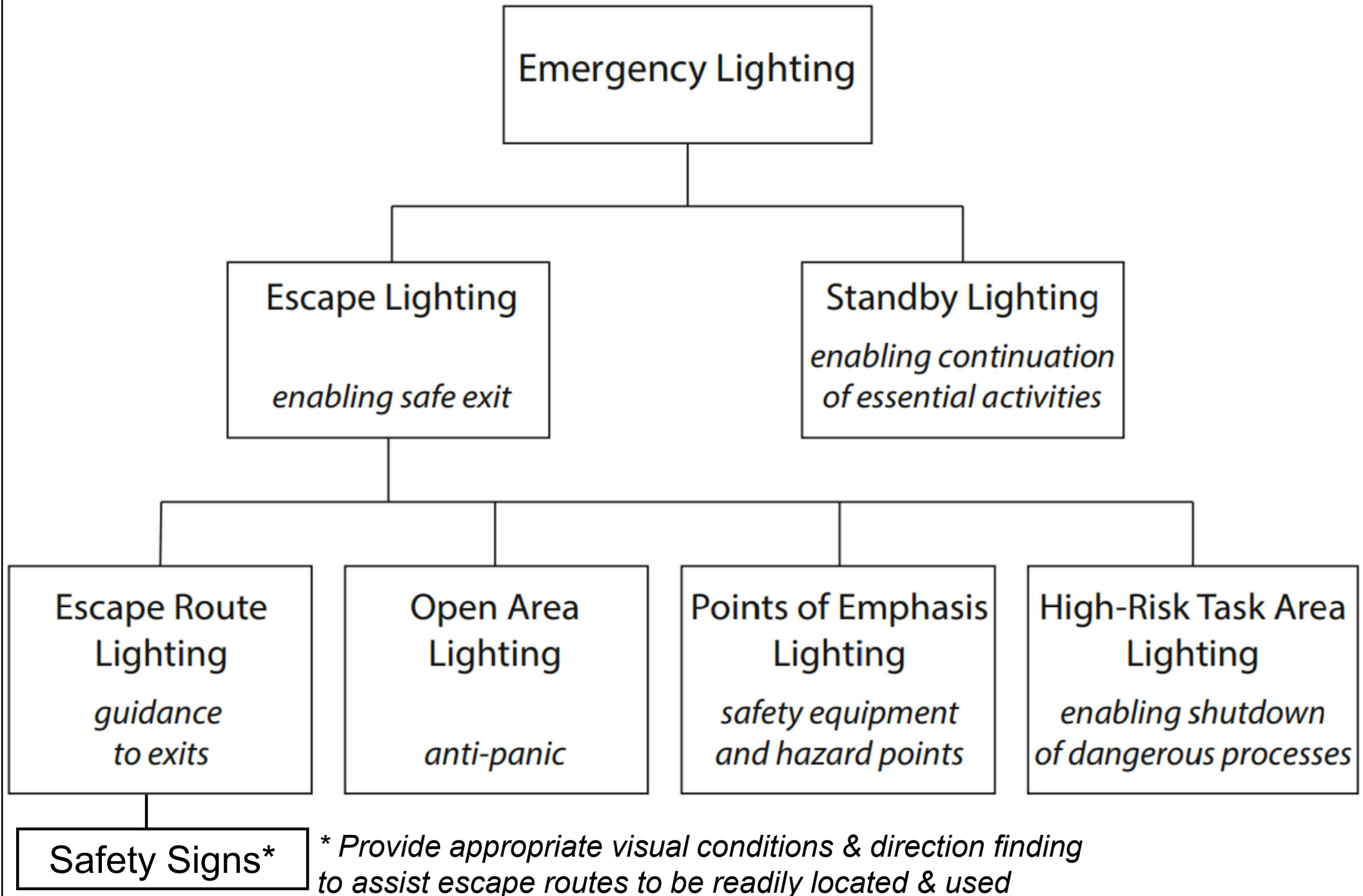
Basic concepts



- Main purpose (when normal lighting fails)
 - Guide people quickly & safely from the building
 - Enable specific tasks to be completed
 - Avoid panic & restore confidence
- Typical examples of installations
 - Emergency exit lighting, escape route lighting, standby lighting, open area (or anti-panic) lighting, the illumination of exit signs, specific lighting for high-risk task areas
 - Exit signs & safety signs

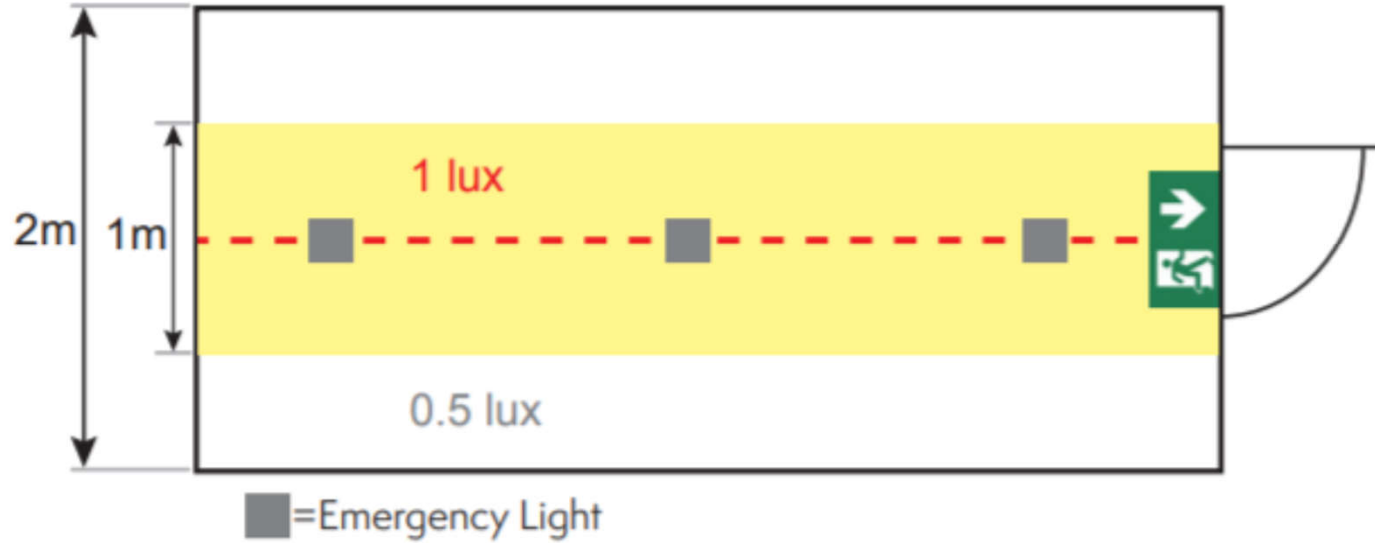


Different categories of emergency lighting & their objectives

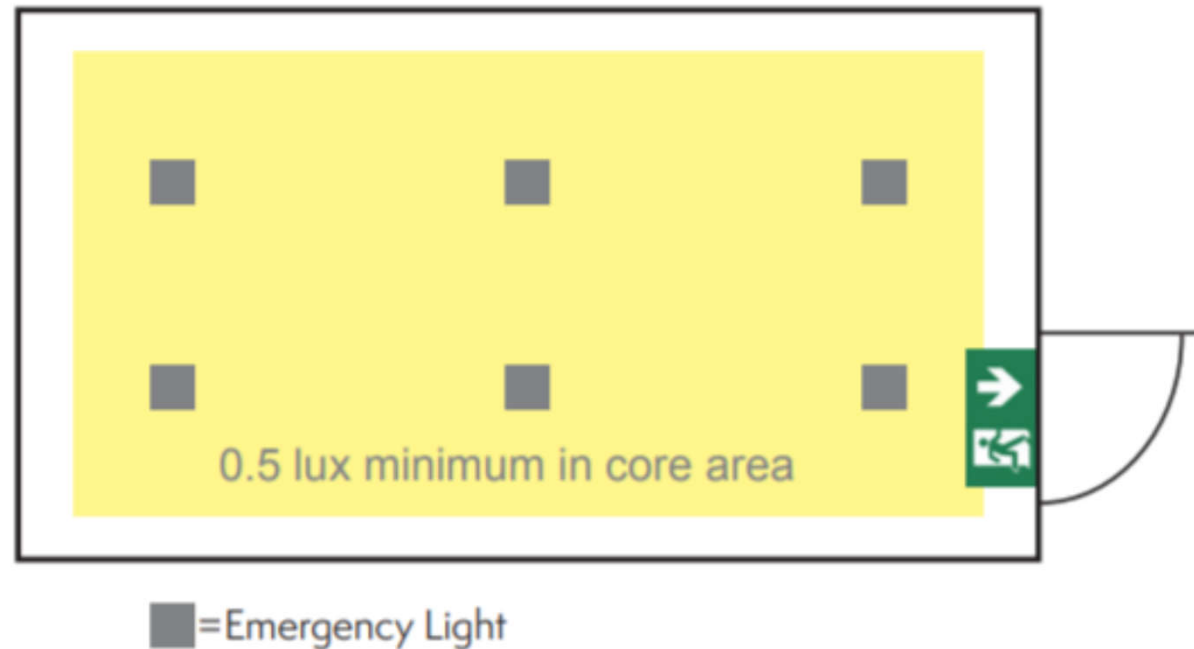


Escape route & open area illumination for emergency lighting

Escape Route Illumination



Open Area Illumination



Example of an escape route lighting design

Escape route with transverse luminaires

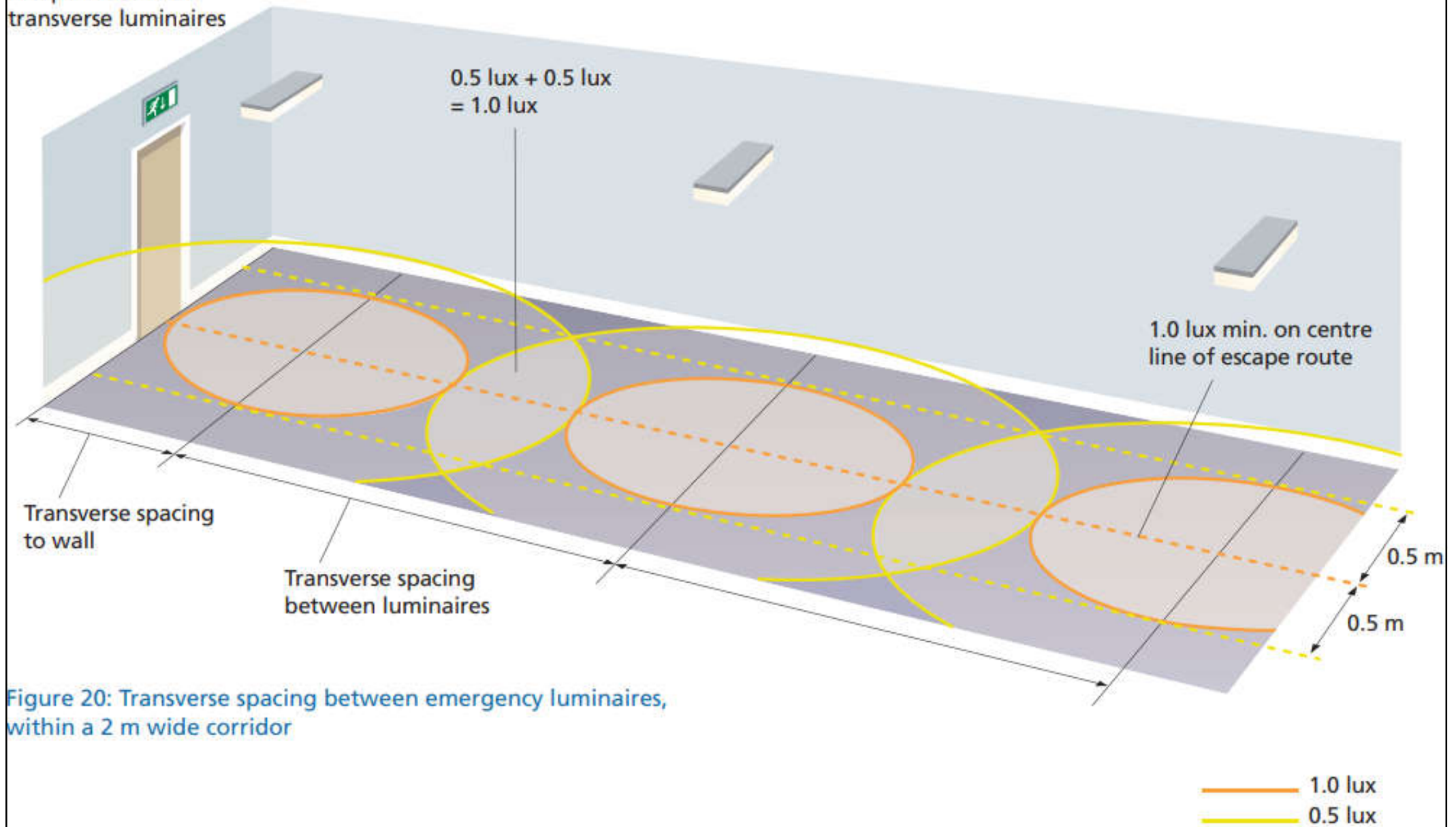
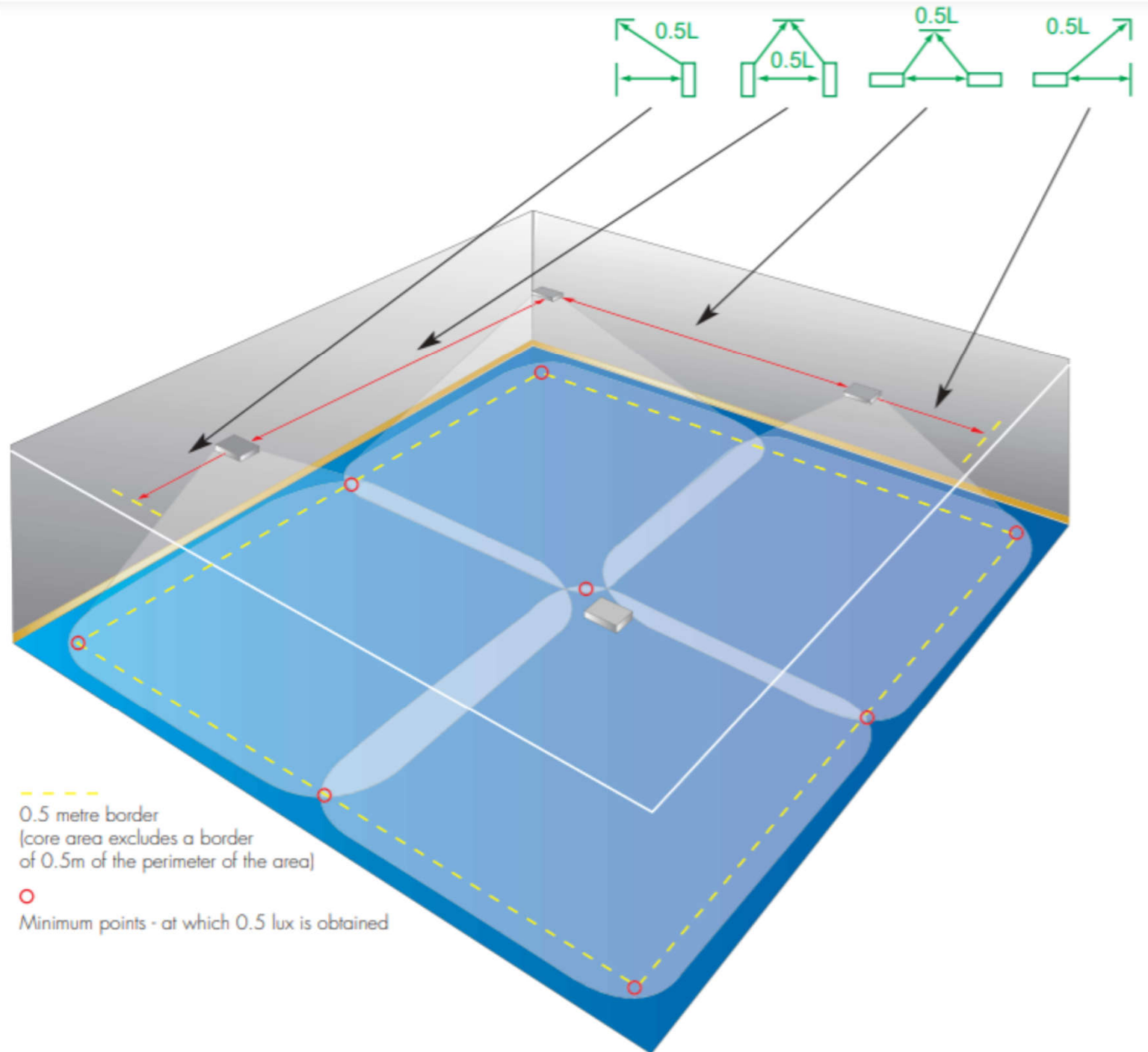
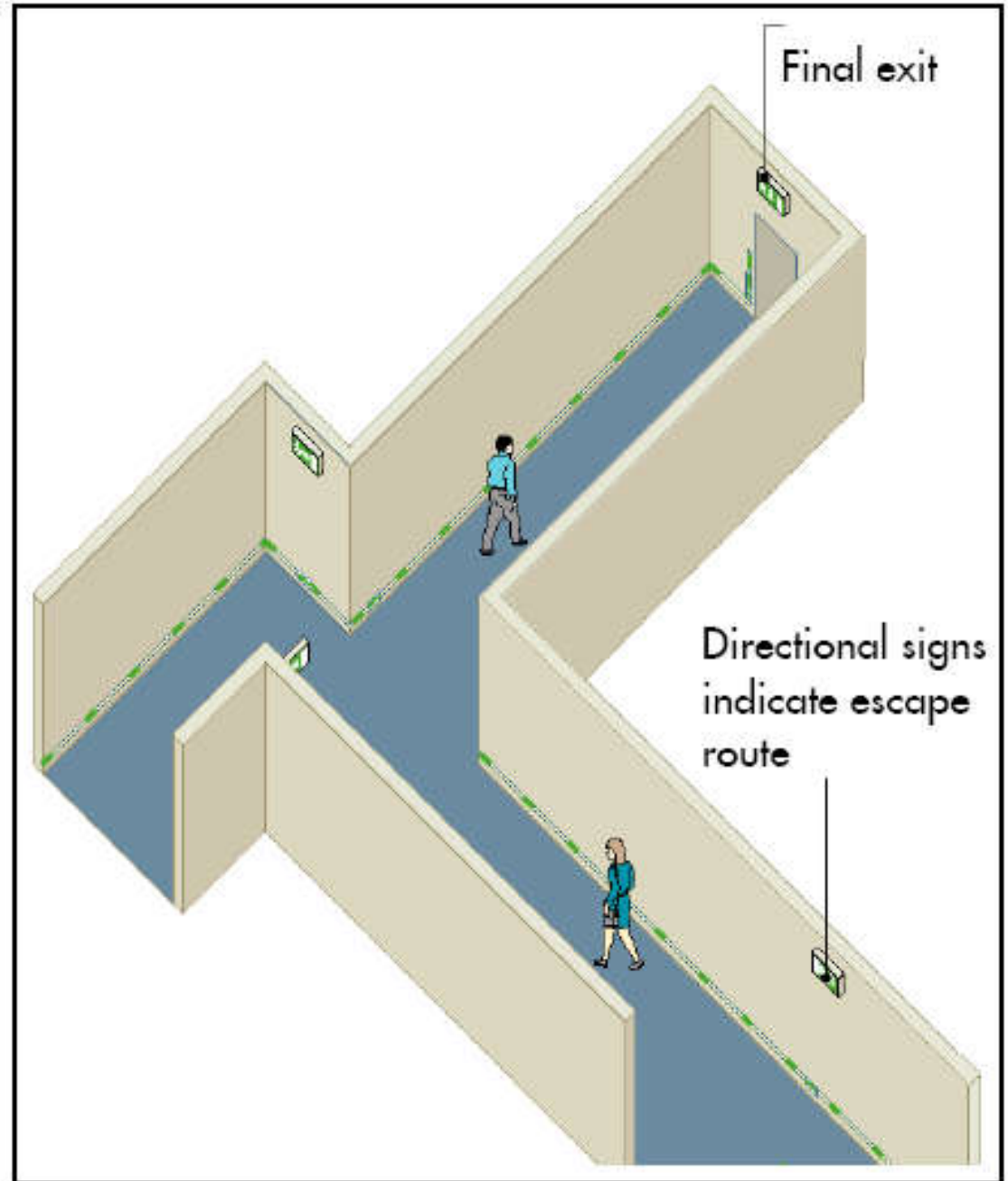
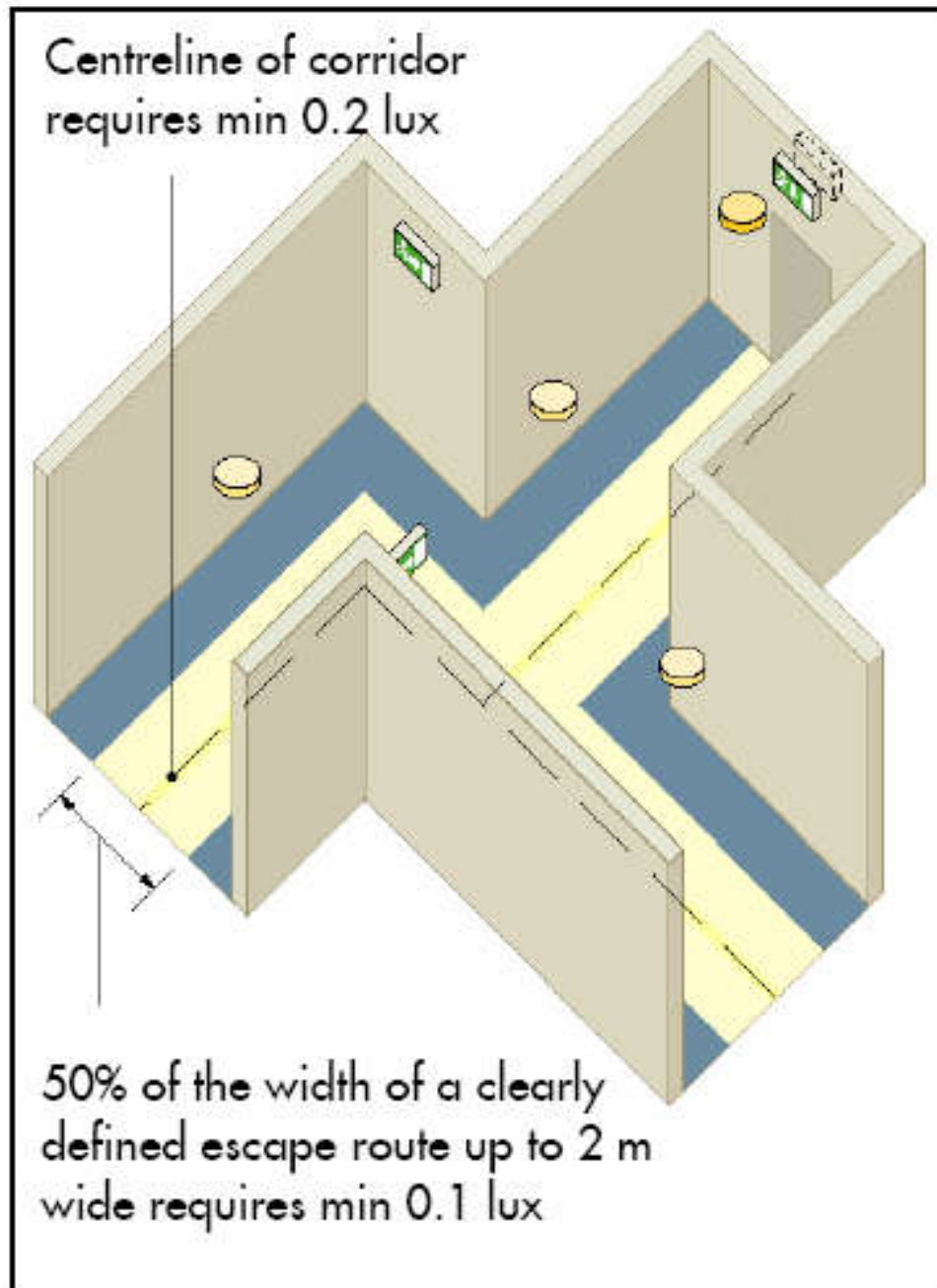


