Lightning Protection System

Data Supported by U Win Myint BE(EP/1977)(Nov)

Knowledge for everyone

Date-10-8- 2024

Lightning discharge and sequence of lightning current

Thunderstorms come into existence when warm air masses containing sufficient moisture are transported to great altitudes. This transport can occur in a number of ways.

In the case of heat thunderstorms, the ground is heated up locally by intense isolation. The layers of air near the ground heat up and rise. For frontal thunderstorms, the invasion of a cold air front causes cooler air to be pushed below the warm air, forcing it to rise.

Additional physical effects further increase the vertical upsurge of the air masses. This forms updraught channels with vertical speeds of up to 100km/h which create towering cumulonimbus clouds with typical heights of 5- 12 km and diameter of 5-10km.

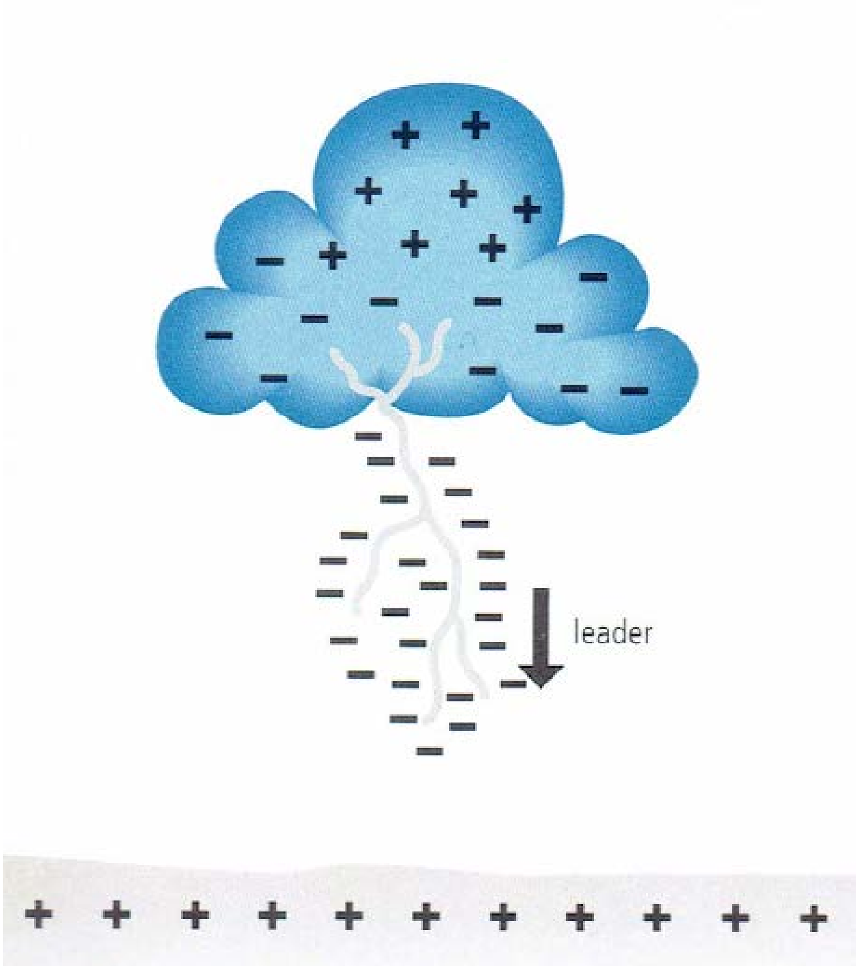
Electrostatic charge separation process,
e.g. friction and sputtering, are responsible for charging water droplets and particles of ice in the cloud.

Positively charged particles accumulate in the upper part, and negatively charged particles in the lower part of thundercloud.

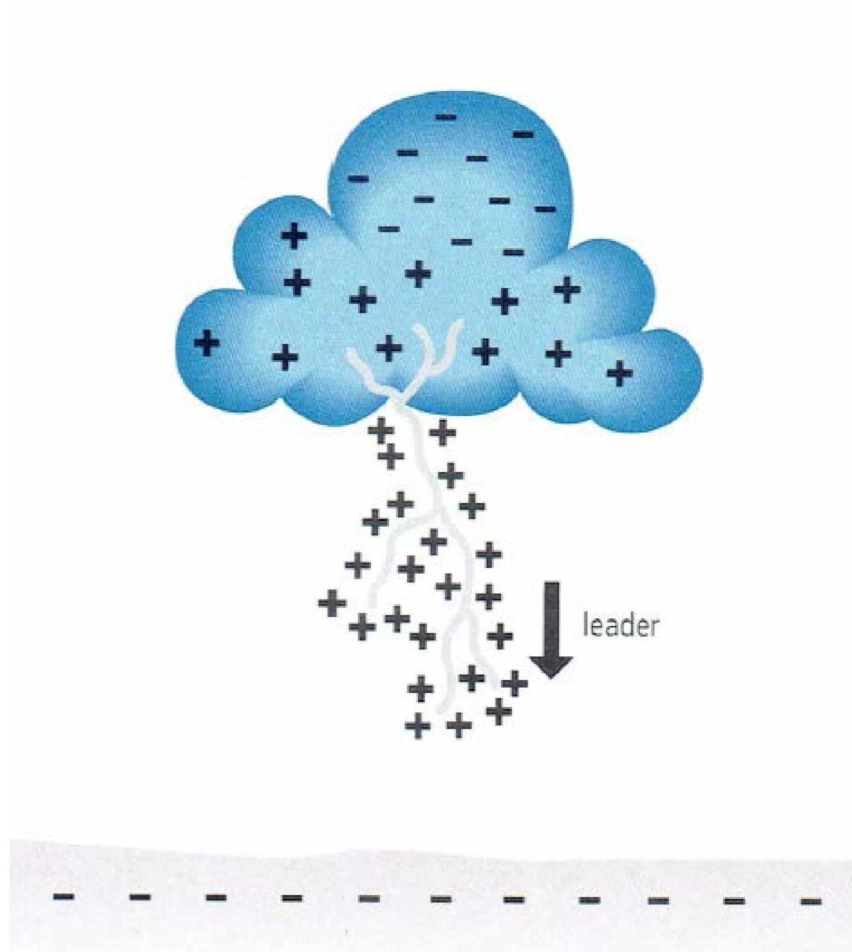
If the space charge densities, which happen to be present in a thundercloud, produce local field strengths of several 100kV/m, leader discharges (leaders) are formed which initiate a lightning discharge. Cloud –to- Cloud flashes result in charge neutralization between positive and negative cloud charge centers, and do not directly strike objects on the ground in the process.

The lightning electromagnetic impulse(LEMP) they radiate must be taken into consideration, however, because they endanger electrical and electronic systems.

Downward flash (cloud-to-earth flash)



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



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

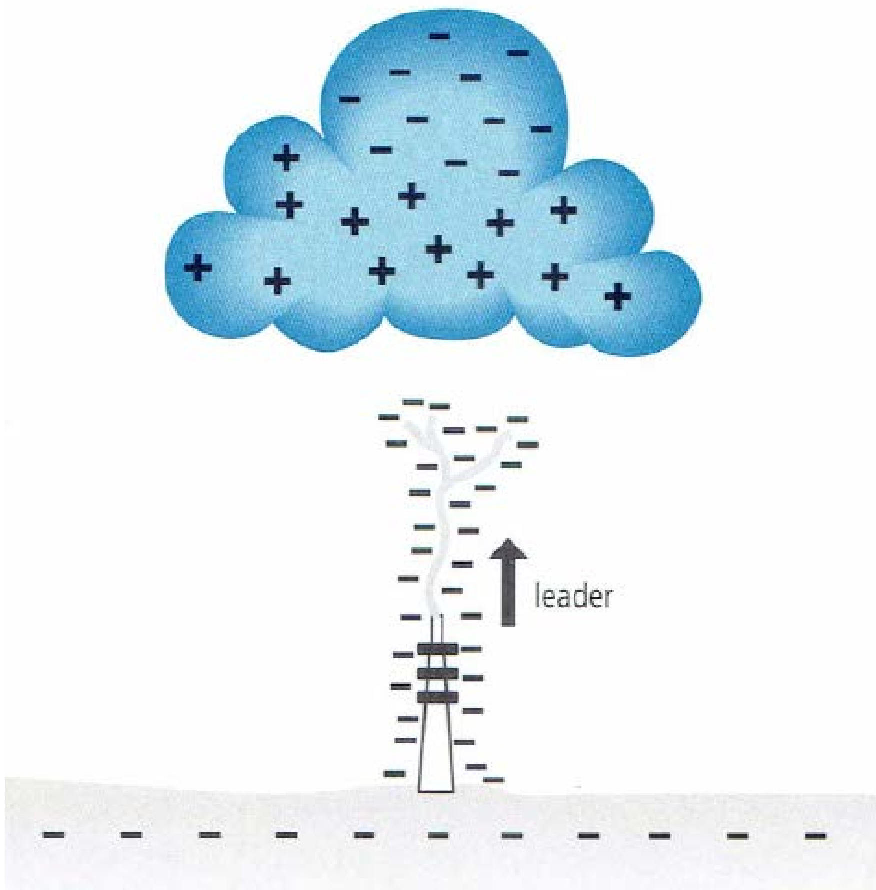
Lightning flashes

Lightning flashes to earth lead to a neutralization of charge between the cloud charges and the electrostatic charges on the ground. We distinguish between two types of lightning flashes to earth:

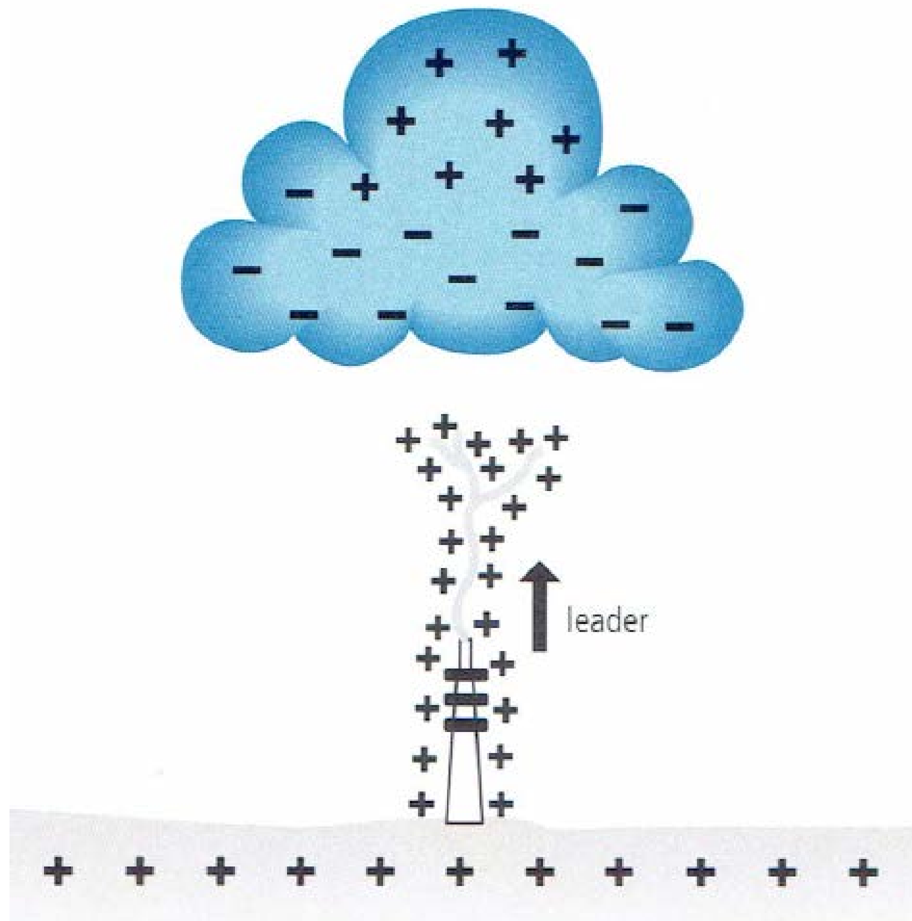
Downward flash (cloud-to-earth flash)

Upward flash (earth-to-cloud flash)

Upward flash (earth-to-cloud flash)



Discharge mechanism of a negative upward flash (earth-to-cloud flash)



Discharge mechanism of a positive upward flash (earth-to-cloud flash)

I. The Need for Protection

Before proceeding to design a detail lightning protection system, first carefully consider if the structure needs protection.

In many cases, it is obvious that some form of protection is required. High risk structures ie explosives factories, oil refineries, etc, will require the highest possible class of lightning protection to be provided.

In many other cases the need for protection is not so evident.

II. Major Components

The principle components of a lightning protection system should comprise the following:

Air-termination networks

Down conductors

Earth termination networks

III. External lightning protection

Air-termination systems
The function of the air-termination systems of a lightning protection system is to prevent direct lightning strikes from damaging the volume to be protected. They must be designed to prevent uncontrolled lightning strikes to the structure to be protected.

By correct dimensioning of the air-termination systems, the effects of a lightning strike to a structure can be reduced in a controlled way.

When determining the siting of the air-termination systems of the lightning protection system, special attention must be paid to the protection of corners and edges of the structure to be protected.

This applies particularly to air-termination systems on the surfaces of roofs and the upper parts of facades. Most importantly, air-termination systems must be mounted at corners and edges.

The Methods of Protection System

Three methods can be used to determine the arrangement and the siting of air-termination systems.

a. Rolling Sphere Method

b. Mesh Method

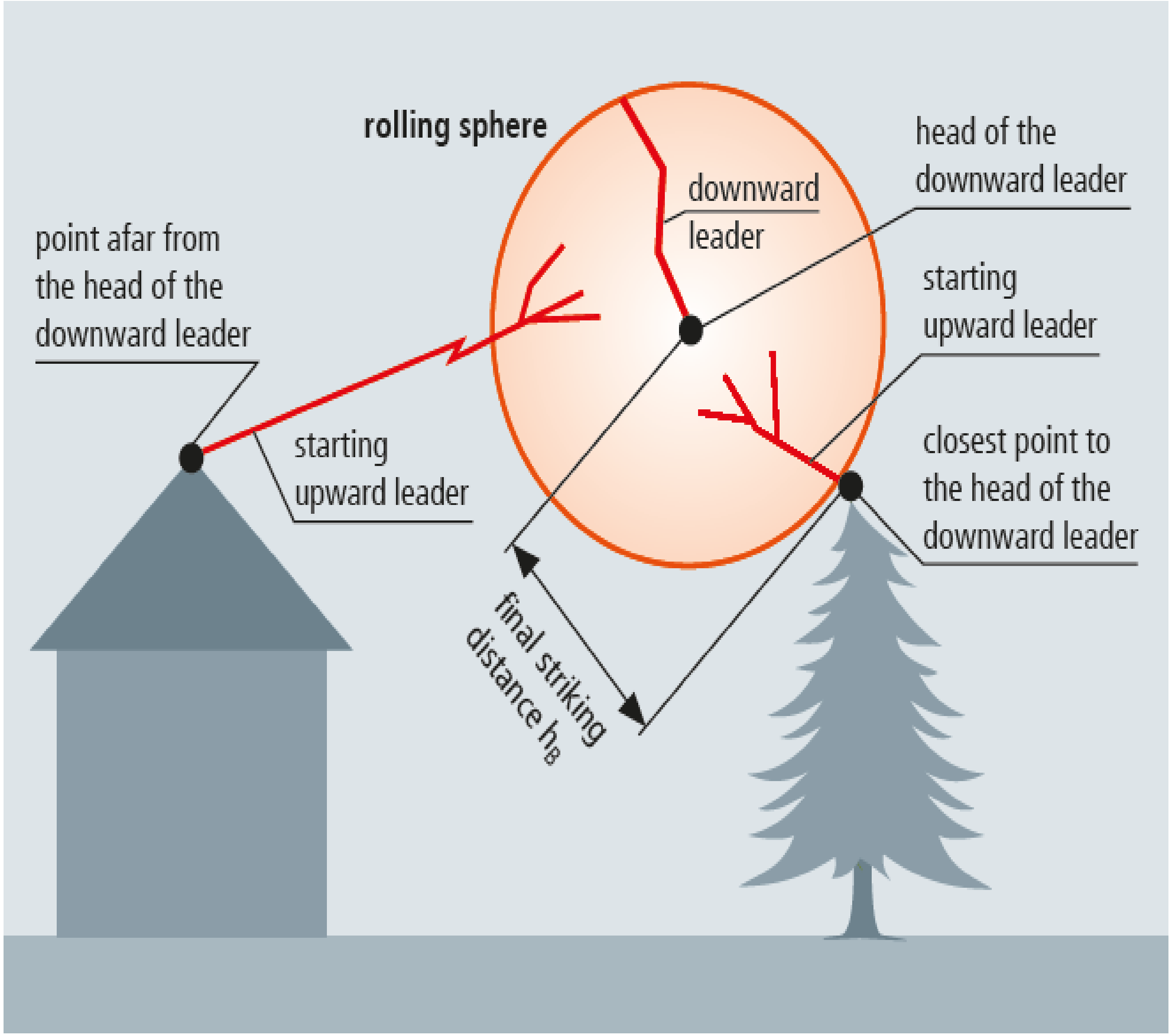
c. Protective Angle Method

The Rolling Sphere Method – “ geometric-electrical model

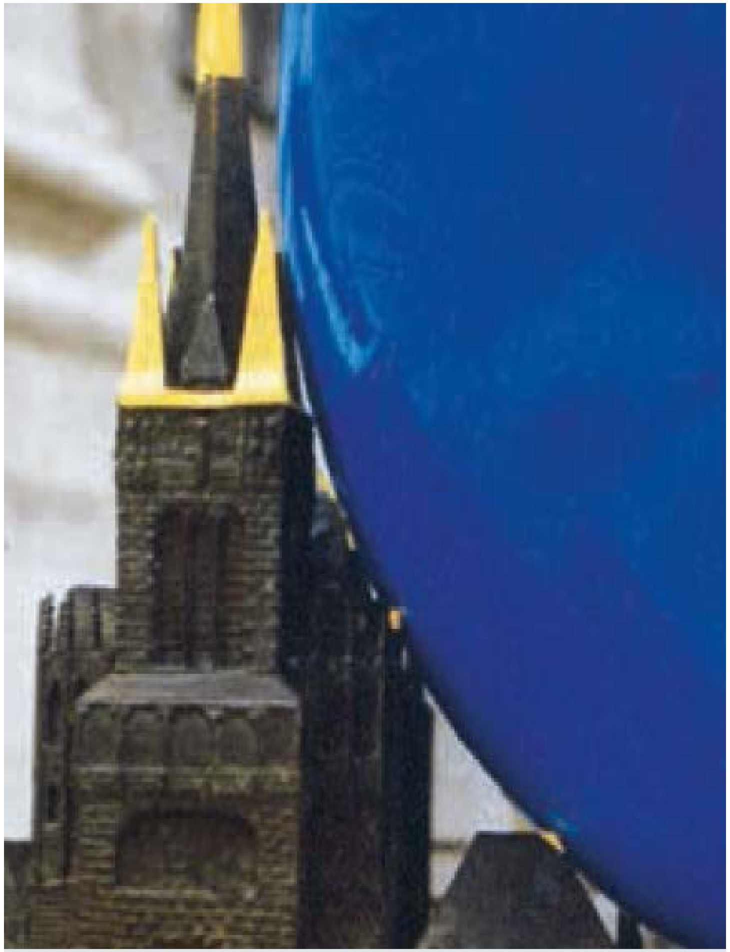
For lightning flashes to earth, a downward leader grows to step-by-step in a series of jerks from the cloud towards the earth.

