Knowledge On
Lightning Protection in Building

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Lightning Hazard in Myanmar

Lightning strikes the United States about 25 million times a year [1]. Although most lightning occurs in the summer, people can be struck at any time of year [1]. **Lightning kills about 20 people in the United States each year**, and hundreds more are severely injured [1]. From 2006 through 2021, **444 people in the United States died from lightning strikes** [2] [3]. On average, **28 people in the United States die each year from lightning strikes** [2]. Males are four times more likely than females to be struck by lightning [3].

According to the MSWRR, **133 people** died and 52 were injured from lightning strikes in 2019. This year, 54 incidents have claimed 62 lives and injured 26 people, according to a director from the Department of Disaster Management, under the MSWRR.

Irrawaddy.com
https://www.irrawaddy.com/news/burma/lightning-strikes-killed-62-myanmar-ye...

Lightning Protection in Building

LIMITATION (Knowledge and Basic Lightning design requirement)

- Myanmar National Building Code 2020
- C P 33 (Singapore)
- SS 555-1~3 (Singapore Standard)
- IEC 62305-1~3 , design standard
- Lightning Protection against Building
- Lightning Protection of Building Services

Myanmar National Building Code-2020, 5B.11
Lightning Protection Of Building

Detail Design Essential Step Of LPS system:

- The structure need protection? If need, comply to SS 555 , IEC62305.
  - Where a large number of people congregate
  - Where essential public services are concerned,
  - Where the area is one in which lightning stroke are prevalent
  - Where there are very tall or isolated structures, and
  - Where there are structures of historic or cultural importance…. As minimum!!
- The covenant among Architect, Structure-builder , LPS designer, and Authorities, through out the design stages.
- Agree the procedures for T&C and future maintenance.

Myanmar National Building Code-2020, 5B.11

Lightning Protection Of Building

Table 3: Overall Assessment of Risk

(Clauses 11.1.4 and 11.1.5)

Table 3A: Weighting Factor 'A'

(Use of Structure)

Use to Which Structure is Put	**Value of 'A'**
Houses and other buildings of comparable size	0.3
Houses and other buildings of comparable size with outside aerial	0.7
Factories, workshops and laboratories	1.0
Office blocks, hotels, blocks of flats and other residential buildings other than those included below	1.2
Places of assembly, for example, churches, halls, theatres, museums, exhibitions, departmental stores, post offices, stations, airports, and stadium structures	1.3
Schools, hospitals, children's and other homes	1.7

Myanmar National Building Code-2020, 5B.11
Lightning Protection Of Building

Table 3B: Weighting Factor 'B'

(Type of Construction)

Type of Construction	Value of 'B'
Steel framed encased with any roof other than metal [1)]	0.2
Reinforced concrete with any roof other than metal	0.4
Steel framed encased or reinforced concrete with metal roof	0.8
Brick, plain concrete or masonry with any roof other than metal or thatch	1.0
Timber framed or clad with any roof other than metal or thatch	1.4
Brick, plain concrete, masonry, timber framed but with metal roofing	1.7
Any building with a thatched roof	2.0

[)] A structure of exposed metal which is continuous down to ground level is excluded from these tables as it requires no lighting protection beyond adequate earthing arrangements.

Table 3C: Weighting Factor 'C'

(Contents or Consequential Effects)

Contents or Consequential Effects	Value of 'C'
Ordinary domestic or office buildings, factories and workshops not containing valuable or specially susceptible contents	0.3
Industrial and agricultural buildings with specially susceptible [1] contents	0.8
Power stations, gas works, telephone exchanges, radio stations	1.0
Industrial key plants, ancient monuments and historic buildings, museums, art galleries or other buildings with specially valuable contents	1.3
Schools, hospitals, children's and other homes, places of assembly	1.7

[1] This means specially valuable plant or materials vulnerable to fire or the results of fire

Lightning Protection Of Building

Table 3D: Weighting Factor 'D'

(Degree of Isolation)

Degree of Isolation	Value of 'D'
Structure located in a large area of structures or trees of the same or greater height, for example, in a large town or forest	0.4
Structure located in an area with few other structures or trees of similar height	1.0
Structure completely isolated or exceeding at least twice the height of surrounding structures or trees	2.0

Table 3E: Weighting Factor 'E'

(Type of Country)

Type of Country	Value of 'E'
Flat country at any level	0.3
Hill country	1.0
Mountain country between 300 m and 900 m	1.3
Mountain country above 900 m	1.7

Myanmar National Building Code-2020, 5B.11
Lightning Protection Of Building

2.2.8 Sample Calculation Of Overall Risk Factor. A hospital is 10 m high and covers an area of 70 m x 12 m. The hospital is located on flat land and isolated from other structures. The construction is of brick and concrete with a non-metallic roof.

To determine whether or not lightning protection is needed, the overall risk factor is calculated, as follows:

(a) Number of flashes per km² per year. The value for N_g is 12.6 flashes per km² per year.

(b) Collection area. Using the first equation in 2.2.2 the collection area, A_c in m², is given by:

$$A_c = (70 \times 12) + 2(70 \times 10) + 2(12 \times 10) + (\pi \times 100)$$

$$A_c = 840 + 1400 + 240 + 314$$

$$A_c = 2794 \text{ m}^2$$

(c) Probability of being struck. Using the second equation in 2.2.2 the probable number of strikes per year, *P*, is given by:

$$P = A_c \times N_g \times 10^{-6}$$

$$P = 2794 \text{ m}^2 \times 12.6 \times 10^{-6}$$

$$P = 3.5 \times 10^{-2} \text{ approximately}$$

(d) Applying the weighting factors. The following weighting factors apply:

factor A = 1.7
factor B = 1.0
factor C = 1.7
factor D = 2.0
factor E = 0.3

The overall multiplying factor = A x B x C x D x E = 1.7

Therefore, the overall risk factor = $1.7 \times 3.5 \times 10^{-2} = 5.95\ 10^{-2}$. The conclusion is, therefore, that protection is necessary.

Myanmar National Building Code-2020, 5B.11
Lightning Protection Of Building

5B .11.1.8 *Sample Calculation of Need for Protection*

A hospital building is 10 m high and covers an area of 70 m x 12 m. The hospital is located in flat country and isolated from other structures. The construction is of brick and concrete with a non-metallic roof. Is lightning protection needed?

a) *Flashes/km²/year* — Let us say, for the protection of the hospital a value for Ng is 0.7.

b) *Collection area*— Using equation (1) in**5B.11.1.2:**

$$A_c = (70 \times 12) + 2\,(70 \times 10) + 2\,(12 \times 10) + (\pi \times 100)$$

$$= 840 + 1\,400 + 240 + 314$$

$$= 2\,794 \text{ m}^2$$

c) *Probability of being struck*— Using equation (2) in **5B.11.1.2:**

$$P = A_c \times N_g \times 10^{-6} \text{ times per year}$$

$$= 2\,794 \times 0.7 \times 10^{-6}$$

$$= 2.0 \times 10^{-3} \text{ approximately}$$

The overall multiplying factor= A x B x C x D x E

$$= 1.7$$

Therefore, the overall risk factor

$$= 2.0 \times 1.7 \times 10^{-3}$$

$$= 3.4 \times 10^{-3}$$

Conclusion: Protection is necessary.

5B.11.2 For detailed requirements of lightning protection of various structures, reference may be made to Standard practice (IEC 62305).

Protection Risk Tolerance

Types of Loss	IEC / EN 62305-2 R_T (y^{-1})	BS EN 62305-2 R_T (y^{-1})
Loss of human life or permanent injuries	10^{-5}	10^{-5}
Loss of service to the public	10^{-3}	10^{-4}
Loss of cultural heritage	10^{-3}	10^{-4}

Table 49. *Comparison of tolerable losses between BS EN 62305-2 and IEC/EN 62305-2.*

Selection of Down Conductor Size

Down-conductor sizing	BS 6651	IEC 62305
Copper - tape	50 mm² (min 20 x 2.5 mm)	50 mm² (min 2 mm thick)
Copper - round	50 mm² (8 mm dia)	50 mm² (8 mm dia)
Copper - stranded		50 mm²
Aluminum - tape	50 mm² (min 20 x 2.5 mm)	70 mm² (min 3 mm thick)
Aluminum - round	50 mm² (8 mm dia)	50 mm² (8 mm dia)
Aluminum - stranded		50 mm²

Table 48. *Comparison of BS 6651 and IEC 62305 down-conductor requirements.*

Down Conductor FIXING

Down conductor fixing (mm)	BS 6651	IEC 62305	
		Tape & stranded	Round conductors
Horizontal conductors, horizontal surfaces	1000	500	1000
Horizontal conductors, vertical surfaces	500	500	1000
Vertical conductors up to 20 m	1000	1000	1000
Vertical conductors above to 20 m	500	500	1000

Table 46. *Comparison of BS 6651 and IEC 62305 conductor fixing requirements.*

Minimum Roof Thickness

Minimum roof thickness	BS 6651	IEC 62305	
		Preventing puncture	Puncture permitted
Galvanized Steel	0.5 mm	4 mm	0.5 mm
Stainless Steel	0.4 mm	4 mm	0.5 mm
Copper	0.3 mm	5 mm	0.5 mm
Aluminum & Zinc	0.7 mm	7 mm	0.65 mm
Lead	2.0 mm		2.0 mm

Table 47. *Comparison of BS 6651 and IEC 62305 natural roof air-terminations.*

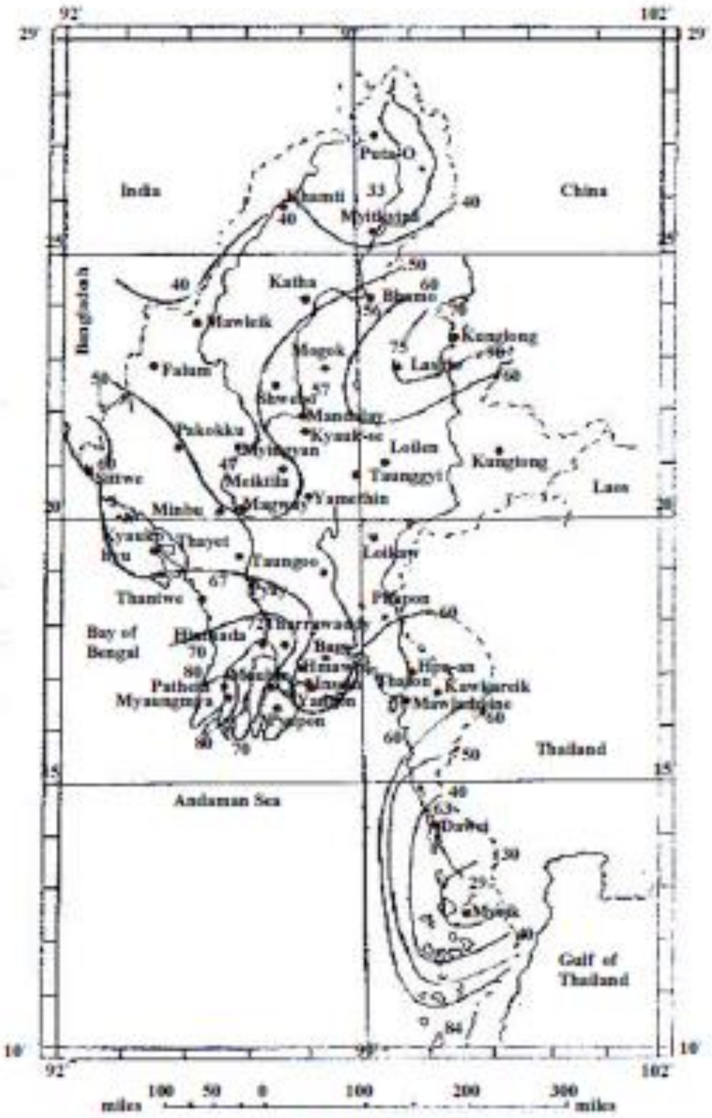
Myanmar National Building Code-2020, 5B.11
Lightning Protection Of Building

- ***Estimation Of Exposure Risk***
    - ***Thunderstorm days per year***

- ***Suggested acceptable risk***
- ***Overall assessment of risk***
- ***Weighting Factors***
- ***Interpretation of Overall Risk Factor***
- ***Calculate the Level of protection needed***

MYANMAR

PLACES FOR AVERAGE NUMBER OF THUNDERSTORMS DAYS IN A YEAR



(CONTOUR MAP NEED TO BE UP-DATED)

Figure - 5

Code, and Standard

The main difference between code and standard is:

- **A code is a model that is established after years of use and can be adopted into law.**
- **A standard is a set of technical definitions, specifications, and guidelines.**
- **A code tells you what to do, while a standard tells you how to do it.**
- **A code is a set of rules and regulations, while a standard is a set of methodological definitions, qualifications, and guidelines.**
- **A code can be incorporated into law, while a standard is not legalized.**

Understanding standards

- **A standard is an agreed way of doing something in a consistent and repeatable way. Standards set minimum requirements in terms of safety, reliability, efficiency and trust**

Lightning Protection in Building

A Brief to BS EN, IEC,

BS EN >> British Standard European Norm by British Standard Institution(BSI)

[CENELEC – CEN – ETSI >> 34 National Committees(NCs) All IEC members, Implementing IEC Standards as CENELEC Standards (EN IEC)

IEC >> **International** Electrotechnical Commission, Geneva, Switzerland,, **GLOBAL**

SS >> Singapore Standard < Enterprise Singapore-2018< SPRING Singapore

Myanmar is participating the member of Affiliates country to IEC, [2011 list]

Lightning Protection in Building

Standard	Title	Type
IEC 62305-1 (EN 62305-1)	Protection against lightning – Part 1: General principles	Design Standard
IEC 62305-2 (EN 62305-2)	Protection against lightning – Part 2: Risk Management	Design Standard
IEC 62305-3 (EN 62305-3)	Protection against lightning – Part 3: Physical Damage to Structure and Life Hazard	Design Standard
IEC 62305-4 (EN 62305-4)	Protection against lightning – Part 4: Electrical and Electronic Systems within Structures	Design Standard
EN 50164-1	Lightning protection components (LPC) – Part 1: Requirements for connection components	Component Standard
EN 50164-2	Lightning protection components (LPC) – Part 2: Requirements for conductors and earth electrodes	Component Standard
EN 50164-3	Lightning protection components (LPC) – Part 3: Requirements for isolating spark gaps	Component Standard
EN 50164-4	Lightning protection components (LPC) – Part 4: Requirements for conductor fasteners	Component Standard
EN 50164-5	Lightning protection components (LPC) – Part 5: Requirements for earth electrode inspection housings and earth electrode seals	Component Standard
EN 50164-6	Lightning protection components (LPC) – Part 6: Requirements for lightning strike counters	Component Standard
EN 50164-7	Lightning protection components (LPC) – Part 7: Requirements for earthing enhancing compounds	Component Standard

Table 1. *Main IEC and EN standards relating to design and testing of lightning protection systems/components.*

Pioneers Of Lightning Protection

Fundamental of Lightning Protection Theory

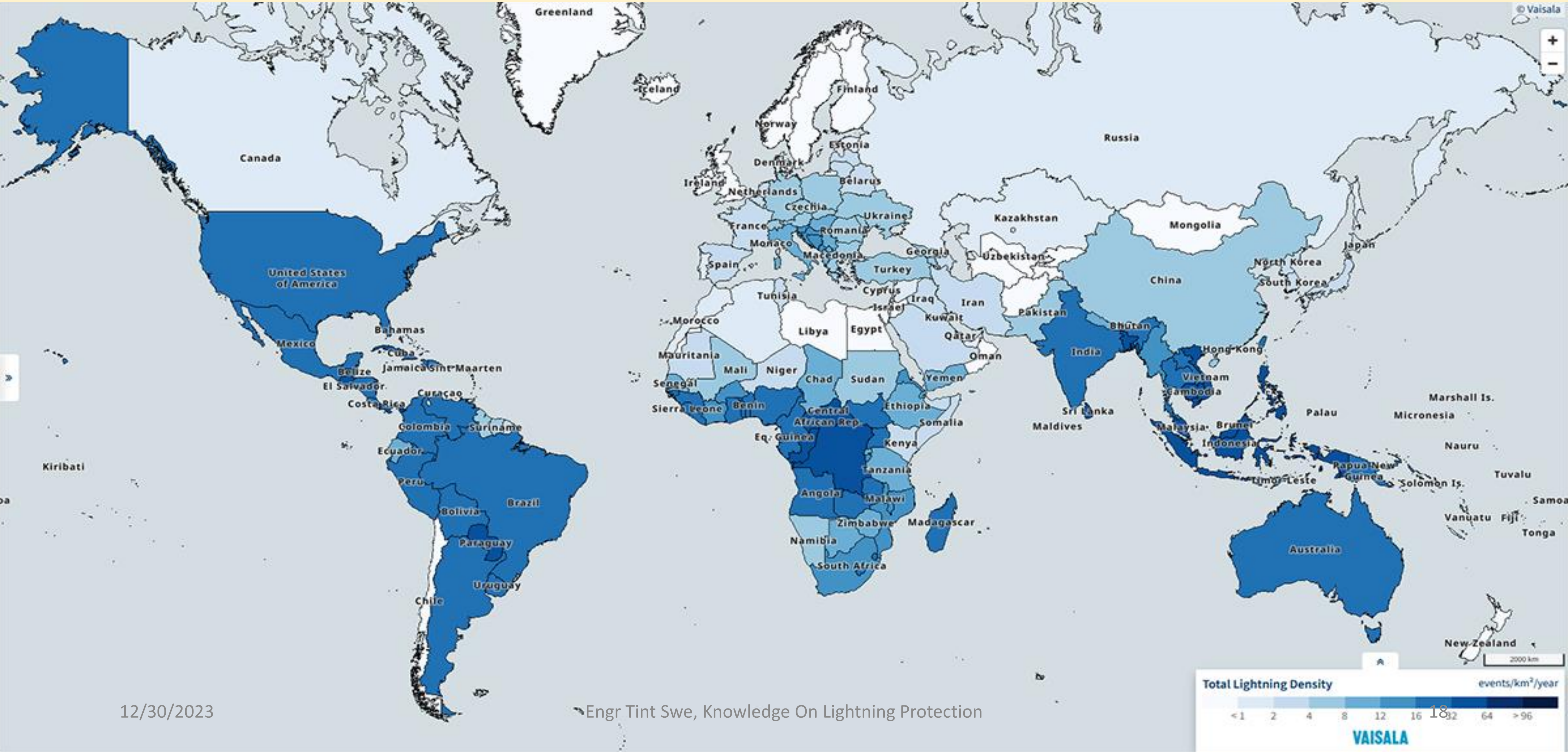
- **Benjamin Franklin**
  - inventor of Lightning Rod