Figure 20: Transverse spacing between emergency luminaires, within a 2 m wide corridor

Luminaire spacing in open (anti-panic) core areas



Emergency lighting & signage on escape route

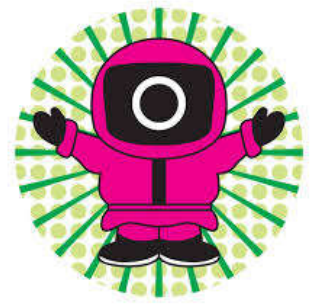




Design requirements

- Legislation & standards
 - Building regulations
 - Fire safety legislation
 - Technical standards
 - e.g. BS 5266-1
- Typical requirements:
 - Illumination level = 1 lux; uniformity 40 : 1
 - Must be in operation ≤ 5 sec, last for 1 or 2 hours
 - Correct positioning & power supply
 - Battery backed up & automatic switch on



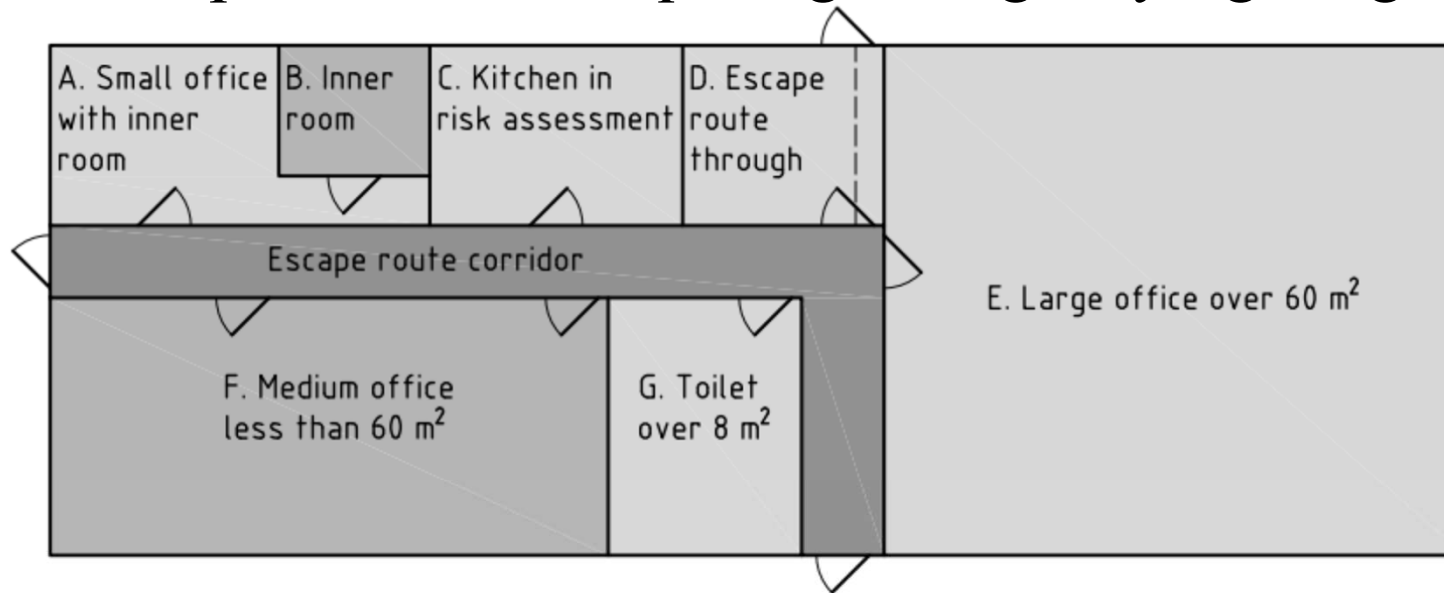


Design requirements

- HK FSD requirements for emergency lighting:
 - Comply with BS 5266-1 & BS EN 1838
 - ≥ 2 lux for staircase/exit route
 - ≥ 1 lux for night club, restaurant, dance hall, etc.
 - ≥ 0.5 lux for cinemas & theatres (auditorium)
 - Activation time within 5 sec. & emergency generator set be up in 15 sec.
 - A minimum of 2 luminaires per compartment (to ensure uniformity & reliability)
 - Batteries shall be heavy duty, rechargeable type
 - Routine inspections & tests



Example of rooms requiring emergency lighting

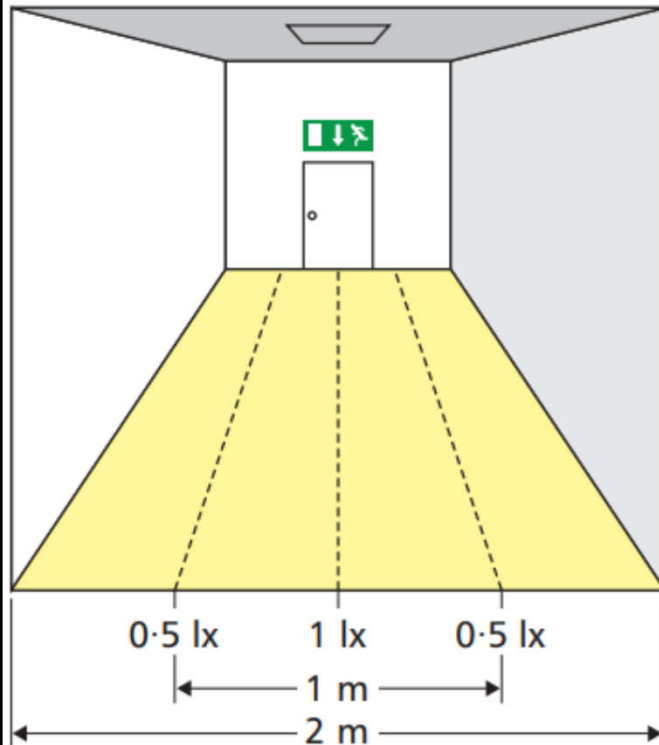


Key

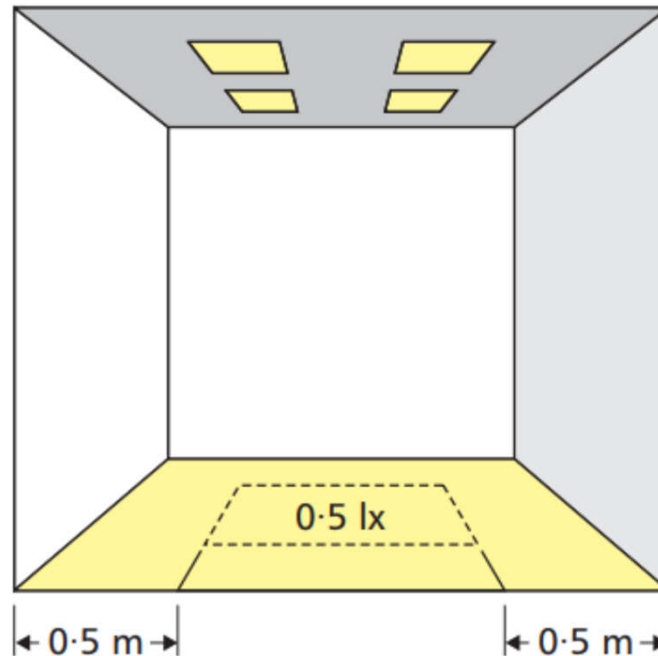
Area	Dimensions	Function and relevant considerations	Emergency lighting needed
Escape route	(2 × 17) m	Corridor leading to exits; luminaires required at change of direction, exits and outside building to place of safety	Yes
Room A with inner room	(3 × 9) m = 27 m ²	Small office in which the office becomes the escape route of the inner room and needs emergency lighting	Yes
Room B	(2 × 4) m = 8 m ²	Inner room with no risks	No
Room C	(3 × 4) m = 12 m ²	Kitchen needing emergency lighting in the risk assessment for the premises	Yes
Room D	(3 × 4) m = 12 m ²	Small office, escape route passes through this open area	Yes
Room E	(10 × 8) m = 80 m ²	Main office larger than 60 m ² floor area	Yes
Room F	(5 × 11) m = 55 m ²	Medium office smaller than 60 m ² floor area	No
Room G	(5 × 6) m = 30 m ²	Toilet larger than 8 m ² floor area	Yes

Requirements for escape route/area lighting

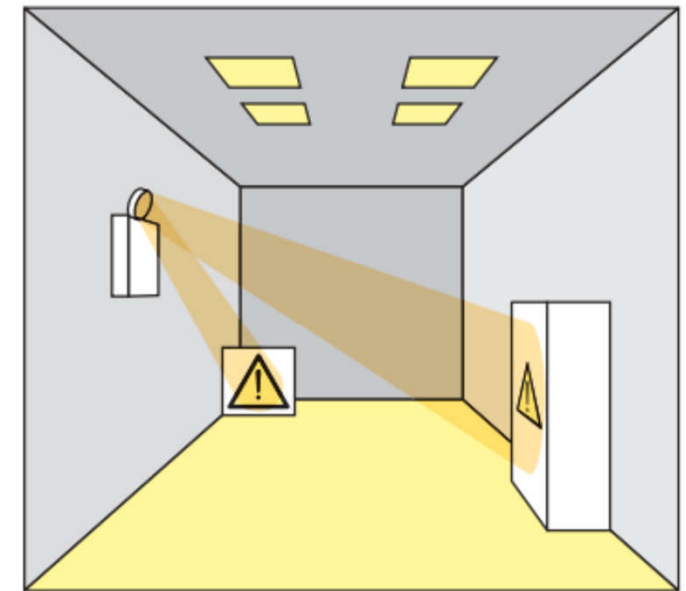
Escape route lighting



Escape area lighting



Emergency task spotlighting



Practical skills (Videos):



Emergency Lighting Design Guide (10:16) <https://youtu.be/crUjqnvhn5Y>

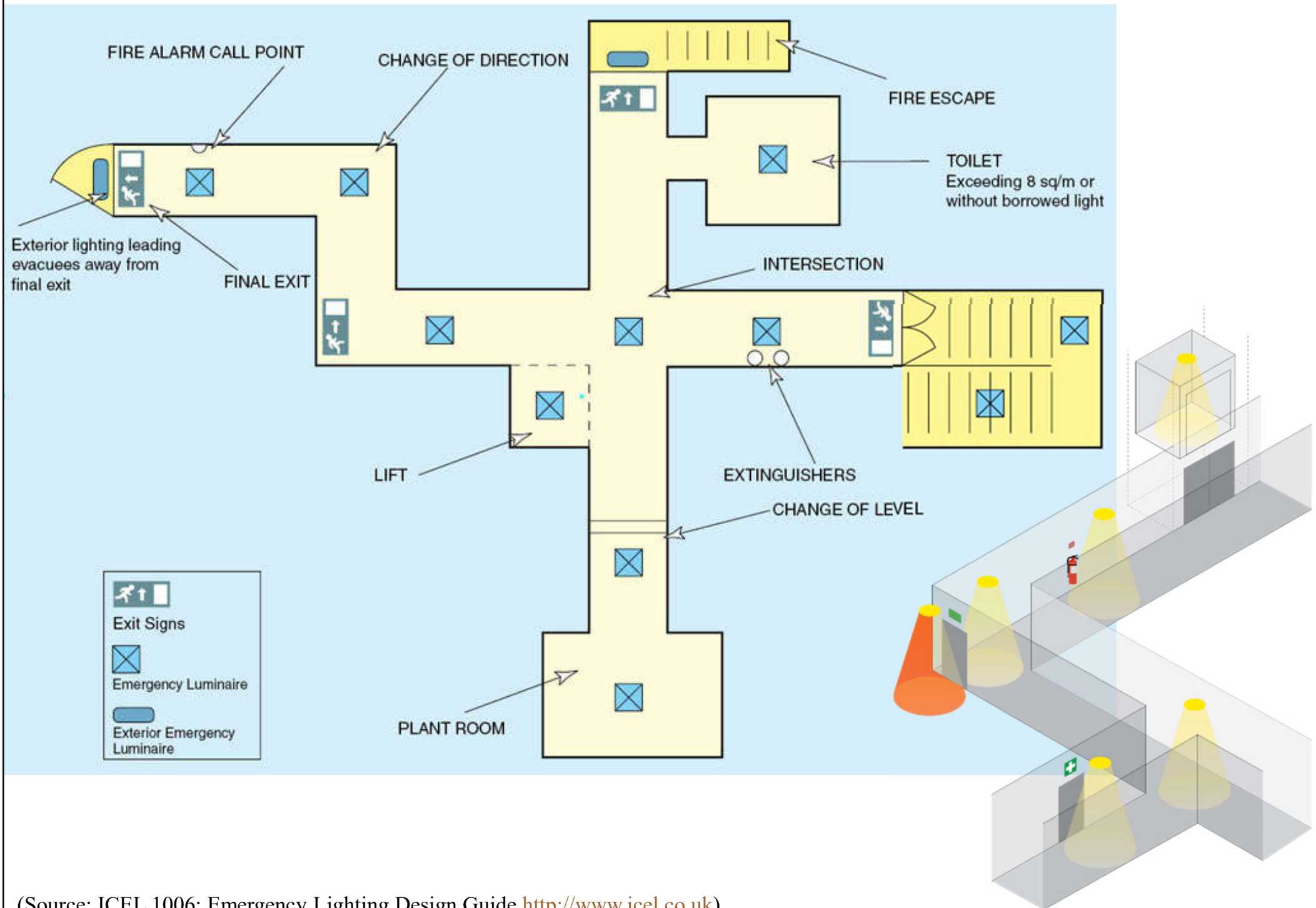
Tutorial: Emergency lighting with DIALux evo 10 (5:11)