When the leader has got close to the earth within a few tens, to a few hundreds of meters, the electrical insulation strength of the air near the ground is exceeded. A further “leader” discharge similar to the downward leader begins to grow towards the head of the downward leader: the upward leader

The smallest distance between the head of the downward leader and the starting point of the upward leader is called the final striking distance h_B (corresponds to the radius of rolling sphere).



Starting upward leader during the point of strike

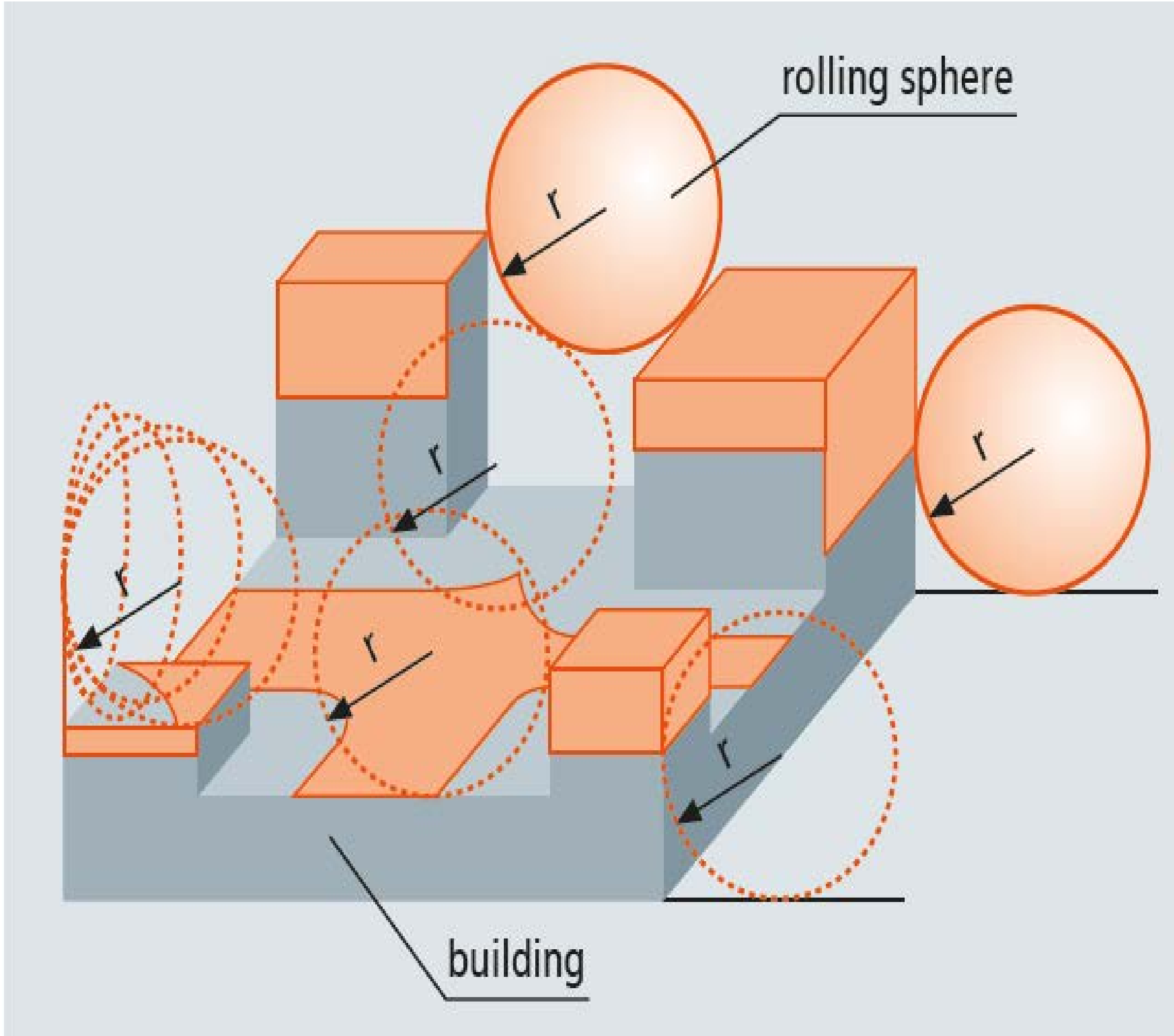


A rolling sphere cannot only touch the steeple, but also the nave of the church at multiple points, as this model experiment shows. All these points are potential points of strike.

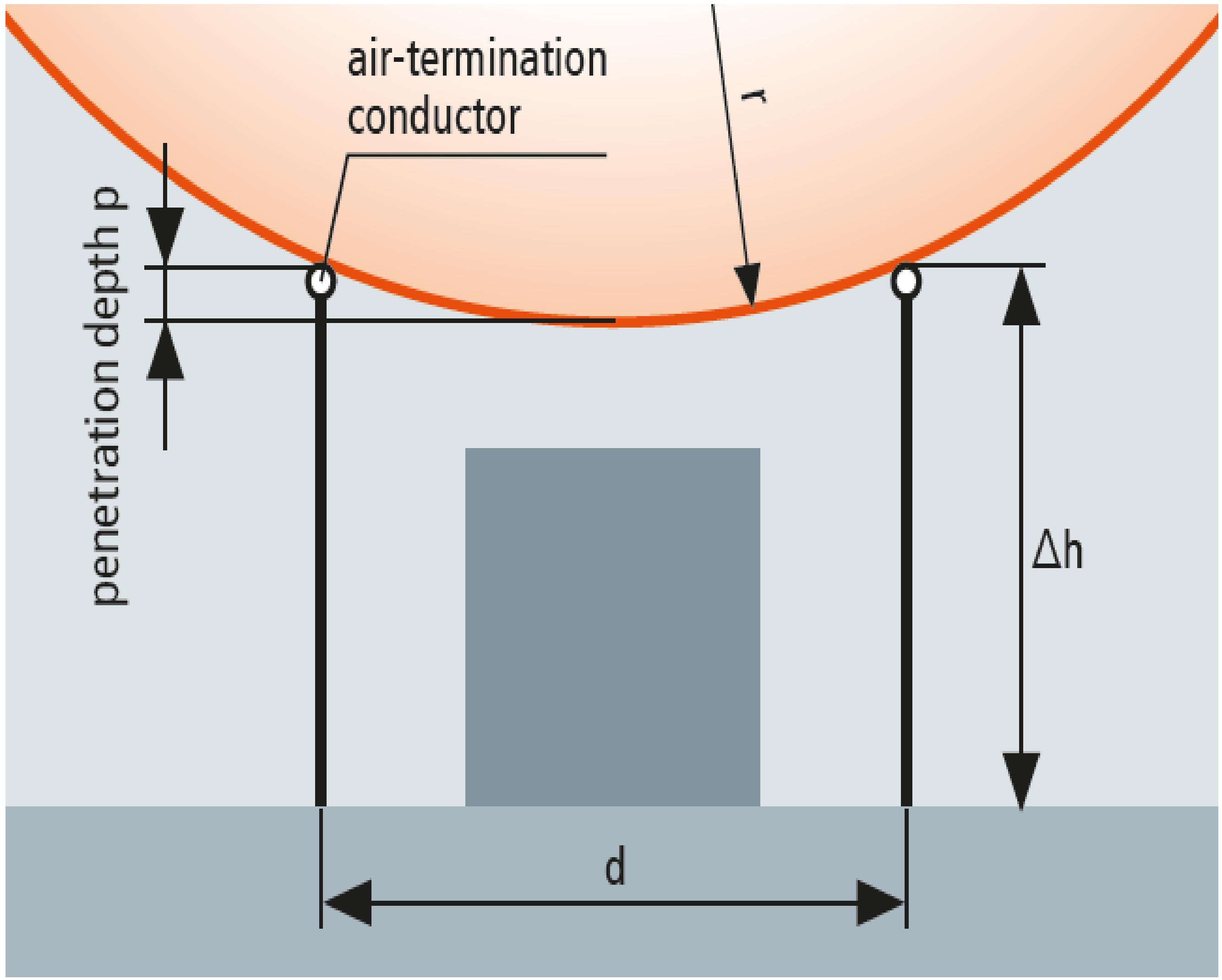
Model of a rolling sphere Ref: Prof. Dr A. Kern, Aachen

Lightning protection level LPL	Radius of the Rolling Sphere (Final striking distance h_B) r in m	Peak value current KA
IV	60	15
III	45	10
II	30	5
I	20	3

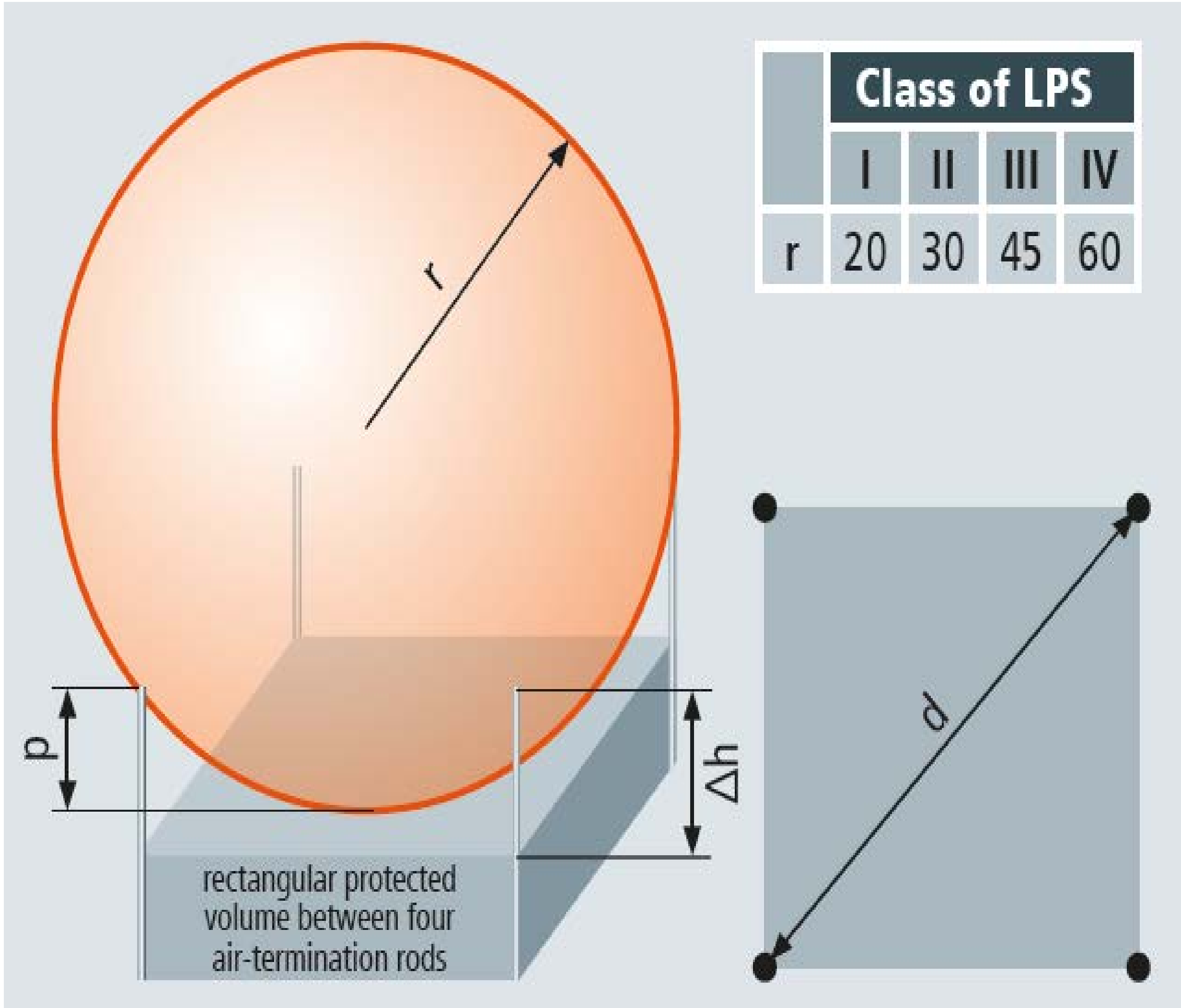
Relations between lightning protection level, final striking distance h_B and min, peak value of current



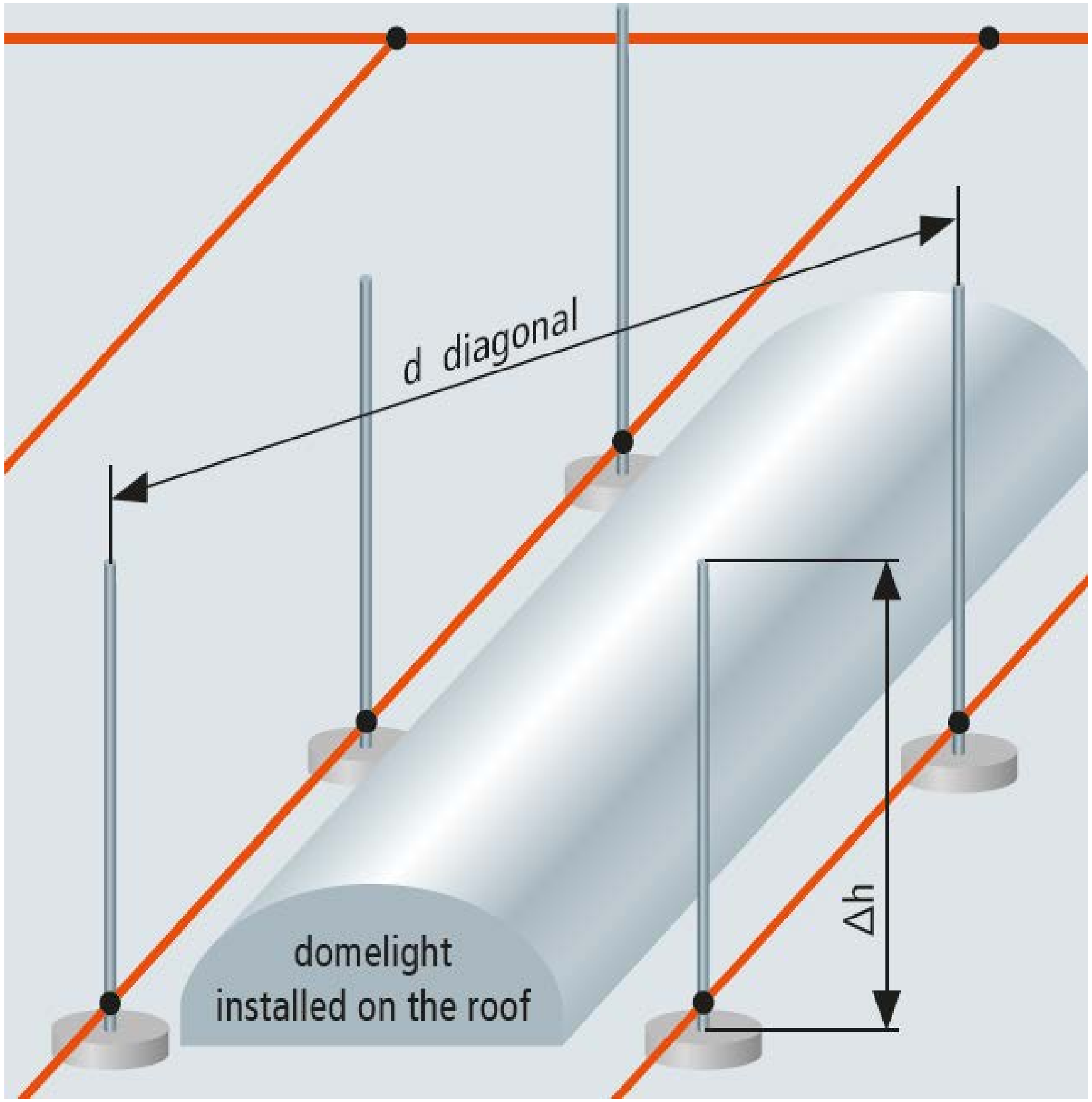
Schematic application of the "rolling sphere" method at a building with considerably structure surface