- **Michael Faraday**
  - inventor of Faraday Cage

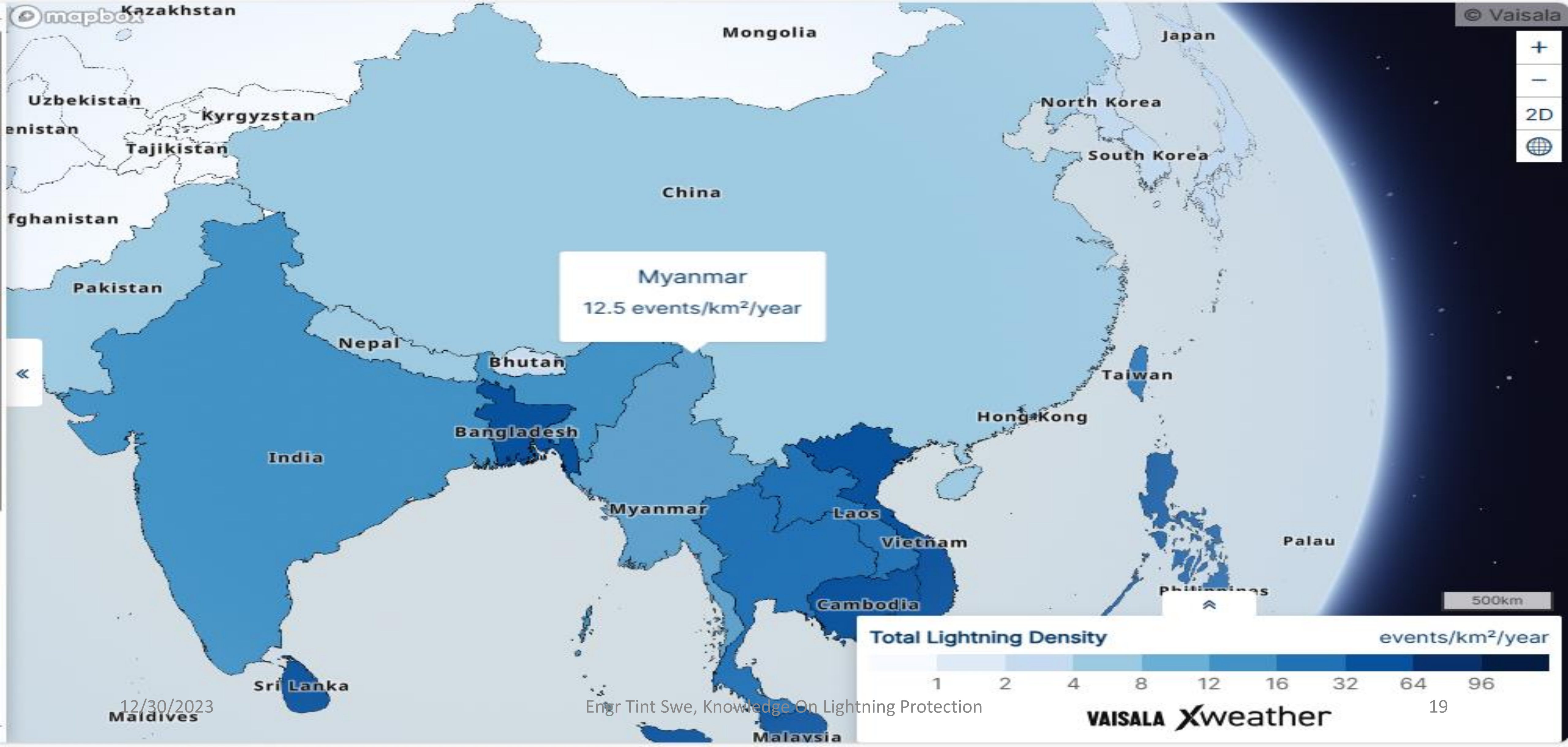
Lightning Protection System

- **4 classes of structural LP**
- **2 types of earthing arrangements**
- **encourages use of natural metalwork**
- **focus on importance of equipotential bonding**

Global Statistics Of Lightning Density



Global Statistics Of Lightning Density



World Thunder Day Map,

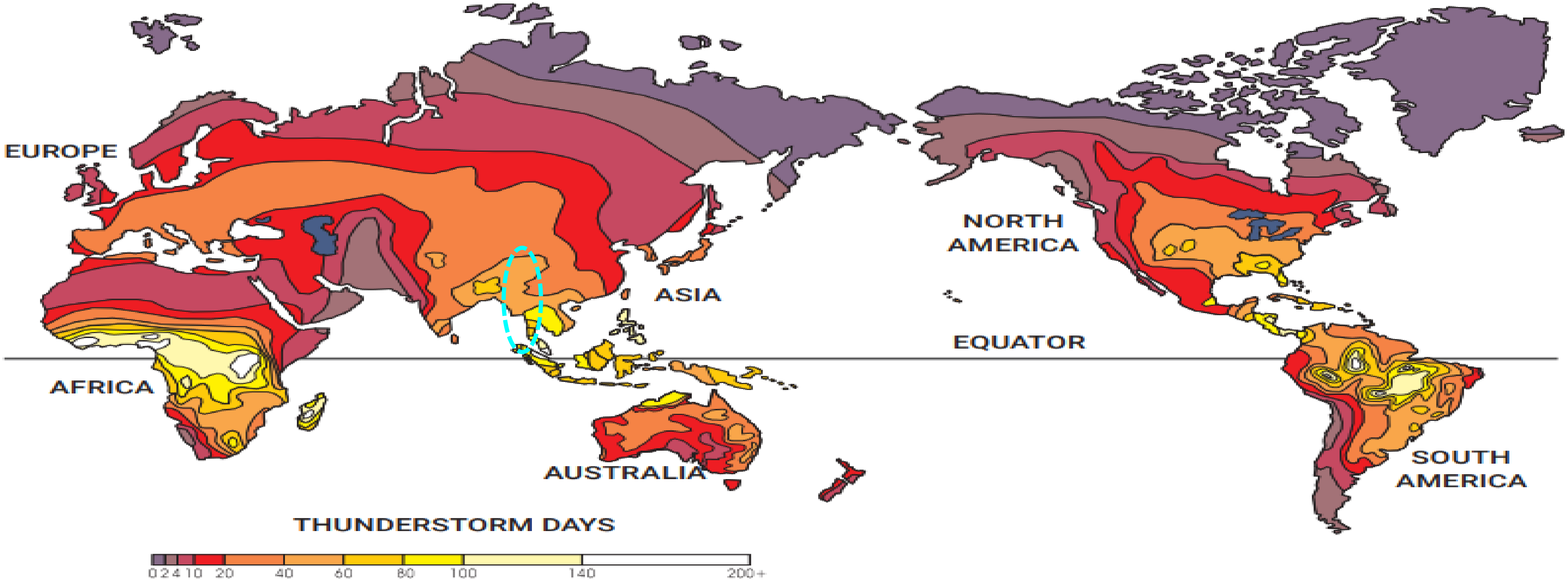
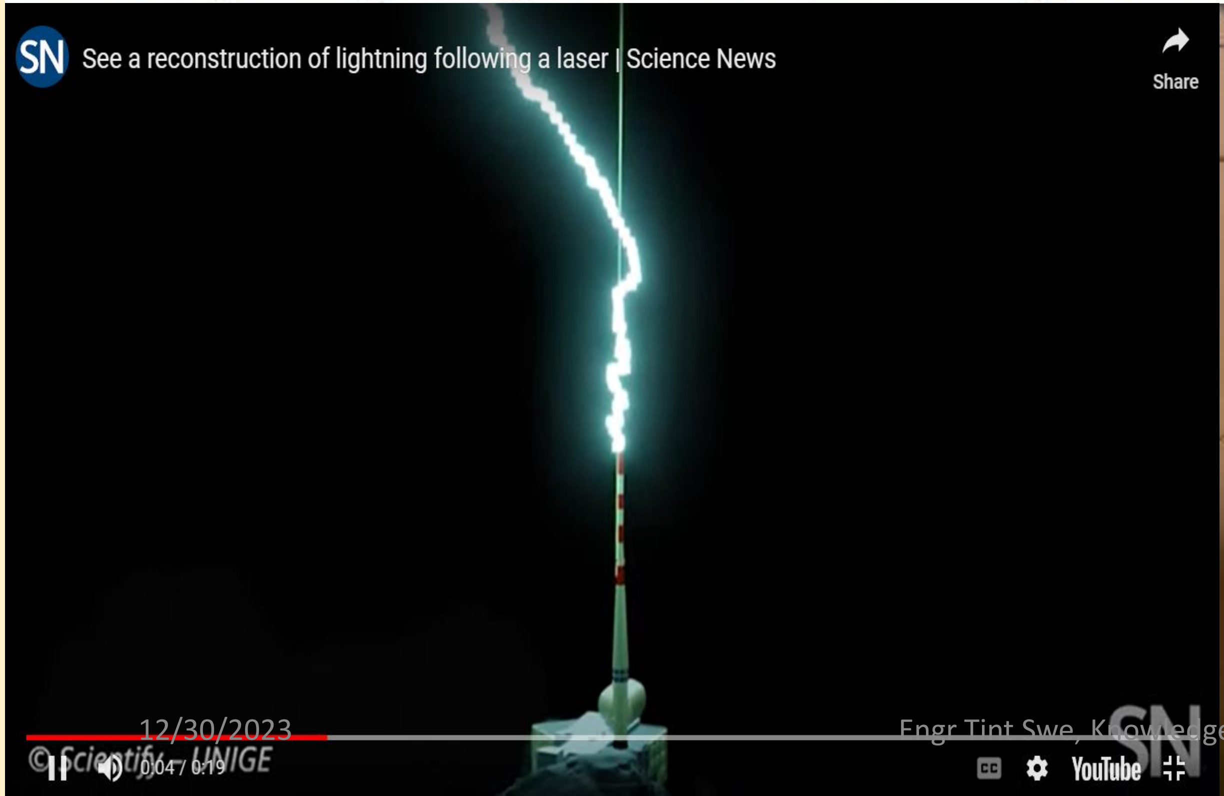


Figure 1. *World thunder day map; note the high lightning density areas are regionalized around the equator.*

IEC 62305-(EN 62305):

The committee considered methods for artificially increasing the range of attraction of a lightning conductor but on the evidence available, was unable to make a recommendation. It was noted that none of the reference codes used in the drafting of this Code recommends the use of such methods. The codes referred to were IEC 62305 : 2010 Parts 1 to 4. In addition, there are no devices nor methods capable of modifying the natural weather phenomena to the extent that they can prevent lightning discharges. Lightning flashes to, or nearby, structures (or services connected to the structures) are



IEC 62305 Covers ~

- Structures including their installations and contents as well as persons,
- Services connected to a structure,

IEC 62305 Outside the scope ~

- ➢ Railway systems,
- ➢ Vehicles, ships, aircraft, offshore installations,
- ➢ Underground high pressure pipelines,
- ➢ Pipe, power and telecommunication lines not connected to a structure,

Note: Usually these systems are under special regulations made by various specific Authorities.

About The IEC 62305

- IEC 62305-1 (EN 62305-1): **General principles**,, **overview** of the IEC 62305 (EN 62305) standard series is given, **procedures and protection principles**, which form the basis for the following parts the risk of lightning strikes, lightning characteristics and the resulting parameters.

- IEC 62305-2 (EN 62305-2): **Risk management** in accordance with IEC 62305-2 (EN 62305-2) includes a risk analysis to determine whether lightning protection is required, *Starting with the unprotected state of the building, the remaining risk is reduced and reduced until it is below the tolerable risk.*

- IEC 62305-3(EN 62305-3): **Physical damage to structures and life hazard** from material damage and life –threatening situations caused by the effects of lightning currents or dangerous sparking, specially in the event of direct lightning strikes.

- IEC 62305-3(EN 62305-4): E**lectrical and electronic systems within structures** against the effects of lightning electromagnetic impulse. Also considers the effects of electrical and magnetic fields as well as induced voltages and currents caused by direct and indirect lightning strikes.
- IEC 62305-3(EN 62305-): **Services (***to be Published)*

IEC62305, SS555:2018- Protection Against Lightning

- SS 555 : 2018-" for **protection against lightning**" [replacement of 2010]