<https://youtu.be/6T0HehEV828>

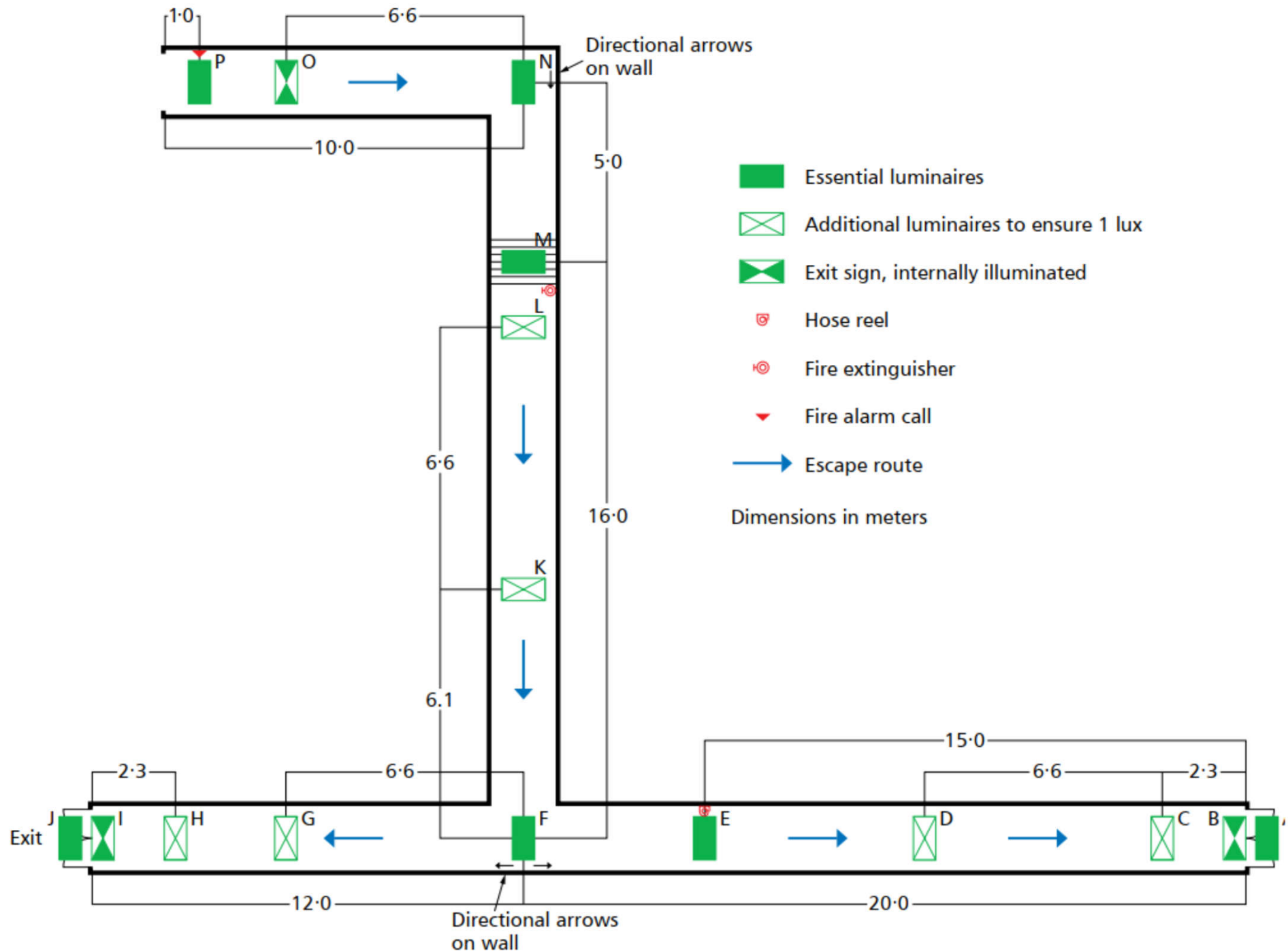
DiaLux evo - How to create emergency lighting (15:43)

<https://youtu.be/fh3LsHHKWk0>

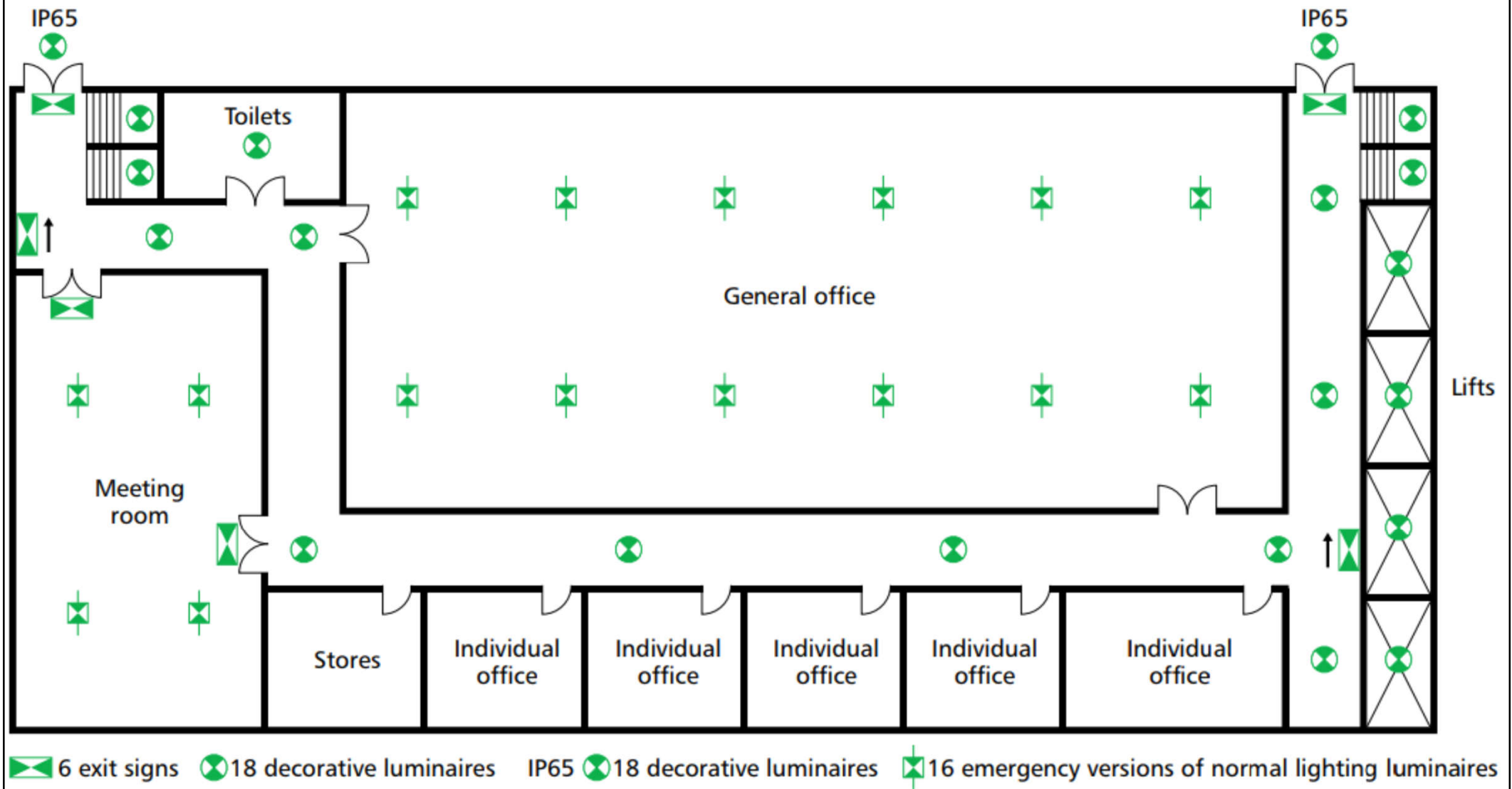
Specific forms of emergency lighting & design drawings



Worked example: escape route emergency lighting positioning



Typical floor plan for an office block showing the emergency lighting scheme



Summary of standards covering emergency lighting

Base guidance document

BS 5266-1:2016 Emergency lighting – Part 1: Code of practice for the emergency lighting of premises

Gives general recommendations and guidance on the provision and operation of emergency lighting in most premises other than dwellings

System standards

BS EN 1838: 2013 Lighting applications – Emergency lighting

Specifies the illumination to be provided by emergency lighting (including illuminance, duration and colour)

BS EN 50172:2004 (BS 5265: 2004) Emergency escape-lighting systems

Specifies the minimum provision and testing of emergency lighting for different premises

Product standards

BS EN 60598-2-22: 2014 Luminaires for emergency lighting

Specifies self-contained and centrally powered luminaires for use in emergency lighting systems

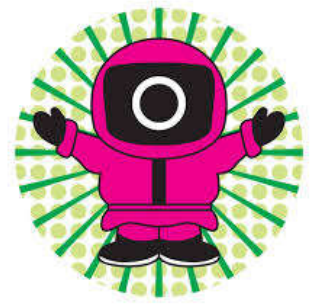
BS EN 62034: 2012 Automatic test systems for battery-powered emergency escape lighting

Specifies a test system for battery-powered emergency lighting

BS EN 50171: 2001 Central power-supply systems

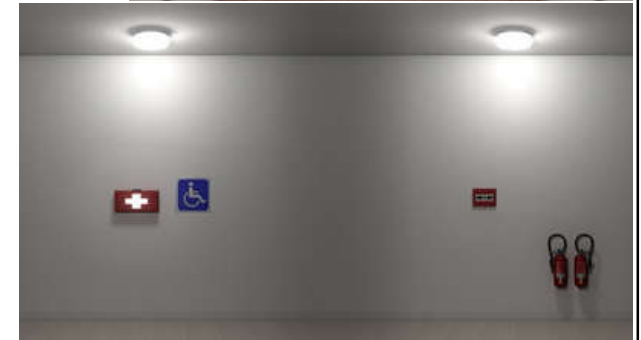
Specifies central power-supply systems for luminaires for emergency lighting

Courtesy of BSI

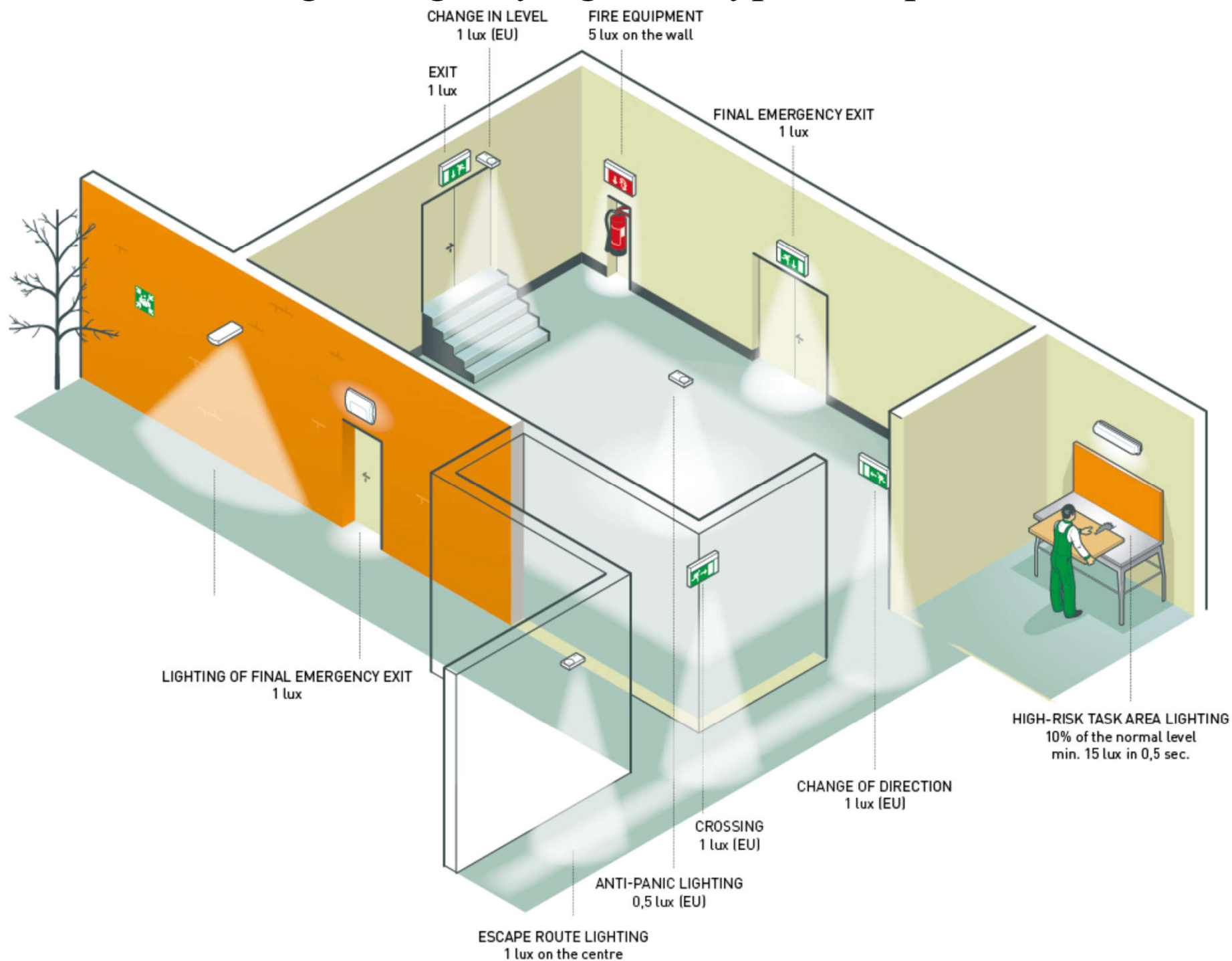


Design requirements

- Locating emergency lights
 - Changes in direction
 - Stairways, steps & ramps
 - Fire & first aid points
 - Exit doors (external & internal)
 - Escalators
 - Lifts & elevators
 - Toilets
 - Large open areas
 - Generator room & high risk areas

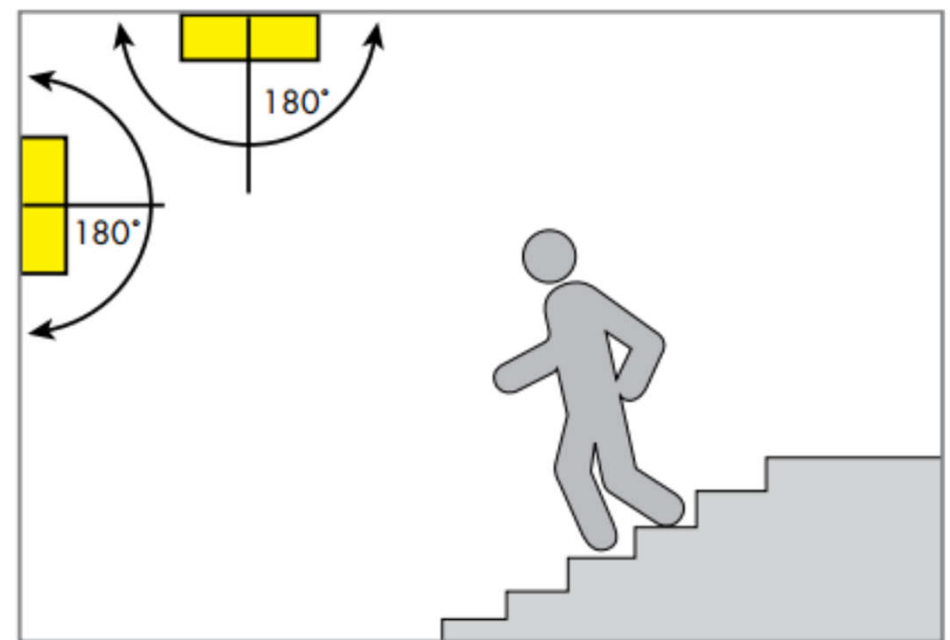
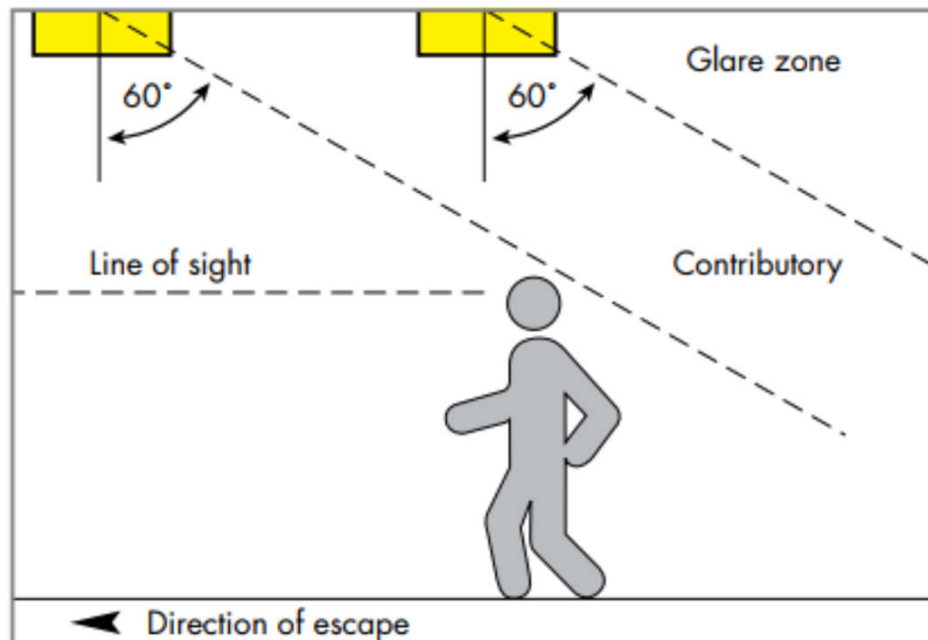


Locating emergency lights & typical requirements



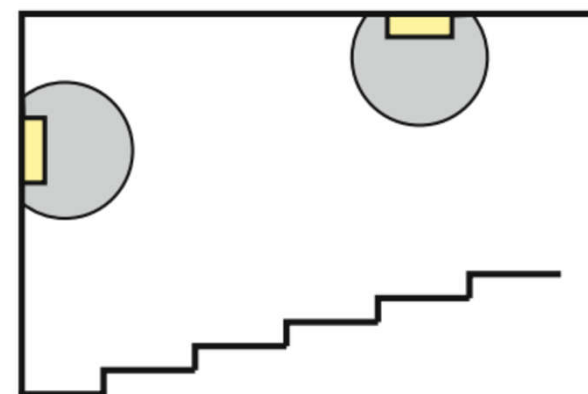
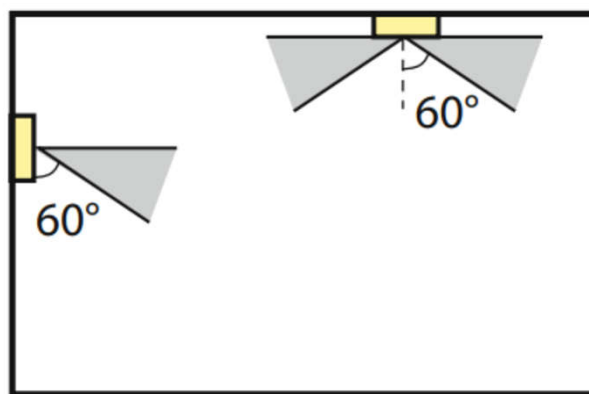
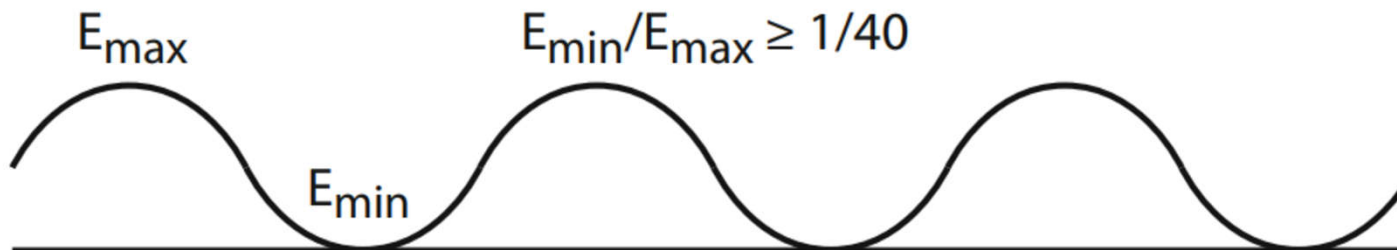
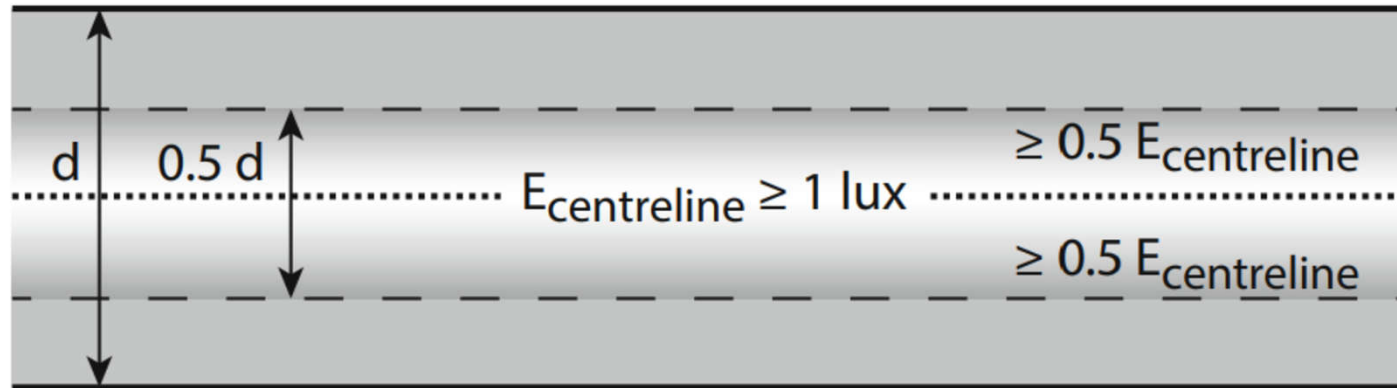
Disability glare limits

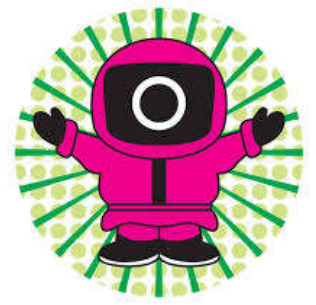
Mounting height h (m)	Escape route & open area max. luminous intensity I_{max} (cd)	High risk max. luminous intensity I_{max} (cd)
$h < 2.5$	500	1,000
$2.5 < h < 3.0$	900	1,800
$3.0 < h < 3.5$	1,600	3,200
$3.5 < h < 4.0$	2,500	5,000
$4.0 < h < 4.5$	3,500	7,000
$h \geq 4.5$	5,000	10,000



(Source: BSI, 2013. *BS EN 1838:2013, Lighting applications -- Emergency lighting*, British Standards Institution (BSI), London.)