Penetration depth P of the rolling sphere



Air-termination system for installations mounted on the roof with their protective area



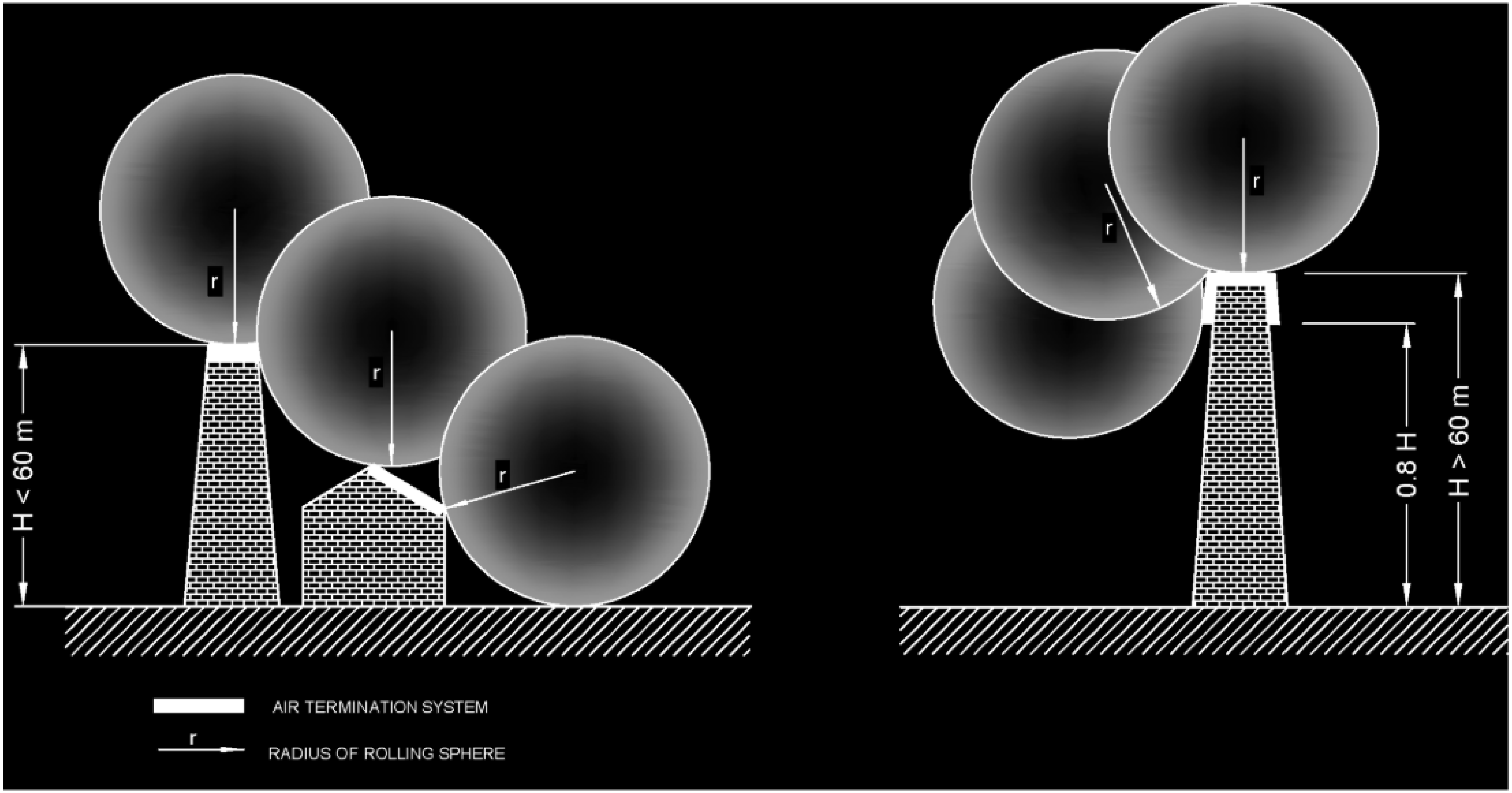
Calculation Δh for several air-termination rods according to rolling sphere method

Sag of rolling sphere over two air-termination rods or two parallel air-termination conductors

d	Sag of the rolling sphere(m) (rounded up)			
Distance between air-termination rods(m)	Class of LPS with rolling sphere radius in meter			
	I (20m)	II (30m)	III(45m)	IV(60m)
2	0.03	0.02	0.01	0.01
4	0.10	0.07	0.04	0.03
6	0.23	0.15	0.10	0.08
8	0.40	0.27	0.18	0.13
10	0.64	0.42	0.28	0.21
12	0.92	0.61	0.40	0.30
14	1.27	0.83	0.55	0.41
16	1.67	1.09	0.72	0.54
18	2.14	1.38	0.91	0.68
20	2.68	1.72	1.13	0.84
23	3.64	2.29	1.49	1.11
26	4.80	2.96	1.92	1.43
29	6.23	3.74	2.40	1.78
32	8.00	4.62	2.94	2.17
35	10.23	5.63	3.54	2.61

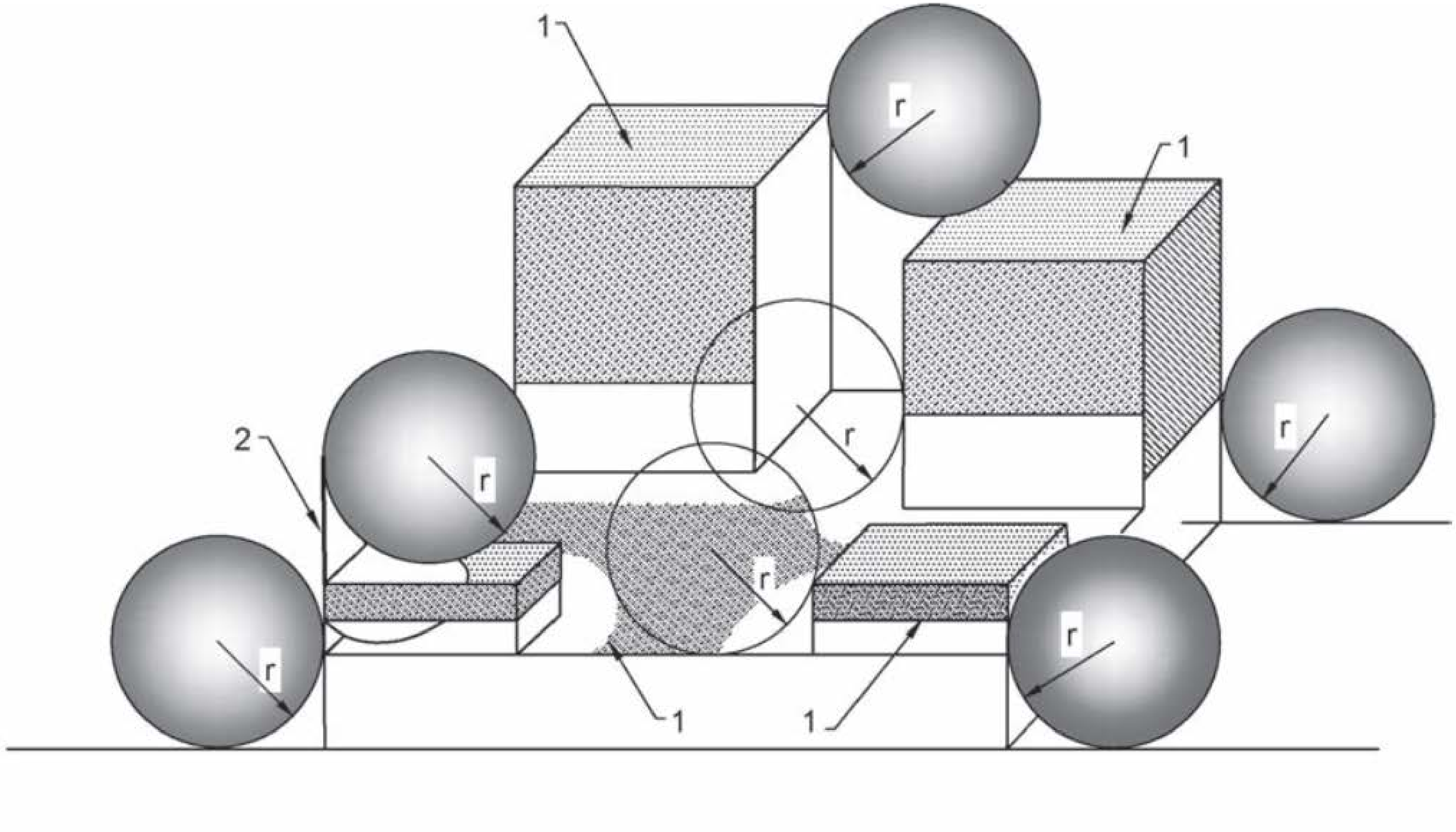
On structures lower than 60 m in height, generally flashes to the side may not occur, hence air-termination protection on sides will not be required.

On structure taller than 60 m, flashes to the side may occur, especially to points, corners an edges of surfaces.



NOTE — The rolling sphere, *r* should comply with the selected class of LPS (*see* Table 6).

FIG. 18 DESIGN OF AIR-TERMINATION SYSTEM ACCORDING TO THE ROLLING SPHERE METHOD

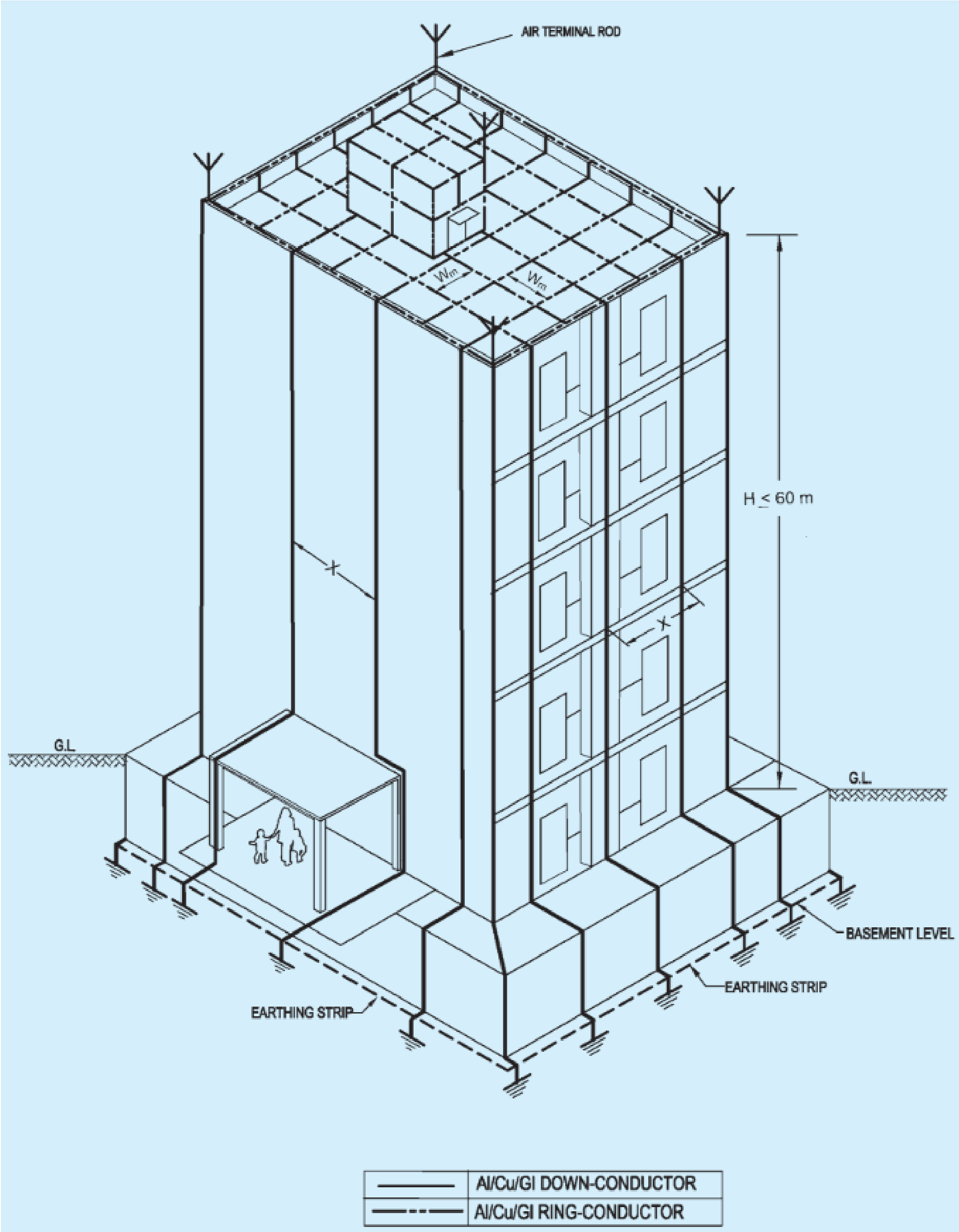


Key

1 Shaded areas are exposed to lightning interception and need protection according to Table 6
2 Mast on the structure
r Radius of rolling sphere according to Table 6

NOTE — Protection against side flashes is required {*see* good practice [8-2(45)] for details}.

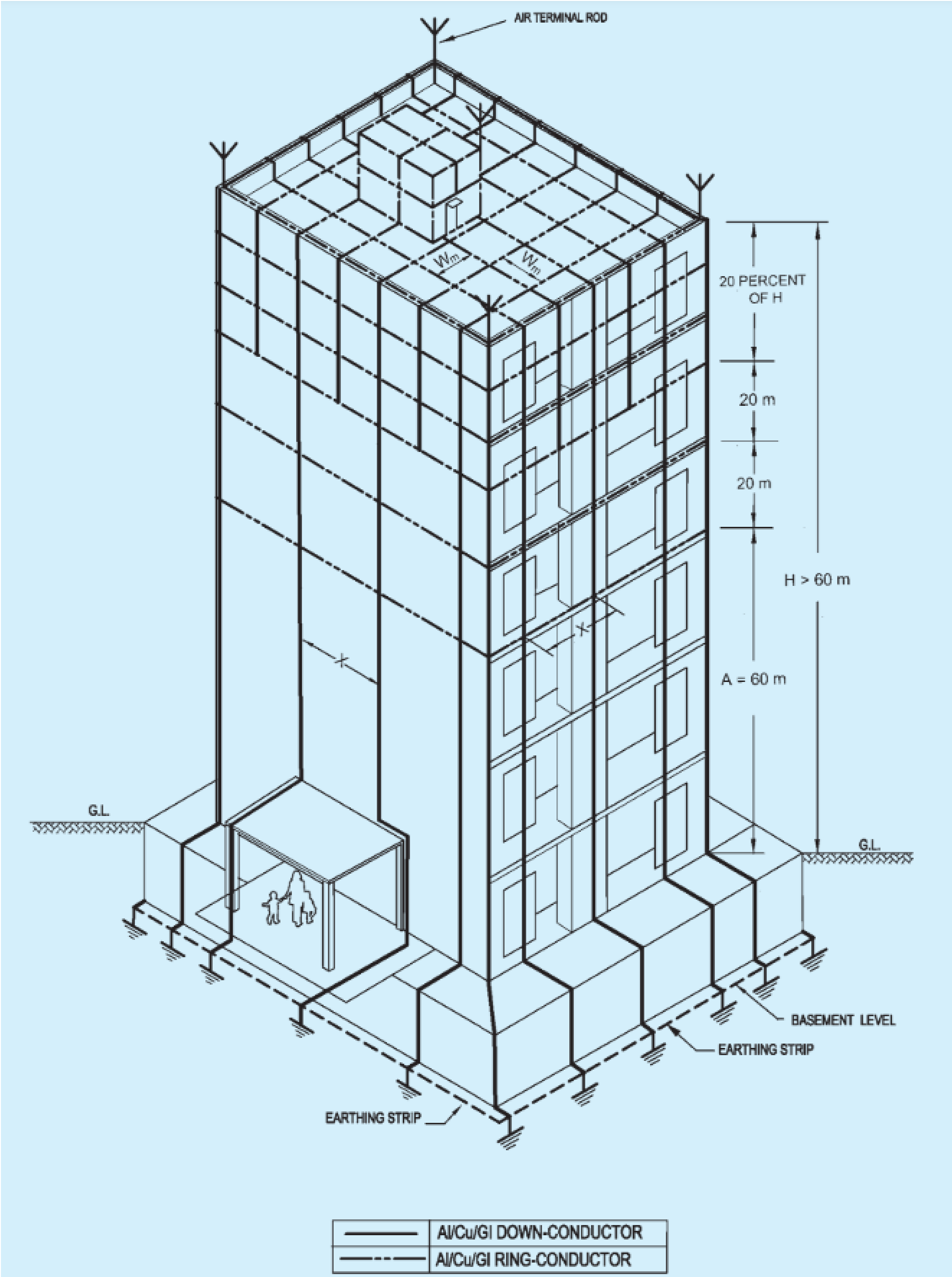
FIG. 19 DESIGN OF AIR-TERMINATION CONDUCTOR NETWORK FOR A STRUCTURE WITH COMPLICATED SHAPE



NOTES

1. Mesh size, W_m shall be as per Table 6.
2. Down-conductor spacing X, shall be as per Table 7.

21A TYPICAL LIGHTNING PROTECTION SYSTEM FOR BUILDINGS OF HEIGHT, H≤ 60 m
FIG 21



NOTES

1. Mesh size, W_m shall be as per Table 6.
2. Down-conductor spacing X, shall be as per Table 7.

21B TYPICAL LIGHTNING PROTECTION SYSTEM FOR BUILDINGS OF HEIGHT, H> 60 m

FIG 21 TYPICAL LIGHTNING PROTECTION SYSTEM FOR BUILDINGS

Mesh Method

A “Mesh Method” air-termination system can be used universally regardless of the height of the structure and shape of the roof. A reticulated air-termination network with a mesh size according to the class of lightning protection system is arranged on the roofing (See Table)

To simplify matters, the sag of the rolling sphere is assumed to be zero for a meshed air-termination system.