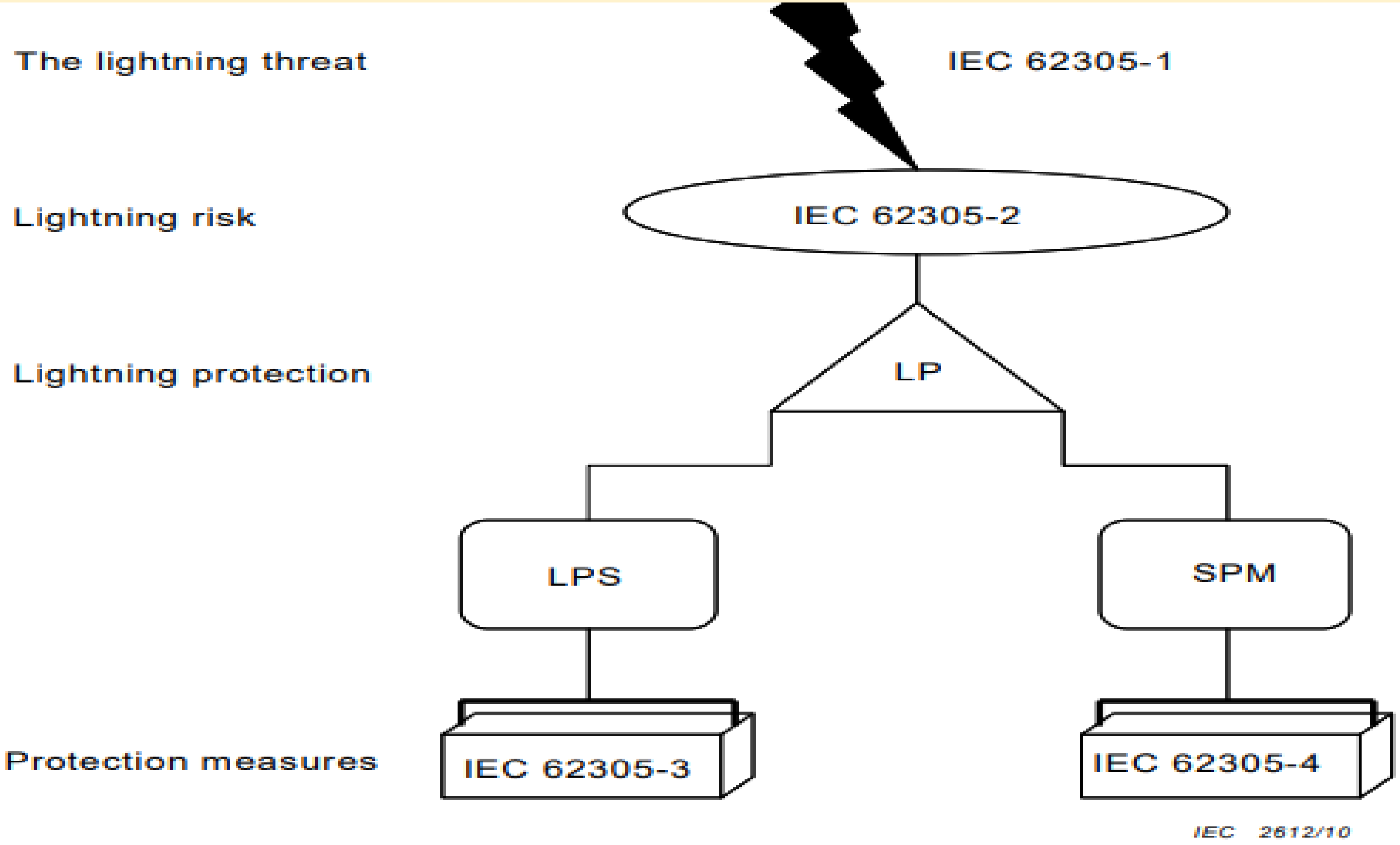


Figure 1 – Connection between the various parts of IEC 62305

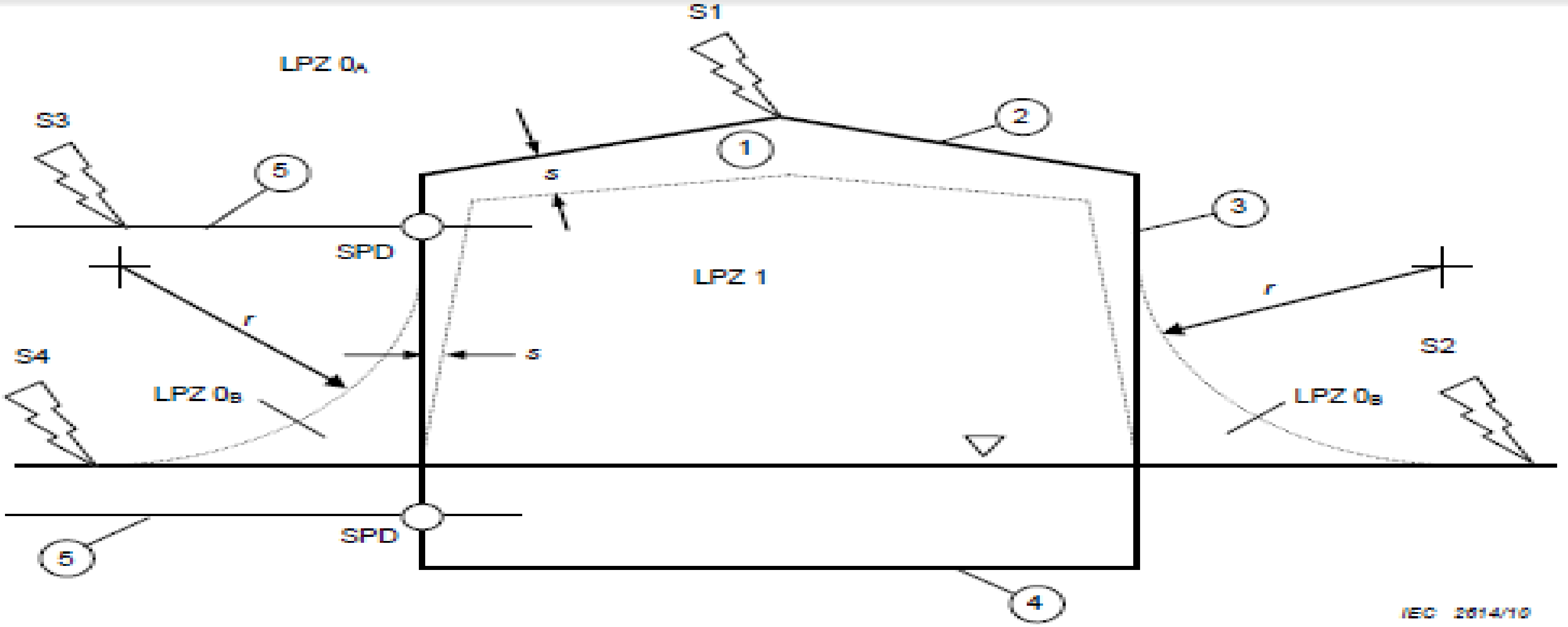
Protection Measures to Reduce the Risk

- Adequate insulation of exposed conductive parts;
- Equipotentialization by means of a meshed earthing system;
- Physical restrictions and warning notices
- Lightning equipotential bonding(EB)

Protection Measures to Reduce the physical damage

- Air-termination system;
- Down-conductor system;
- Earth-termination system;
- Lightning equipotential bonding(EB);
- Electrical insulation (and hence separation distance) against the external LPS.

Fig3: Lightning Protection Zone defined by LPS



Key

1	structure	S1	flash to the structure
2	air-termination system	S2	flash near to the structure
3	down-conductor system	S3	flash to a line connected to the structure
4	earth-termination system	S4	flash near a line connected to the structure
5	incoming lines	*r*	rolling sphere radius
		s	separation distance against dangerous sparking

▽ ground level

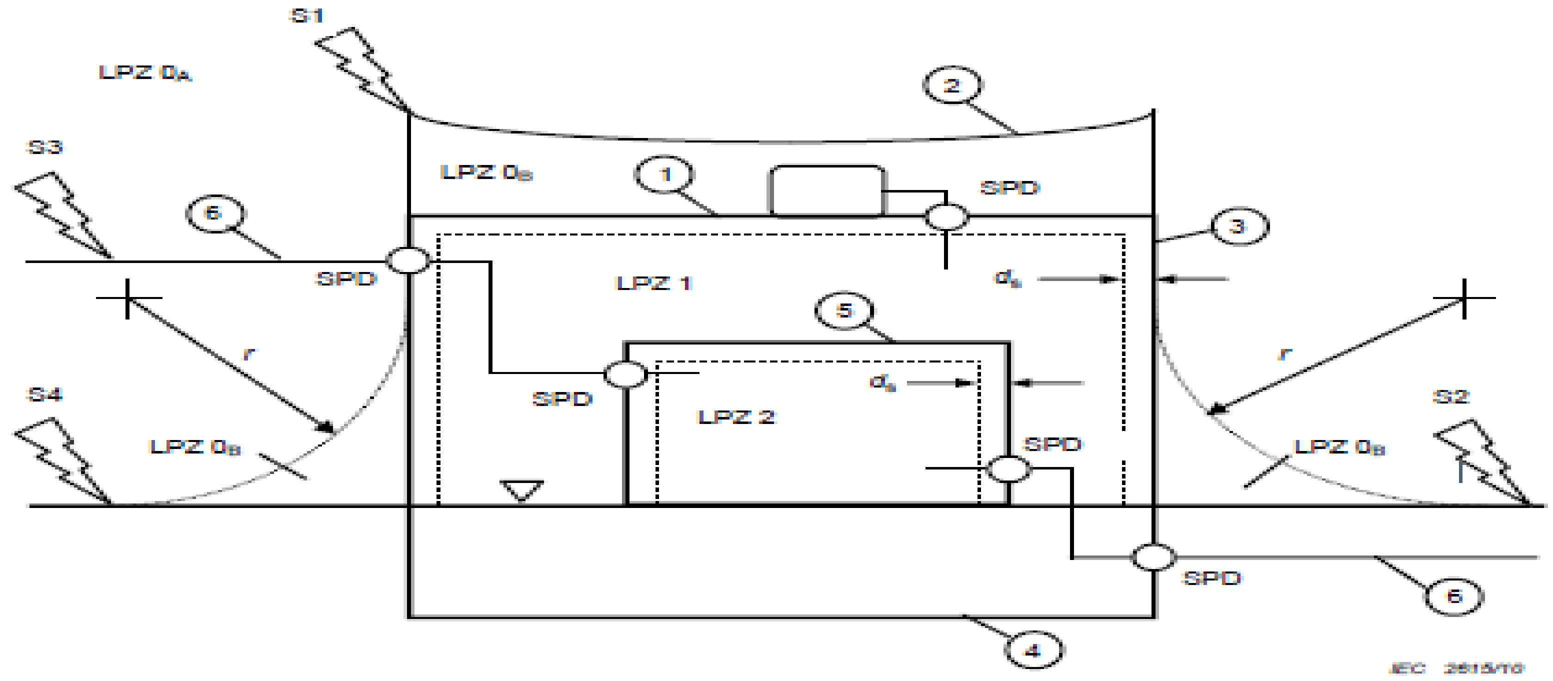
◯ lightning equipotential bonding by means of SPD

LPZ 0_A direct flash, full lightning current

LPZ 0_B no direct flash, partial lightning or induced current

LPZ 1 no direct flash, limited lightning or induced current
protected volume inside LPZ 1 must respect separation distance *s*

Fig4: Lightning Protection Zone defined by SPM



Key

1	structure (shield of LPZ 1)	S1	flash to the structure
2	air-termination system	S2	flash near to the structure
3	down-conductor system	S3	flash to a line connected to the structure
4	earth-termination system	S4	flash near a line connected to the structure
5	room (shield of LPZ 2)	r	rolling sphere radius
6	lines connected to the structure	d_S	safety distance against too high magnetic field

▽ ground level

○ lightning equipotential bonding by means of SPD

LPZ 0_A direct flash, full lightning current, full magnetic field

LPZ 0_B no direct flash, partial lightning or induced current, full magnetic field

LPZ 1 no direct flash, limited lightning or induced current, damped magnetic field

LPZ 2 no direct flash, induced currents, further damped magnetic field

protected volumes inside LPZ 1 and LPZ 2 must respect safety distances d_S

Fig 1: Procedure for deciding the need of protection and selecting protection measures

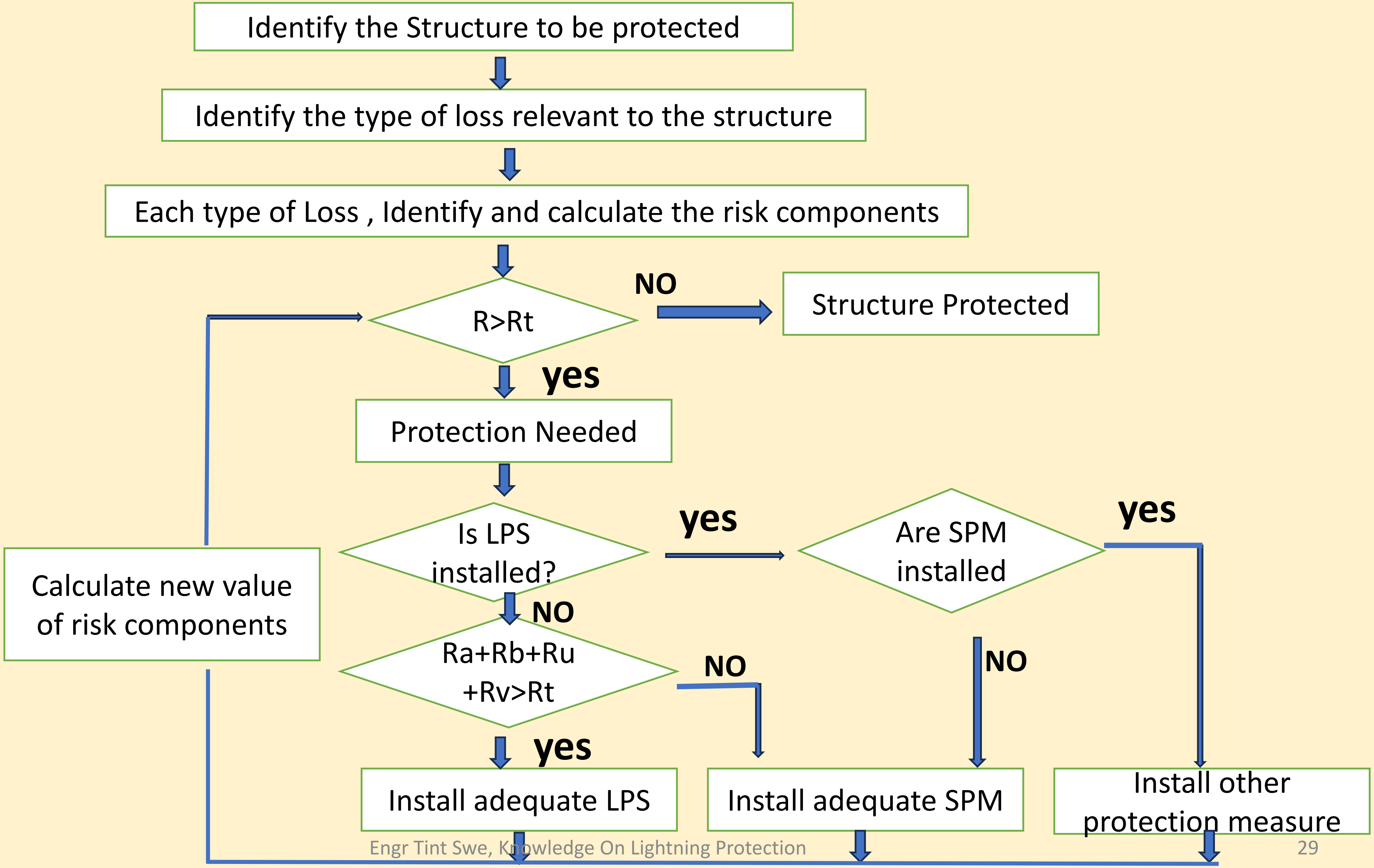
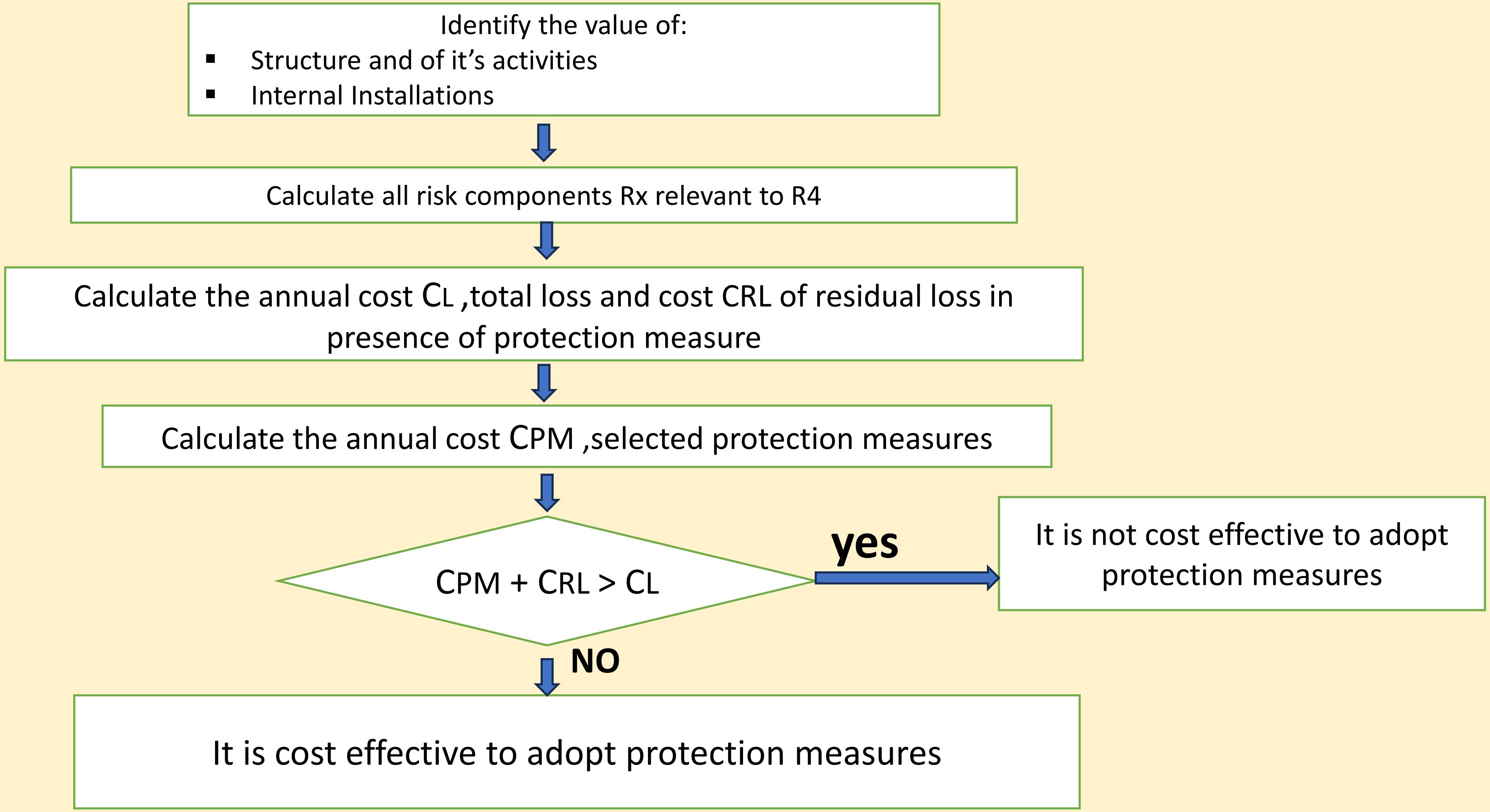


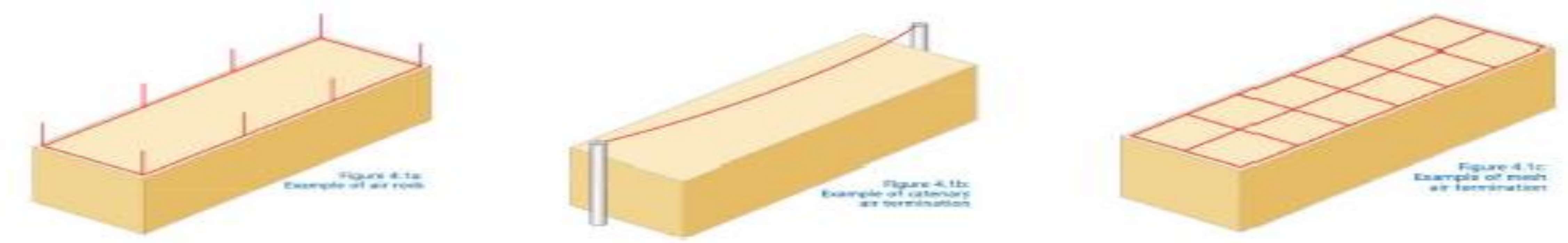
Fig-2:Procedure for evaluating the cost-effectiveness of protection



Air Termination System

Air-Termination systems can be composed of the elements ;