Escape-route lighting requirements for routes up to 2 m in width
(Illuminance levels, illuminance diversity & zones in which luminous intensities have to be limited to restrict disability glare)





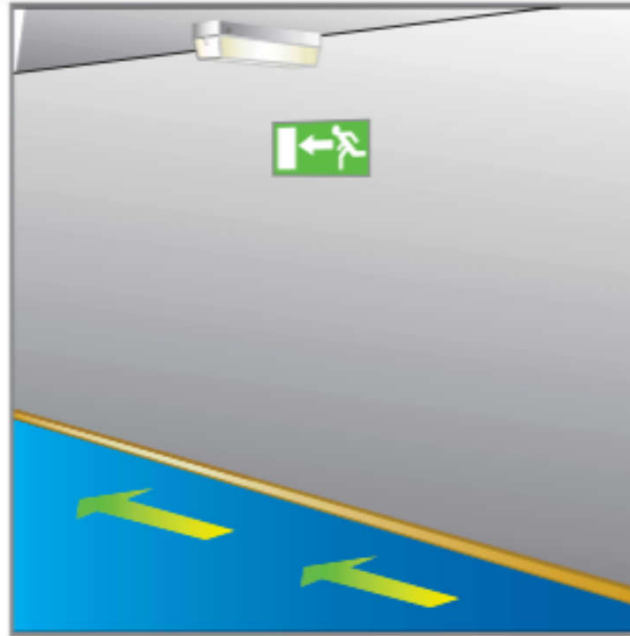
Design requirements

- Points-of-emphasis lighting
 - Can be part of the escape route or anti-panic open-area lighting
 - Critical points of emphasis are:
 - Exit doors intended for use in an emergency
 - Each flight of stairs or any other change in level
 - Each change of direction & intersection of corridors
 - First-aid posts, call points & disabled escape equipment
 - Disabled refugee points
 - Safety signs that are part of the emergency plan
 - Outside the final exit at a place of safety

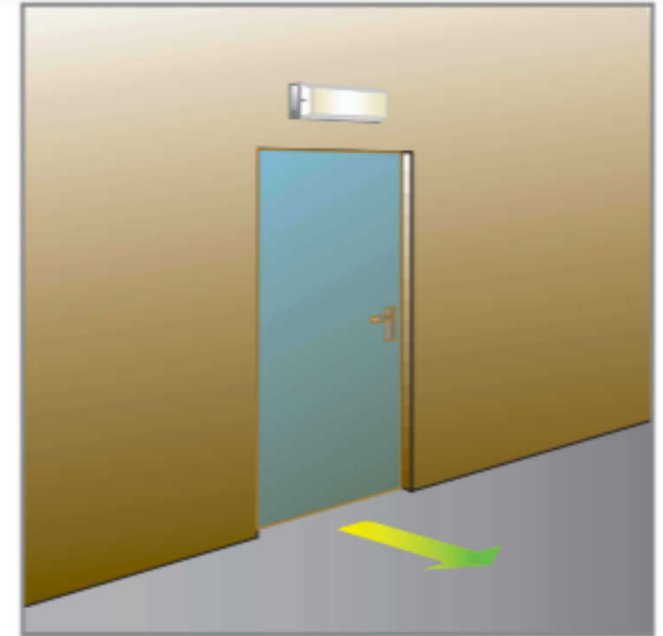
Examples of points-of-emphasis lighting



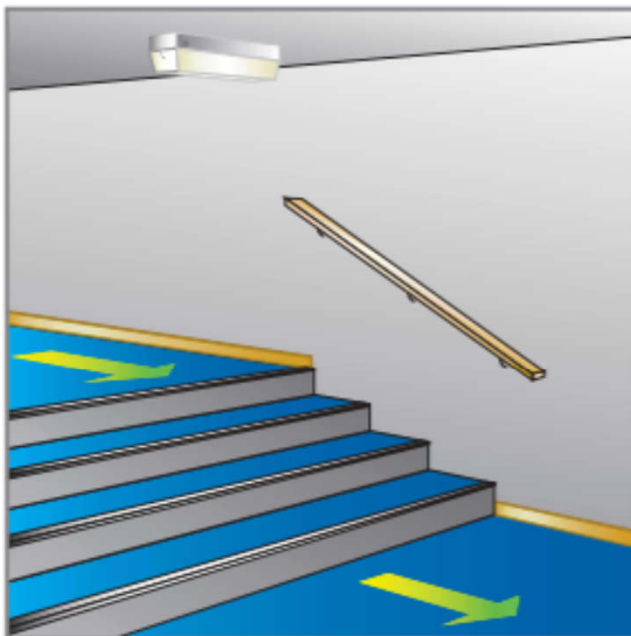
At each exit door



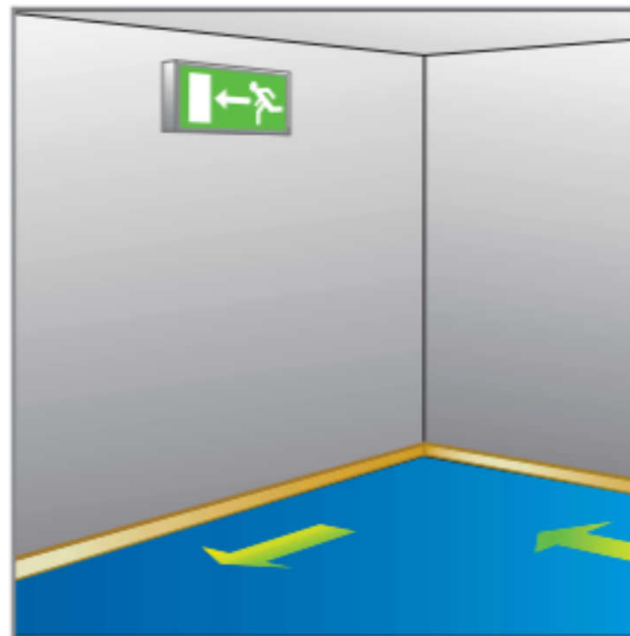
All safety exit signs



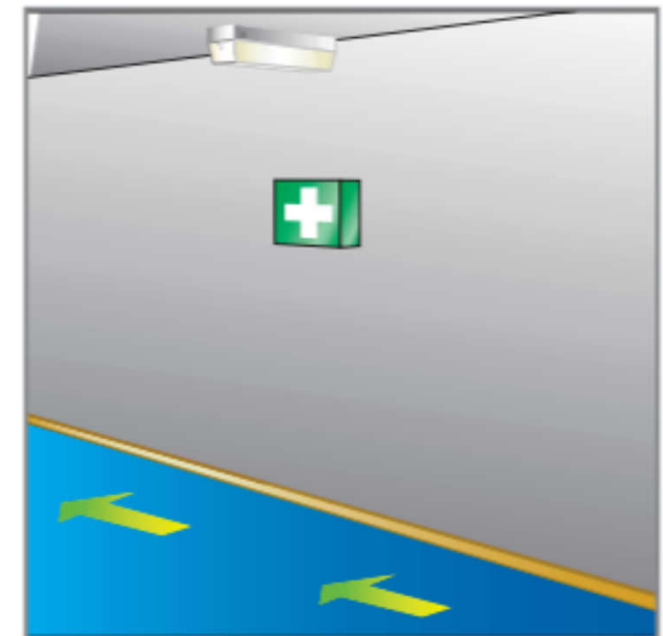
Outside and near each final exit



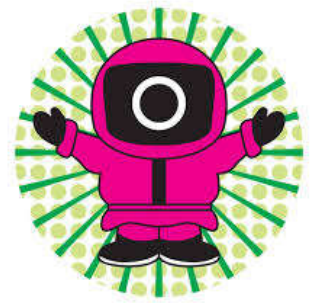
Near stairs so that each tread receives direct light



At each change of direction



Near each first aid post



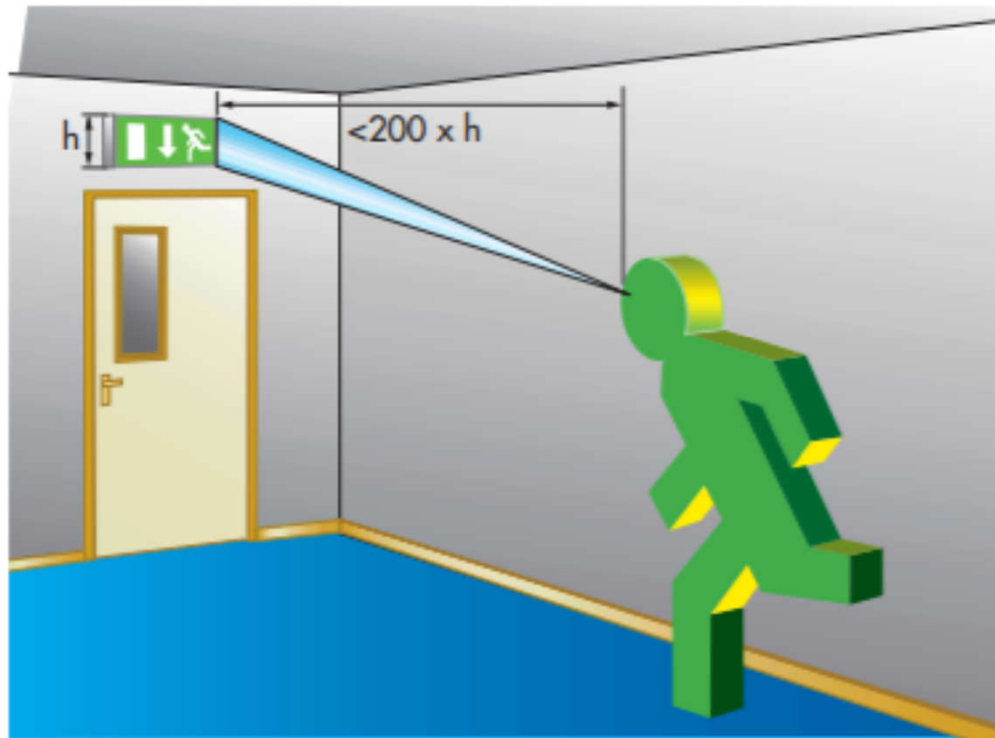
Design requirements

- Escape route indication
 - Escape routes may lead either towards normal exits or to emergency exits, which are indicated by means of appropriate signs
 - Normal exit signs: illuminated at all times & should remain so when the normal supply fails
 - Emergency exit signs: illuminated in times of emergency & may be illuminated at all times in general practice
- Methods for illumination of signs:
 - 1. Lamps external to the sign
 - 2. Lamps contained within the sign

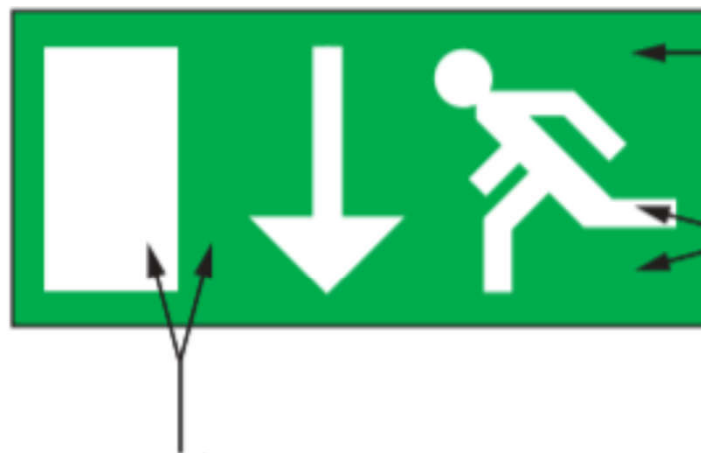
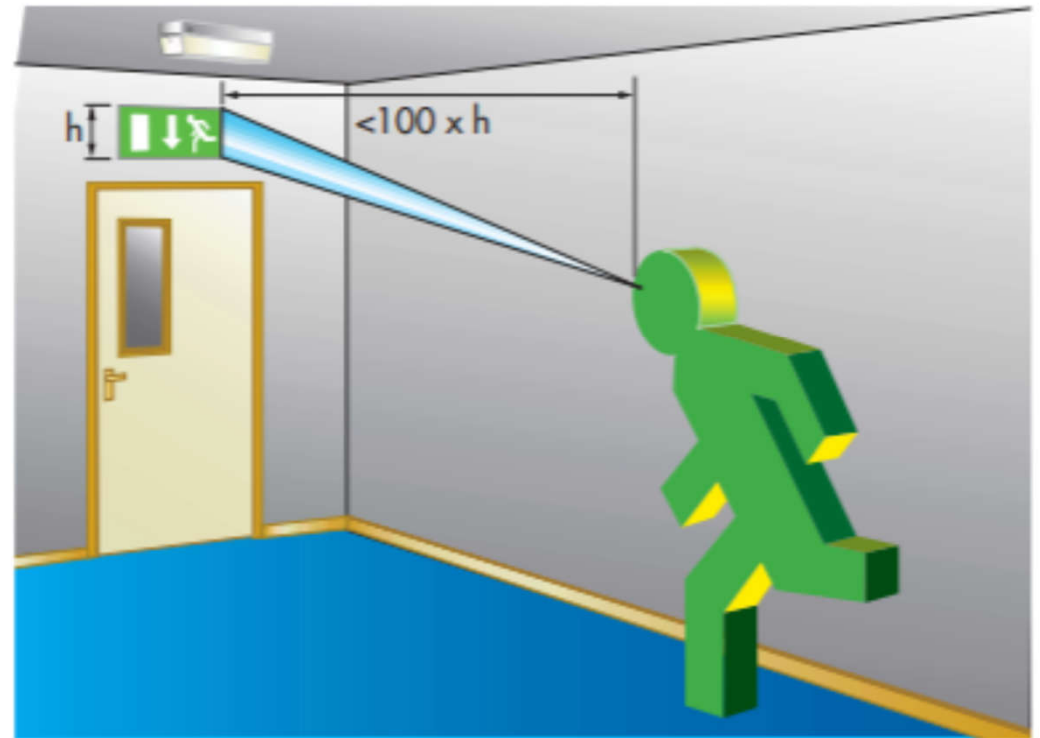


Maximum viewing distances & luminance/contrast of safety signs

Internally illuminated signs - $200 \times$ the panel height



Externally illuminated signs - $100 \times$ the panel height



min luminance = 2cd/m^2

ratio of luminance shall be less than 10:1 for either colour

Summary of requirements for safety signs

Item	Requirement
Luminance	Safety colour 2 cd/m ² minimum
Diversity	Luminance of a colour < 10 (max./min.)
Contrast	Luminance of white to colour > 5 but < 15 ($L_{\text{white}}/L_{\text{colour}}$)
Viewing distance	100 × height of externally illuminated sign 200 × height of internally illuminated sign
Mounting height	Minimum 2 m above floor
Response time	50% of design value in 5 s, 100% of design value in 60 s
Minimum duration	As risk assessed for the premises