III b-1

Class of LPS	Mesh Size
I	5 x 5 m
II	10 X 10 m
III	15 X 15 m
IV	20 X 20 m

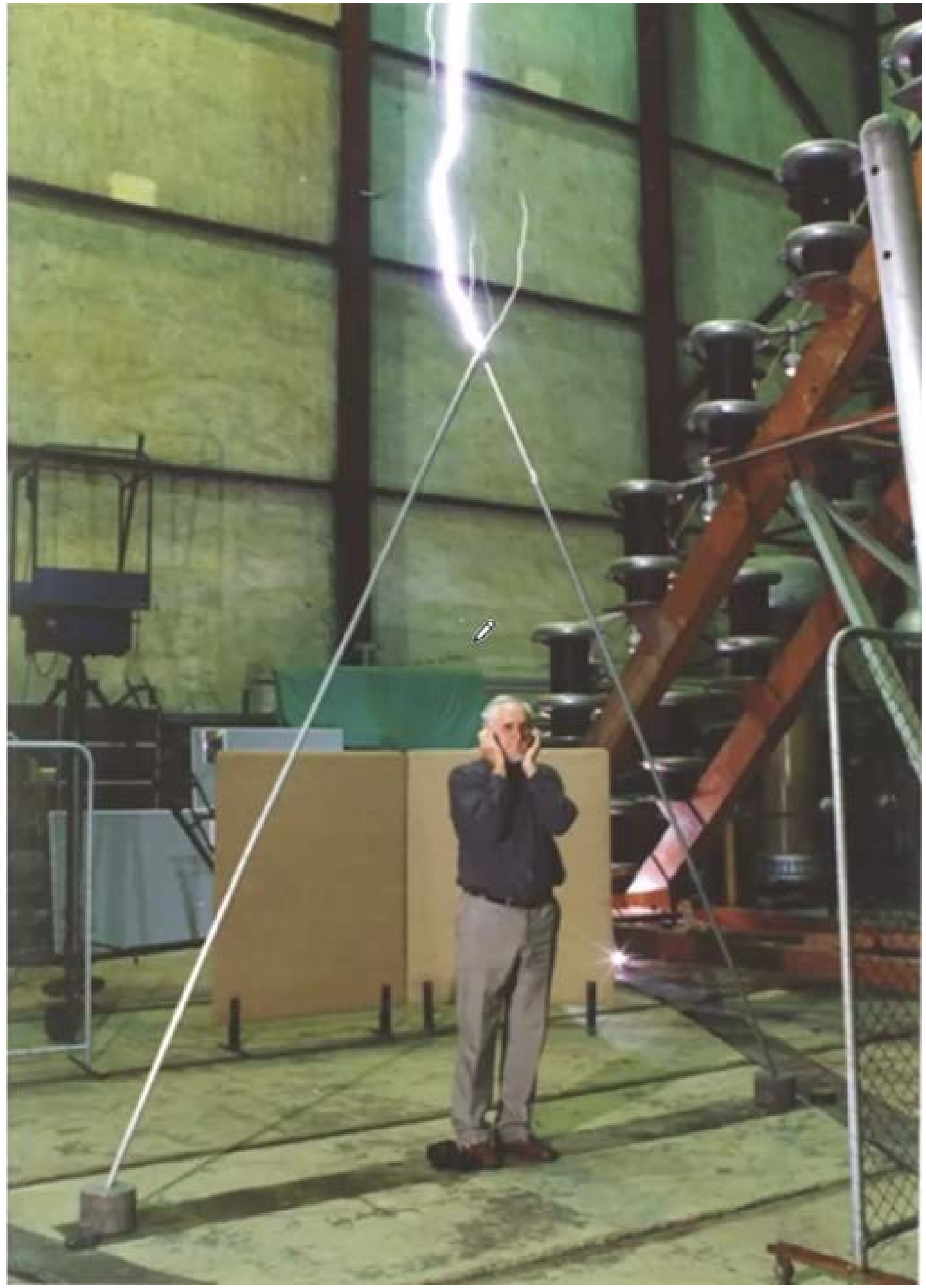
Mesh Size

Protective angle method

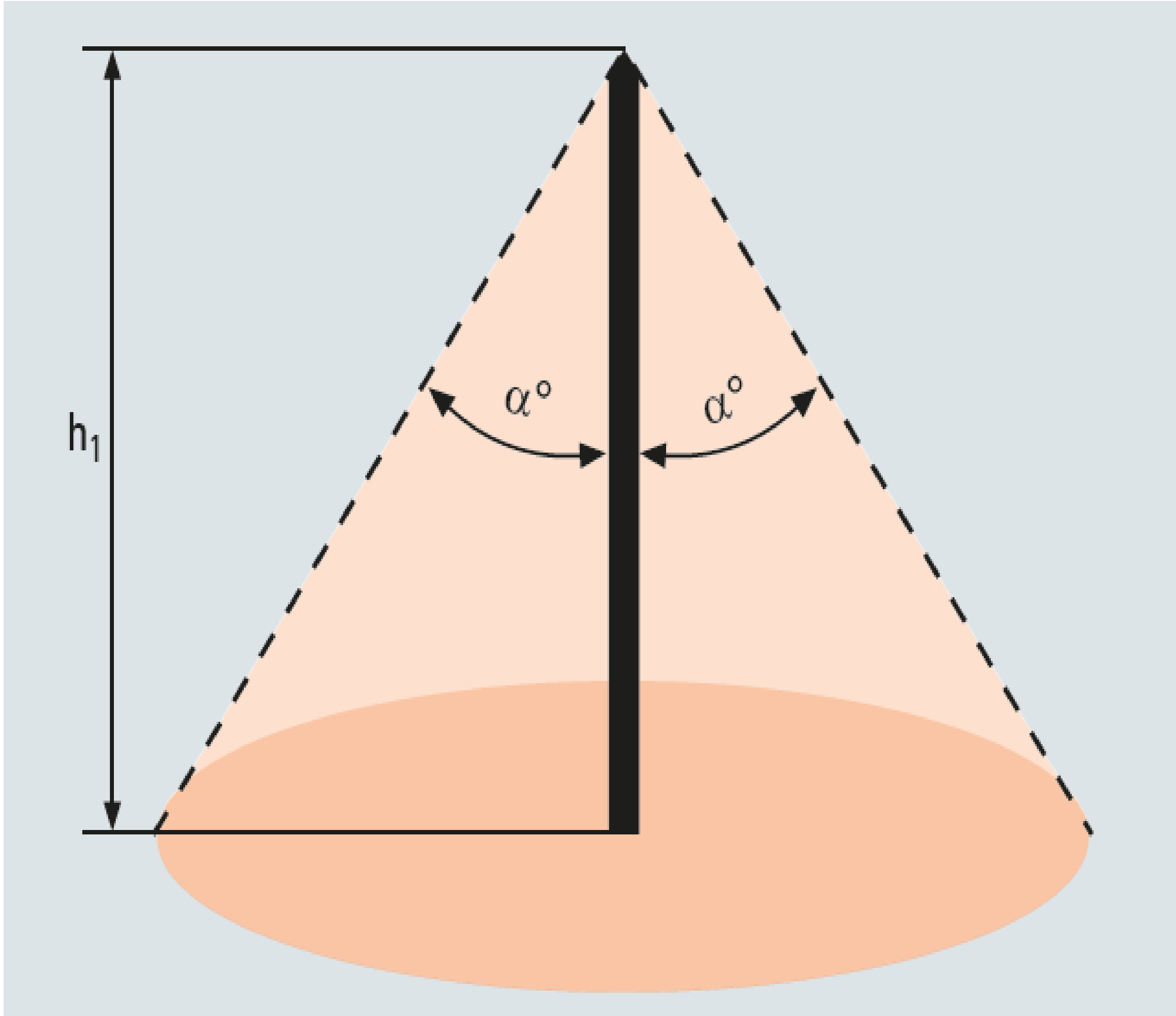
The protective angle depends on the class of lightning protection system and the height of air termination system above the reference plane.