- ➢ Rods(including free standing Masts)
- ➢ Catenary wires
- ➢ meshed conductors

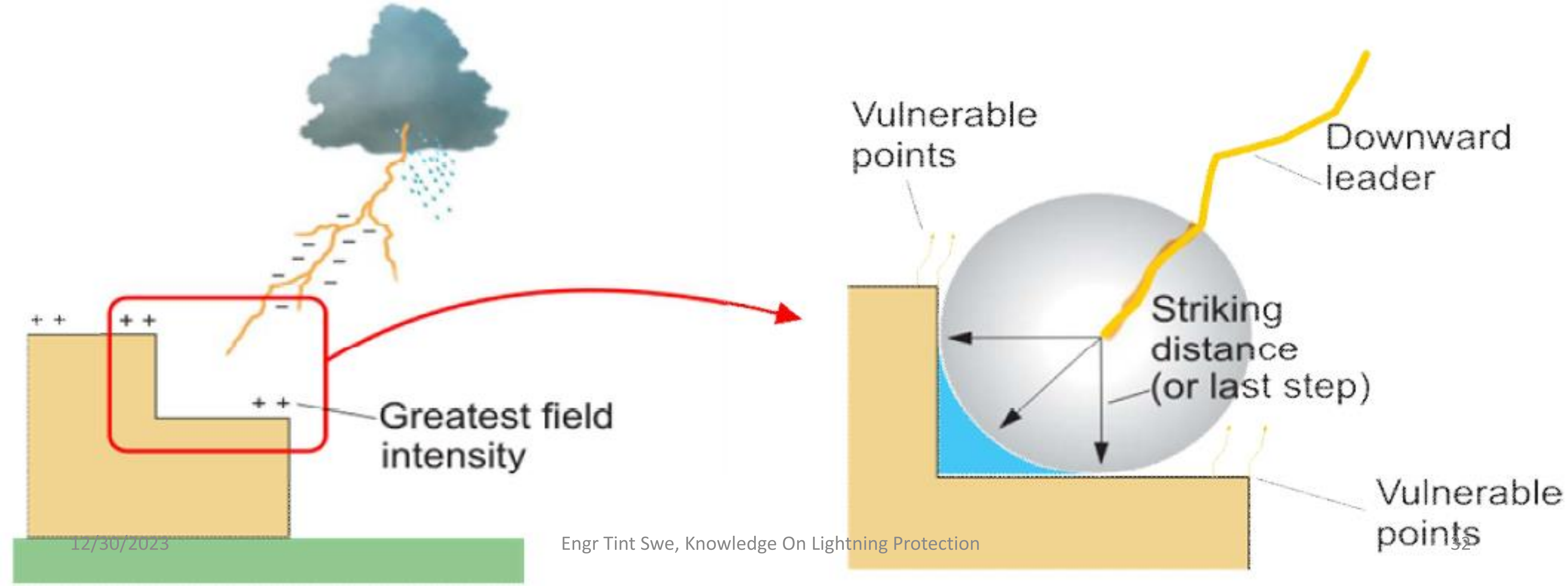


Three basic protective methods determining the position of Air-Termination systems ;

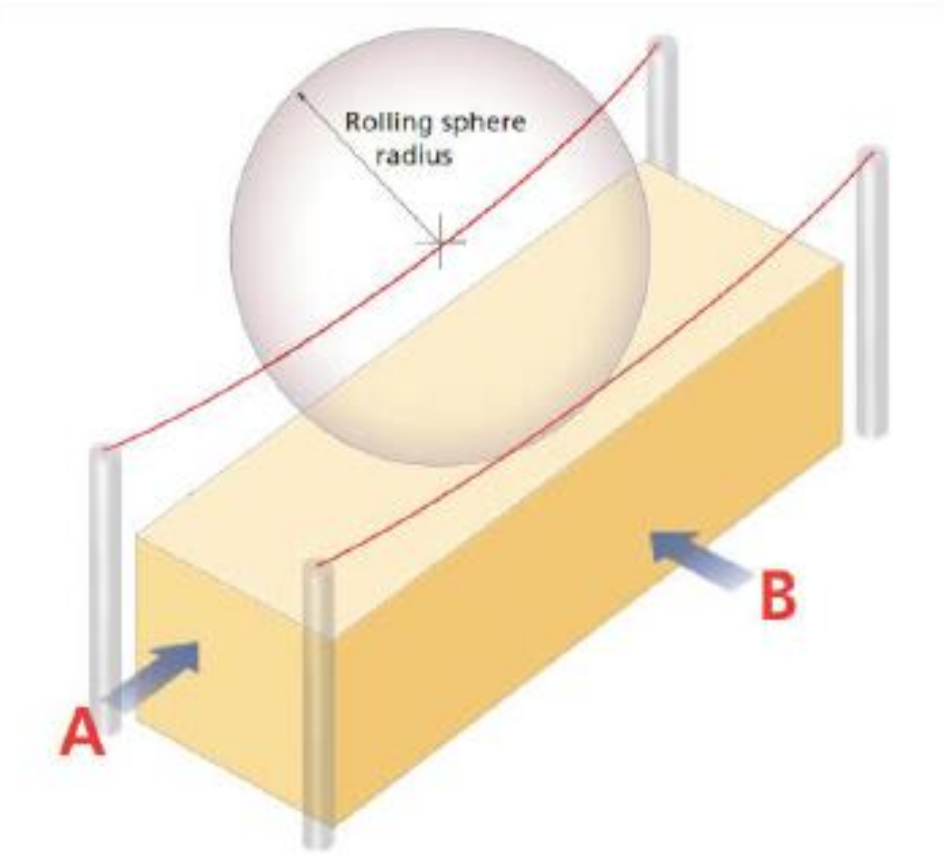
- ❖ Rolling Sphere Method
- ❖ Protective Angle Method
- ❖ Mesh Method

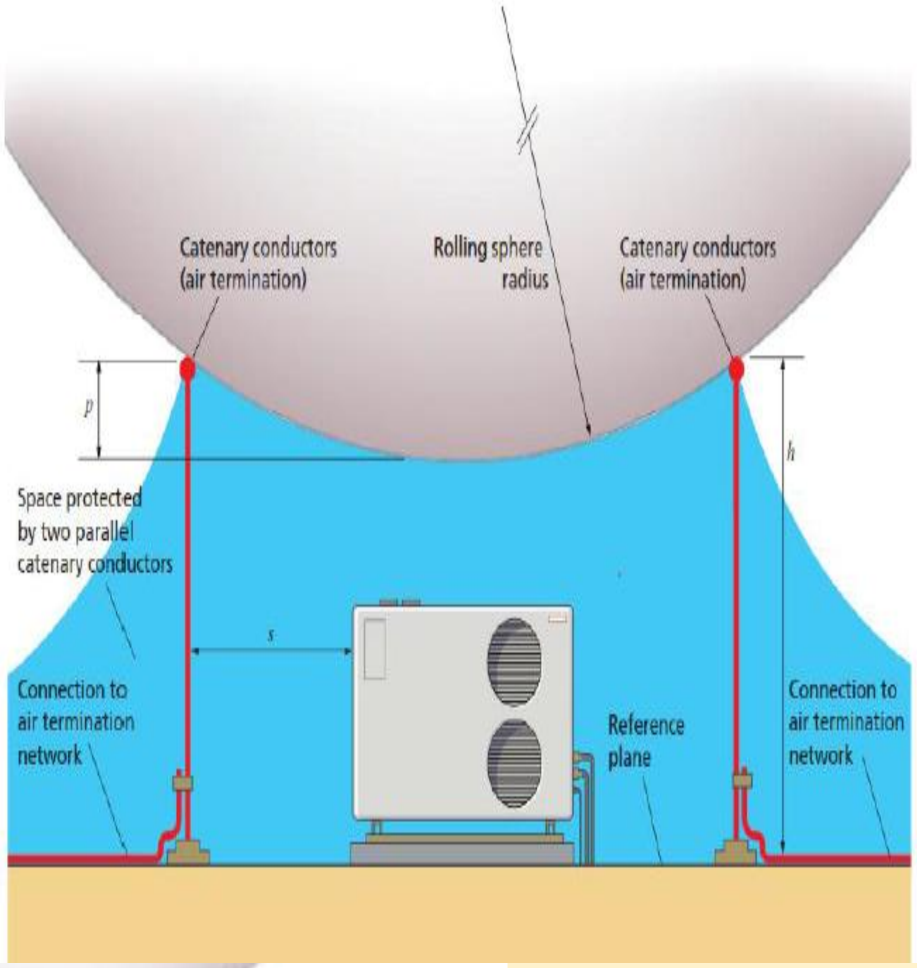
Protection Methods

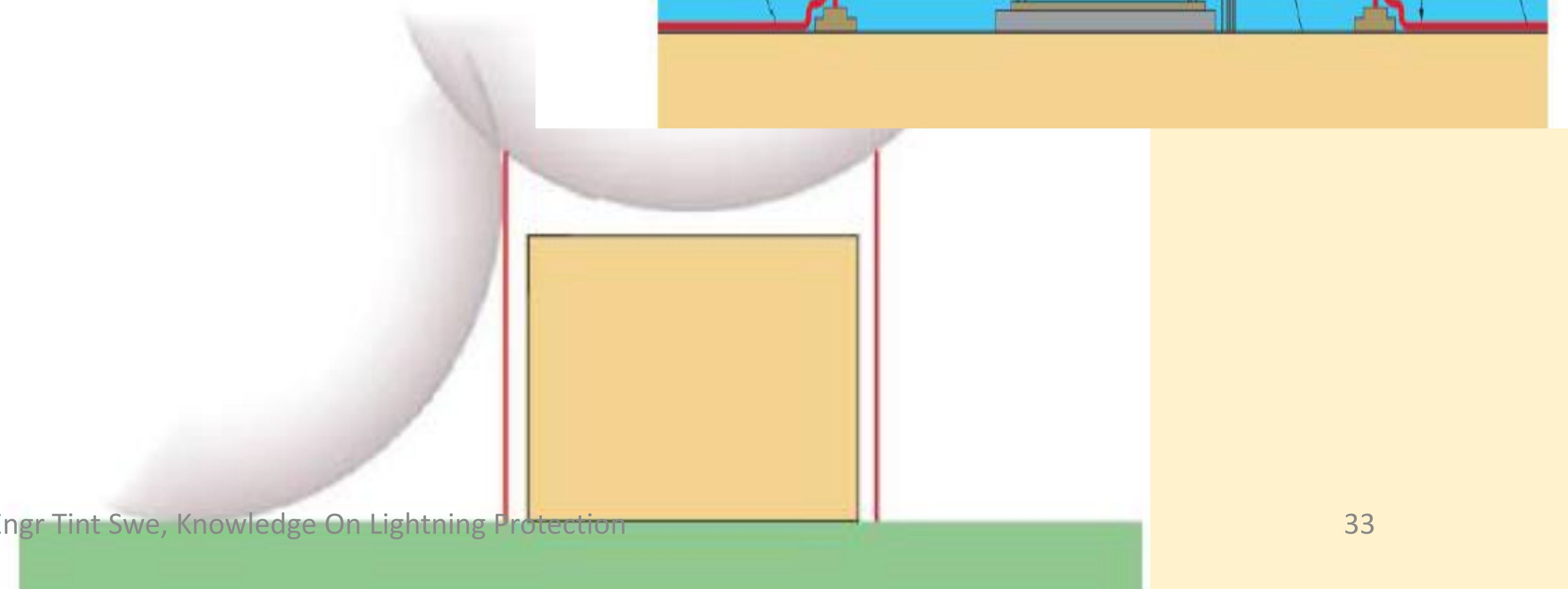
- Rolling Sphere Method
  - Based on the LPL
  - No point protected ,Rolling Sphere with radius “r” touching the Structure adequate provision of air termination system compulsorily.
  - Strike to the Side of structure lower than 60M is Negligible, regardless of class of LPS

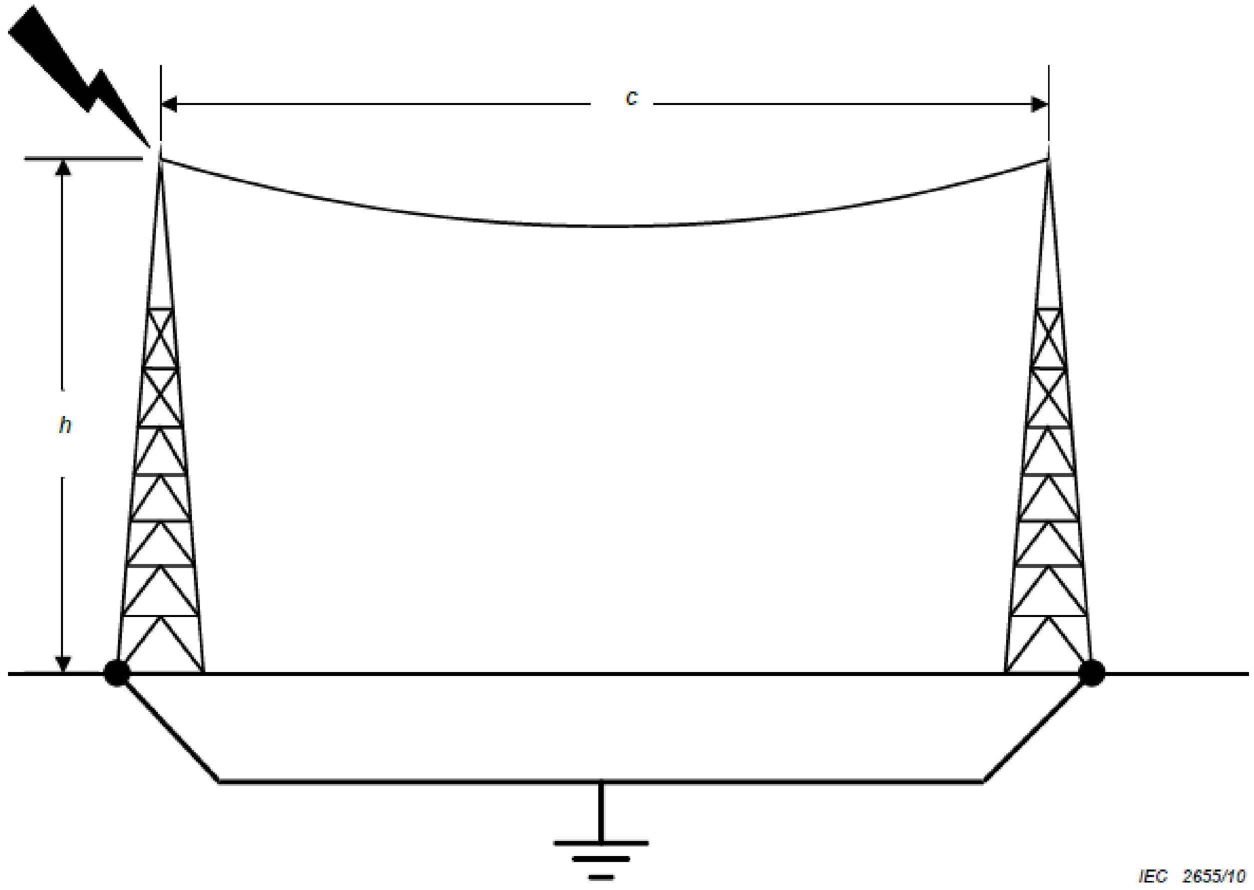


Rolling Sphere
Catenary (Or Suspended) Conductors





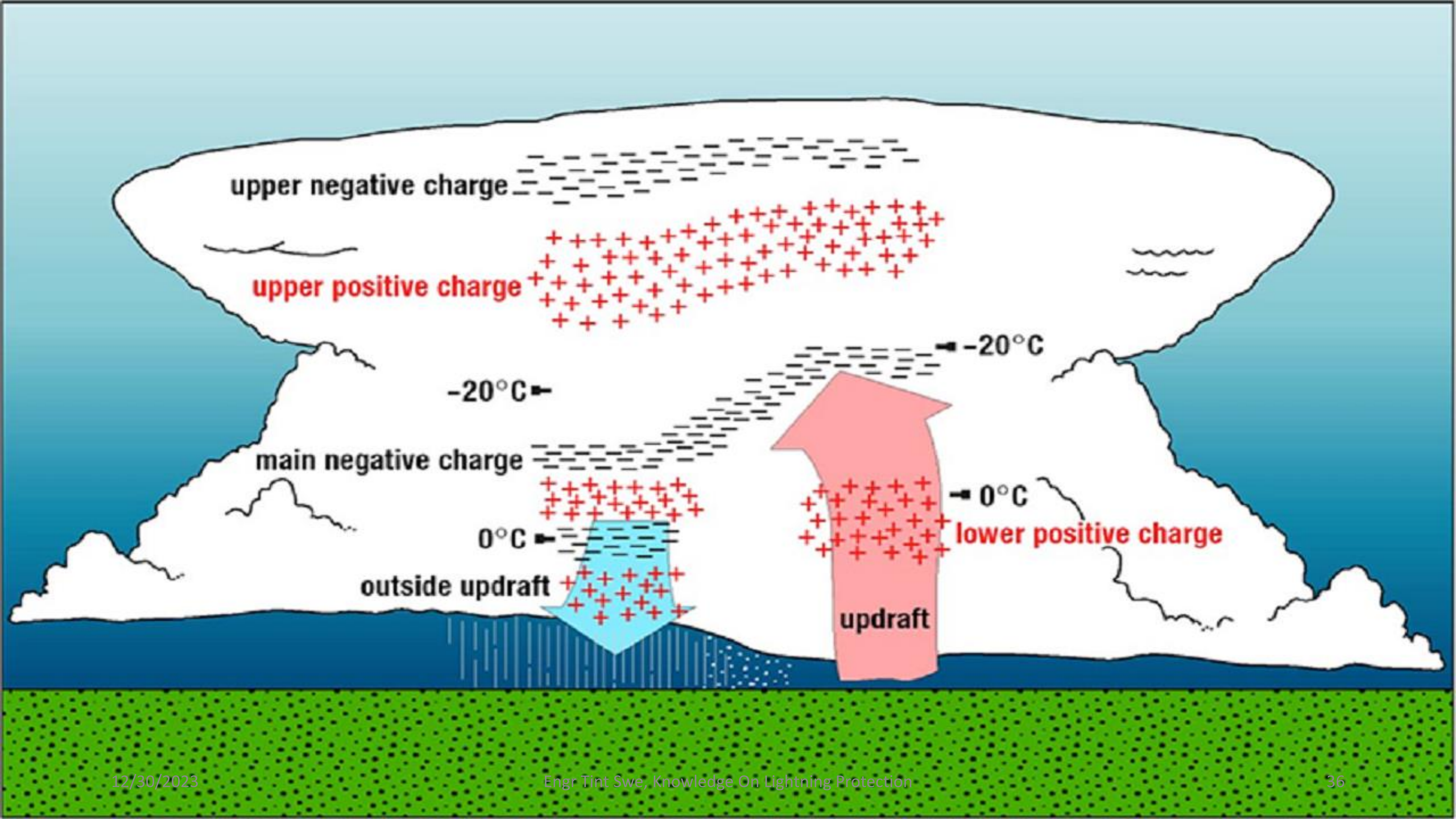




$$k_c = \frac{h+c}{2h+c}$$

Figure C.1 – Values of coefficient k_c in the case of a wire air-termination system