Common exit & safety signs in Hong Kong



Characters exit signs



Combined graphical symbol
& characters exit signs



Graphical symbol
exit signs

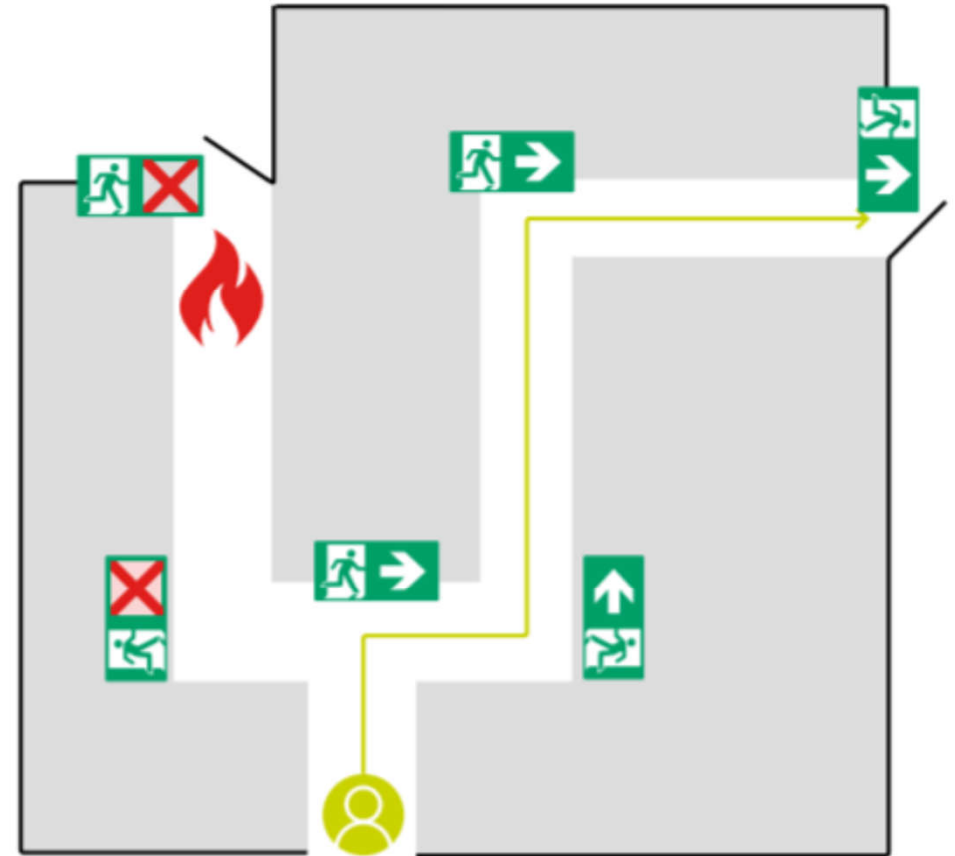
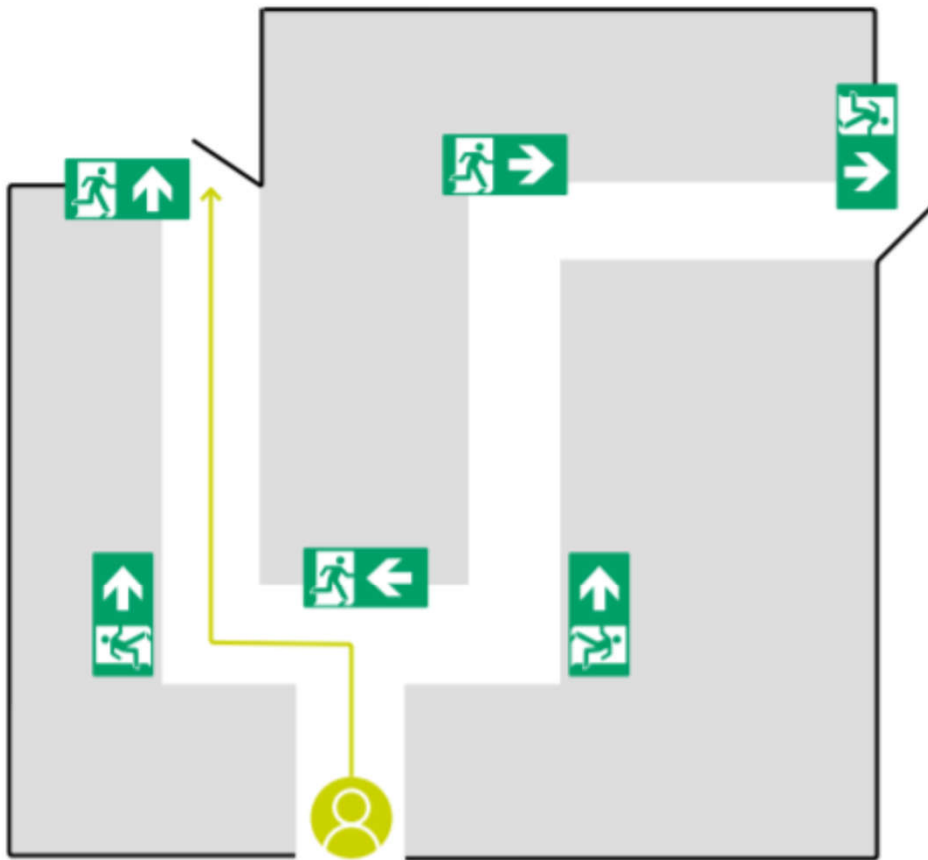


Directional signs



Other signs

Adaptive signage changes to indicate shortest escape route avoiding fire hazard

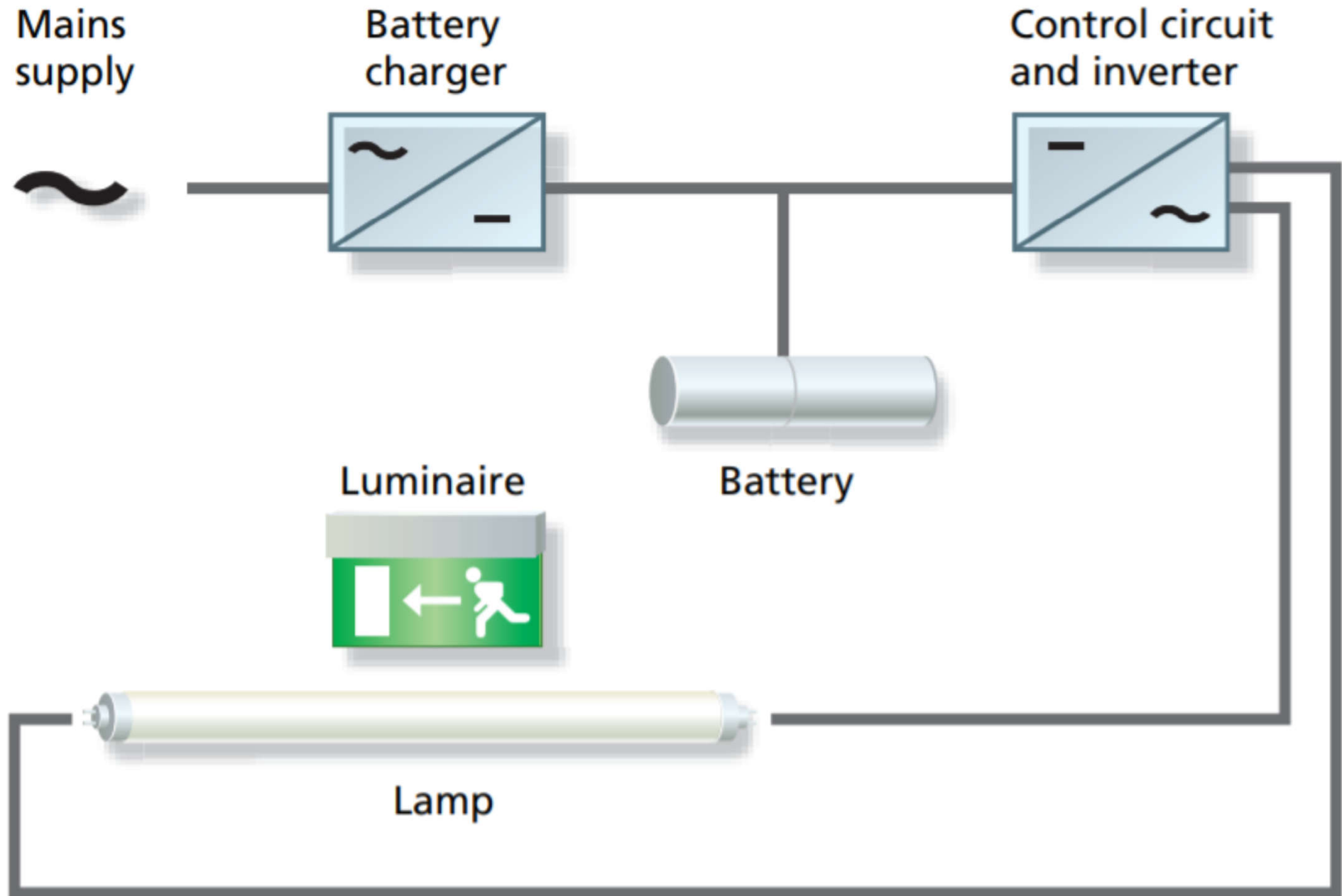


System components

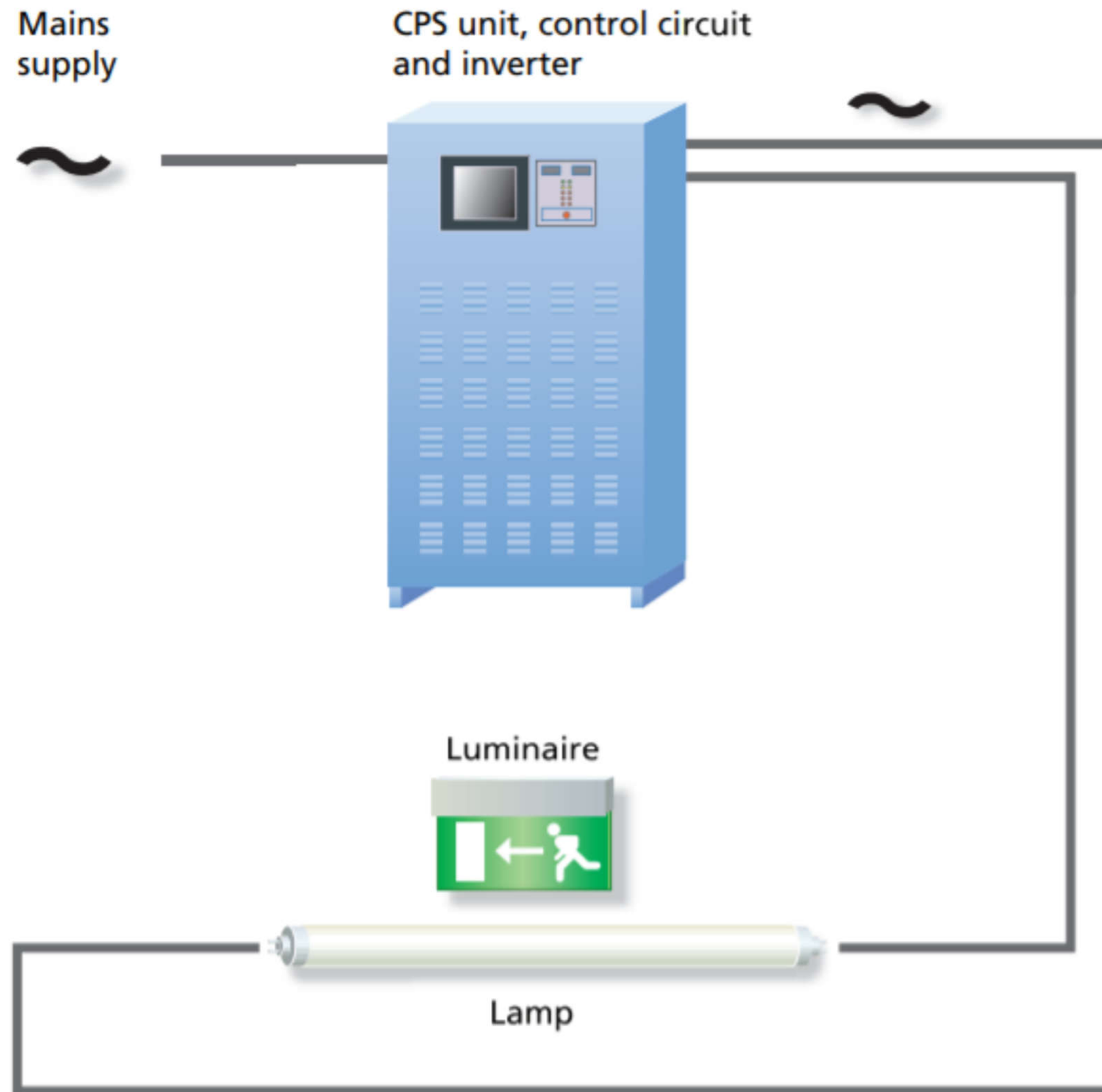


- System types
 - Self contained systems (with their own secondary battery power supply)
 - Centrally powered systems (centrally located power source connected by protected wiring)
 - AC/DC battery powered systems
 - AC/AC battery powered systems
 - Uninterruptible power supplies (UPS)
 - Compound systems with a central control unit & intelligent addressing (can receive input from fire detection systems to assist users to direct occupants)

Schematic of a self-contained emergency luminaire



Schematic of a centrally powered system with slave emergency lighting

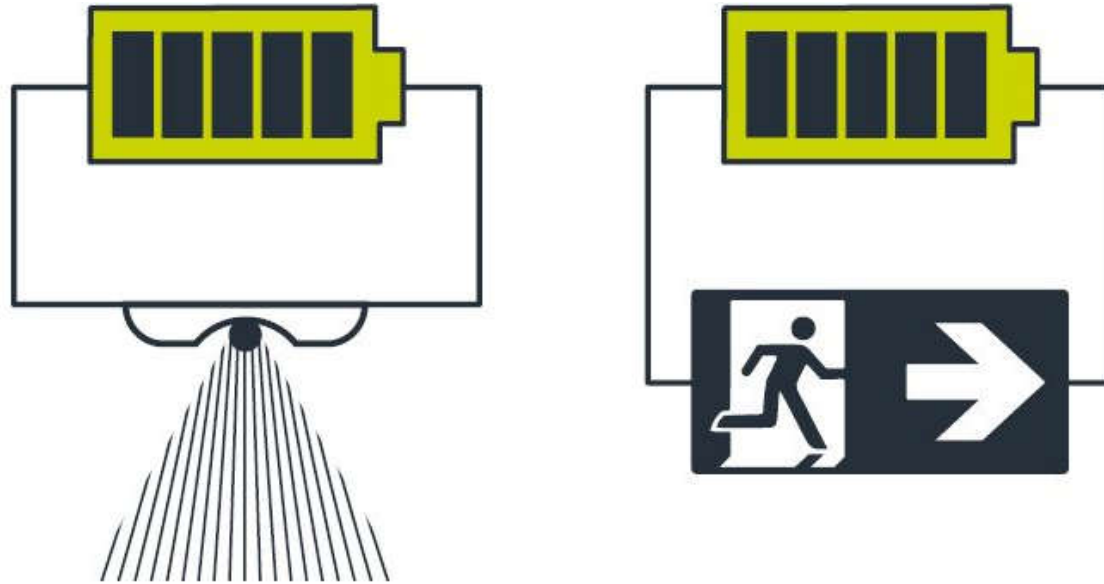


System components

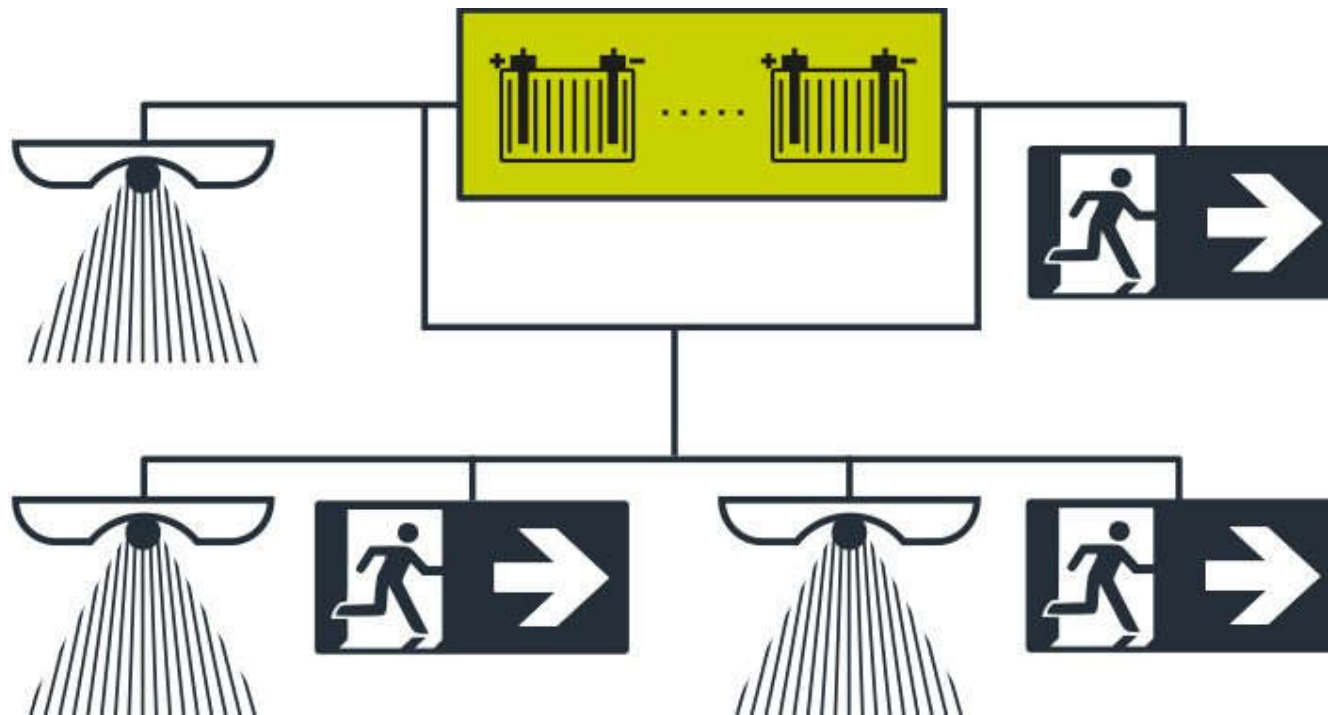


- Power sources:
 - Batteries for self-contained systems
 - Sealed rechargeable cells: nickel-cadmium (Ni-Cd) or nickel-metal hydride (Ni-MH) or lead acid (Pb)
 - Batteries for central systems
 - Vented or sealed lead acid or nickel-cadmium alkaline rechargeable batteries (have high storage capacity, long operational life & wide operating voltage range)
 - Generators
 - A prime mover driving an alternator, fuel tanks, operating controls & starter batteries
 - Start automatically to provide power within 5 s

Emergency lighting battery technologies



(a) Self-contained emergency lighting



(b) Central battery systems

System components



- Modes of operation:

- Maintained luminaires 長明式



- Permanently illuminated, and remain illuminated when power fails, e.g. for emergency exit lighting
 - In some cases they may be switched off deliberately, but are required to be active when the building is occupied

- Non-maintained luminaires 後備式









- May be switched on & off normally
 - If the power fails, they turn on automatically



- Sustained or combined luminaires

- Includes two lamps, one operating on a mains supply, and the other from a battery source

Summary of modes of operation

	Mains mode	Emergency mode
Non-maintained (NM)	 lamp is off	 lamp is on
Maintained (M)	 lamp is on	 lamp is on
Sustained/ Combined (C) or (S)	  mains lamp is on	  emergency lamp is on

System components



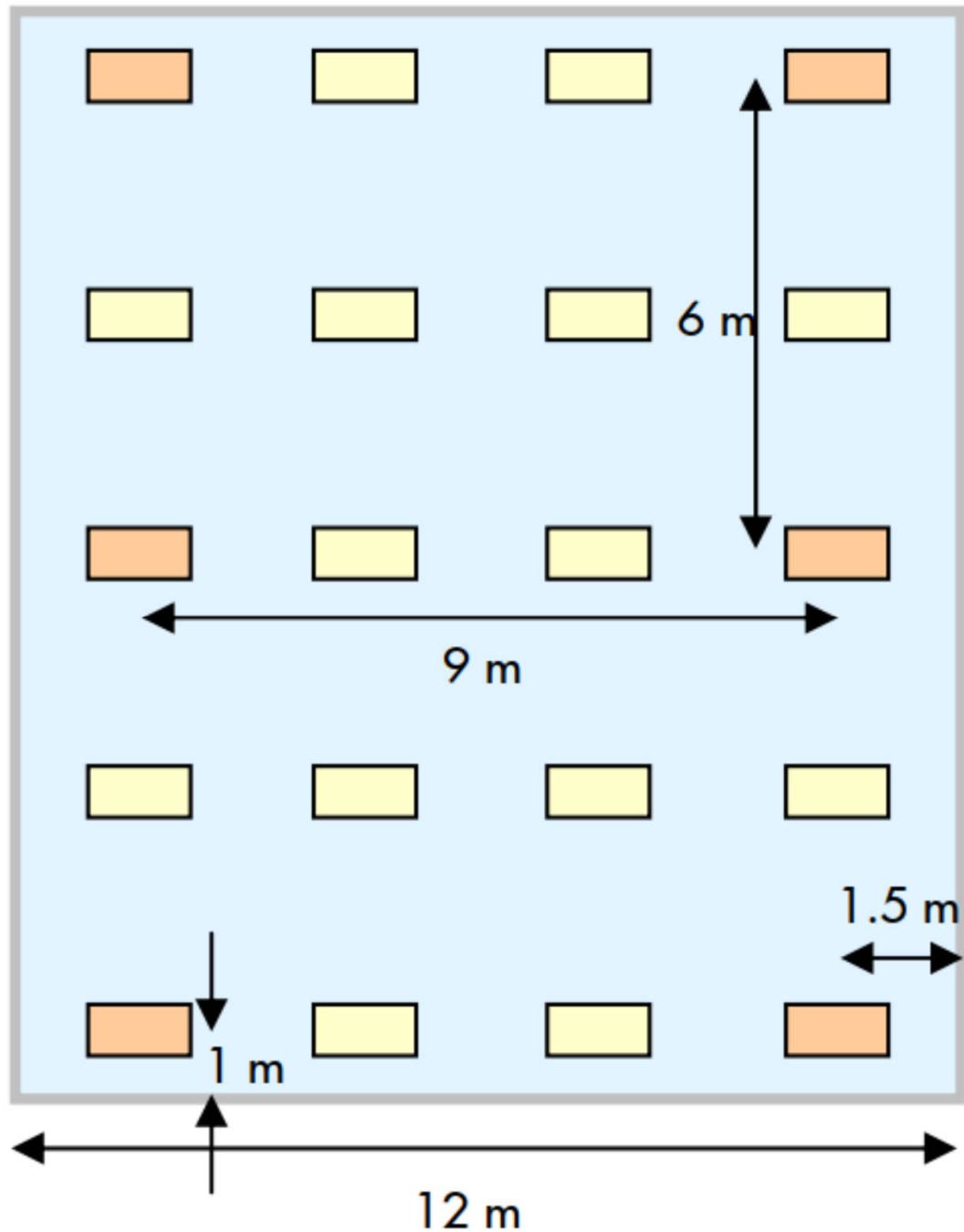
- Wiring systems & circuits
 - Should adequately resist the effects of fire & mechanical damage and retain circuit integrity
 - Cables with high resistance to the effects of fire, mechanical damage, physical damage or rodent attack
 - Routed through areas of low fire risk wherever practicable
 - Methods of cable support & fixings should be non-combustible
 - Conduit, ducting, trunking & channel should have adequate strength & be non-flame propagating
 - Periodic inspection & testing