Three Rods Model

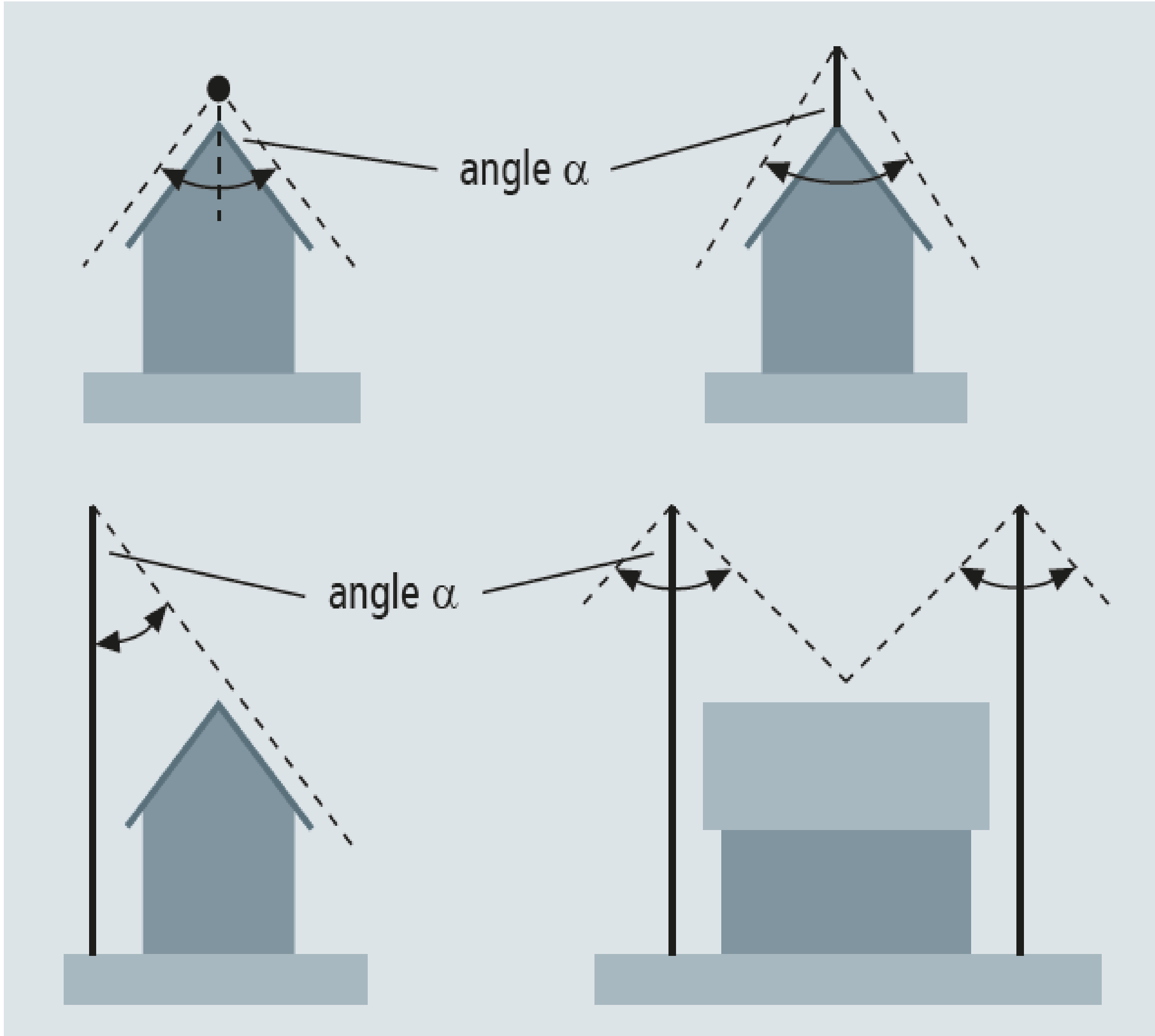
Two Rods Model



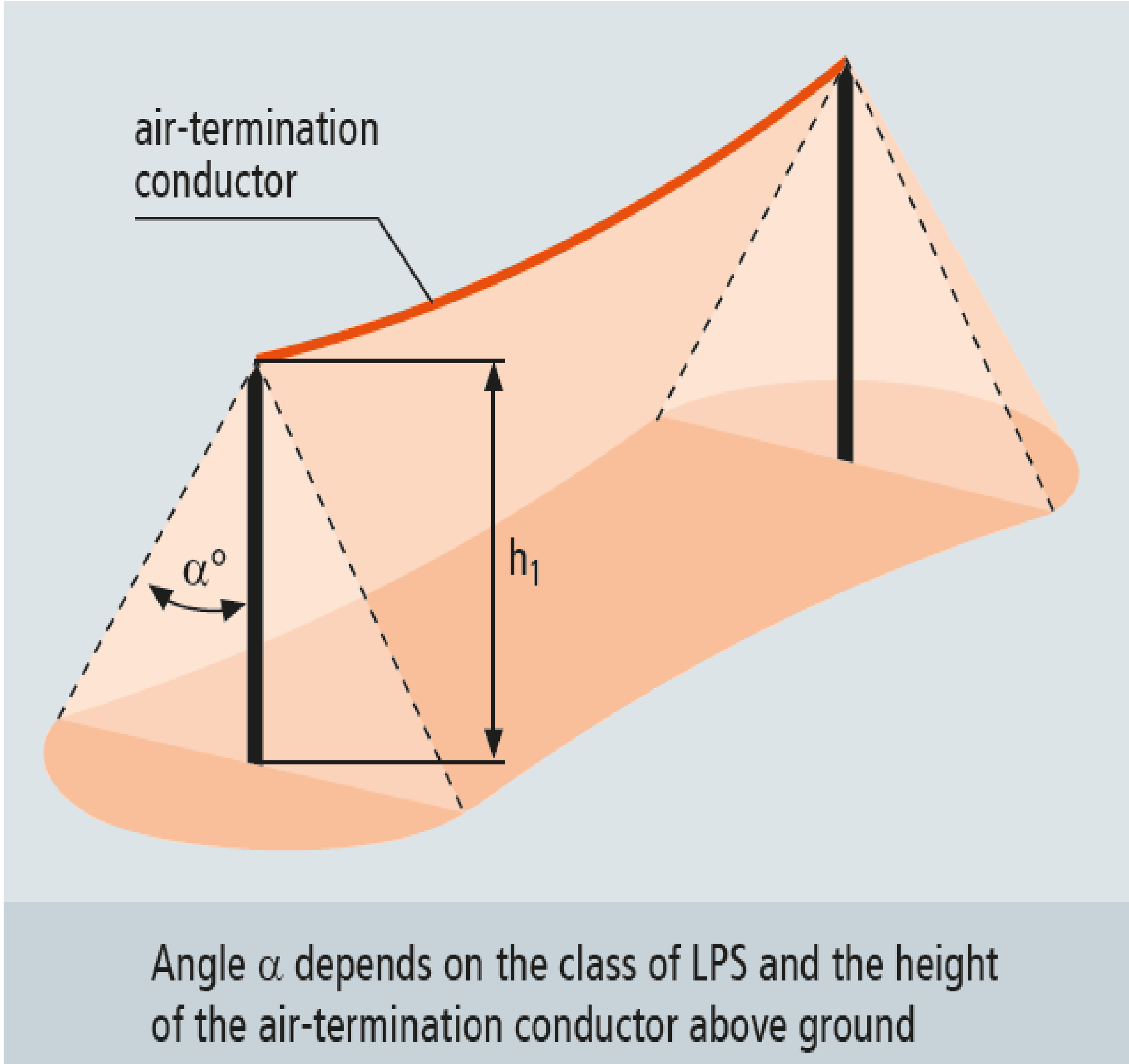
Golf Car Model



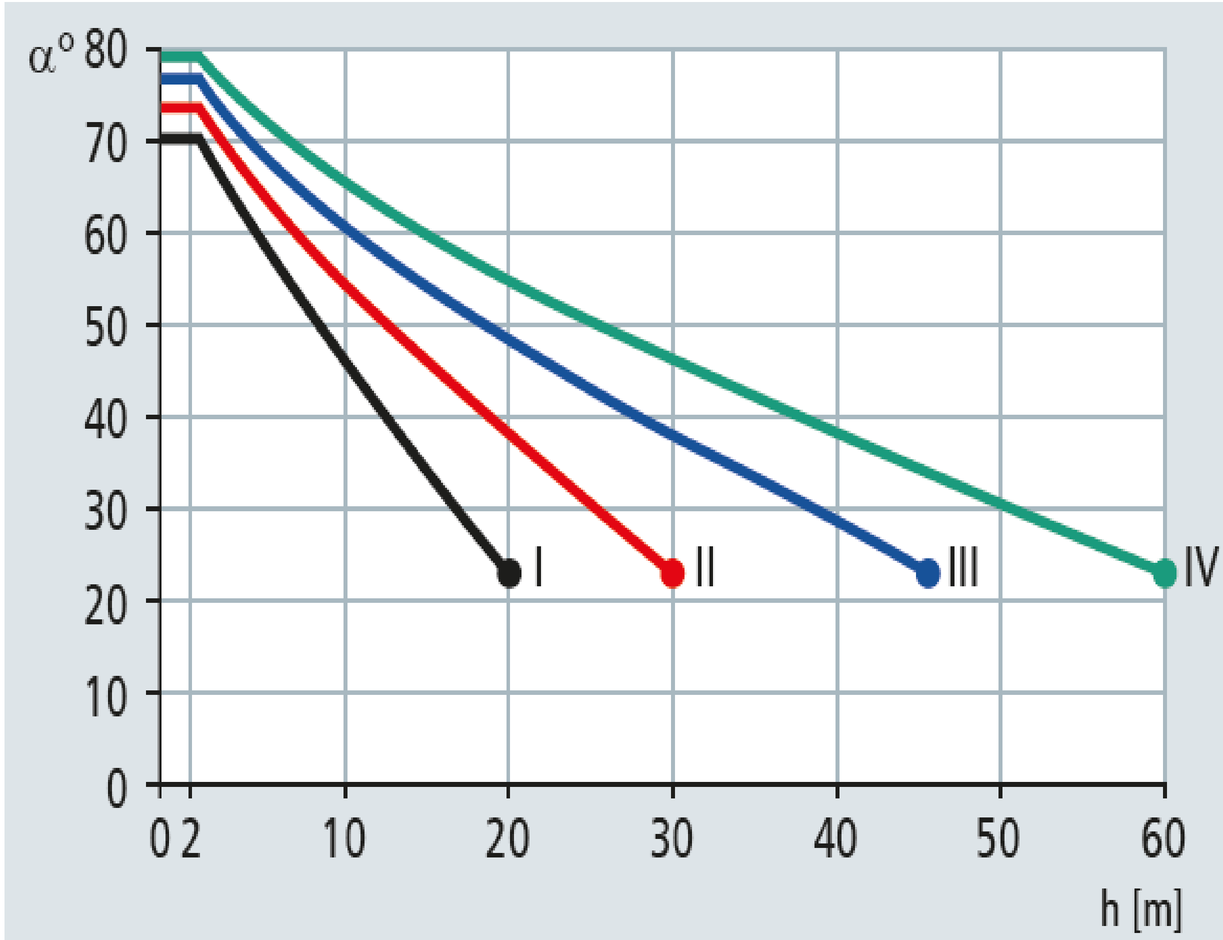
Cone-shaped protection zone



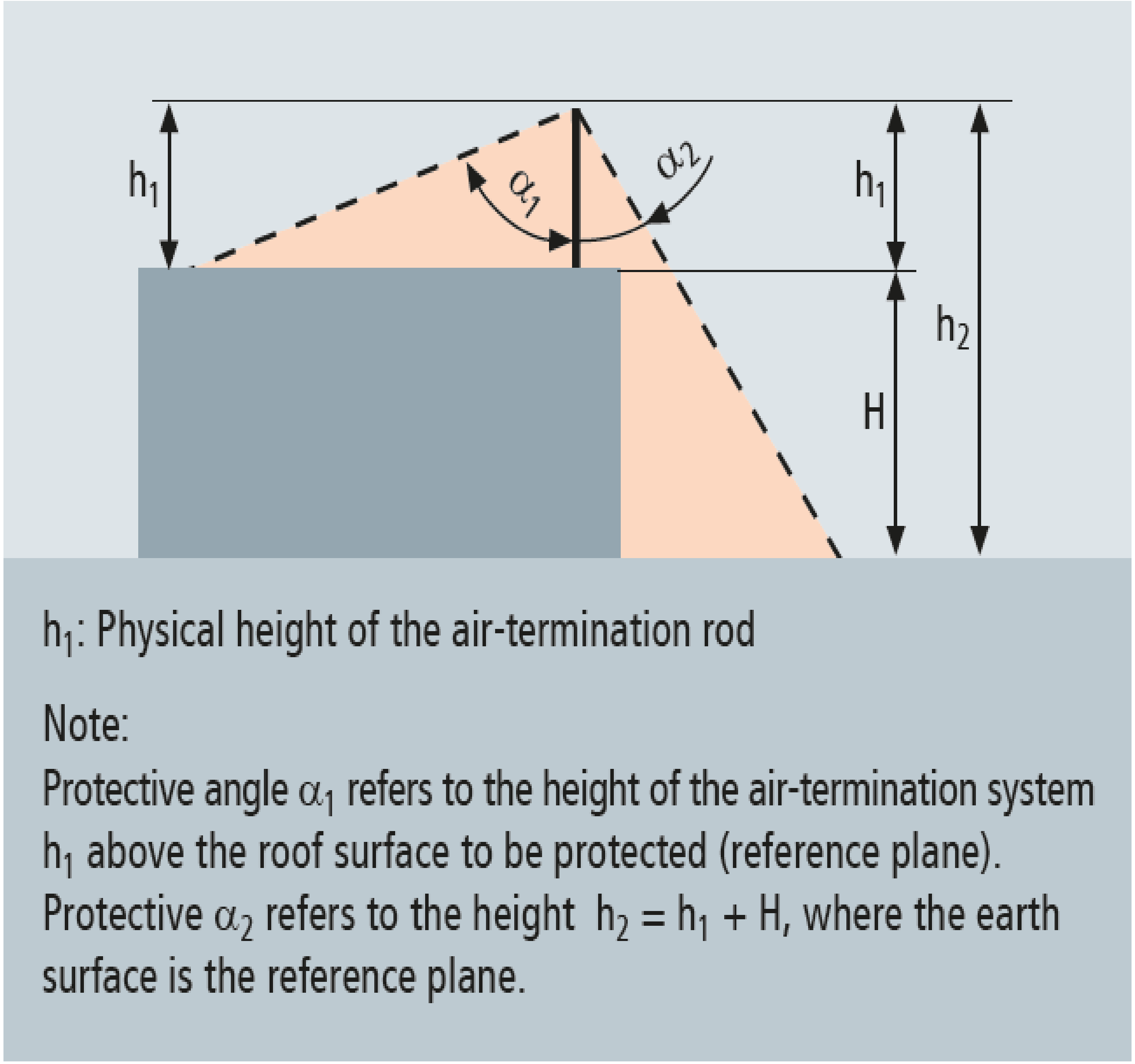
Example of air- termination systems with protective angle α



Area protected by an air-termination conductor



Protective angle α as a function of height h depending on the class of lightning protection system



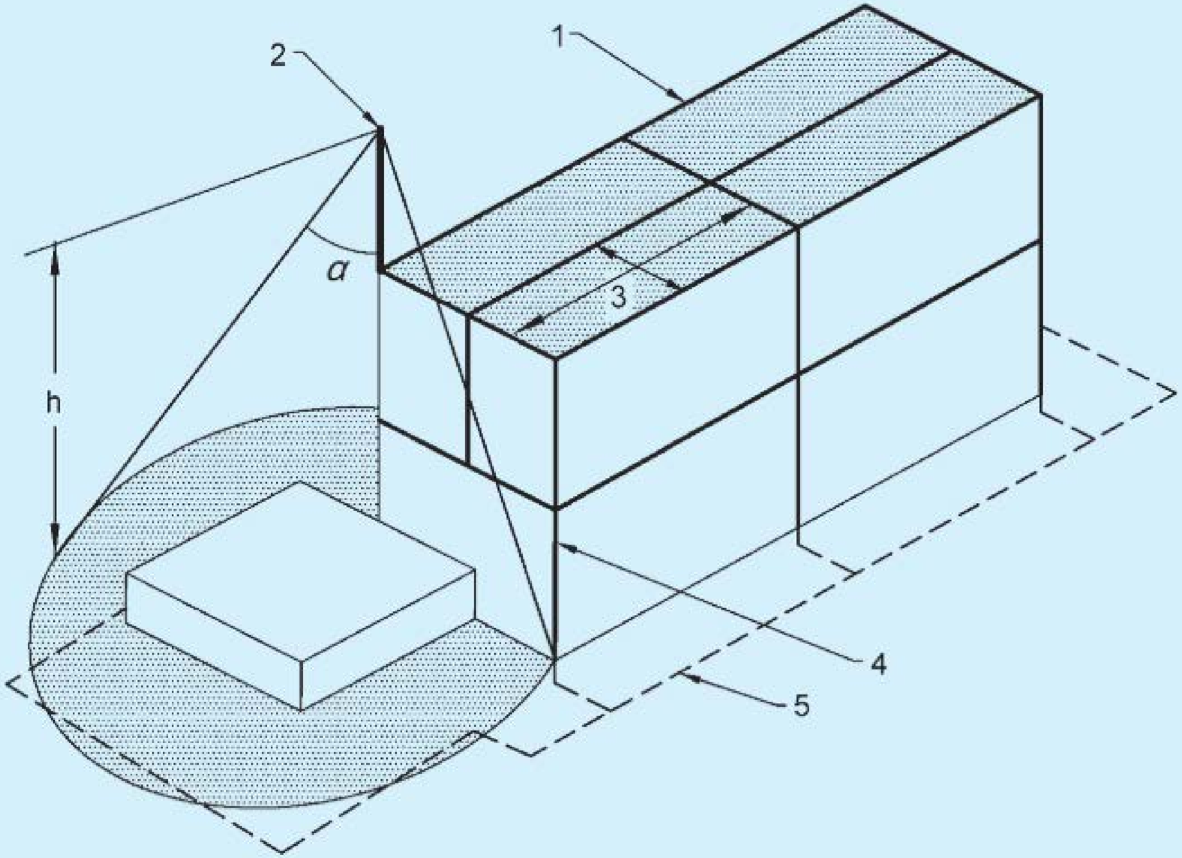
External lightning protection system, volume protected by a vertical air-termination rod

Height of the air-termination rod h in m	Class of LPS I		Class of LPS II		Class of LPS III		Class of LPS IV	
	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m
1	71	2.90	74	3.49	77	4.33	79	5.14
2	71	5.81	74	6.97	77	8.66	79	10.29
3	66	6.74	71	8.71	74	10.46	76	12.03
4	62	7.52	68	9.90	72	12.31	74	13.95
5	59	8.32	65	10.72	70	13.74	72	15.39
6	56	8.90	62	11.28	68	14.85	71	17.43
7	53	9.29	60	12.12	66	15.72	69	18.24
8	50	9.53	58	12.80	64	16.40	68	19.80
9	48	10.00	56	13.34	62	16.93	66	20.21
10	45	10.00	54	13.76	61	18.04	65	21.45
11	43	10.26	52	14.08	59	18.31	64	22.55
12	40	10.07	50	14.30	58	19.20	62	22.57
13	38	10.16	49	14.95	57	20.02	61	23.45
14	36	10.17	47	15.01	55	19.99	60	24.25
15	34	10.12	45	15.00	54	20.65	59	24.96
16	32	10.00	44	15.45	53	21.23	58	25.61
17	30	9.81	42	15.31	51	20.99	57	26.18
18	27	9.17	40	15.10	50	21.45	56	26.69
19	25	8.86	39	15.39	49	21.86	55	27.13
20	23	8.49	37	15.07	48	22.21	54	27.53

Height of the air-termination rod h in m	Class of LPS I		Class of LPS II		Class of LPS III		Class of LPS IV	
	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m
21			36	15.26	47	22.52	53	27.87
22			35	15.40	46	22.78	52	28.16
23			36	16.71	47	24.66	53	30.52
24			32	15.00	44	23.18	50	28.60
25			30	14.43	43	23.31	49	28.76
26			29	14.41	41	22.60	49	29.91
27			27	13.76	40	22.66	48	29.99
28			26	13.66	39	22.67	47	30.03
29			25	13.52	38	22.66	46	30.03
30			23	12.73	37	22.61	45	30.00
31					36	22.52	44	29.94
32					35	22.41	44	30.90
33					35	23.11	43	30.77
34					34	22.93	42	30.61
35					33	22.73	41	30.43
36					32	22.50	40	30.21
37					31	22.23	40	31.50
38					30	21.94	39	30.77
39					29	21.62	38	30.47
40					28	21.27	37	30.14

Height of the air-termination rod h in m	Class of LPS I		Class of LPS II		Class of LPS III		Class of LPS IV	
	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m	Angle α	Distance a in m
41					27	20.89	37	30.90
42					26	20.48	36	30.51
43					25	20.05	35	30.11
44					24	19.59	35	30.81
45					23	19.10	34	30.35
46							33	29.87
47							32	29.37
48							32	29.99
49							31	29.44
50							30	28.87
51							30	29.44
52							29	28.82
53							28	28.18
54							27	27.51
55							27	28.02
56							26	27.31
57							25	26.58
58							25	27.05
59							24	26.27
60							23	25.47

Table 5.1.1.4 Protective angle α depending on the class of LPS



Key

1 Air-termination conductor (also called as mesh/Faraday cage). *See* Table 6 for mesh size

2 Air-termination rod

3 Mesh size

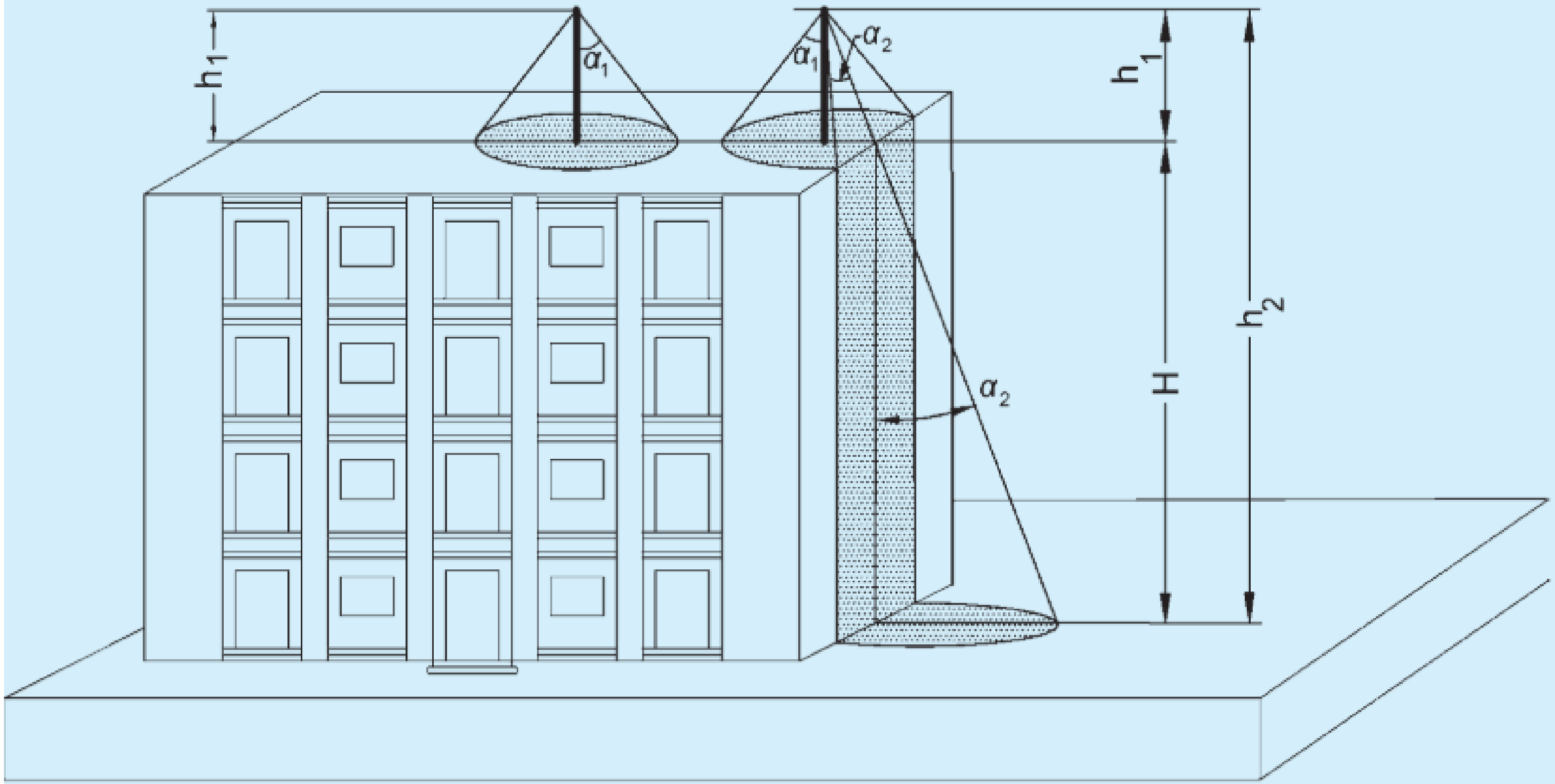
4 Down-conductor

5 Earthing system with ring conductor

h = Height of the air-terminal above ground level

α = Protection angle

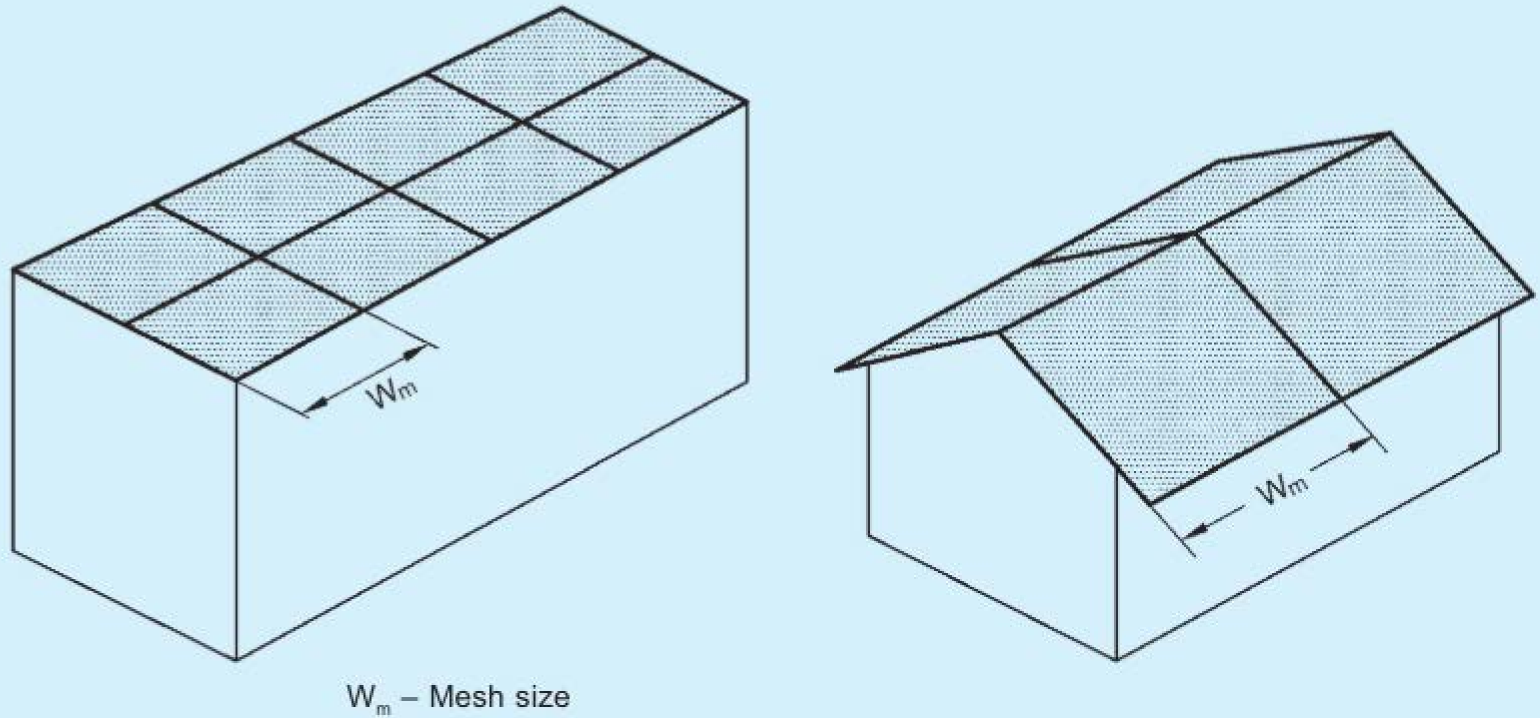
FIG. 20 DESIGN OF AN LPS AIR-TERMINATION ACCORDING TO THE PROTECTION ANGLE METHOD, MESH METHOD AND GENERAL ARRANGEMENT OF AIR-TERMINATION ELEMENTS