Some Applications Of Lightning Protection


upper negative charge
upper positive charge
-20°C
-20°C
main negative charge
0°C
0°C
lower positive charge
outside updraft
updraft

90% Downward Negatively charged leader and 10% Downward Positively charged leader

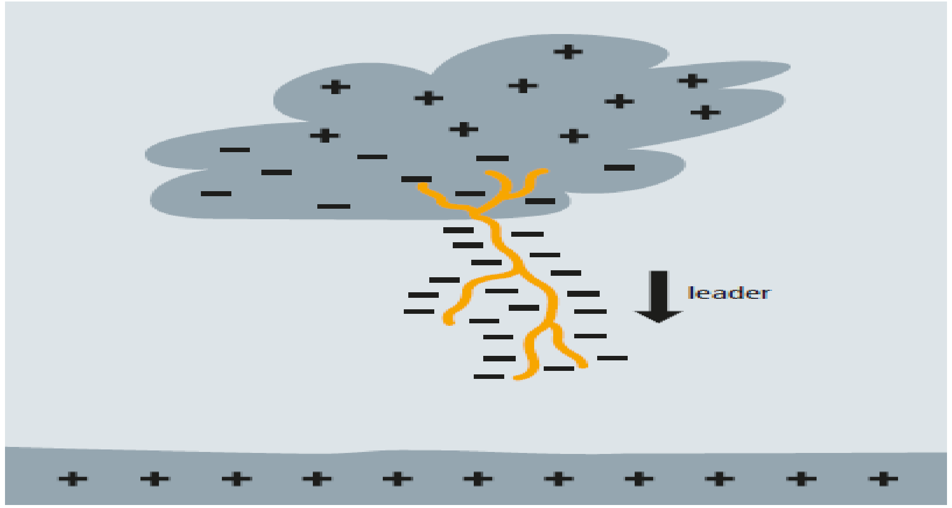


Figure 2.1.2 Discharge mechanism of a negative downward flash (cloud-to-earth flash)

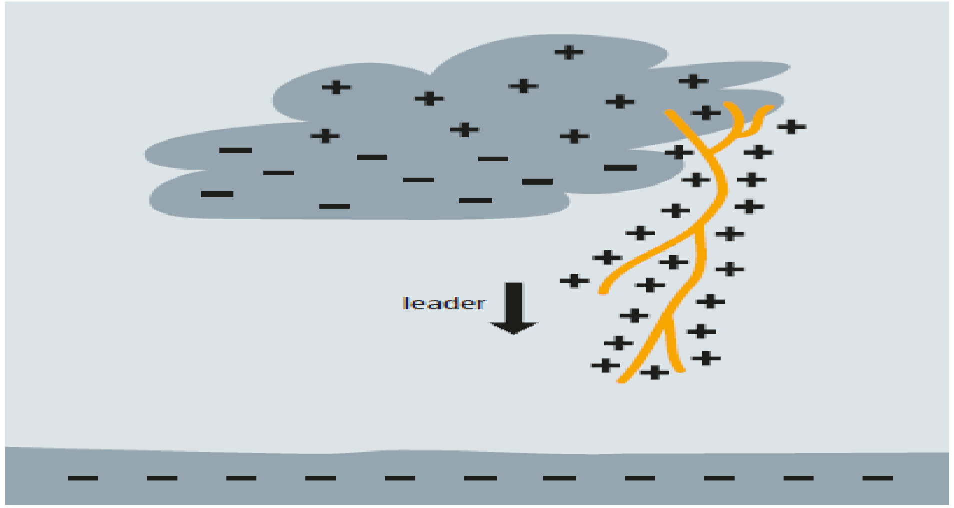


Figure 2.1.3 Discharge mechanism of a positive downward flash (cloud-to-earth flash)

Figure 2.1.1 Downward flash (cloud-to-earth flash)

Figure 2.1.4 Upward flash (earth-to-cloud flash)

90% Downward Negatively charged leader and 10% Downward Positively charged leader

Table 3 – Maximum values of lightning parameters according to LPL

First positive impulse			LPL			
Current parameters	Symbol	Unit	I	II	III	IV
Peak current	I	kA	200	150	100	
Impulse charge	Q_{SHORT}	C	100	75	50	
Specific energy	W/R	MJ/Ω	10	5,6	2,5	
Time parameters	T_1 / T_2	µs / µs	10 / 350			
First negative impulse[a]			**LPL**			
Current parameters	Symbol	Unit	I		II	III
Peak current	I	kA	100		75	50
Average steepness	di/dt	kA/µs	100		75	50
Time parameters	T_1 / T_2	µs / µs	1 / 200			
Subsequent impulse			**LPL**			
Current parameters	Symbol	Unit	I	II	III	IV
Peak current	I	kA	50	37,5	25	
Average steepness	di/dt	kA/µs	200	150	100	
Time parameters	T_1 / T_2	µs / µs	0,25 / 100			
Long stroke			**LPL**			
Current parameters	Symbol	Unit	I	II	III	IV
Long stroke charge	Q_{LONG}	C	200	150	100	
Time parameter	T_{LONG}	s	0,5			
Flash			**LPL**			
Current parameters	Symbol	Unit	I	II	III	IV
Flash charge	Q_{FLASH}	C	300	225	150	

[a] The use of this current shape concerns only calculations and not testing.

Nature Of Lightning , Flashes

- (Type A)Downward lightning, negatively charged leader, [90 ~ 95%]
- (Type B)Upward Lightning, positively charged leader,
- (Type C)Downward lightning, positively Charged Leader, [5 ~ 10%]
- (Type D)Upward Lightning, negatively charged leader,

Note: Positively charged lightning can be 10 times more powerful than negative lightning, can carry 10billion volts and can strike more than 20 miles away from a thunder storm.

Rolling Sphere Radius, Protection Angle, Mesh size

Table 2 – Maximum values of rolling sphere radius, mesh size and protection angle corresponding to the class of LPS

Class of LPS	Protection method		
	Rolling sphere radius r m	Mesh size w_m m	Protection angle $\alpha°$
I	20	5 × 5	See Figure 1 below
II	30	10 × 10	
III	45	15 × 15	
IV	60	20 × 20	

IEC 2646/10

NOTE 1 Not applicable beyond the values marked with •. Only rolling sphere and mesh methods apply in these cases.

NOTE 2 h is the height of air-termination above the reference plane of the area to be protected.

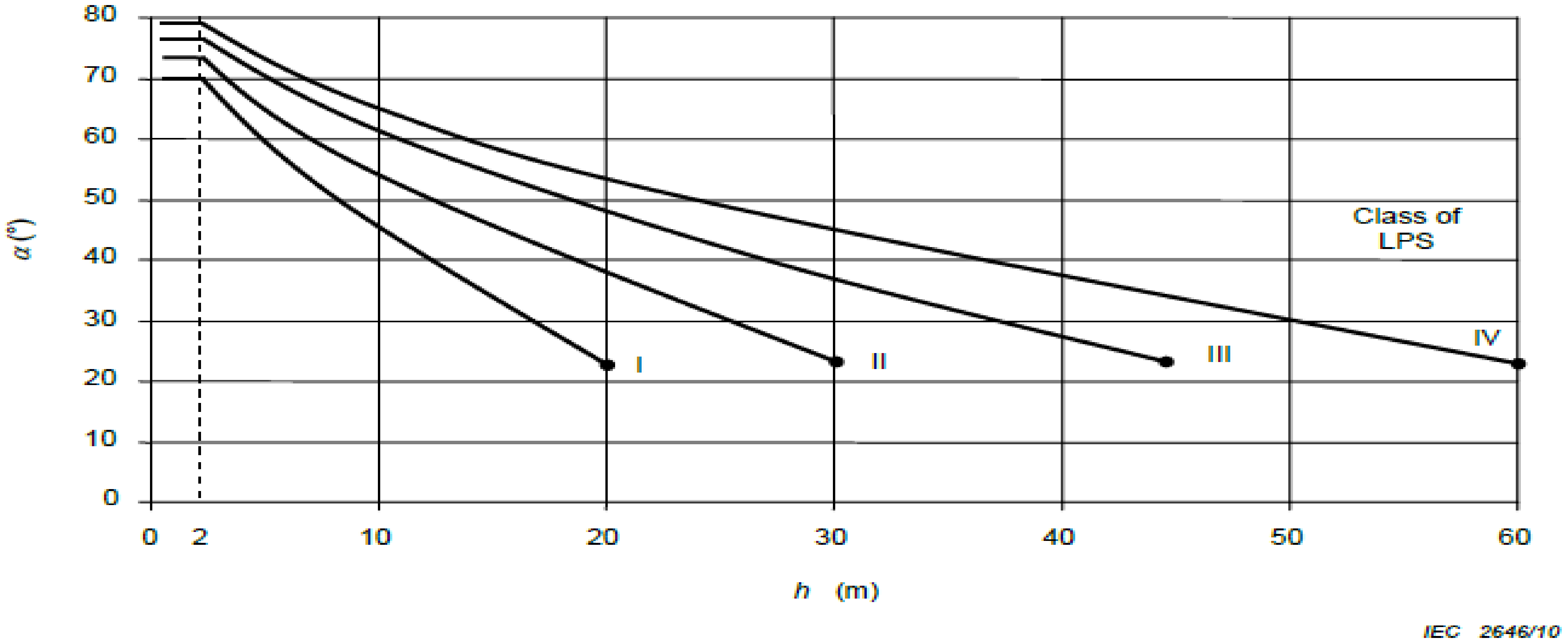
NOTE 3 The angle will not change for values of h below 2 m.

Figure 1 – Protection angle corresponding to the class of LPS

5.2.3 Air-terminations against flashes to the side of tall structures

5.2.3.1 Structures less than 60 m tall

Rolling Sphere Radius, Protection Angle, Mesh size



NOTE 1 Not applicable beyond the values marked with •. Only rolling sphere and mesh methods apply in these cases.

NOTE 2 *h* is the height of air-termination above the reference plane of the area to be protected.

NOTE 3 The angle will not change for values of *h* below 2 m.

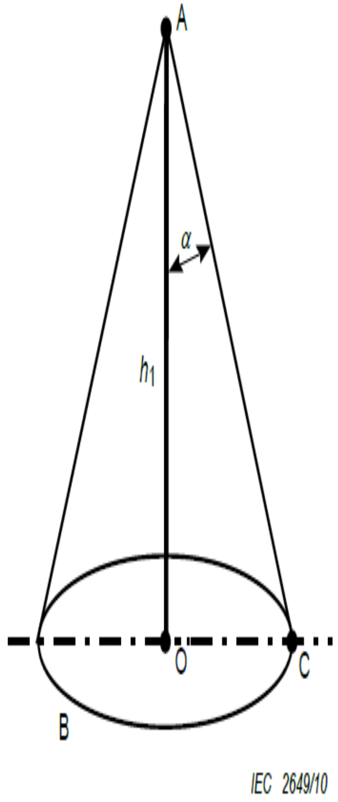
Figure 1 – Protection angle corresponding to the class of LPS

5.2.3 Air-terminations against flashes to the side of tall structures

5.2.3.1 Structures less than 60 m tall

PROTECTION ANGLE METHOD

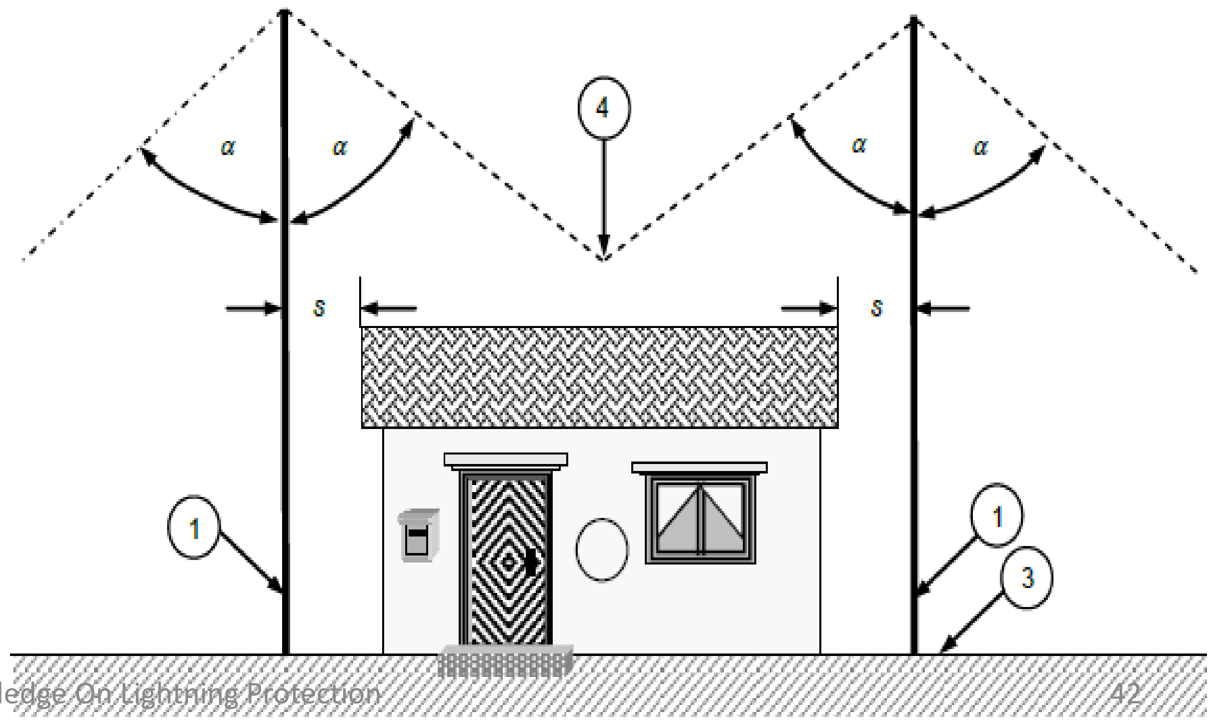
The volume protected by a vertical rod is assumed to have the shape of a right circular cone with the vertex placed on the air-termination axis, semi-apex angle α, depending on the class of LPS, and on the height of the air-termination system as given in Table 2. Examples of the protected volume are given in Figures A.1 and A.2.



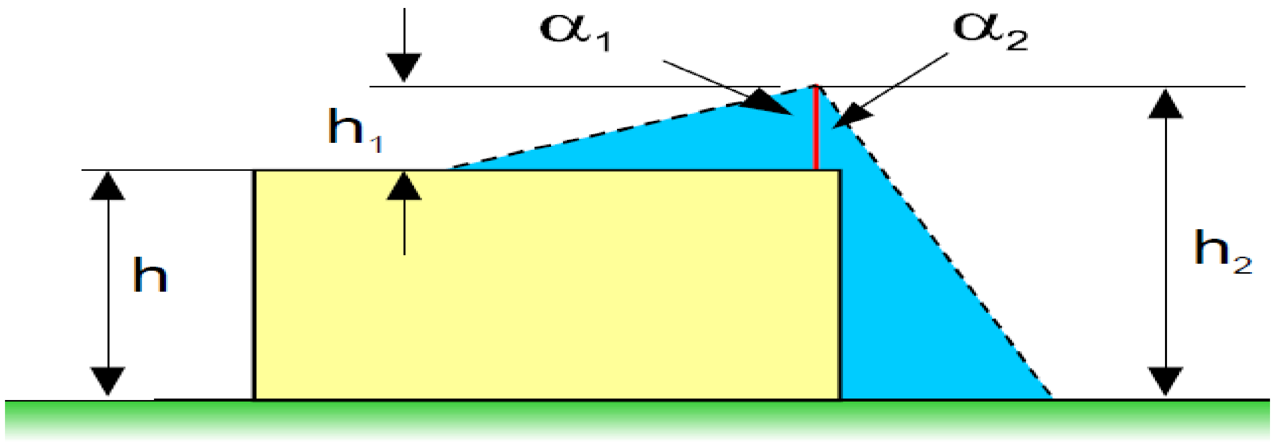
The protection angle method has geometrical limits and cannot be applied if H is larger than the rolling sphere radius, r, as defined in Table 2.

If structures on the roof are to be protected with finials and the protection volume of the finials is over the edge of the building, the finials should be placed between the structure and the edge. If this is not possible, the rolling sphere method should be applied.