System components








- Integration with normal lighting luminaires
 - By using emergency version of the main luminaires (e.g. with a charge/healthy indicator)
- Extreme environments: special considerations
 - Hazardous areas: self contained luminaire systems need appropriately protected luminaires
 - Cold environments
 - Hot & humid environments (affect battery life)
 - Corrosive environments
 - Other conditions (e.g. vibration)

Open area using the emergency version of standard luminaire



 Emergency version of standard luminaire

14 m

LED Indication	Condition
	Battery charged and PSU OK
	Emergency mode activated
	Function Test
	Self-test
	Commissioning
	Fault - further troubleshooting required

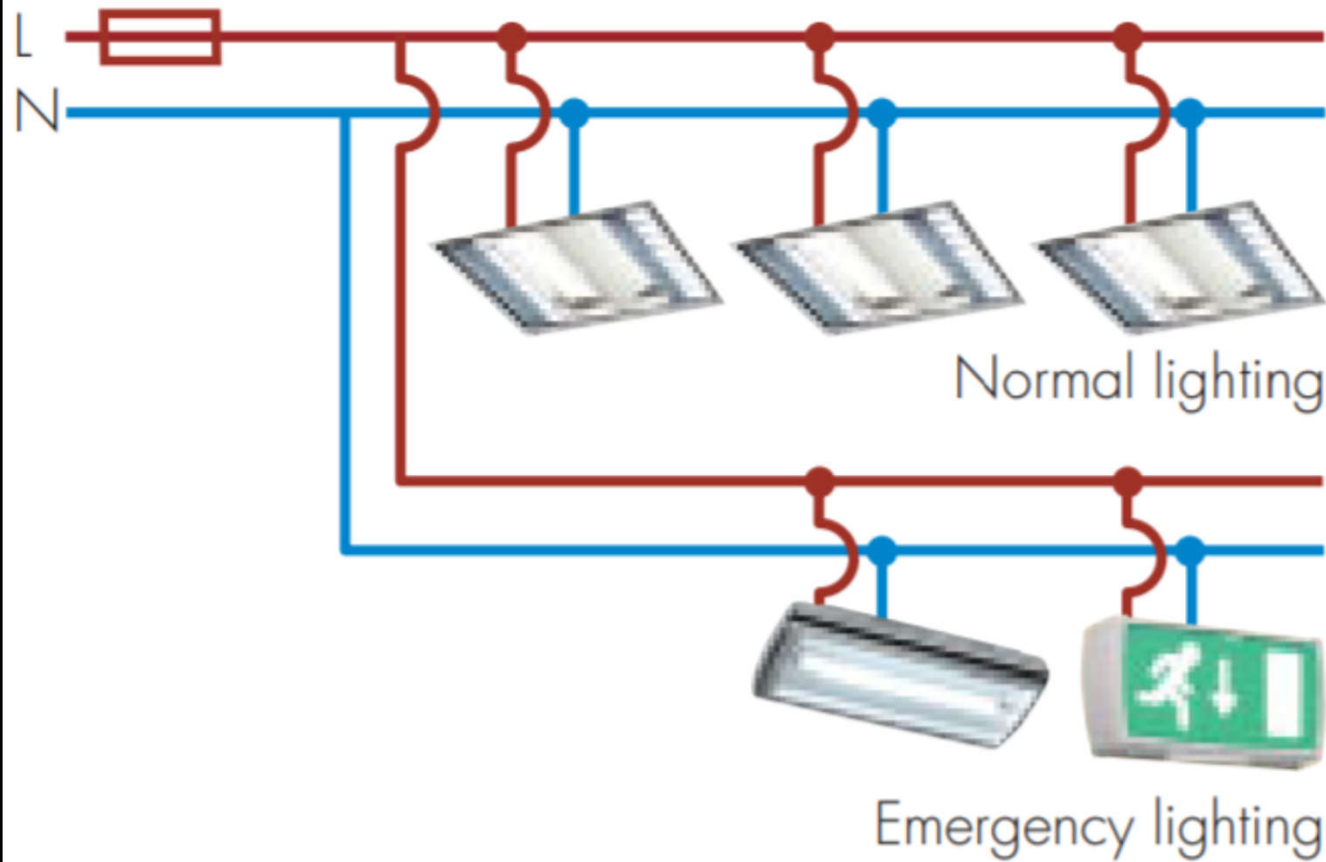
System components



- The adoption of LED luminaires & the upgrading of battery technologies have opened the door to a new class of system that didn't exist before distributed central power supplies
 - Offer extensions in rated battery life from four to 10-plus years, with reduced spatial requirement & lower facility management & capital costs
 - LED luminaires are now often the first choice for emergency lighting, but there are pitfalls, e.g. the introduction of batteries & an inverter changing the ambient temperature within the luminaire



Control of luminaires for normal & emergency lighting

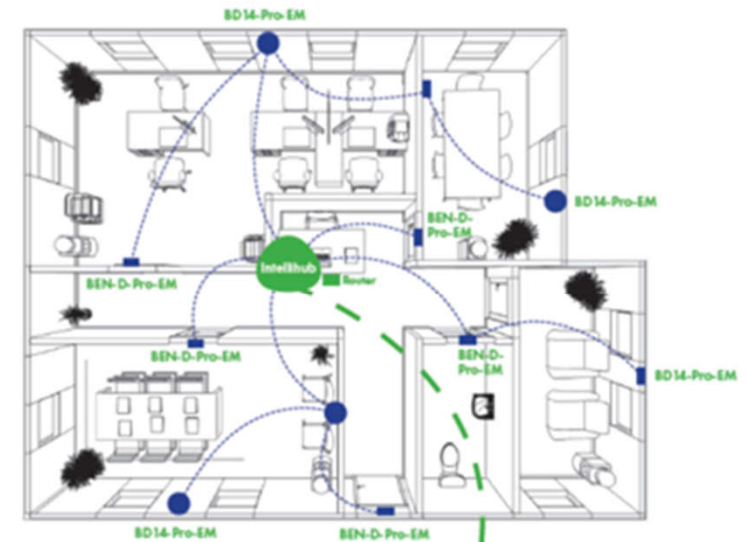


Network control of luminaires for emergency lighting



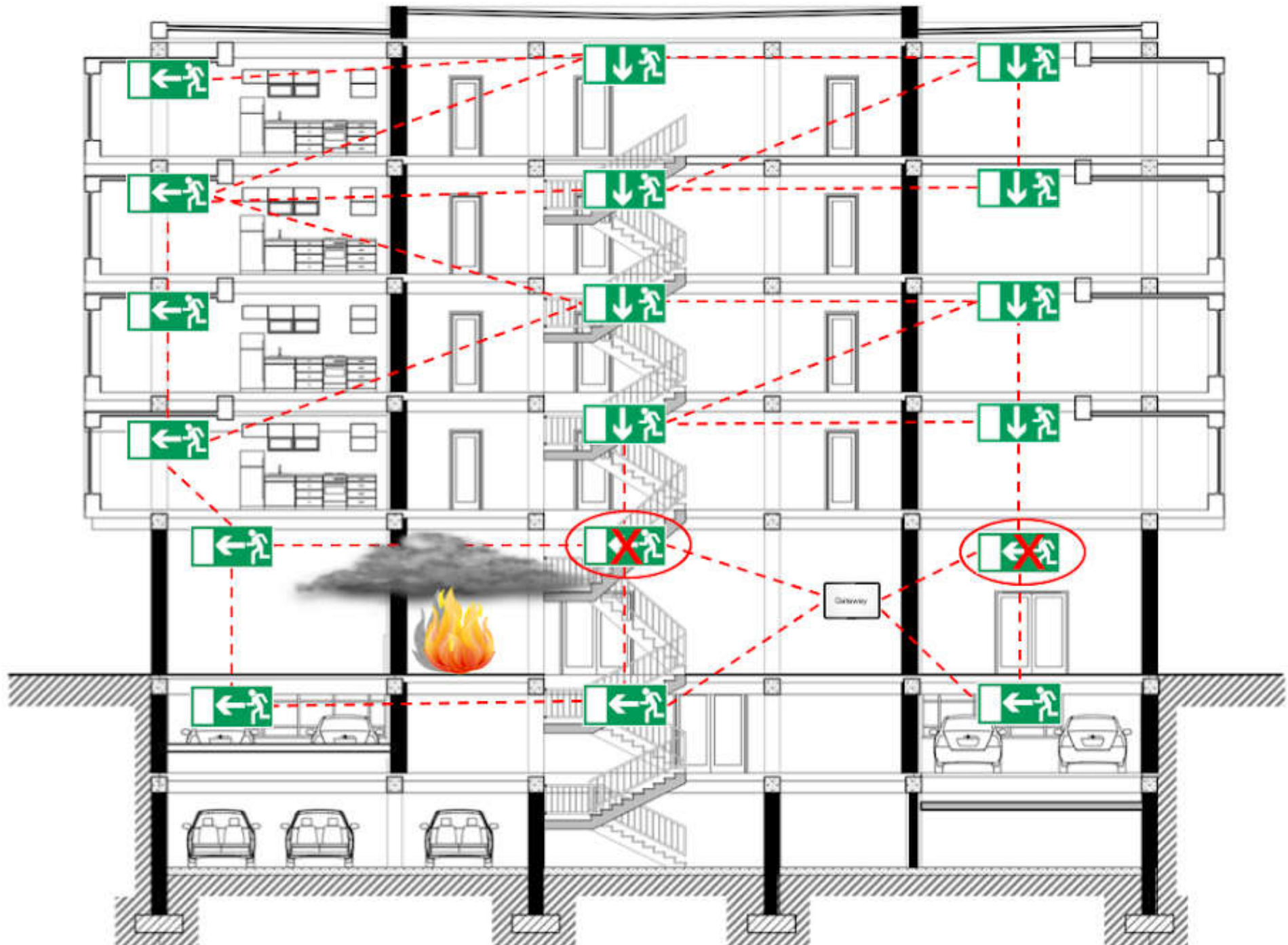
Smart wireless systems to control emergency lighting

SMART WIRELESS EMERGENCY LIGHTING



The Pro-EM® controller provides complete compliance with statutory and mandatory requirements without human intervention. Selectable weekly, monthly, bi-annual and annual tests with date/time options available and the ability to print hardcopy reports.

Adaptive emergency lighting built with wireless mesh



(Source: <https://lumenradio.com/the-future-of-emergency-lighting-go-wireless/>)

System design & operation



- Important design considerations

- **1. Building user profiles**



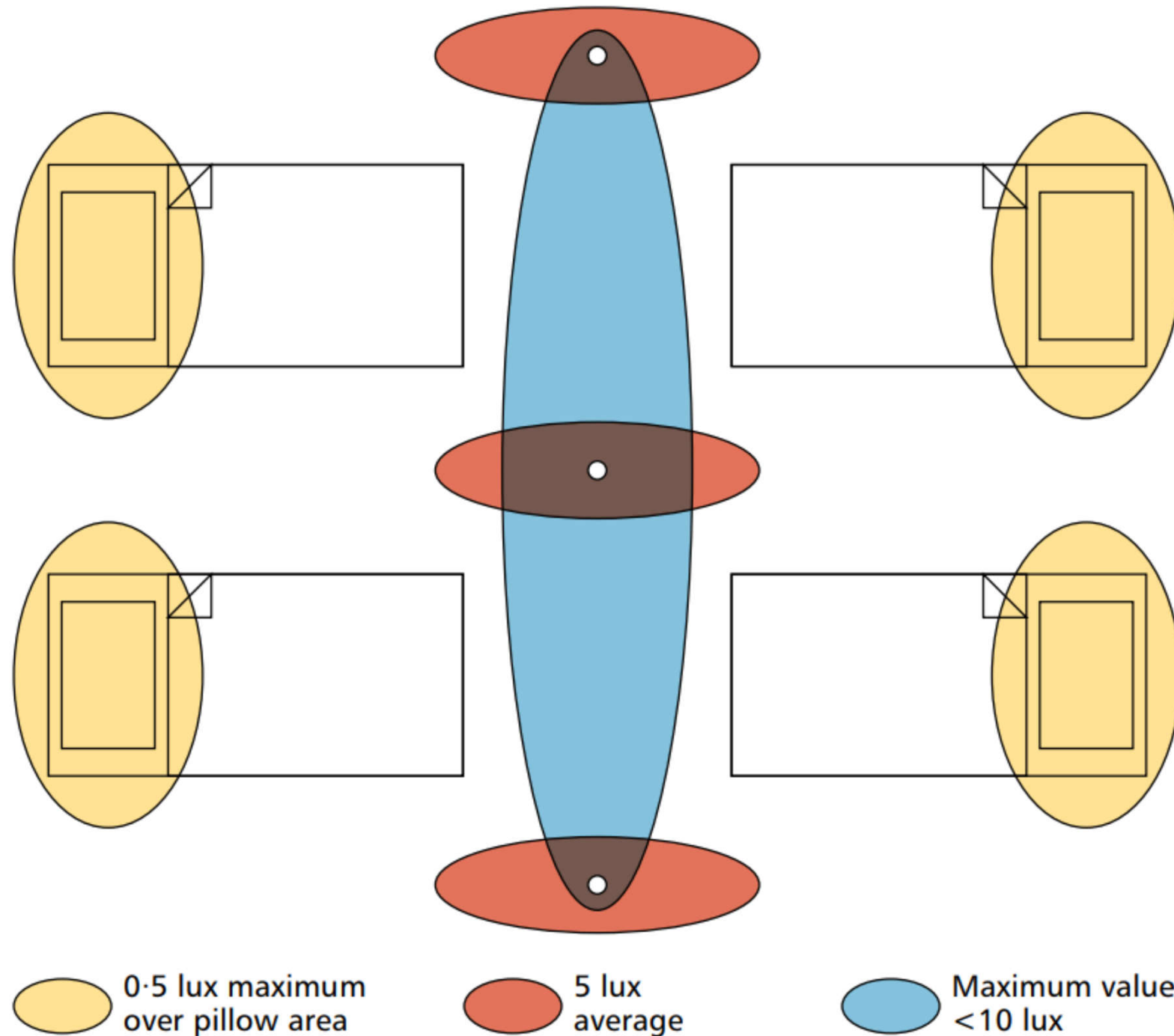
- (Commercial) buildings have a wide variety of users
 - Important risk factors that affect the ease of evacuation of these users include age, health & wellbeing, lifestyle & familiarity with the building

- **2. Building type & usage**



- How safely tasks can be stopped by people within a building impacted by a reduction in illuminance
 - Three categories: low risk, high risk & high risk+

Night lighting requirements in hospital ward areas



(Source: SLL, 2019. *Lighting for Healthcare Premises*, Lighting Guide 2, Society of Light and Lighting (SLL), London.)

System design & operation



- Important design considerations (cont'd)

- **3. Building scale & complexity**



- They can make evacuation difficult
 - A building's age may also present problems
 - Facilities with large public gatherings, high-rise buildings or phased evacuation buildings

- **4. Life-cycle considerations**



- Lifecycle total cost of ownership (TCO)
 - A trade-off between how much the system will initially cost to design & build and the operating costs involved over its lifetime

System design & operation



- Design procedure
 - 1. Determine requirements (e.g. escape routes)
 - 2. Design of illuminance (e.g. position, duration)
 - 3. Design of system (e.g. operation, wiring)
 - 4. Design of circuit protection & controls
 - 5. Installation, operating & commissioning
 - 6. Handover (e.g. system documentation, training)
- Certificates & log book
- Routine inspections & tests (monthly, annual)
- Servicing & repair (components, spares)

System design & operation



- Design checklist:
 - 1. Choose the luminaire types (viewing distance, IP classification, mounting height etc.)
 - 2. Placing of luminaires (luminaire technical design)
 - 3. Choose system type (central battery or self-contained)
 - 4. Size of the batteries (back up operation time)
 - 5. Type of the cables for the system cabling
 - 6. Cross section of the cabling, taking into account the loss of voltage & the minimum short circuit current (electrotechnical design)

Emergency lighting design process

- Examination of the risk assessment
- Duration of the emergency lighting
- Identify emergency escape routes & take account of potential hazards
- Identify the locations of fire alarm call points, fire fighting equipment & fire safety signs
- Determine type of emergency lighting system
- Means of isolation for testing and/or maintenance
- Coordination/interface with luminaire manufacturers where main luminaires are to be converted into emergency lighting luminaires
- Identify the exit sign requirements
- Identify any high risk areas
- Open areas larger than 60 m² floor areas need to be identified
- Need for external illumination outside final exit doors & on a route to a place of safety