Key

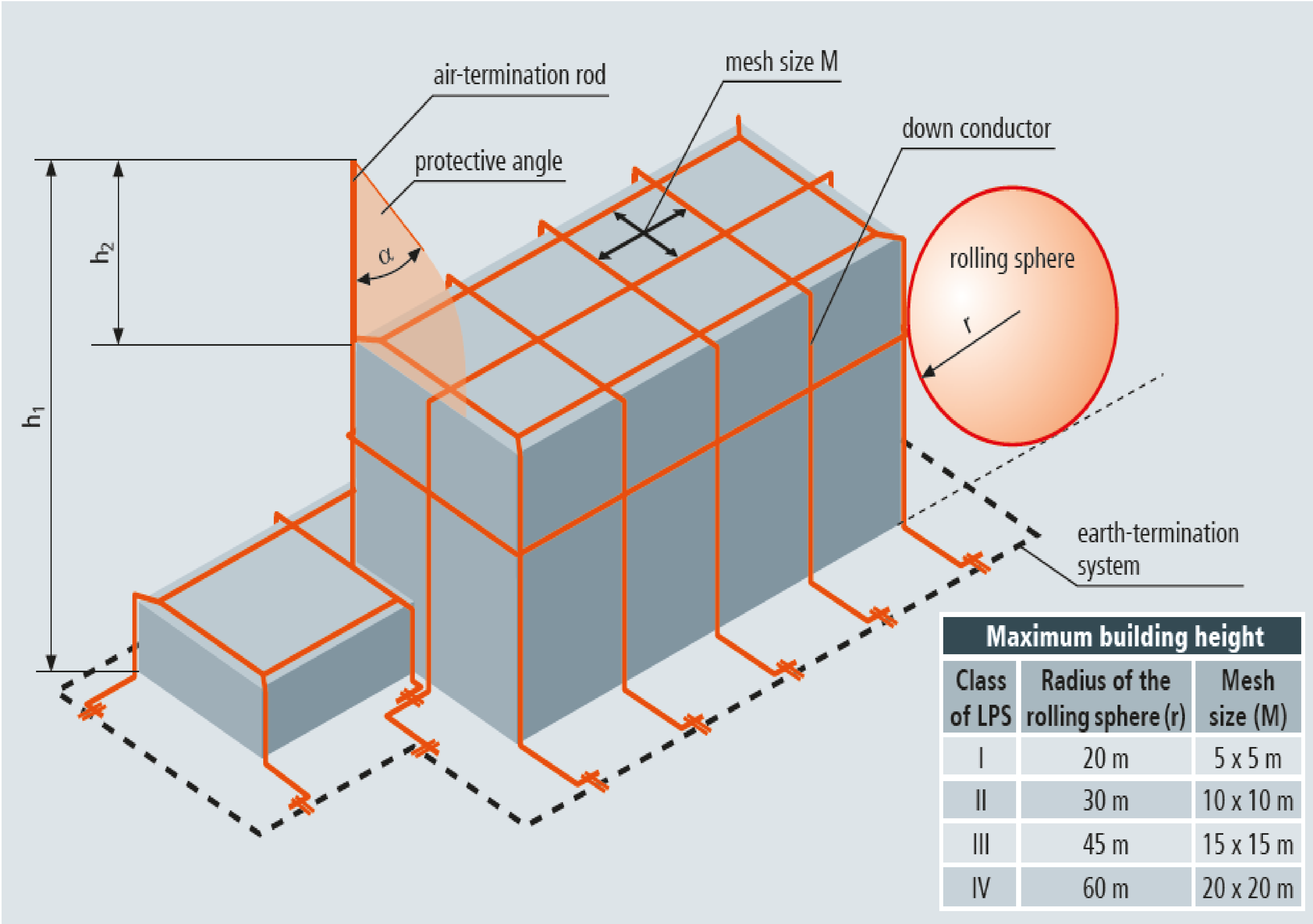
H	Height of the building over the ground reference plane
h_1	Physical height of an air-termination rod
h_2	Height of the air-termination rod over the ground (= h_1 + H)
α_1	The protection angle corresponding to the air-termination height, h = h_1, being the height above the roof surface to be measured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

FIG. 16 PROTECTION ANGLE METHOD OF AIR-TERMINATION DESIGN FOR DIFFERENT HEIGHTS ACCORDING TO TABLE 6



NOTE — The mesh size should comply with table 6.

FIG. 17 DESIGN OF AIR-TERMINATION SYSTEM ACCORDING TO MESH METHOD



Maximum building height		
Class of LPS	Radius of the rolling sphere (r)	Mesh size (M)
I	20 m	5 x 5 m
II	30 m	10 x 10 m
III	45 m	15 x 15 m
IV	60 m	20 x 20 m

Method for designing of air-termination systems for high buildings

Down Conductor System

The down conductor system is the electrically conductive connection between the air-termination system and the earth-termination system. The function of down-conductor system is to conduct the intercepted lightning current to the earth-termination system without intolerable temperature rises,

For example, to damage the structure.

To avoid damage caused during the lightning current discharge to the earth-termination system, the down-conductor systems must be mounted to ensure that from the point of strike to the earth,

* Several parallel current paths exist.
* The length of the current paths is kept as short as possible(straight, vertical, no loops)

Determination of the number of down conductors

The number of down conductors depends on the perimeter of the external edges of the roof (Perimeter of the projection on the ground surface).

The down conductors must be arranged to ensure that, starting at the corners of the structure, they are distributed as uniformly as possible to the perimeter.

Depending on the structural features(e.g. gates, precast components), the distance between the various down conductors can be at least the total number of down conductor required for the respective class of lightning protection system.

The IEC 62305-3(EN-62305-3) standard gives typical distances between down conductors and ring conductors for each class of lightning protection system(Table below)

Class of LPS	Typical Distance
I	10 m
II	10 m
III	15 m
IV	20 m

Distance between down conductors according to IEC 62305-3/ EN 62305-3)

Earth-Termination System

Earth-termination system is a part of an external LPS which is intended to conduct and disperse lightning current into the earth.

In general, a low earthing resistance (if possible lower than 10 ohms when measured at low frequency) is recommended.

Definition of Touch Voltage

Touch voltage is a voltage acting upon a person between his position on the earth and when touching the down conductor.

The current path leads from the hand via the body to the feet (Figure 5.7.1).

For a structure built with a steel skeleton or reinforced concrete, there is no risk of intolerably high touch voltages provided that the reinforcement is safely interconnected or the down conductors are installed in concrete.

Moreover, the touch voltage can be disregarded for metal facades if they are integrated into the equipotential bonding and/or used as natural components of the down conductor.

If there is a reinforced concrete with a safe tying of the reinforcement to the foundation earth electrode under the surface of the earth in the areas outside the structure which is at risk, then this measure already improves the curve of the gradient area and acts as a potential control.

Hence step voltage can be left out of the considerations.

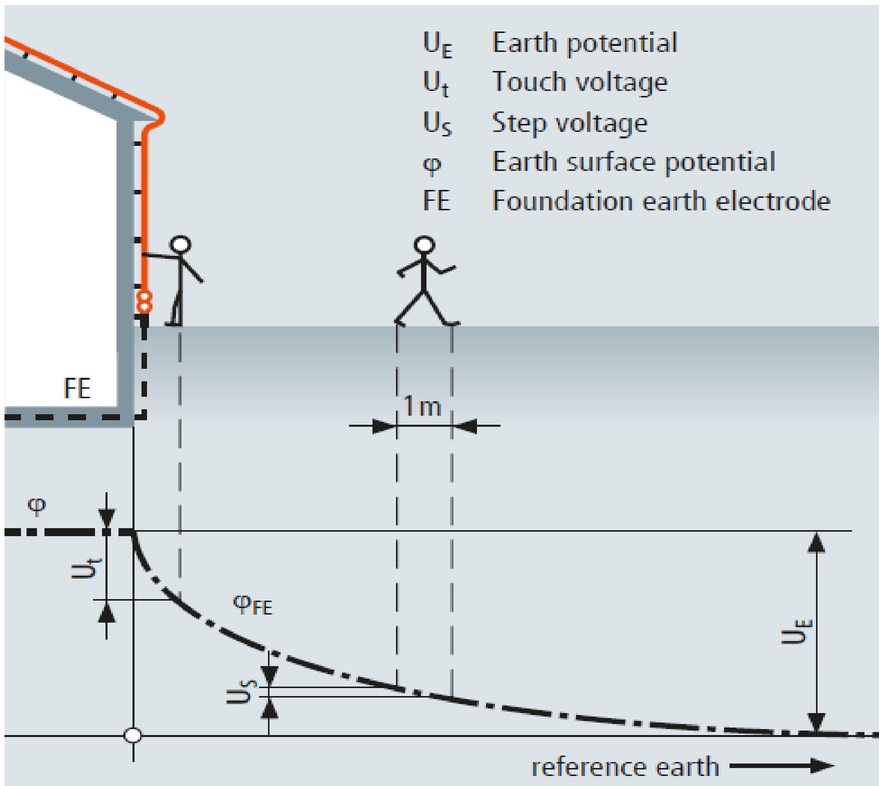


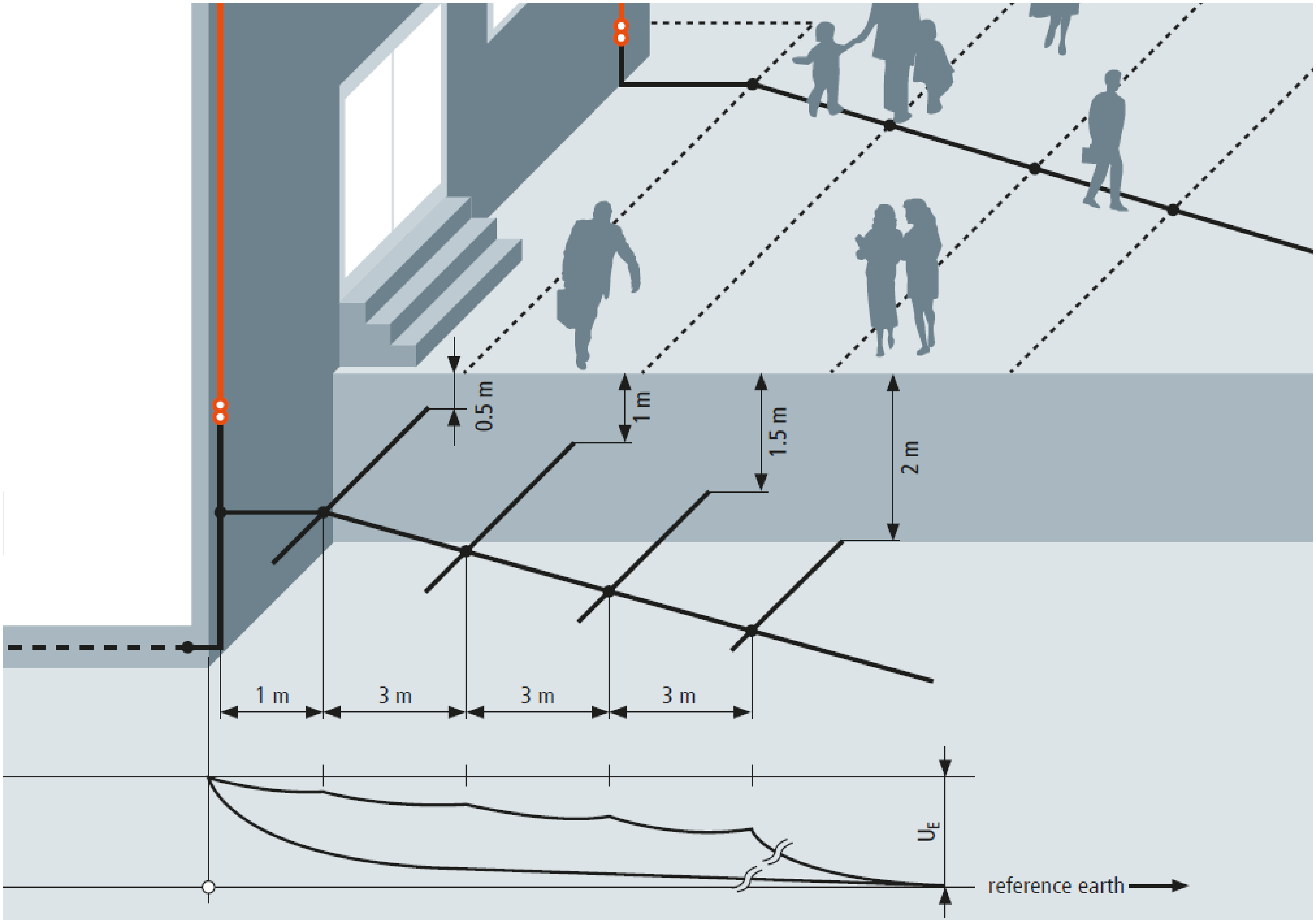
Figure 5.7.1 Step and touch voltage

The following measures can reduce the risk of someone being injured by touching the down conductor:

- The down conductor is sheathed in insulating material (min. 3 mm cross-linked polyethylene with an impulse withstand voltage of 100 kV 1.2/50 μs).
- The position of the down conductors can be changed, e.g. not in the entrance of the structure.
- The probability of people accumulating can be reduced with information or prohibition signs; barriers can also be used.
- The specific resistance of the surface layer of the earth at a distance of up to 3 m around the down conductor must be not less than 5000Ωm.

A layer of asphalt with a thickness of 5 cm, or 5 cm thick bed of gravel, generally meets this requirement.

Note – A downpipe, even if it is not defined as a down conductor, can present a hazard to persons touching it. In such a case, one possibility is to replace the metal pipe with PVC one (height: 3m).



0.5 m
1 m
1.5 m
2 m
1 m
3 m
3 m
3 m
U_E
reference earth

Definition of Step Voltage

Step voltage is a part of the earthing potential which can be bridged by a person taking a step over 1 m.

The current path runs via the human body from one foot to the other (Figure 5.7.1).

The step voltage is a function of the form of the gradient area.

As is evident from the illustration, the step voltage decreases as the distance from the structure increases.

The risk to persons therefore decreases the more they are away from the structure.

The following measures can be taken to reduce the step voltage:

- Persons can be prevented from accessing the hazardous areas (e.g. by barriers of fences)
- Reducing the mesh size of the earthing installation network-potential control.
- The specific resistance of the surface layer of the earth at a distance of up to 3 m around the down-conductor system must be not less than 5000Ωm.

A layer of asphalt with a thickness of 5 cm, or a 15 cm thick bed of gravel generally meets this requirement.

Peak Value of Lightning Current

Lightning currents are load-independent currents, i.e. a lightning discharge can be considered an almost ideal current source.

If a load-independent active electric current flows through conductive components, the amplitude of the current, and the impedance of the conductive component the current flows through, help to regulate the potential drop across the component flown through by the current.