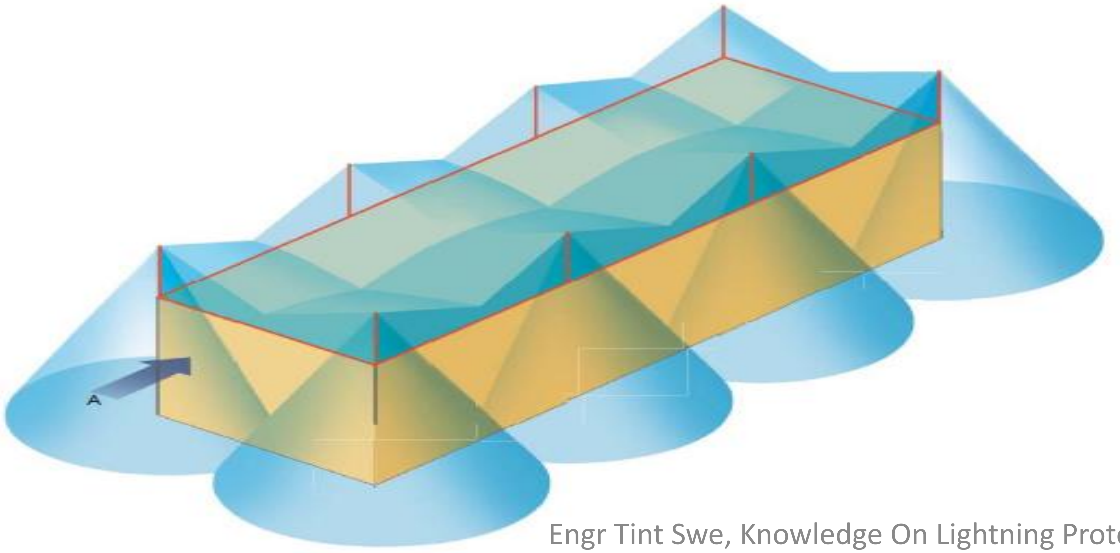
The design of air-termination using the protection angle air-termination design method is also shown in Figures E.13 and E.14 for an isolated LPS and in Figures E.15 and E.16 for a non-isolated LPS.

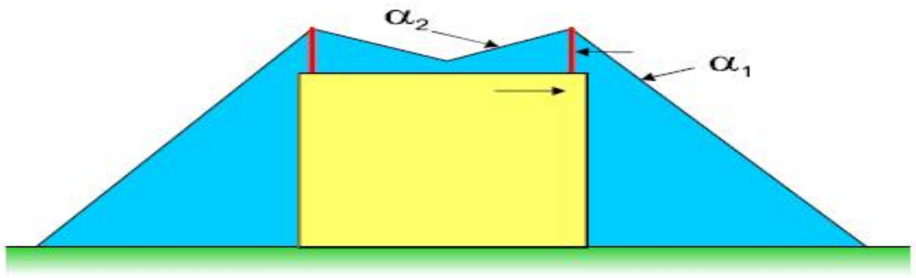


PROTECTION ANGLE METHOD



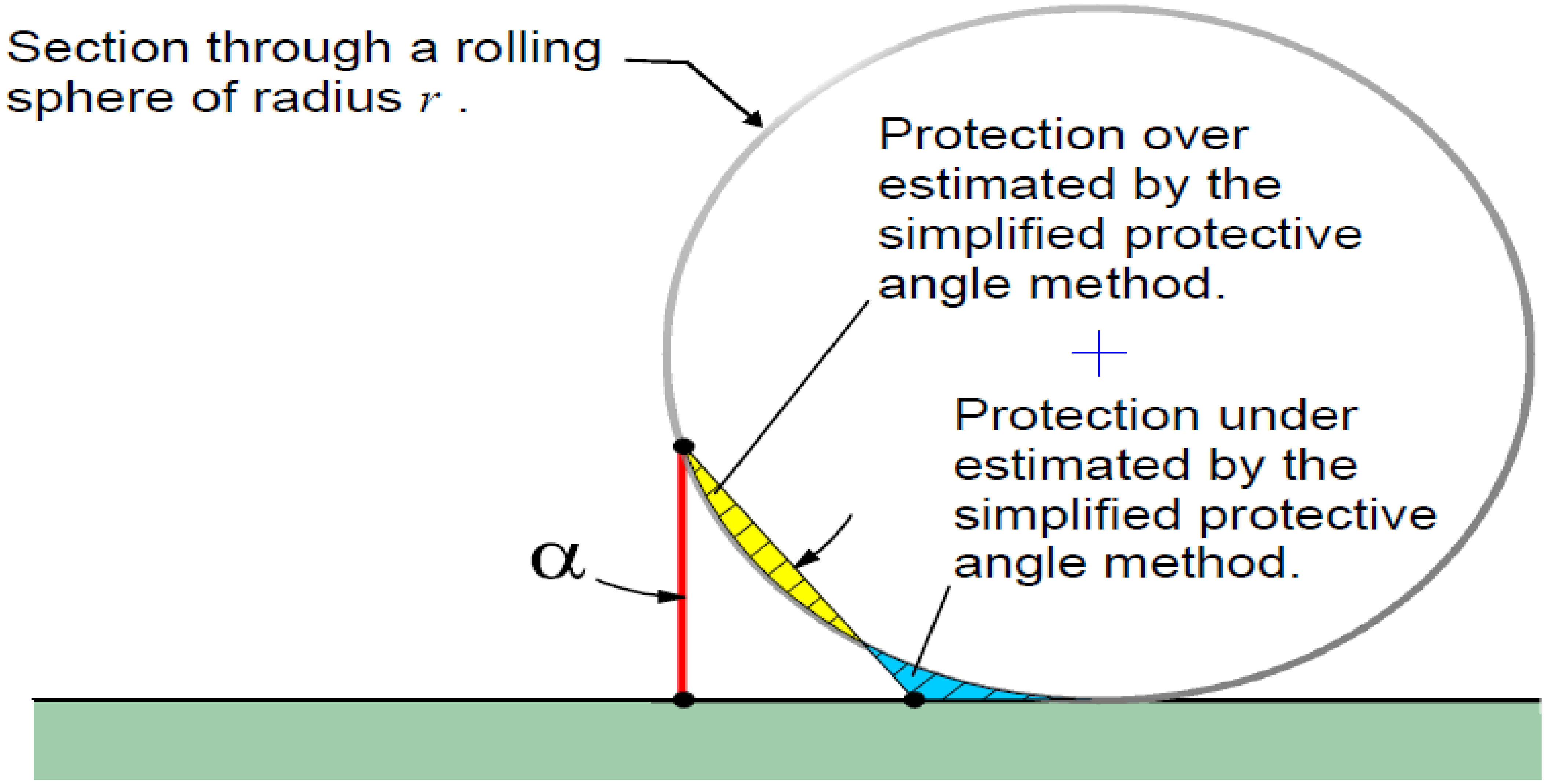
Variable angles depending on height to reference plane and class of LPS





View on arrow A

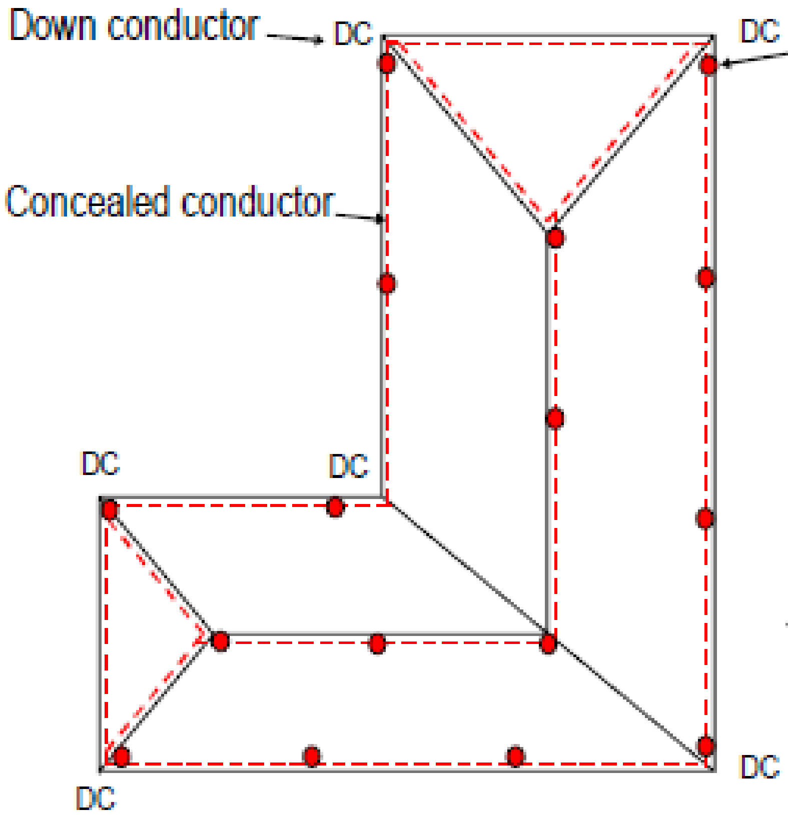
PROTECTION ANGLE METHOD

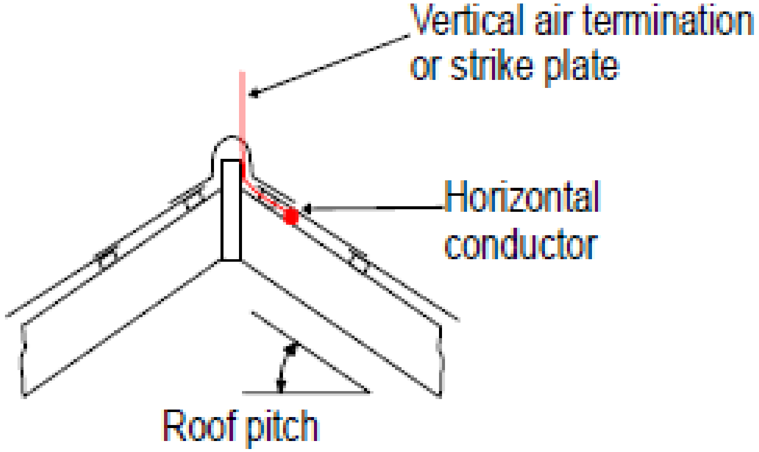


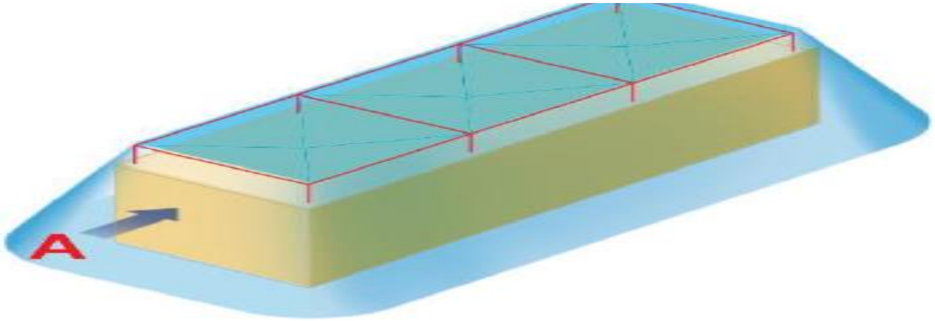
Mathematical simplification of rolling sphere method

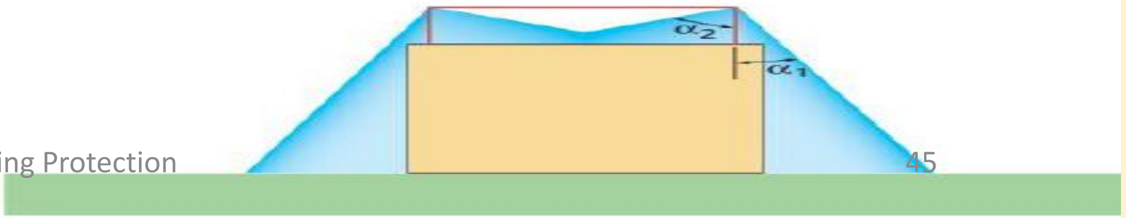
MESH Protection System

Class	Mesh size (m x m)
I	5 x 5
II	10 x 10
III	15 x 15
IV	20 x 20

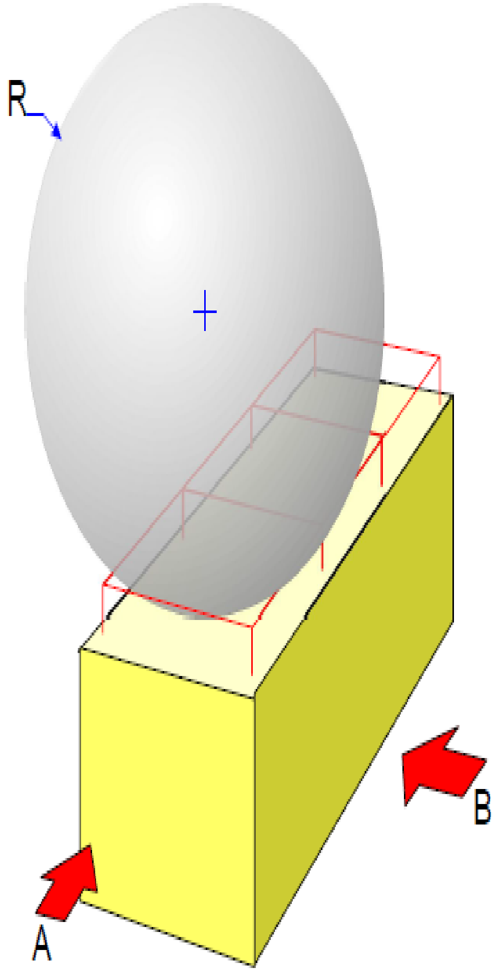


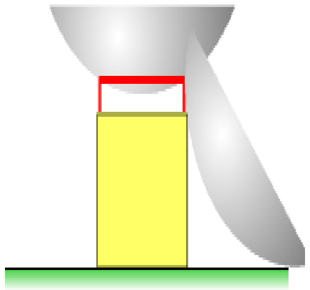




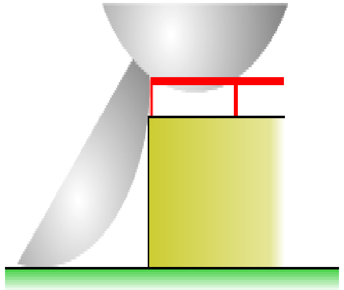


MESH Protection System in Relation with Rolling Sphere

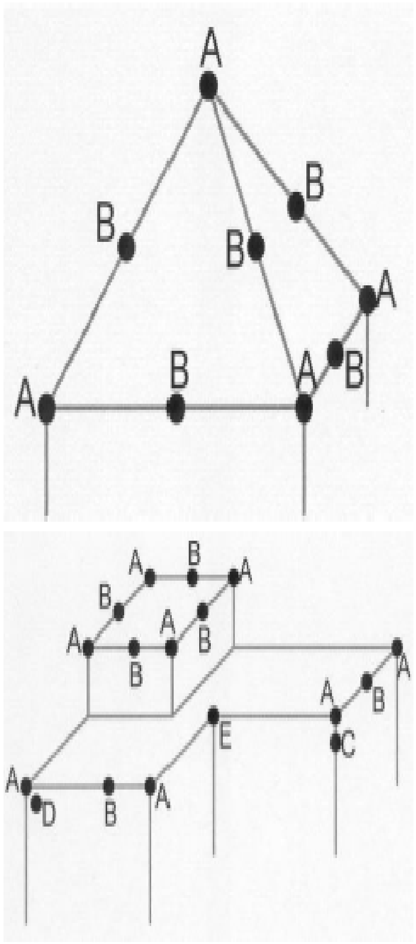




View on arrow A

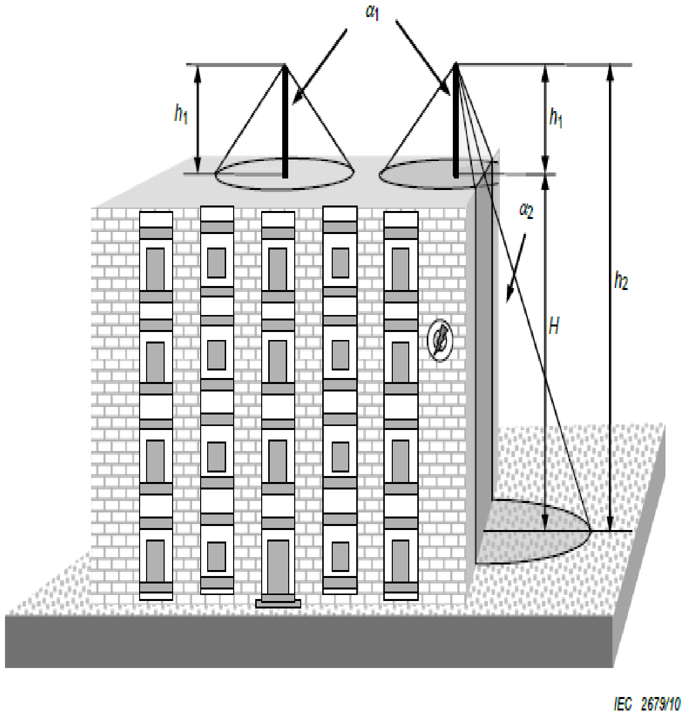


View on arrow B



Lighting Damage Location	2000	1995
(a) Sharp corners points	>90%	>80%
(b) Horizontal slant edges	<5%	<10%
(c) Vertical edges	<2%	<5%
(d) flat surface	<1%	<5%
(e) other locations	0%	N/A