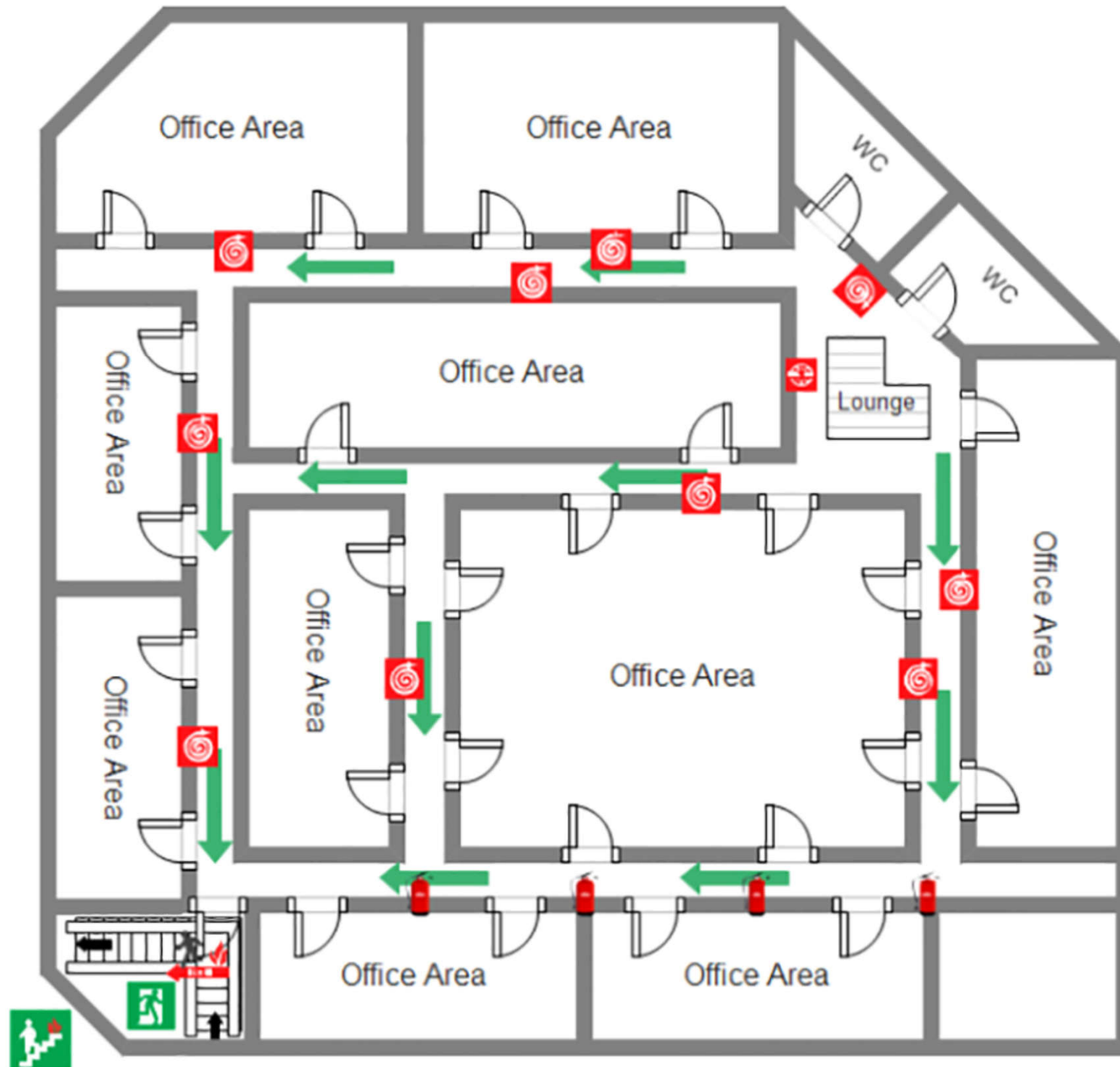


System design & operation



- Risk assessment
 - Evaluate potential risks to occupants in a building that could occur in the event of failure of the supply to the normal lighting, and determine suitable compensating safety provisions
 - Safe movement of people along escape routes
 - Report on the adequacy of the emergency lighting, fire alarms, extinguishers, etc.
 - Keep the occupants safe in a power supply failure
- Emergency lighting testing, maintenance, operation & update

Office building emergency evacuation plan



(Source: <https://www.zenithfireprotection.com/emergency-lighting-exit-signs-inspection.php>)

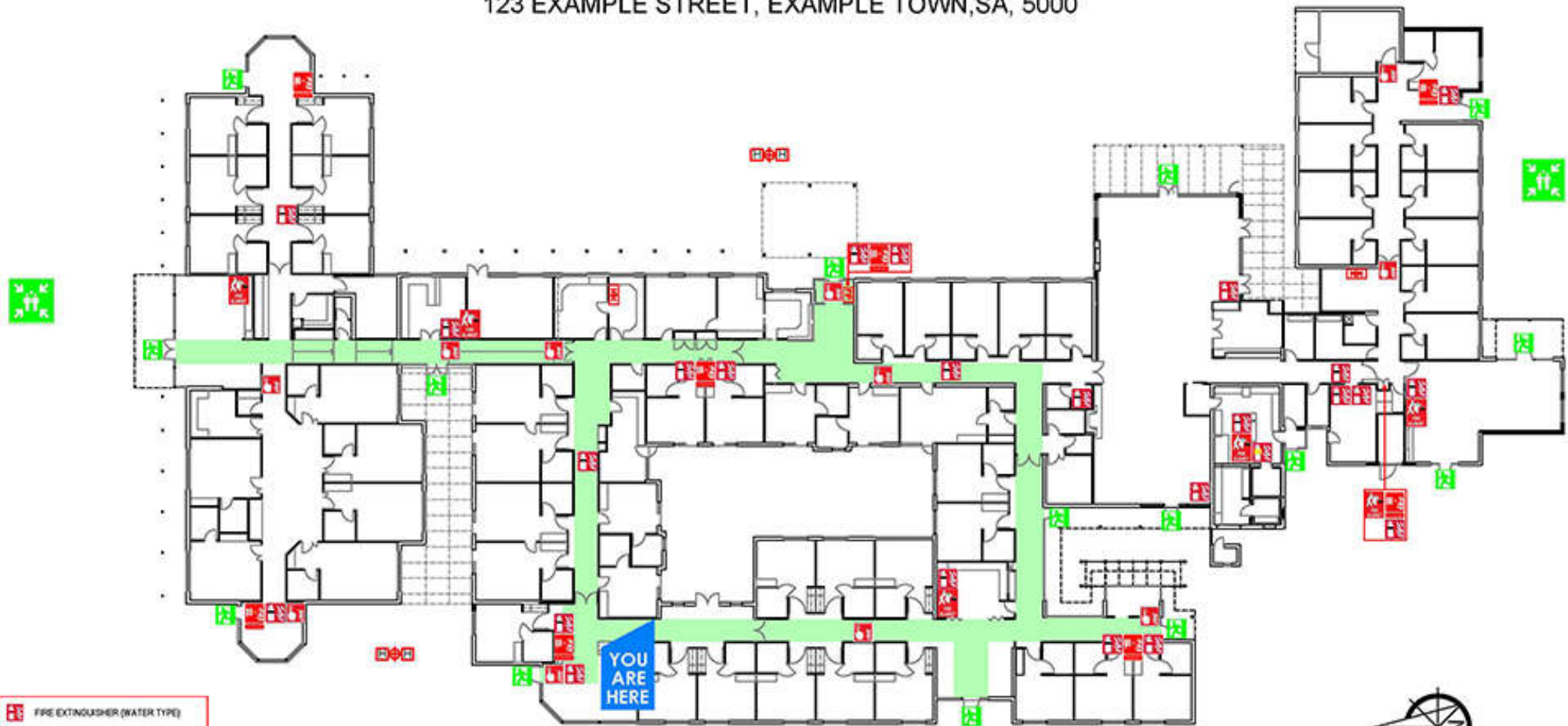
An example of evacuation diagram for emergency planning

EVACUATION DIAGRAM

EXAMPLE SITE

123 EXAMPLE STREET, EXAMPLE TOWN, SA, 5000

LOGO



- FIRE EXTINGUISHER (WATER TYPE)
- FIRE EXTINGUISHER (CO₂ TYPE)
- FIRE EXTINGUISHER (WET CHEM. TYPE)
- MANUAL CALL POINT
- FIRE HOSE REEL
- FIRE BLANKET
- EMERGENCY EXIT
- FIRE INDICATOR PANEL
- MASTER EVACUATION CONTROL PANEL
- FIRE HYDRANT

ISSUE DATE: JUNE 2018 - VALIDITY DATE: JUNE 2024

EVACUATION procedure

STAGE 1: REMOVAL OF PERSONS FROM THE IMMEDIATE DANGER AREA
Occupants are removed from the effected room, eg. from a room into a corridor.

STAGE 2: REMOVAL TO A SAFE AREA
If the severity of the emergency warrants further evacuation, occupants and visitors should be moved to an adjacent compartment.

STAGE 3: COMPLETE EVACUATION OF THE FLOOR
Should the emergency necessitate evacuation of the affected floor, wardens are to direct occupants to the assembly area via the emergency exits.

REMOVE PEOPLE

FROM THE IMMEDIATE DANGER TO A PLACE OF SAFETY

ALERT

OBTAIN ASSISTANCE, ACTIVATE MCP (CONTACT FIRE SERVICE '000')

CONTAIN FIRE / EMERGENCY

BY CLOSING DOOR OR ISOLATING FUEL SOURCE

E VACUATE OR EXTINGUISH

IF SAFE TO DO SO



VERIFIRE
FIRE PROTECTION SERVICES
WWW.VERIFIRE.COM.AU

System design & operation



- Design calculations for emergency lighting
 - Must consider the emergency lighting ballast, the starting of the lamp, the reduction in light output as the battery discharges, and the reduced performance of the battery after a number of years of use
 - Practical emergency lamp flux (PELF)
 - Lowest luminous flux of the lamp observed during the rated duration of the emergency mode
 - $PELF = LDL \times EBLF$
 - LDL is the initial lighting design lumens at 100 h as declared by the manufacturer
 - EBLF = Emergency ballast lumen factor

System design & operation



- Emergency ballast lumen factor (EBLF)
 - Ratio of the luminous flux of the lamp supplied by the emergency ballast to the luminous flux of the same lamp operated with the appropriate reference ballast at its rated voltage & frequency
 - EBLF is the minimum of the values measured at the appropriate time after failure of the normal supply & continuously to the end of the rated time
 - $EBLF = BLF \times F_{Time}$
 - BLF: Ballast lumen factor
 - F_{Time} : minimum light output values measured during the emergency operating time period

System design & operation



- Maintenance, commissioning & testing
 - Ensure that the system remains fully operational
 - Testing routine, consumable items & spare parts
- Facilities for testing & operation
 - 1. Luminaire with test device
 - 2. Luminaire with remote test device (centralised)
 - 3. Luminaire with inhibiting mode (to prevent the discharge of batteries at times when unoccupied)
 - 4. High risk areas & special occupancies (e.g. plantroom, health care)

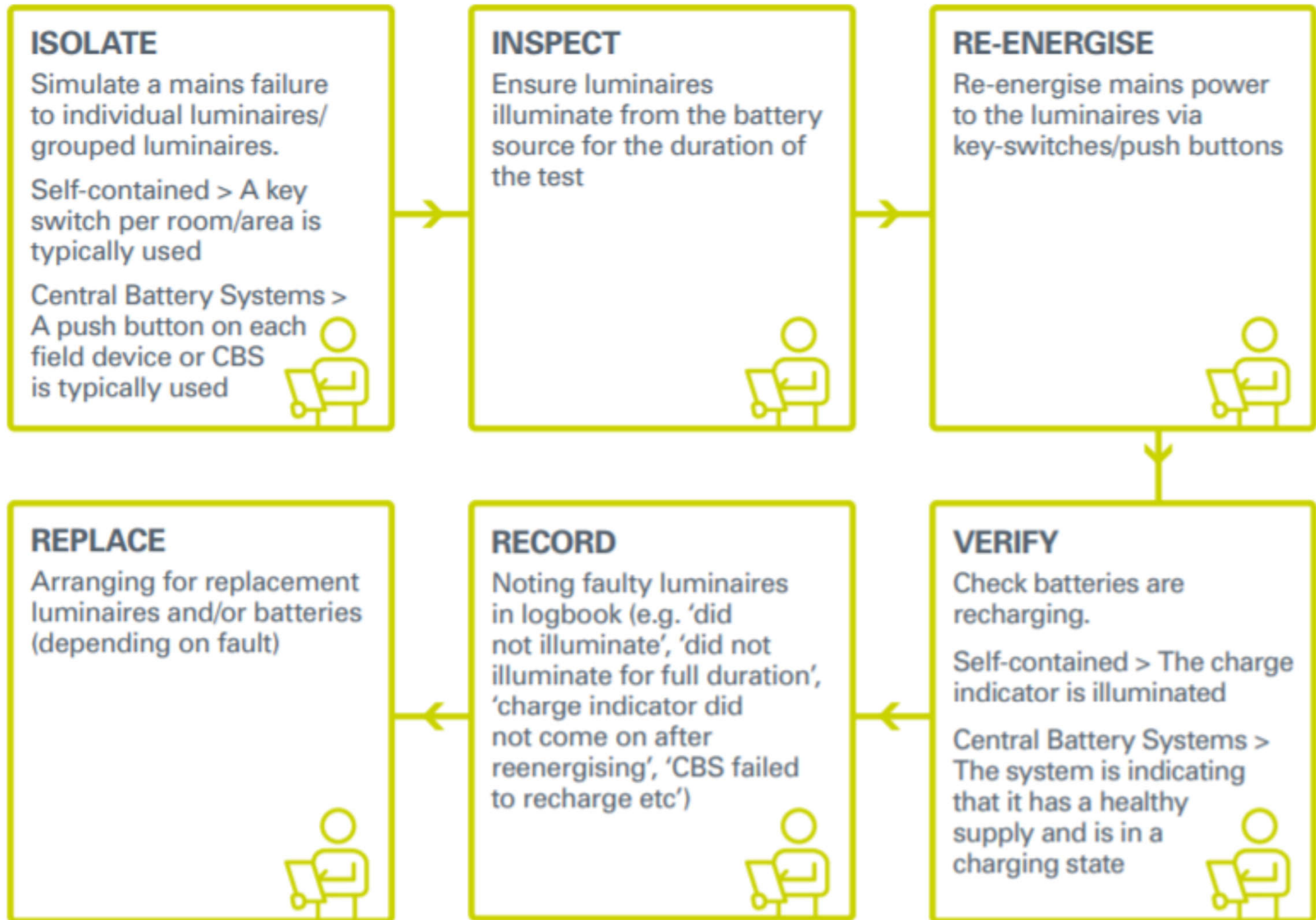
System design & operation



- Commissioning certificate
 - Written declarations of compliance
 - 1. Installation quality
 - Conform to electrical & fire safety regulations
 - 2. Photometric performance
 - Evidence of compliance with light levels supplied by the system designer or contractor
 - 3. Declaration of a satisfactory test of operation
 - A log of all system tests & results, with commissioning forms, testing forms & instructions
- Manual & automatic testing



Typical manual testing process for emergency lighting



System design & operation



- Testing requirements & record logs

- Function test (once per month)

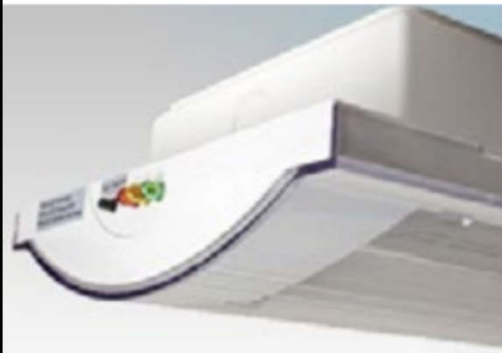
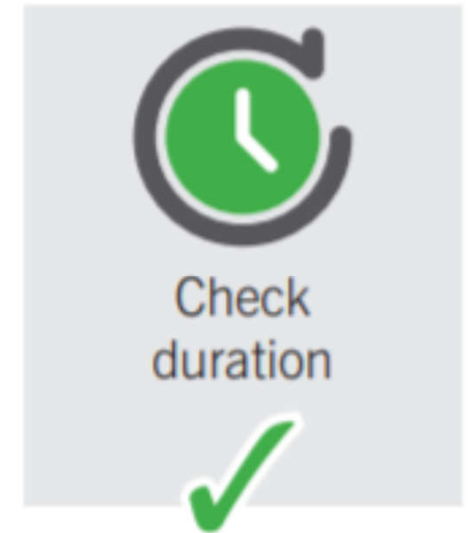
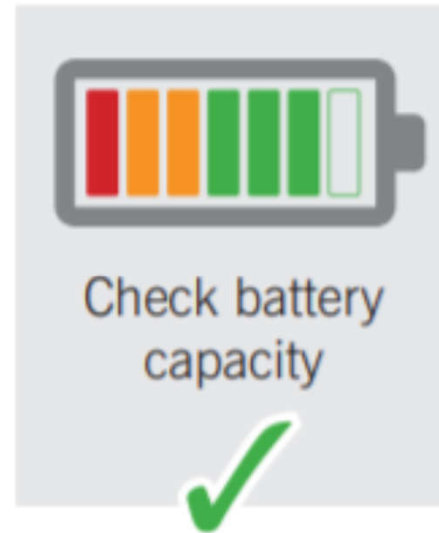
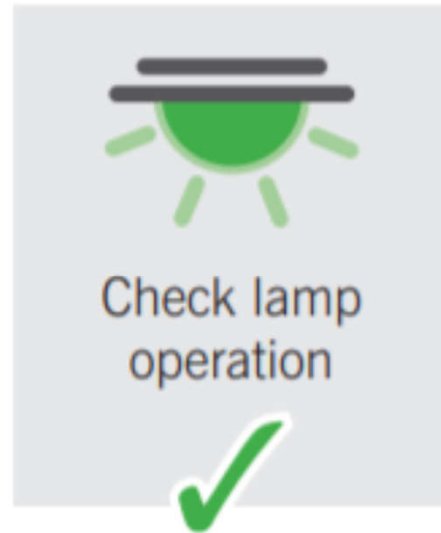
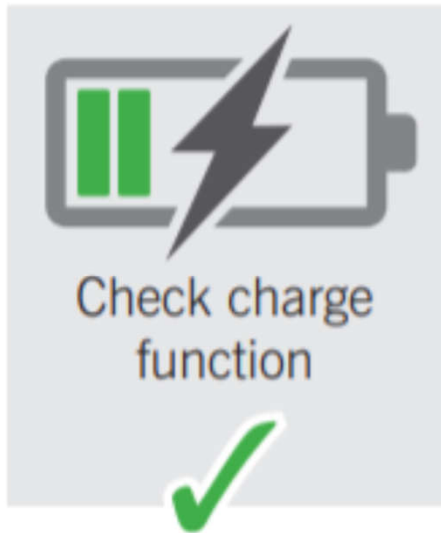


- Breaking the supply to them & checking that they operate satisfactorily
 - The supply must then be restored & the charging indicators must be seen to be operating correctly

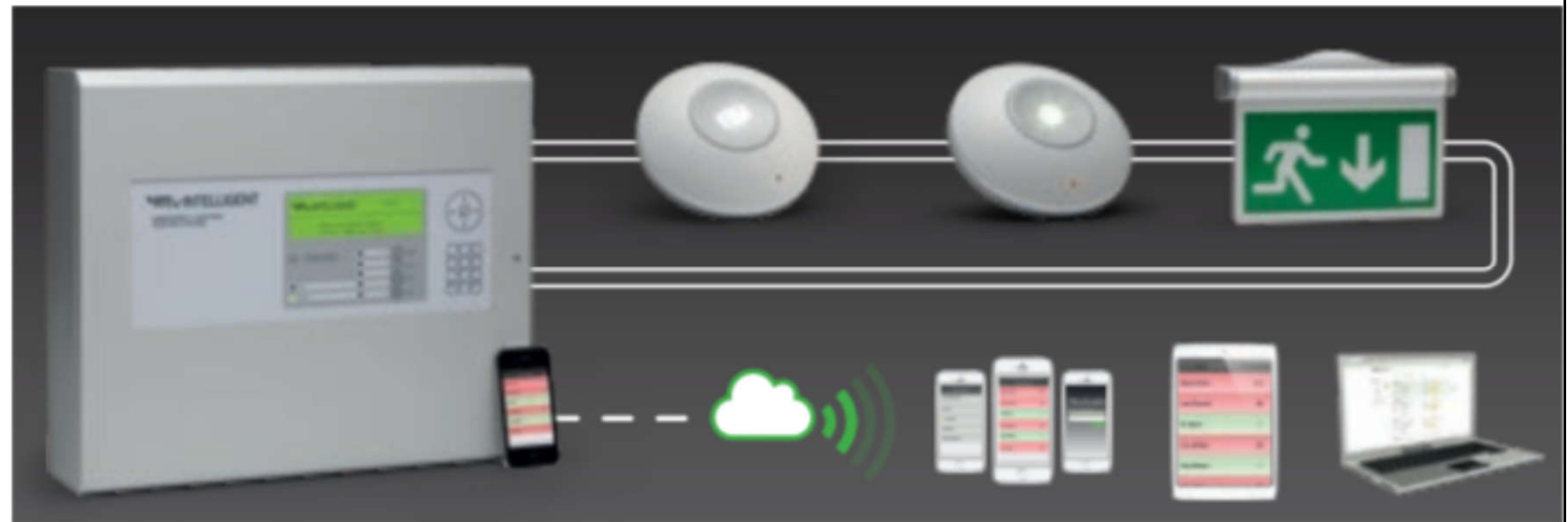
- Discharge test (annually)