In the simplest case, this relationship can be described using Ohm's Law.

$$U = I \cdot R$$

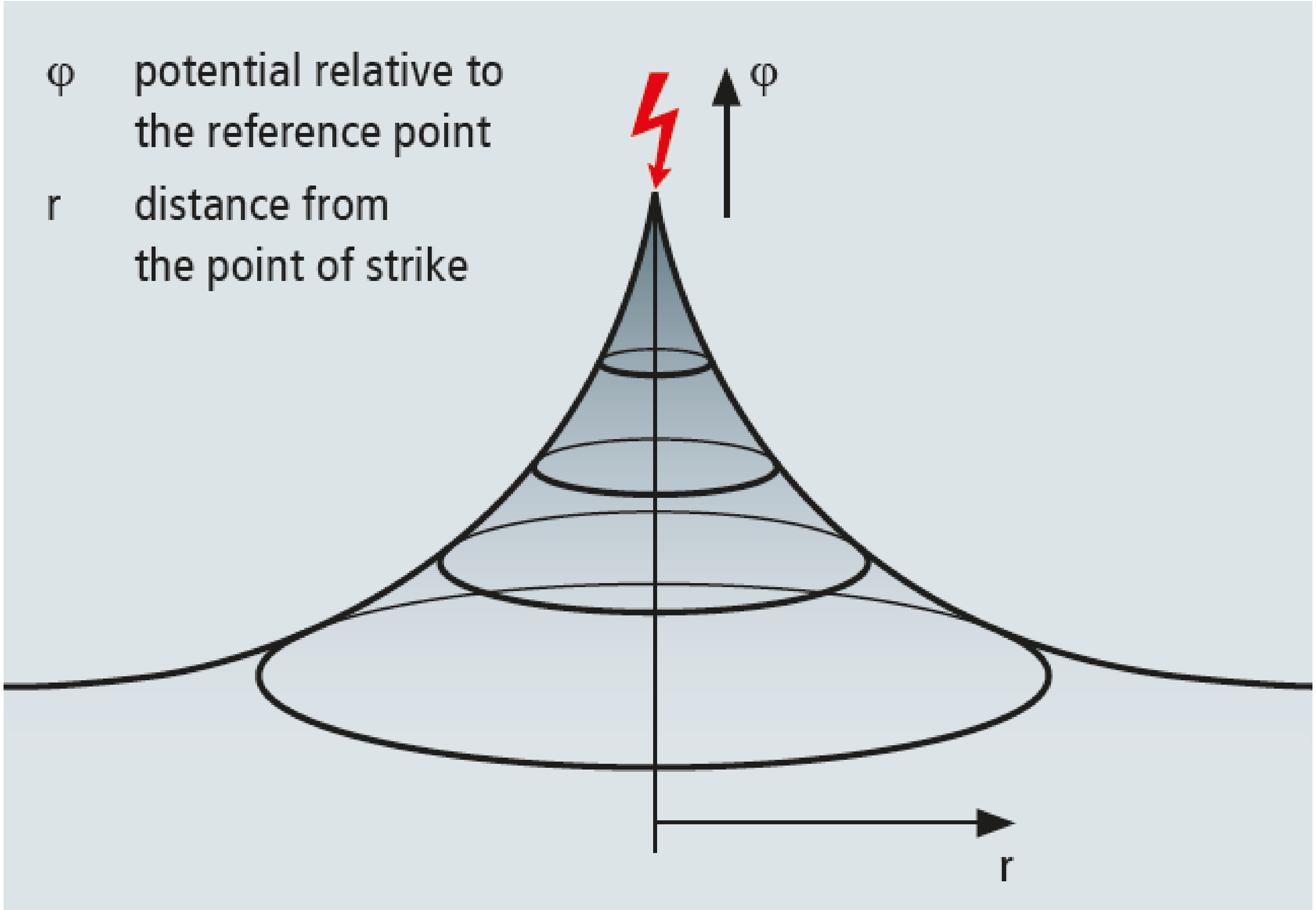


Figure 2.2.1 Potential distribution in case of a lightning strike to homogenous ground

Figure 2.2.2   Animals killed by electric shock due to step voltage

If a current is formed at a single point on a homogeneously conducting surface, the well-known potential gradient area arises.

This effect also occurs when lightning strikes homogeneous ground (Figure 2.2.1).

If living beings (people or animals) are inside this potential gradient area, a step voltage is formed which can case a shock current to flow through the body (Figure 2.2.2).

The higher the conductivity of the ground, the flatter the shape of the potential gradient area.

The risk of dangerous step voltages is thus also reduced.

If lightning strikes a building which is already equipped with a lightning protection system, the lightning current flowing away via the earth-termination system of the building gives rise to a potential drop across the earthing resistance R_E of the earth-termination system of the building (Figure 2.2.3).

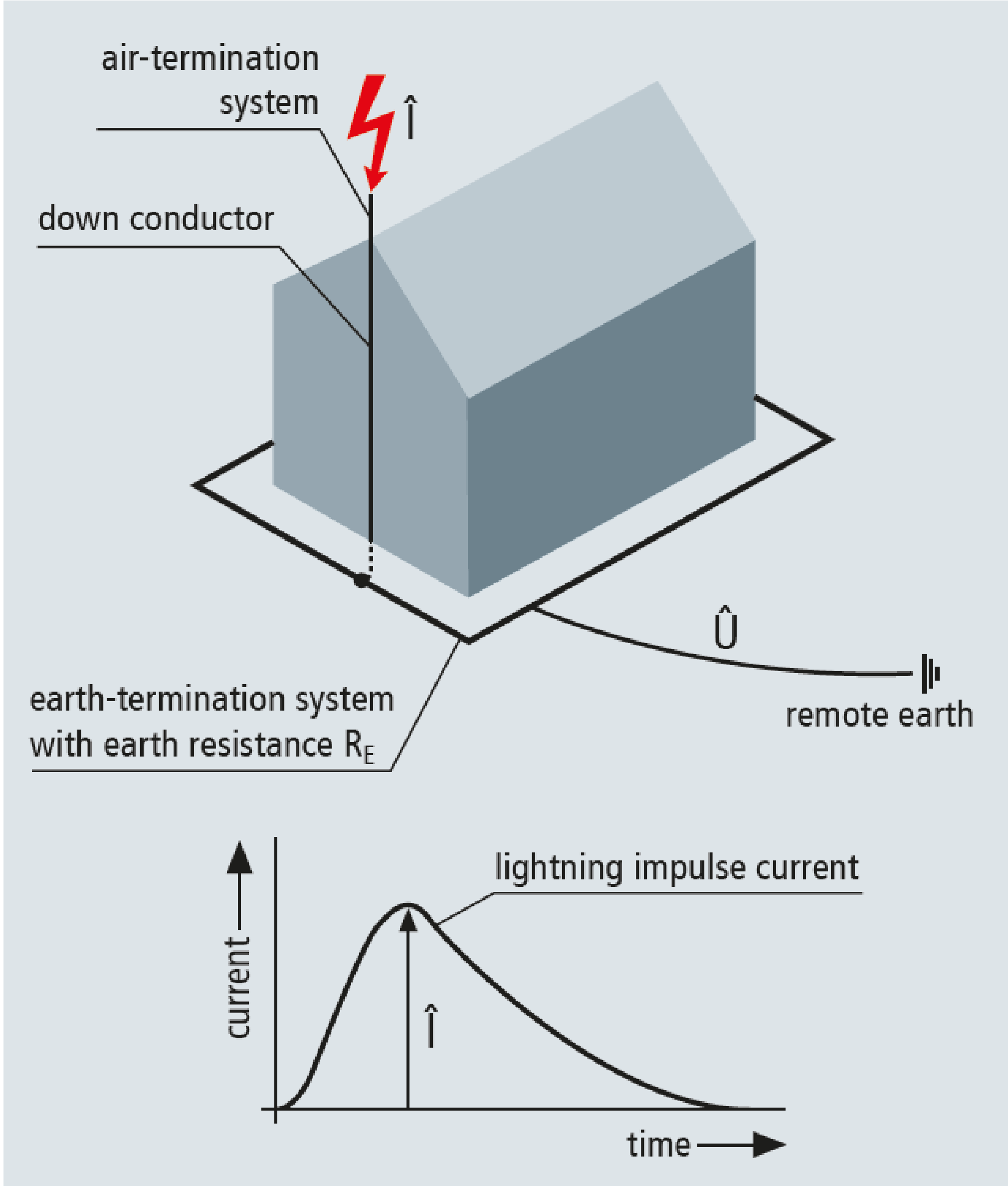


Figure 2.2.3 Potential rise of the building's earth-termination system with respect to the remote earth caused by the peak value of the lightning current

As long as all conductive objects in the building which persons can come into contact with, are raised to the same high potential, persons in the building cannot be exposed to danger.

This is why it id necessary for all conductive parts in the building with which persons can come into contact, and all external conductive parts entering the building, to have equipotential bonding.

If this is disregarded, there is a risk of dangerous shock hazard voltages if lightning strikes.

The rise in potential of the earth-termination system as a result of lightning current also creates a hazard for electrical installations (Figure 2.2.4).

In the example shown, the operational earth of the low-voltage supply network is located outside the potential gradient area caused by the lightning current.

If lightning strikes the building, the potential of the operational earth R_B is therefore not identical to the earth potential of the consumer system within the building.

In the present example, there is a difference of 1000 kV .

This endangers the insulation of the electrical system and the equipment connected to it.

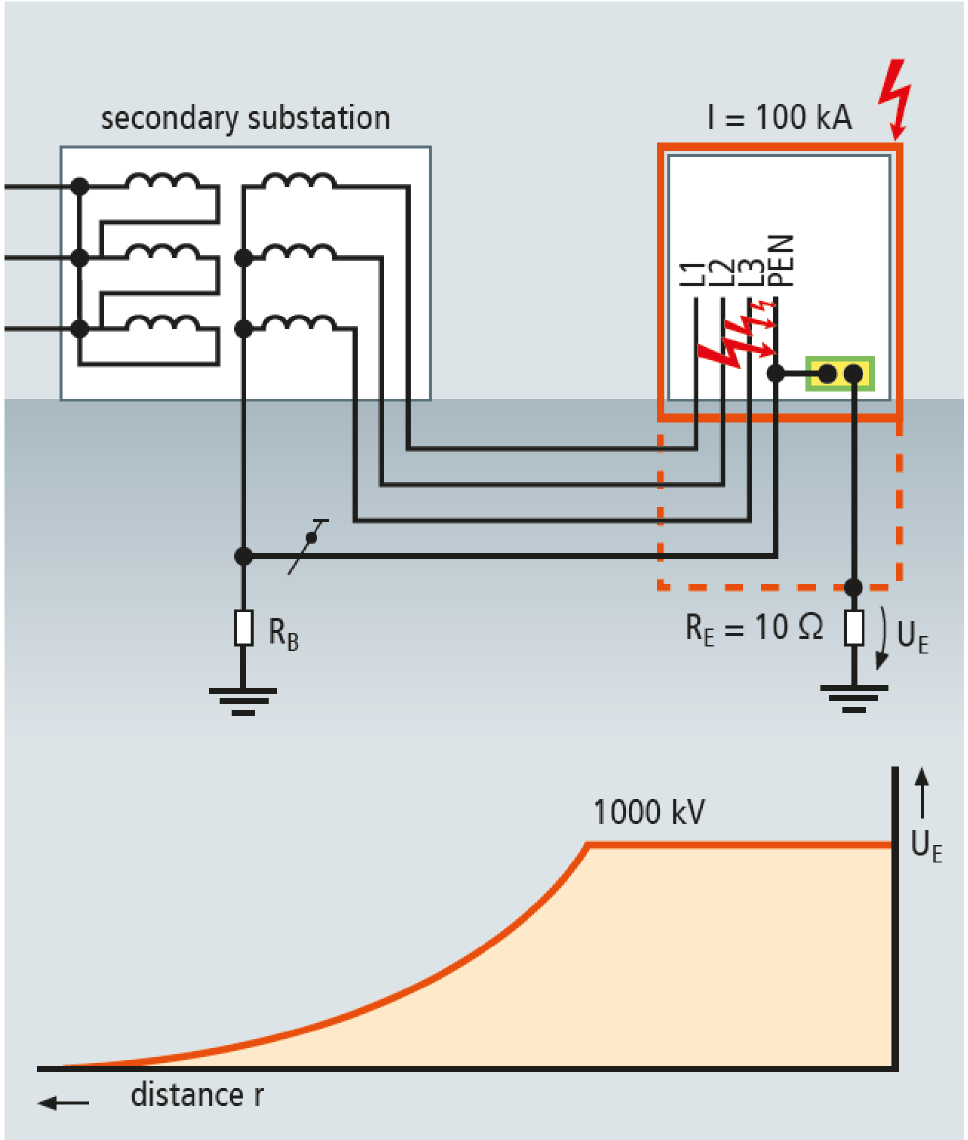


Figure 2.2.4 Risk for electrical installations resulting from a potential rise of the earth-termination system

Earthing Theorey

Earthing Principle

The correct design and installation of a quality Earthing System will ensure the safety of both people and equipment.

A good earth should have:

- Low electrical resistance (ohms)
- Good corrosion resistance
- Ability to carry high currents repeatedly
- A reliable life of at least 30 years

Soil resistivity is a crucial factor in obtaining a ‘good earth’

Factors Affecting Soil Resistivity

(a) Physical Composition

Different soil compositions give different average resistivities:

Soil	Resistivity Ohm.m
Maeshy Ground	2-2.7
Loam and Clay	4-150
Chalk	60-400
Sand	90-800
Peat	200 Upward
Sandy Gravel	300-500
Rock	1000 Upward

Wherever possible, dry, sandy, rocky ground should be avoided; however, in many installations no choice is available.

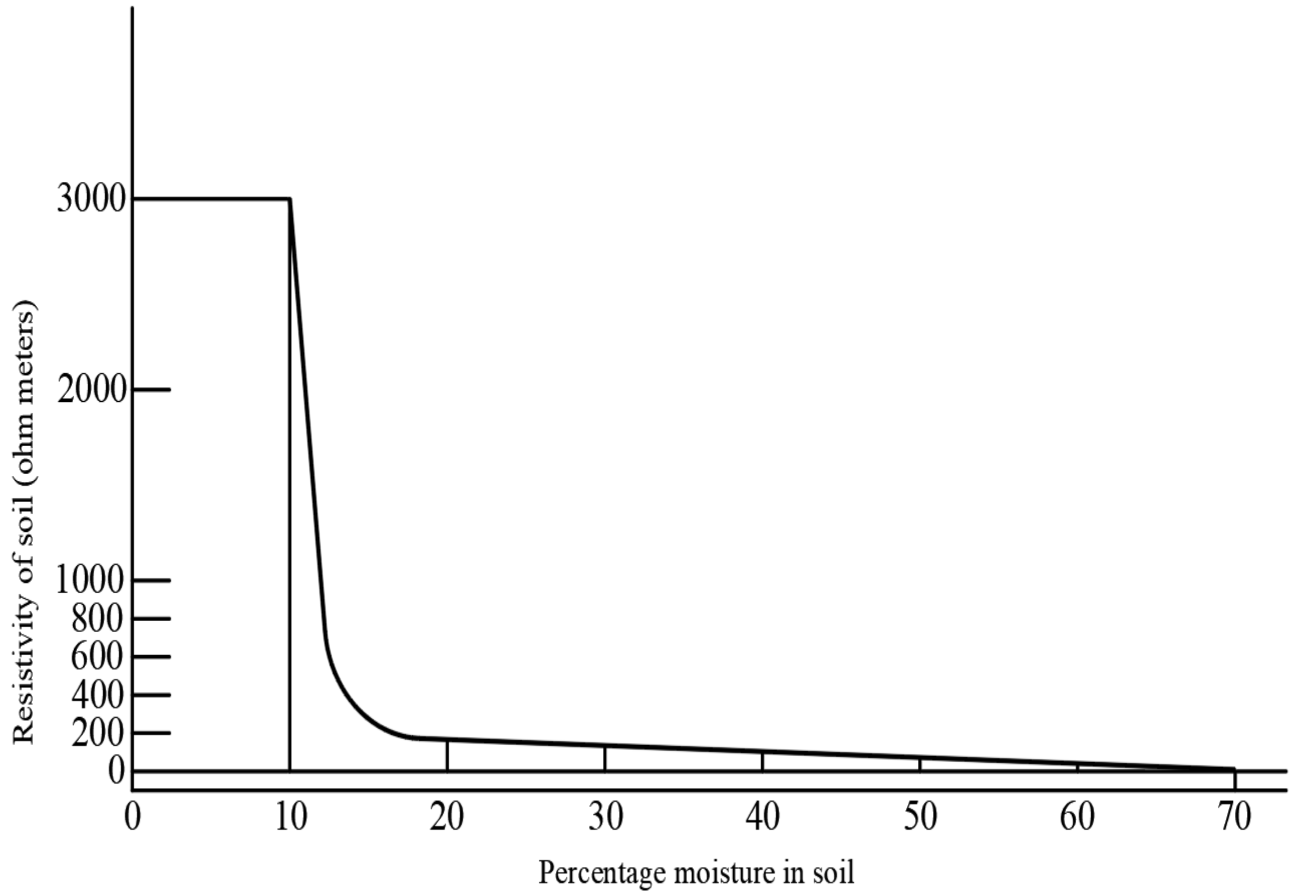
(b) Moisture

Increased moisture content of the ground can rapidly decrease its resistance.

It is especially important to consider moisture content in areas of high seasonal variation in rainfall.

This graph shows how, below 20% moisture content, the resistance of red clay soars. Wherever possible the earth electrode should be installed deep enough to reach the "water table" or "permanent moisture level".

Variation of Soil Resistivity with Moisture Content Red Clay Soil



(c) Chemical Composition

Certain minerals and salts can affect soil resistivity. Their levels can vary with time due to rainfall or flowing water.

Effects of Salt on Resistivity
(Sandy loam, Moisture Content in 15%)

This table shows the effect of adding salt to sandy loam.

Added Salt (Percentage by weight of moisture)	Resistivity (ohm.m)
0.0	107.0
0.1	18.0
1.0	4.6
5.0	1.9
10.0	1.3
20.0	1

(d) Temperature

When the ground becomes frozen, its resistivity rises dramatically. An earth that may be effective temperature weather may become ineffective in winter.