Some example of Protection Angle, and Catenary systems



Key

- H height of the building over the ground reference plane
- h_1 physical height of an air-termination rod
- h_2 $h_1 + H$, being the height of the air-termination rod over the ground
- α_1 the protection angle corresponding to the air-termination height $h = h_1$, being the height above the roof surface to be measured (reference plane)
- α_2 the protection angle corresponds to the height h_2

Figure E.12 – Protection angle method air-termination design for different heights according to Table 2

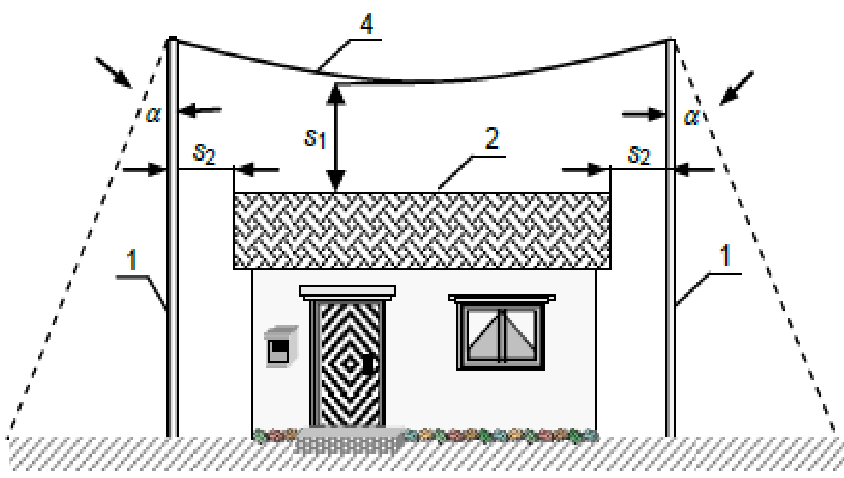


Figure E.14a – Projection on a vertical plane parallel to that containing two masts

IEC 2682/10

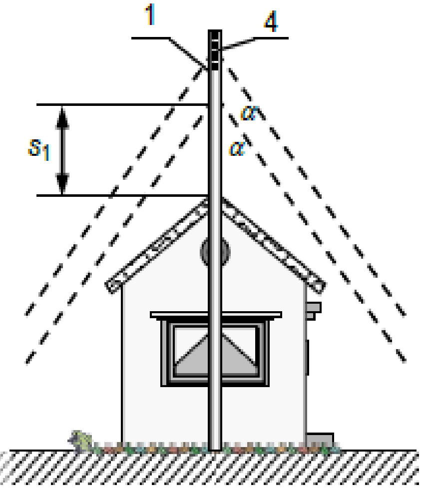


Figure E.14b – Projection on a vertical plane perpendicular to the plane containing the two masts

IEC 2683/10

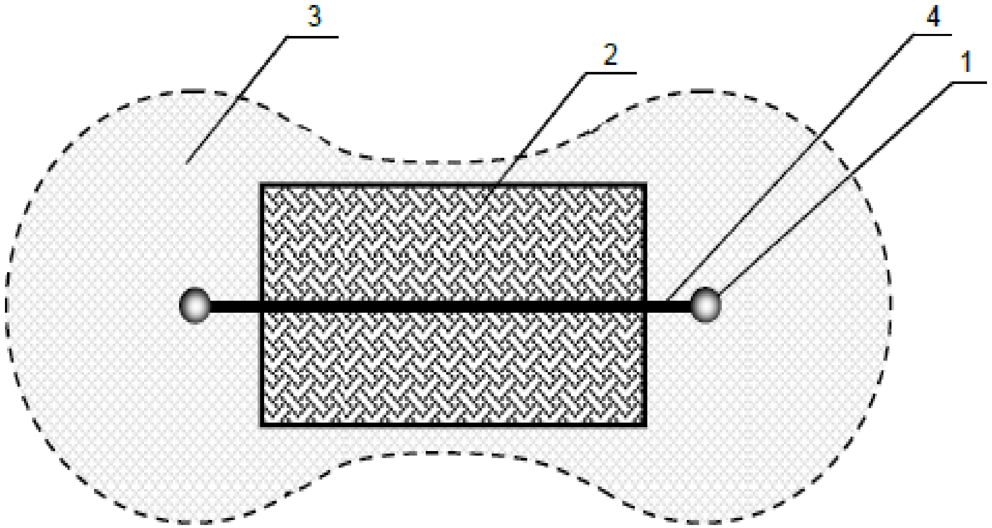
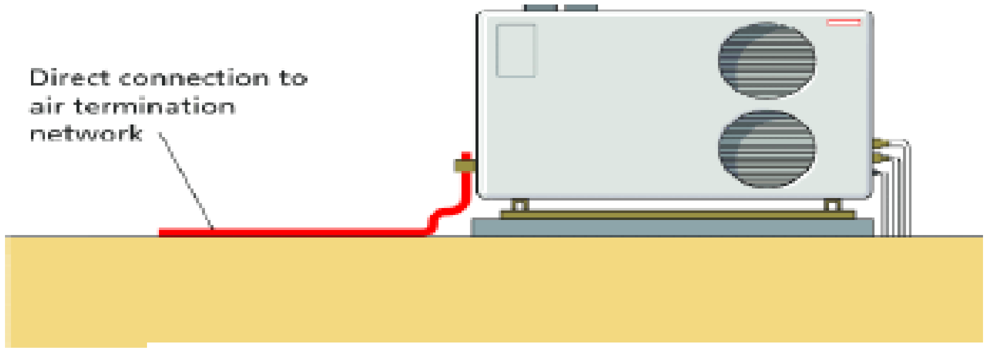
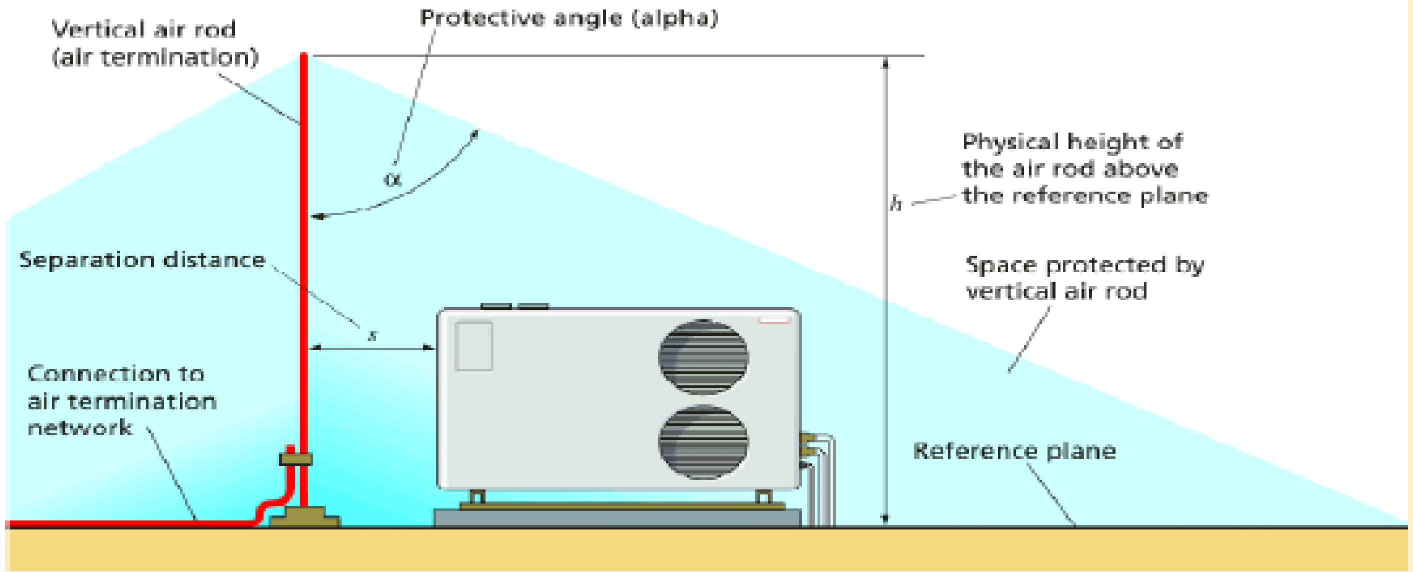
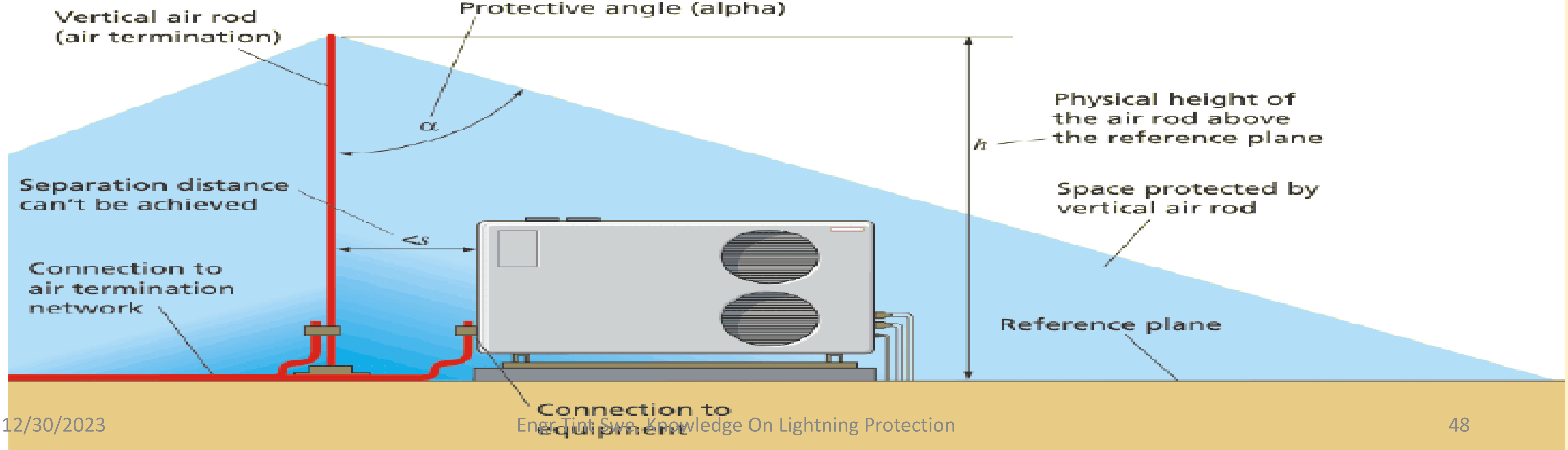


Figure E.14c – Projection on the horizontal reference plane

Roof Top Equipment Protection and external LPS *Separation Distance*







Roof Top Equipment Protection and external LPS *Separation Distance*

Exercise

4 down conductors (K_c = 0.44)

Class II LPS (k_i = 0.06)

Medium air (k_m = 1)

Type A earthing arrangement

Length of air termination/d.c to nearest equipotential bar = 25 m

$$s = k_i \times \frac{k_c}{k_m} \times l$$

Required separation distance "S" will be ?

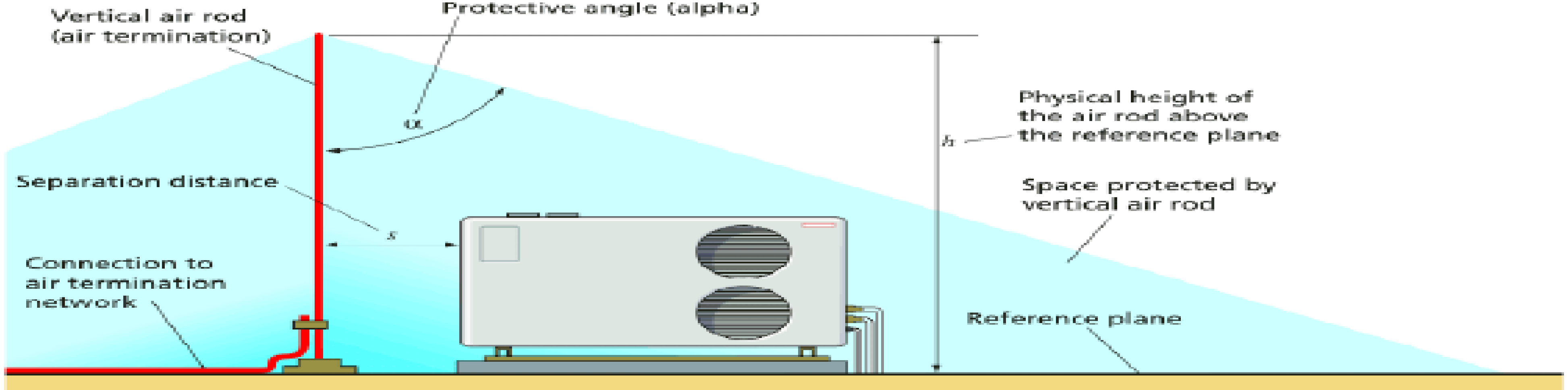
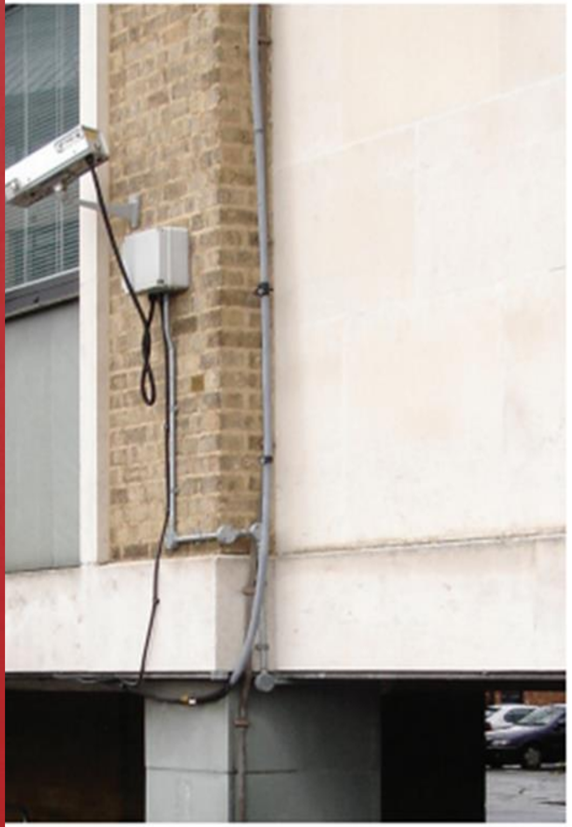


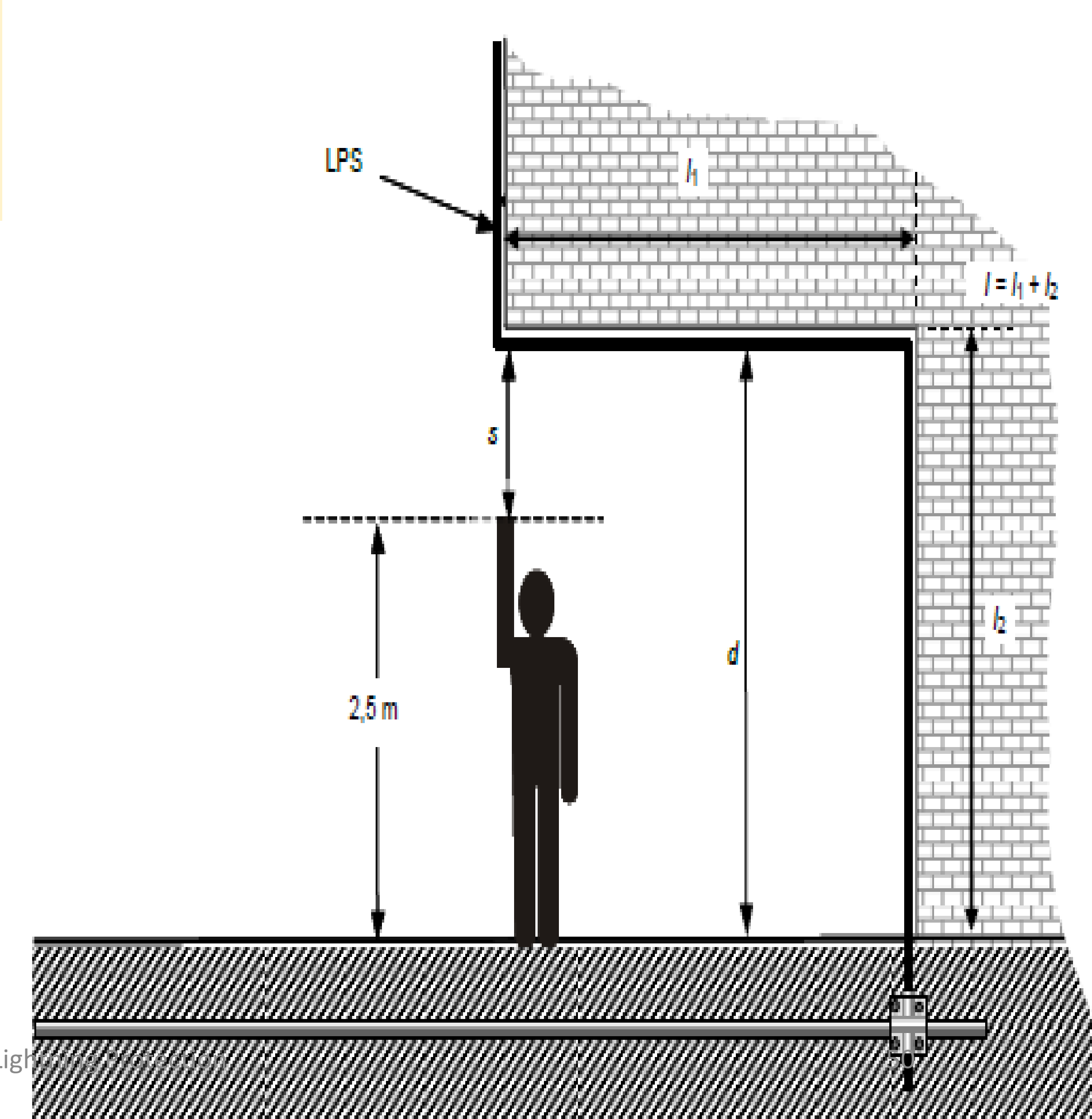
Table 10 – Isolation of external LPS – Values of coefficient k_i