- The luminaires must be tested for their full rated duration period & checked for satisfactory operation
 - The supply must then be restored & the charging indicators rechecked
 - Done outside normal working hours, or by phase

Emergency lighting testing & automatic testing systems



Self-testing



Automatic addressable testing system








System design & operation



- Automatic testing system
 - Self monitoring/diagnostic

- Timing circuit
- Charging
- Lamp
- Communications

- Testing schedule
- Test result status indication
- Minimise risk by randomising/staggering testing
- Stand-alone luminaires (each device tests itself) & network systems (linked to central monitoring)

MEANING OF THE INDICATOR LED			
GREEN		RED	
	Mains operation No fault		Duration battery fault
	Blinking Functional test		Blinking Lamp / Changeover fault
	Flashing Annual duration test		Flashing Battery / Charging fault
 Mains failure + Emergency light operation			

System design & operation



- Examples of automatic testing
 - Self-contained with built-in auto test
 - Self-contained system with centrally monitored luminaires & automatic testing (addressable)
 - Central battery system with centrally monitored luminaires & automatic testing (addressable)
- Automated testing & electronic logbook (web-based or on integrated panels)
- Visualise the system status on layout plans
- Real-time monitoring of multiple systems

Automatic testing of emergency lighting equipment for self-contained stand-alone luminaires (Self-Test) & self-contained centrally monitored luminaires using Digital Addressable Lighting Interface (DALI)



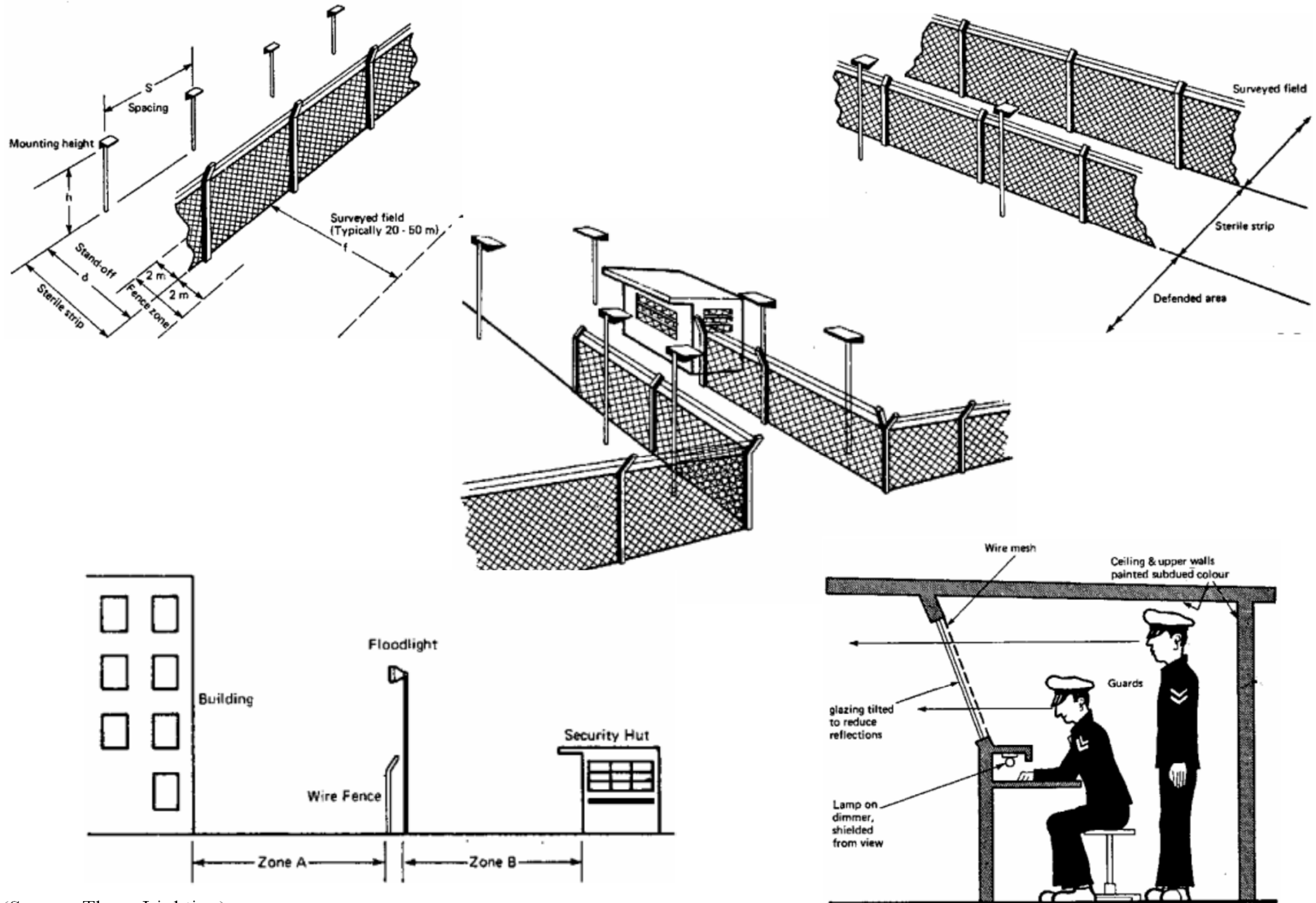
Security lighting



- Primary objectives: to deter, detect & prevent criminal activities; also give a feeling of safety & well being
- Five basic lighting techniques:
 - 1. Perimeter lighting (fence zone)
 - 2. Checkpoint lighting (gatehouse)
 - 3. Area lighting (luminaires mounted on adjacent buildings or on columns or high masts)
 - 4. Floodlighting (intruder may be readily seen)
 - 5. Topping up (avoid hiding of an intruder)



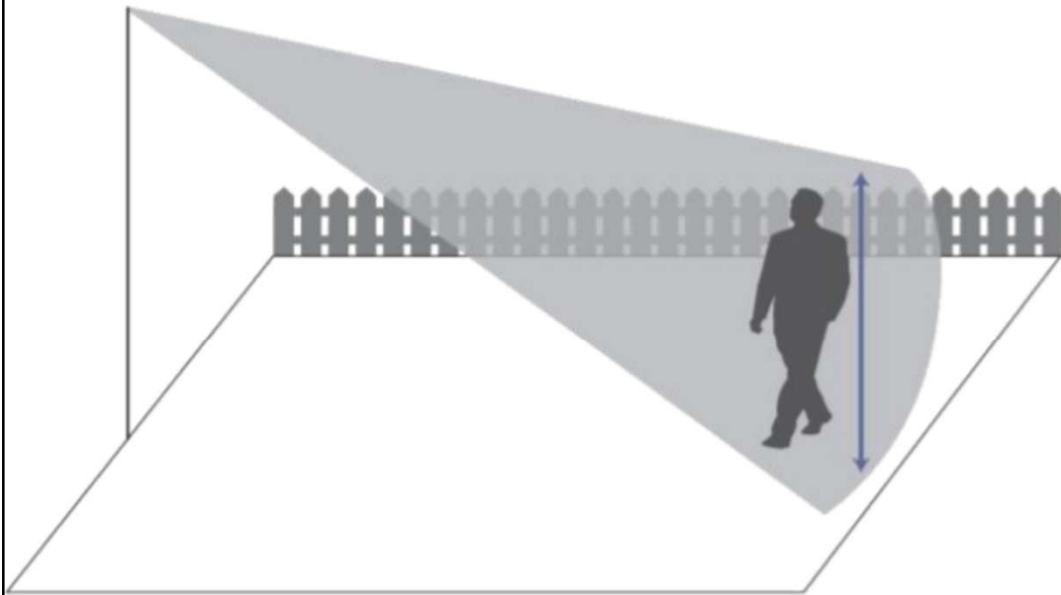
Perimeter lighting, checkpoint lighting, area lighting & floodlighting



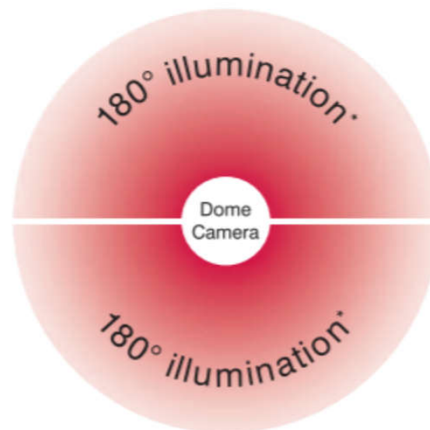
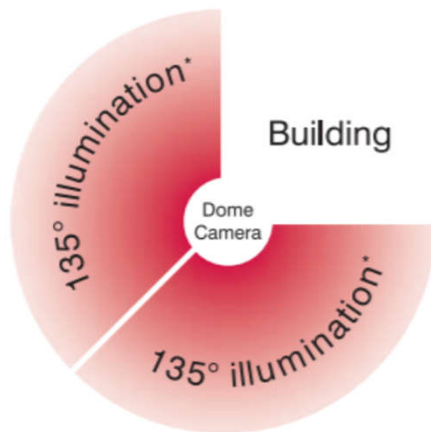
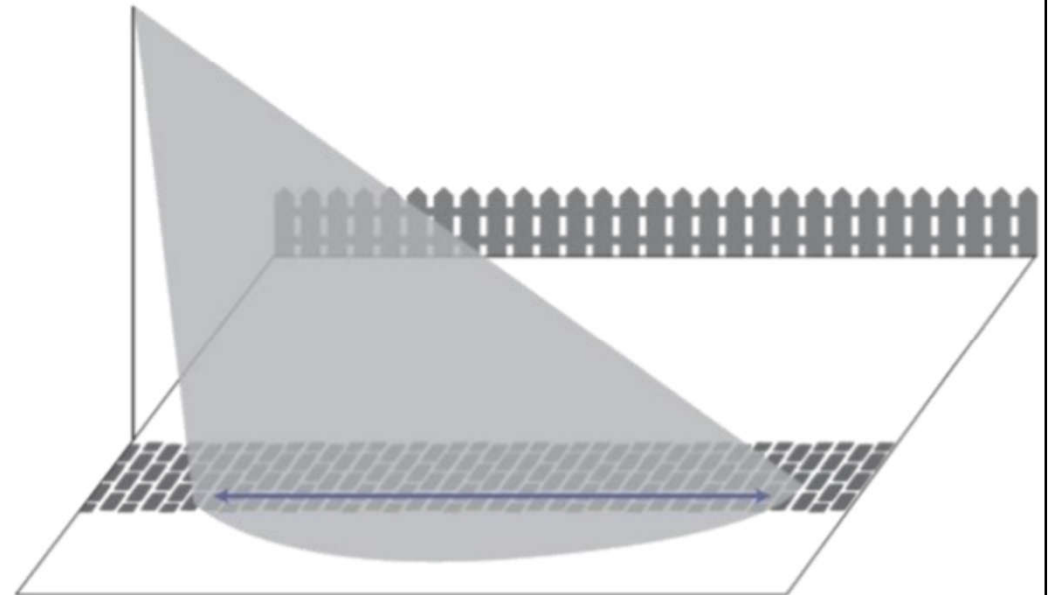
(Source: Thorn Lighting)

Illuminating on different planes for different purposes significantly alters the amount of light required

**Vertical Plane
(CCTV Lighting Usage)**



**Horizontal Plane
(General Area Lighting Usage)**



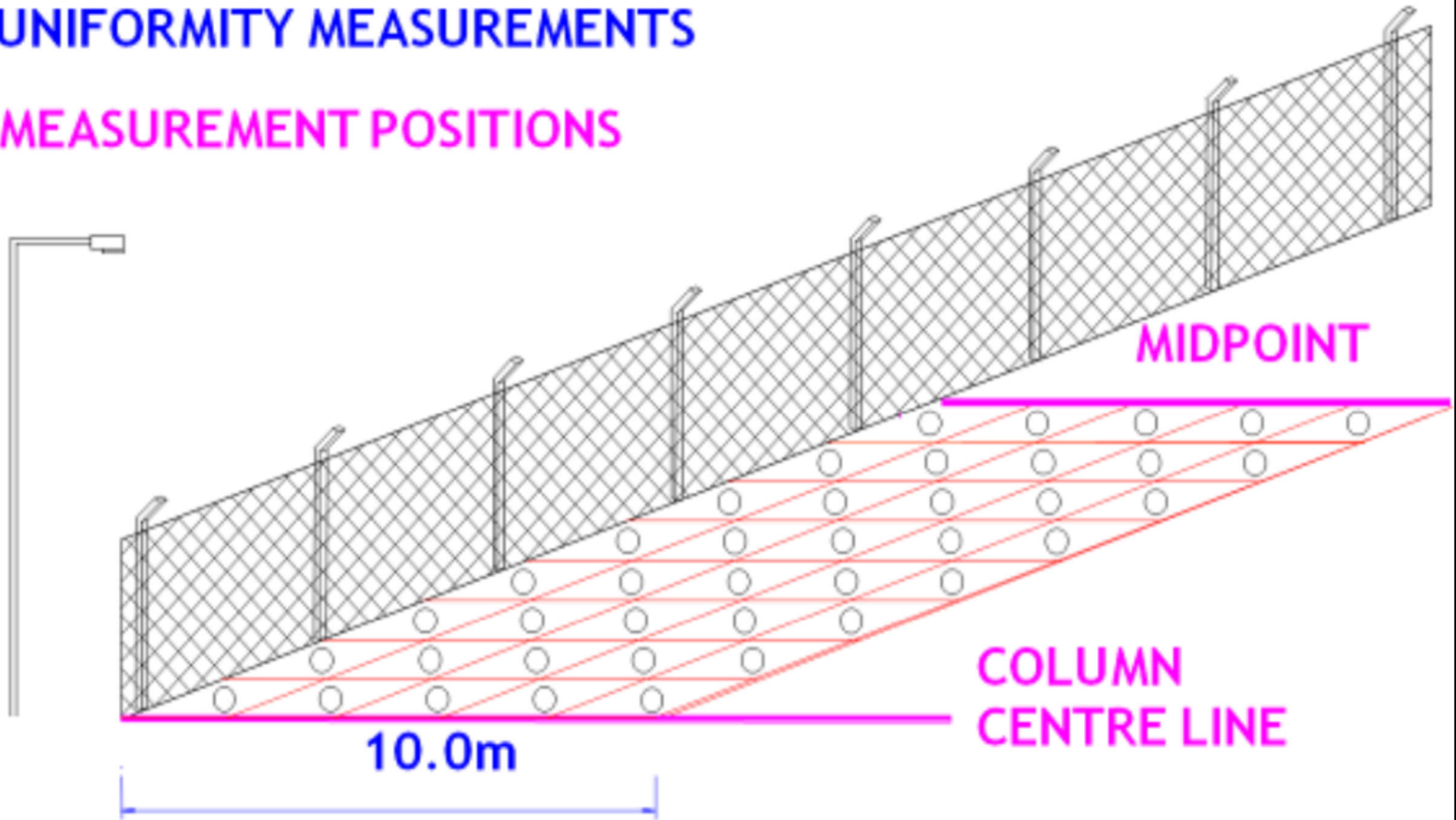
CCTV dome camera



Illumination measurement positions in the centre of the squares

UNIFORMITY MEASUREMENTS

MEASUREMENT POSITIONS



Security lighting



- Types of security lighting:
 - Continuous lighting (at boundaries, e.g. in prisons)
 - Standby lighting (supplement continuous systems)
 - Movable (portable) lighting (temporary)
 - Emergency lighting (for use when normal light fail)
- Lighting for closed circuit television (CCTV)
 - White light & infra-red (IR), facial recognition
 - Distance, angle, mounting position
 - Camera & lens (wide area, target/local area)
 - Photocell to trigger day/night camera switching



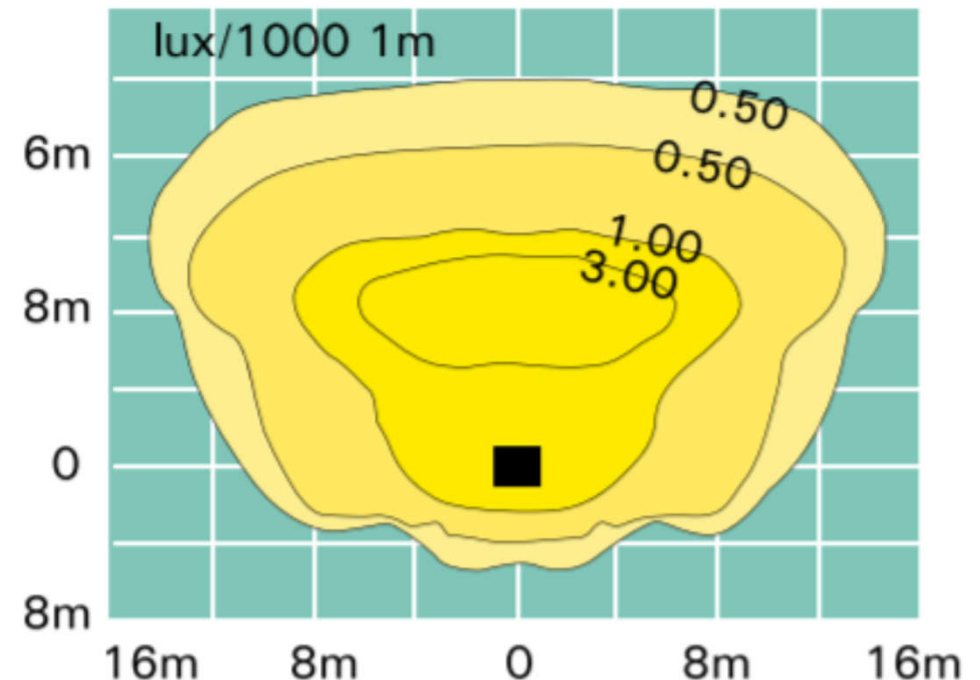
Recommended lighting levels for closed circuit television (CCTV)

Camera	Minimum illuminance in Lux	Overall uniformity not less than	Threshold increment not less than (%)
Monochrome	5	0.4	10
Colour	15	0.4	10

Level of dimming with typical lamps for street lighting

SON	100% - 20%
Metal halide	100% - 50%
Fluorescent	100% - 1%
LEDs	100% - 0%

IsoLux diagrams of a floodlight



Security lighting



- Planning security lighting:
 - Criminal history
 - Nature of the site
 - Degree of obstruction
 - Ambience luminance of the surrounding area
- Visibility concerns
 - Illuminance, glare, light pollution, coverage factor
- Security zones
 - Perimeter, pedestrian, vehicle, building, restricted





Further Reading

- Emergency Lighting
http://ibse.hk/IBTM5680/Emergency_Lighting.pdf
- Fundamentals of emergency lighting
<https://www.eaton.com/content/dam/eaton/markets/buildings/fundamentals-of-emergency-lighting-guide.pdf>
- A Complete Guide to Commercial Security Lighting
<https://uk.rs-online.com/web/generalDisplay.html?id=ideas-and-advice/security-lighting-guide>