Earth electrodes should be installed below the frost line to ensure year long performance.

Effects of Temperature on Resistivity
(Sandy loam, 15.2% Moisture)

Temperature ˚C	Temperature ˚F	Resistivity (ohm.m)
20	68	72
10	50	99
0	32 (Water)	138
0	32 (Ice)	300
-5	23	790
-15	14	3300

Note that if your soil temperature decreases +20˚C to -5 ˚C, the resistivity increases more than ten times.

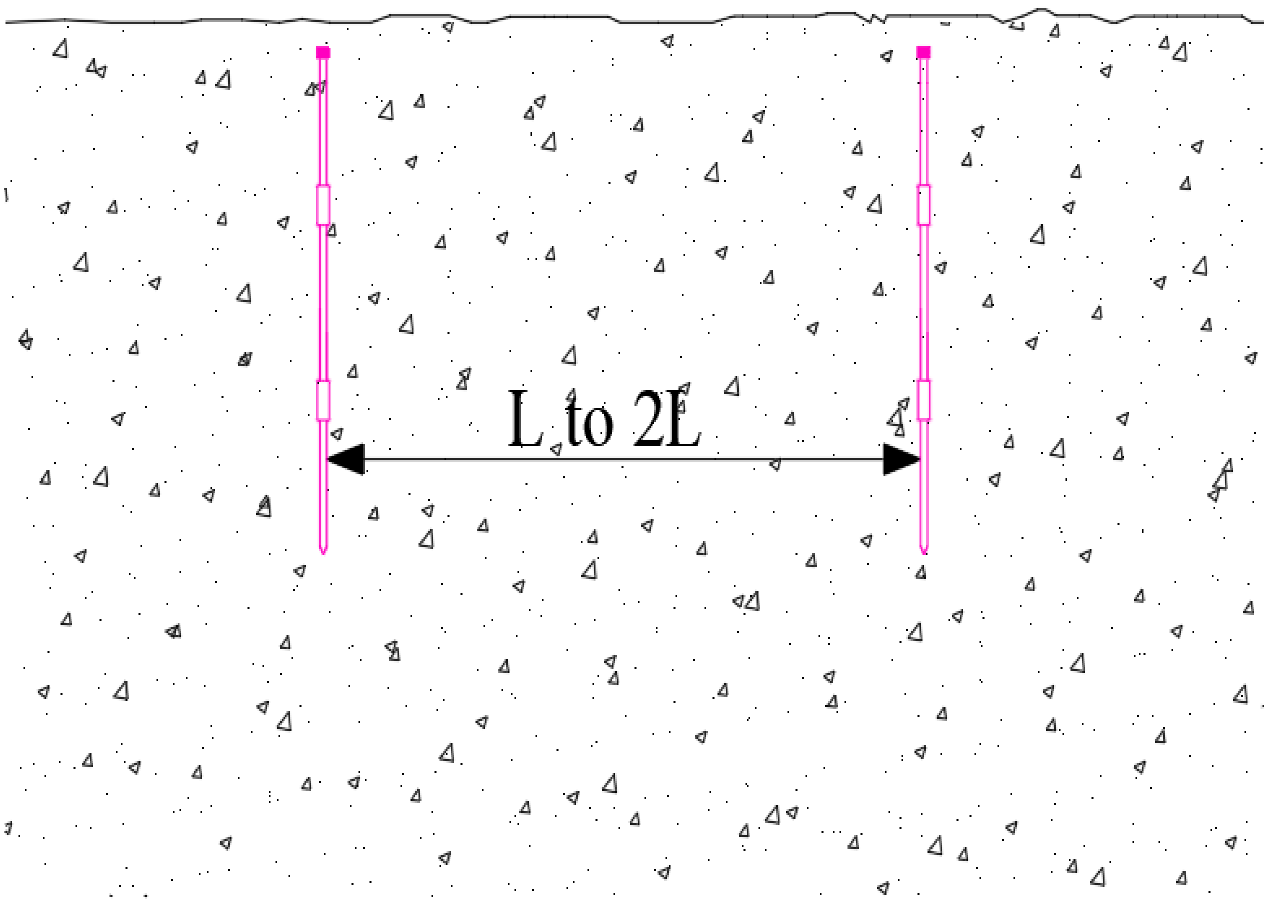
Selecting the Correct Earth Electrode

We have already shown that by reaching permanent moisture and frost free soil levels, low resistance should be achieved. Often these levels are some meters below the surface and the most economical way of reaching them is by extensible deep driven earth rod electrodes.

Furse recommended the use of deep driven earth rod electrodes wherever conditions allow.

Where rods lie just below the surface and deep driving is not possible, parallel driven shorter rods, plates, mats or buried conductors, or a combination of these can be used. However, these should still be buried as deep as possible to avoid seasonal variation and damage from agricultural machinery etc.

Often parallel rods are driven too close together; this decreases their effectiveness. The distance between rods should be greater than the rod length, L.



Earth Rod Electrodes

Earth rods are commonly made from the following materials:

- Copper clad steel (including copper bond and sheathed rods)
- Solid copper
- Galvanized steel
- Stainless steel

Furse can supply all four types, but the copper bonded steel cored rod is by far the most popular.

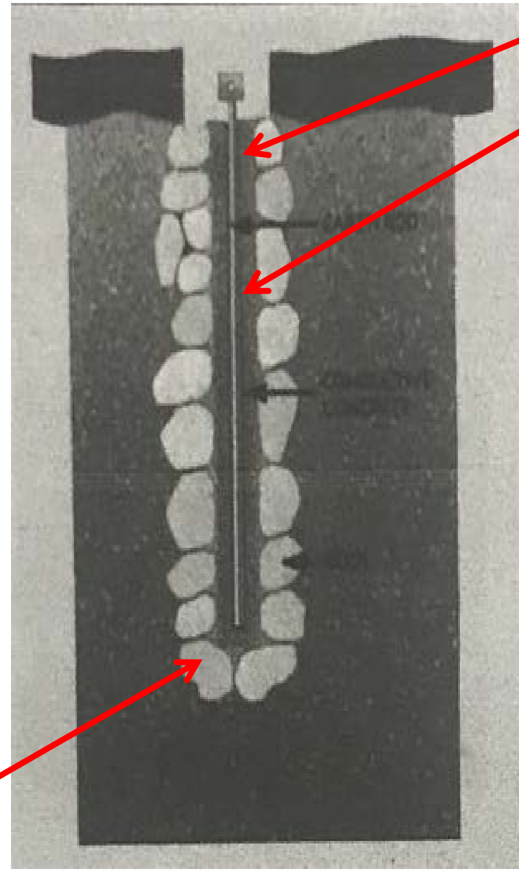
It offers the installer:

- Excellent corrosion resistance
- Ability to carry high fault current for many years
- Much lower cost than solid copper
- A high strength rigid rod essential for deep driving

Current Carrying Capacity of Furse Copperbond Rods

Nominal Diameter (inches)	Actual Diameter (mm)	Fusing Current (Ampere)			Equiv, Copper Conductor (mm sq)
		¼ sec	½ sec	1 sec	
3/8	8.9	15,200	10,700	7,600	25
1/2	12.7	31,200	22,000	15,600	53.4
5/8	14.2	38,800	27,400	19,400	70
3/4	17.3	57,400	40,500	28,700	95
1	23.2	109,800	77,600	54,900	177.3

Suitable for all soil conditions. Provide the lowest potential to earth for a wide range of soil, granite, clay, sand, glacier, rock, etc,.



Conductive medium provides the permanent solution to electrical and construction requirements where other products might provide only a temporary solution.

Picture showing conductive medium used with conventional earth rod to provide increased low-resistance contact area. Thus, provide a low-impedance to earth.

Usage

The conductive medium is available in unmixed form. It should be mixed in the ratio of 3:1 by weight conductive medium : cement, i.e. 6 x 25 kg bags of conductive medium to 1 x 50 kg bag of ordinary Portland cement.

Type and Grading

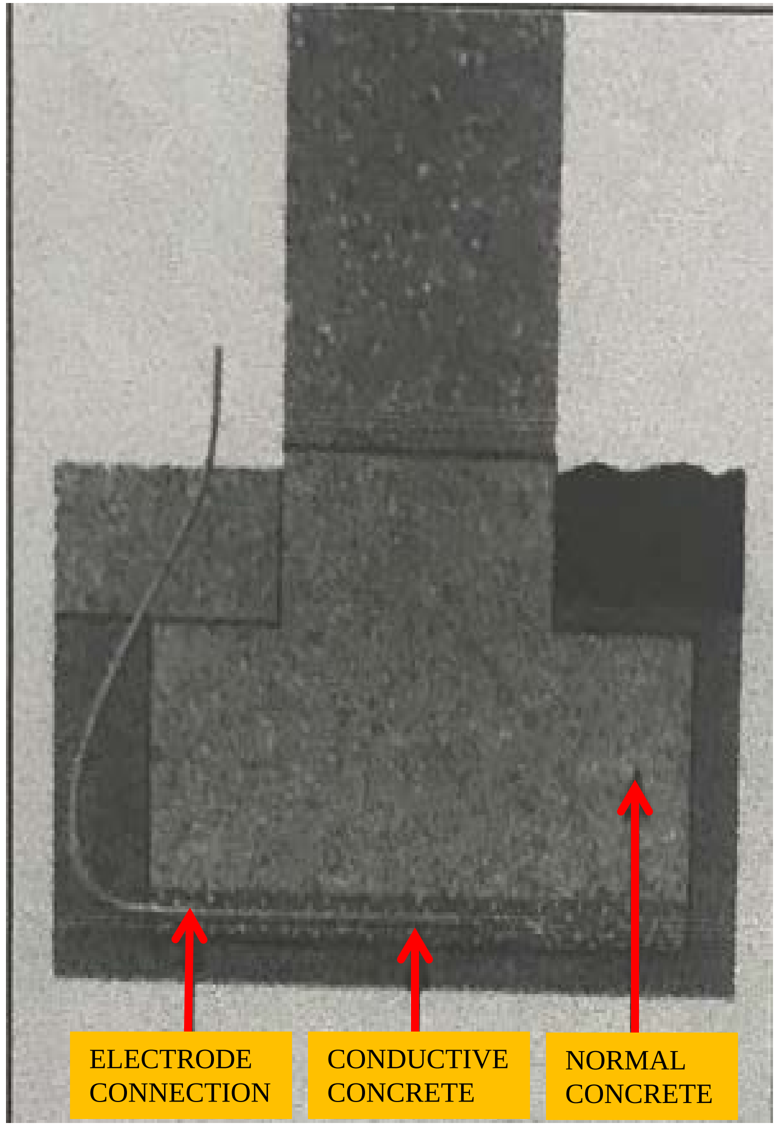
Conductive cement is graded into four classifications, i.e. M1-M4. It is specially designed for different applications.

Each is suitable for making conductive concrete and can be compared to sand ranging from ‘sharp’ (or gritty) to ‘soft’ (fine).

Each grade falls within specified limits to optimize the bulk density and to achieve maximum mechanical strength and minimum lower electrical resistance.

As the medium is chemically insert and the soluble sulphate content in particular is extremely low, it can be used with all conventional types of cement, as well as proprietary resin-based cements, adhesives and gypsum plasters.

Conductive medium pre-mixed of 25 kg bags should be added as 1300 kg per cubic meter.



Conductive medium is also available in pre-mixed with cement of 25 kg bags. Approximately, 5 litres of water should be added to each 25 kg pre-mixed bag.

Picture showing conductive medium being used as a blinding layer with an electrode conductor, used in building foundation as a permanebt earth.

Resistivity

Resistivity of Conductive Medium : 0.001 ohm meter

(0.1 ohm cm)

Resistivity of Bentonite : 3.0 ohm meter

Resistivity of Conducting Concrete : 0.1 ohm meter

(10 ohm cm)

Resistivity Of Ordinary Concrete : 30 to 90 ohm meter

<u>Comparison</u>

Conductive medium is not the same as Bentonite. It’s for a superior system to the Bentonite, whereby the former system is electronic whereas the latter ionic.

In other words, conductive medium is permanent and does not rely on moisture in the ground to perform and provide a low resistance to earth**.**

Bentonite is a temporary system which when dries and cracks in dry conditions which resulting in high resistivity. It also leeches away, in a high water table.

Bentonite and others’ is basically a natural clay which is dug out of the ground, cleaned, dried and granulated and reconstituted by adding water

Testing

The testing of materials for resistivity is to apply a standard pressure of 150 psi to it.
The resistivity of conductive concrete is calculated by British Standard 2030.

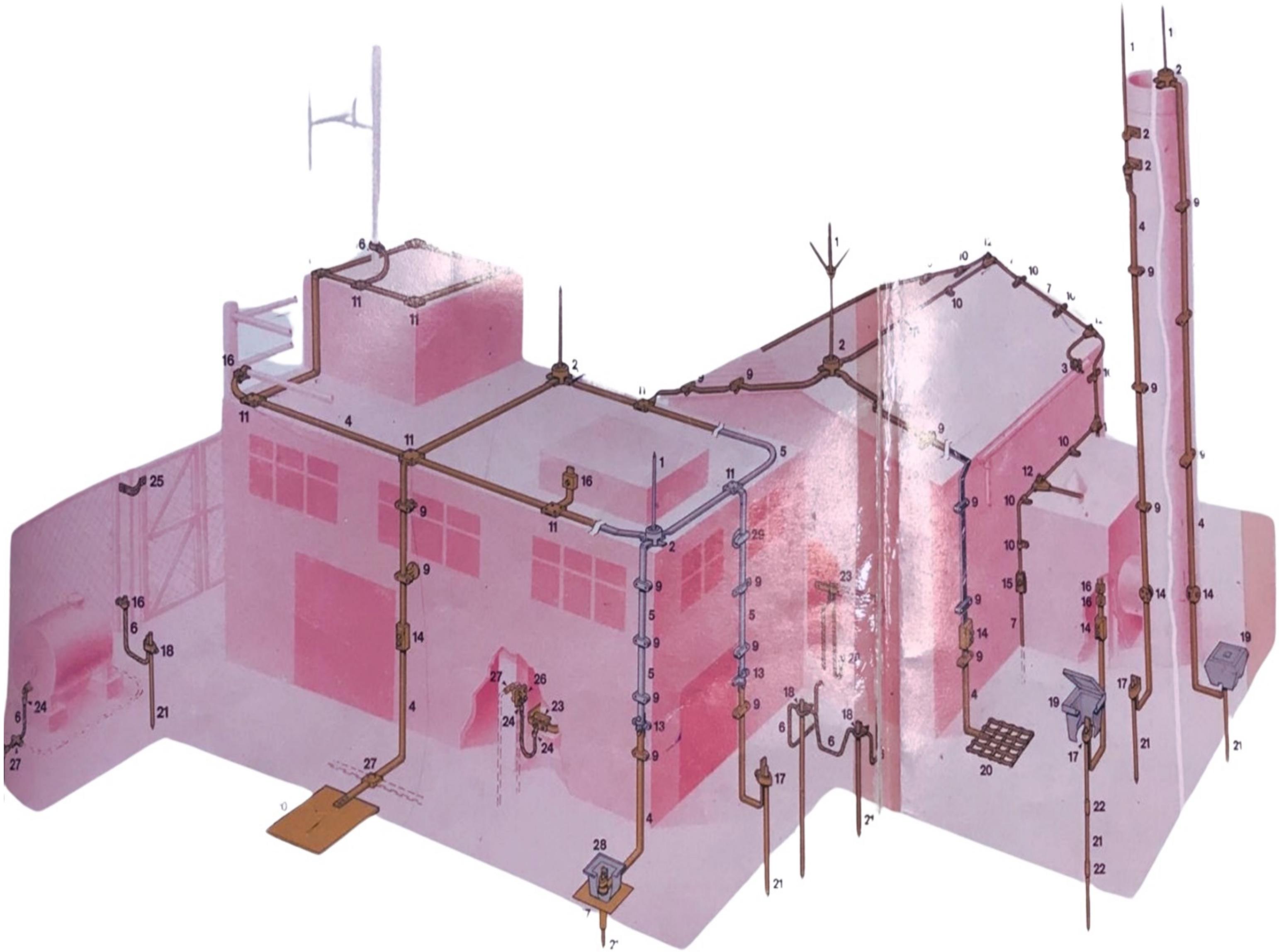
Product Application Guide

The illustration below is designed to demonstrate the position and relationship of individual component.

It is not intended to represent the actual and typical scheme conforming to any National Code of Practice. The drawing is not to scale.

Key No.	Description	Page	Key No.	Description	Page
1	Air Terminals	20	16	Bonds	9
2	Air Terminal Fixings for Tape	20	17	Tape - Earth Rod Clamps	7
3	Holdfast	21	18	Cable - Earth Rod Clamps	7
4	Copper Tape	16	19	Inspection Pits	8
5	Aluminium Tape	17	20	Earth Plates & Mats	8
6	Copper Strand	18	21	Earth Rods	6
7	Copper Solid Circular Conductor	17	22	Earth Rod Couplings	6
8	P.V.C Covered Tape	16	23	Disconnecting Links/Earth Bars	10
9	Tape Fixings	20	24	Cable Lugs	30
10	One Hole Conductor Clip	21	25	Flexible Braidind Bonds	9
11	Junction Clamps for Tape	21	26	Earthing Points	9
12	Junction Clamp	21	27	Furseweld Connections	35
13	Bi-Metallic Connectors	21	28	Earth Rod Seal	10
14	Test Clamps for Tape	22	29	Adhesive D.C. Clip	21
15	Test Clamp	22			

Lightning Protection Systems of Buildings



Q & A

Thank You