Class of LPS	k_i
I	0,08
II	0,06
III and IV	0,04

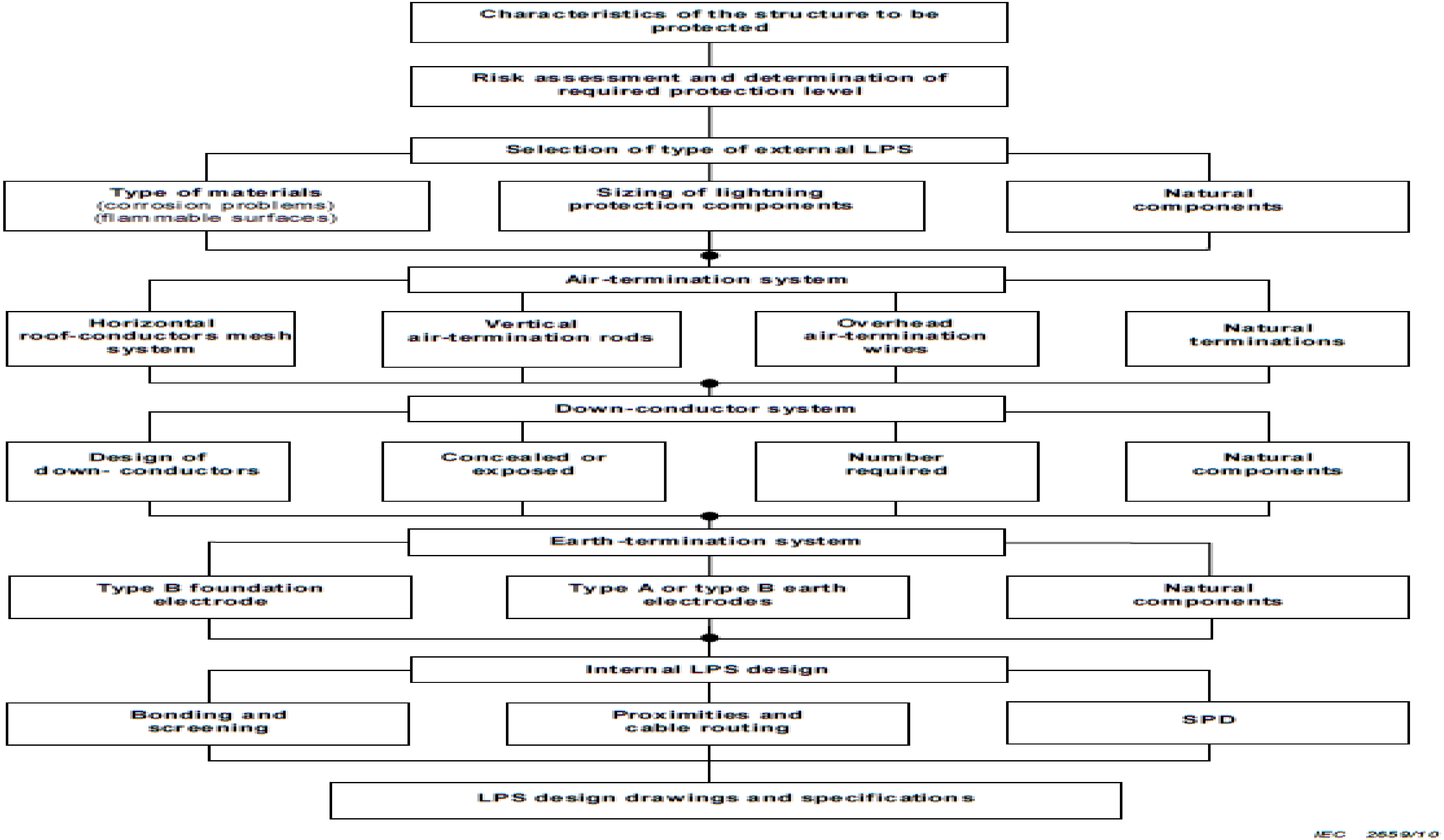
Separation is Important for safe and efficient LPS



entional down-conductor
ration distance problem



LPS Design Flow Diagram



NOTE Interfaces ● require the full cooperation of the architect, engineer and lightning protection designer.

Figure E.1 – LPS design flow diagram

FREQUENCIES for Maintenance, Regular Check and Inspection of Installed LPS

Table E.2 – Maximum period between inspections of an LPS

Protection level	**Visual inspection** year	**Complete inspection** year	**Critical situations** [a] [b] **complete inspection** year
I and II	1	2	1
III and IV	2	4	1

[a] Lightning protection systems utilized in applications involving structures with a risk caused by explosive materials should be visually inspected every 6 months. Electrical testing of the installation should be performed once a year. An acceptable exception to the yearly test schedule would be to perform the tests on a 14 to 15 month cycle where it is considered beneficial to conduct earth resistance testing over different times of the year to get an indication of seasonal variations.

[b] Critical situations could include structures containing sensitive internal systems, office blocks, commercial buildings or places where a high number of people may be present.

The inspection frequencies given in Table E.2 should apply where no specific requirements are identified by the authority having jurisdiction.

Materials

- Air Termination Materials
- Down Conductors
- Bonding and Fasteners
- Earthing and Test links
- Lightning Arresters
- Surge Protectors

Some Facts about Lightning

- People in water are more likely to hit lightning
- People in the field or rise in flat area are likely to hit lightning
- Lightning strike hit Males more than females
- Four lags animals are much vulnerable than human or two lags animals,
- **Trees shall be protected like building from Lightning,**

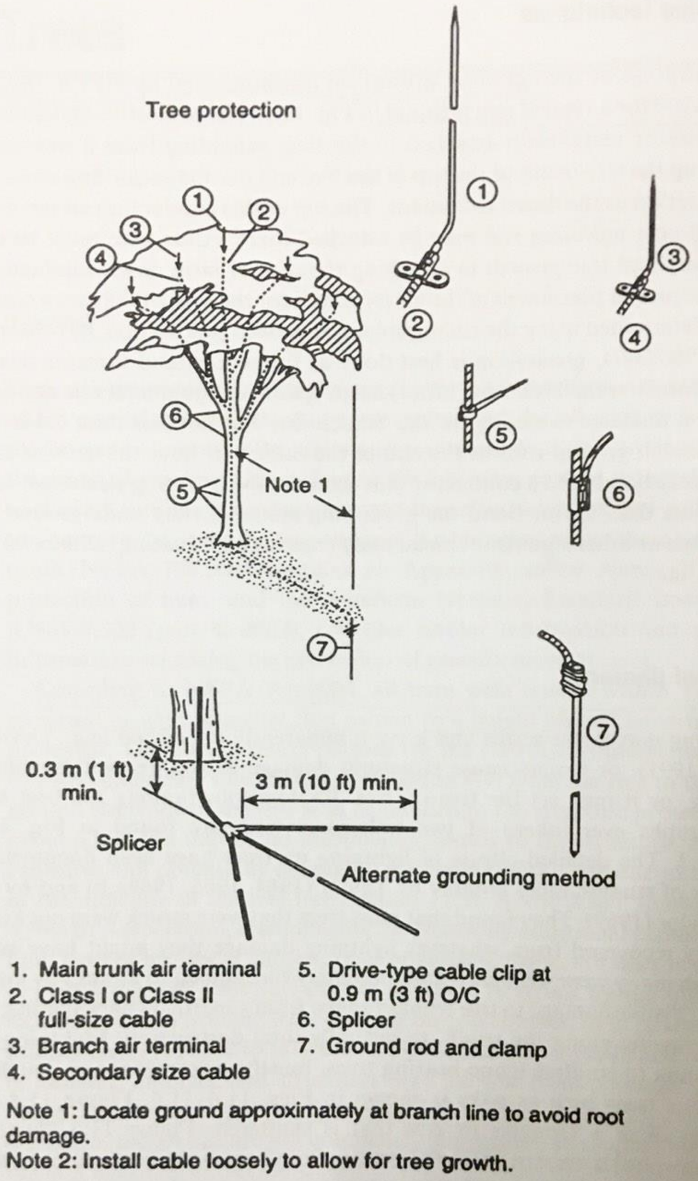


Fig. 11.1 A drawing illustrating the lightning protection of a tree taken from NFPA 780:2004. Reprinted with permission from NFPA 780, *Installation of Lightning Protection Systems*, Copyright ©2004, National Fire Protection Association, Quincy, MA 02169. This reprinted material is not the complete and official position of the National Fire Protection Association on the referenced subject which is represented only by the standard in its entirety.

Protection Measures to Reduce failure of electrical and electronic system,
Possible protection measures < Surge Protection Measure> SPM include;

- Earthing and Bonding measures,
- Magnetic shielding ,
- Line routing,
- Isolating interfaces,
- Coordinated SPM system.

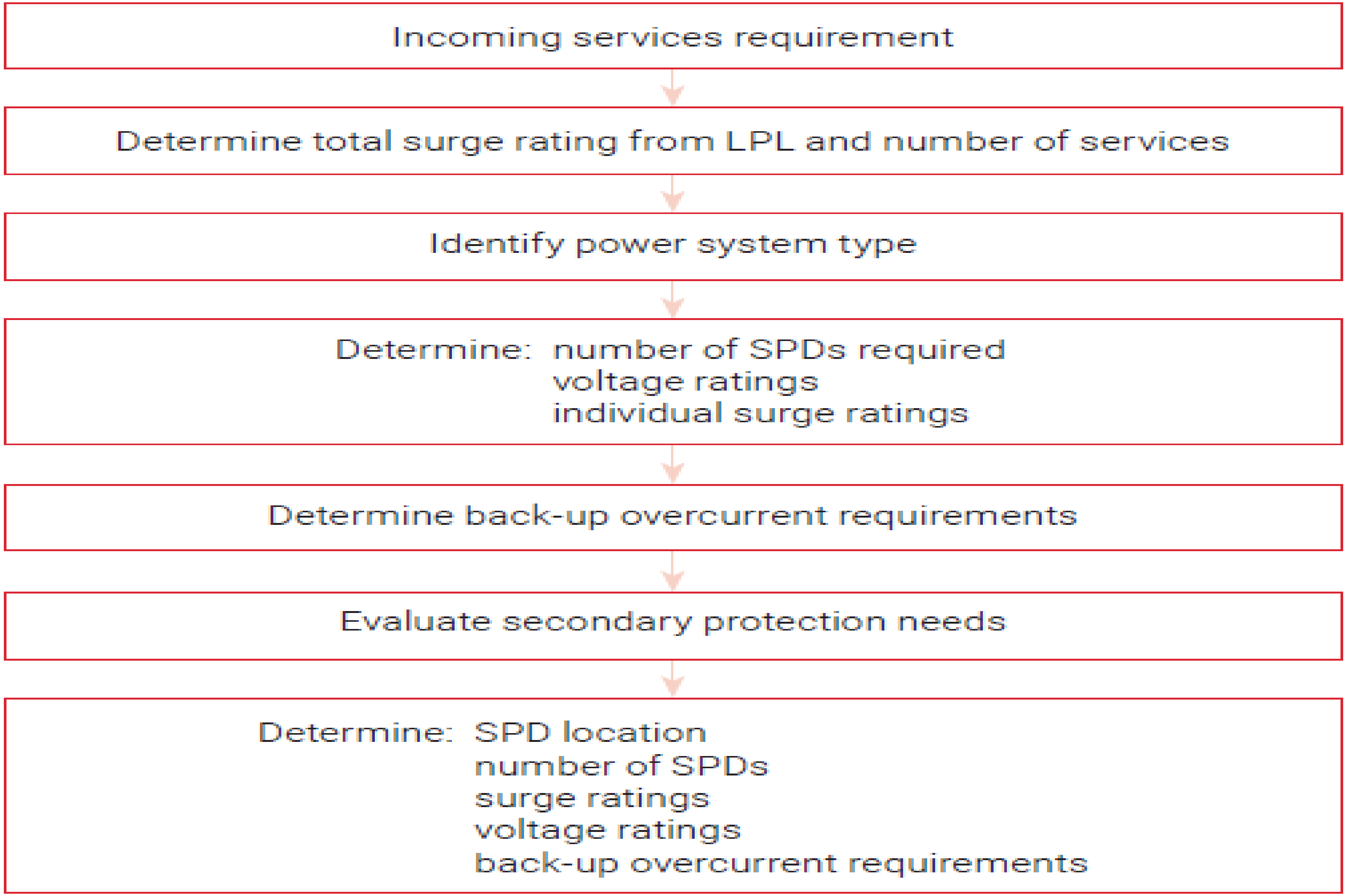
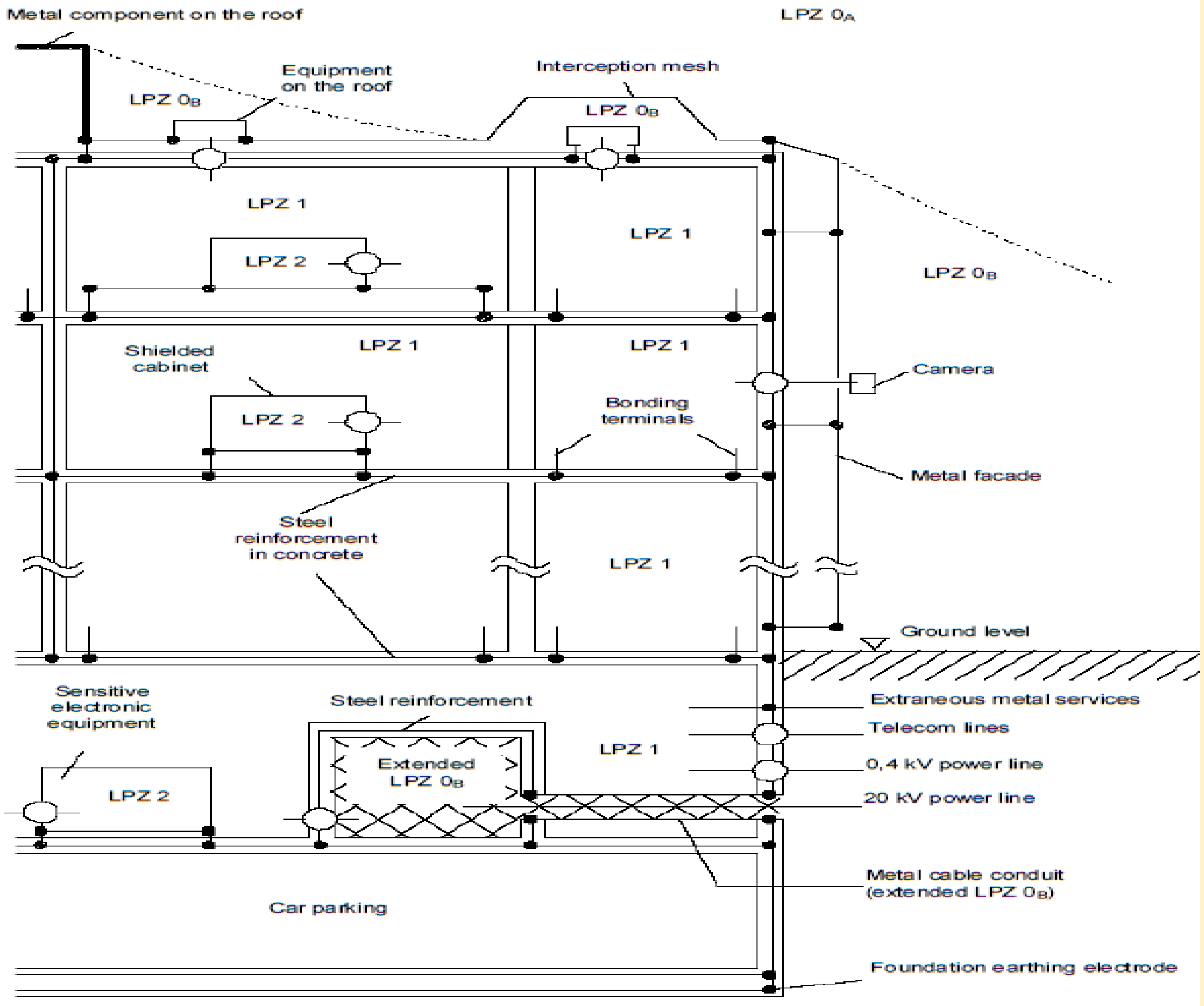


Figure 88. Flow chart for identification of surge protection requirements.

Surge Protection Measures for Office Building



Key

• equipotential bonding

O surge protective device (SPD)

Figure A.6 – Example of SPM for an office building

Sharp edge tip and Round Tip of Air Terminal

- a lightning rod with a moderate blunt tip is more effective than a lightning rod with a sharp tip.
- The ratio of tip height to tip radious of curvature , about 680:1, as oppose d sharper rods or very blunt ones.

REFERENCES:

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- C P 33
- S S 555
- IEC 62305
- Technical Handbook Erico, Designing to IEC 62305
- Lightning Protection Guide, 3rd Edition 2015
- The Arts and Science of Lightning Protection, Martin A Uman
- Mechanical and Electrical Equipment for Building, Walter ,Alison G. Kwok