

Meridian Works (sample)

56 × 38 × 20 m (composed plan). Every study below was carried out against these dimensions — one building, described once.

- 1. Lightning Risk — Report VB-SAMPLE-LIGHTNING-0001, revision 2
- 2. LPS Design — Report VB-SAMPLE-LPS-0001, revision 2
- 3. SPM Design — Report VB-SAMPLE-SPM-0001, revision 2

What the parts of this design share

Established	Value	By	Reference
Number of down conductors	21	LPS Design	IEC 62305-3:2024, §5.3.3, Table 5
Earth-termination arrangement	Type B	LPS Design	IEC 62305-3:2024, 5.4.2
Metallic services modelled by the risk assessment	2	Lightning Risk	IEC 62305-2:2024, A.4; read by IEC 62305-4 C.2.6
LPS class / lightning protection level	I	LPS Design	IEC 62305-3:2024, Table 2; IEC 62305-1:2024, Table 3
Does the risk assessment require an LPS?	Yes	Lightning Risk	IEC 62305-2:2024, 7.3 (Figure 1)
The structure has an external LPS	Yes	LPS Design	IEC 62305-3:2024
Innermost lightning protection zone established	2	SPM Design	IEC 62305-4:2024, 4.3.3
Lightning protection zone outside the structure	LPZ 0A — assumed; the route outside the structure is not modelled, and this is the more severe half	SPM Design	IEC 62305-4:2024, 4.3.2
Air-termination rod layout	8 rods, at the positions this design states	LPS Design	IEC 62305-3:2024, 5.2.2; read by IEC 62305-4 B.11
LPS class required by the risk assessment	I	Lightning Risk	IEC 62305-2:2024, Table B.3, 7.3

Established	Value	By	Reference
Protected height above the roof — what the design establishes	Stated per roof — this structure has more than one	LPS Design	IEC 62305-3:2024, 5.2.2
Roofs the air termination stands on	5 reference planes, at 20 m, 12 m, 8 m, 8 m, 8 m	LPS Design	IEC 62305-3:2024, 5.2.2.3.1; read by IEC 62305-4 B.11
Rolling-sphere radius (m)	20	LPS Design	IEC 62305-3:2024, Table 2
Dangerous events $N_D + N_L + N_{DJ}$ (1/yr)	0.1516	Lightning Risk	IEC 62305-2:2024, Annex A; read by IEC 62305-4 C.2.2 NOTE 1
Required separation distance s (m)	0.944	LPS Design	IEC 62305-3:2024, 6.3
Structure spatial shielding	none	Lightning Risk	IEC 62305-2:2024, B.6

Lightning Protection Risk Assessment Basis of calculation: IEC 62305-2:2024 (Ed. 3.0)			Report	VB-SAMPLE-LIGHTNING-0001		
			Revision	2		
			Issued	2026-09-28 09:30 UTC		
			This copy	printed 2026-10-19 17:28 UTC		
Project	Meridian Works		Client	Meridian Works — fictional demonstration		
Site address	Illustrative site — not a real installation					
Prepared by	Demonstration Engineer, Fictional example practice					
Checked by	Example reviewer (fictional)		Approved by	Sample approver		
Dimensions	Taken from drawings — Illustrative drawings — not a real building					
Rev.	Date	Description	Prepared	Checked	Approved	
1	2026-09-28	First issue	Demonstration Engineer	Sample checker	Sample approver	
2	2026-09-28	Update the named checker for this demonstration issue.	Demonstration Engineer	Example reviewer (fictional)	Sample approver	

GOVERNING ZONE RISK

0.000127

TOLERABLE

1e-05

VERDICT

Exceeds tolerable

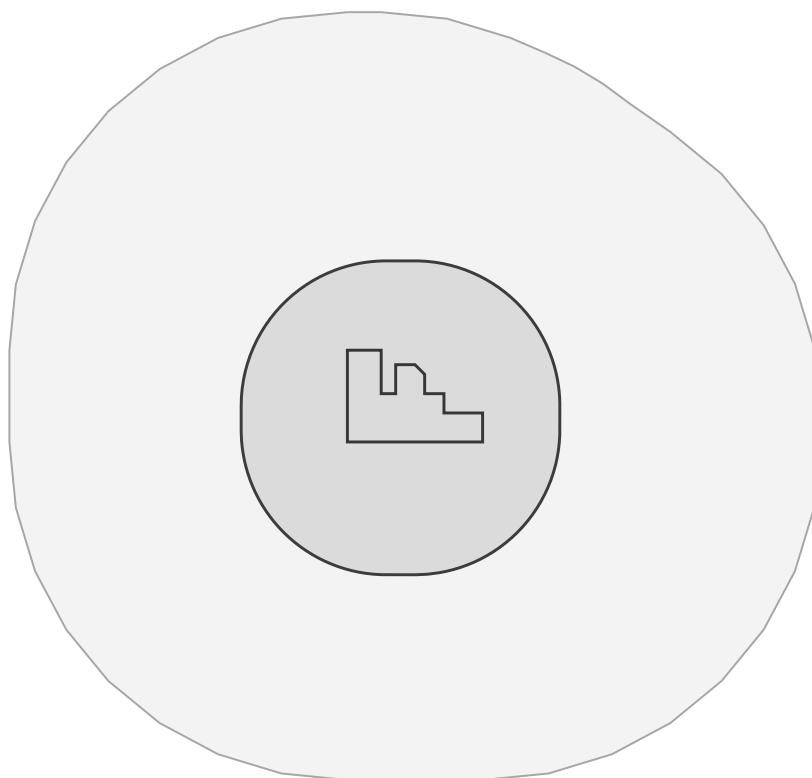
Assumptions for missing inputs — the engine filled in the following defaults; verify each before relying on this assessment:

- The structure has roofs at 3 heights (20, 12, 8 m), so A_D is determined by the graphical method of IEC 62305-2:2024, §A.2.1.3 — the ground within reach of a 1:3 slope from each roof (§A.2.1.1), joined — computed from the roofs as modelled: flat, on vertical walls standing on the ground. A parapet, a pitched roof or plant not drawn as a part is not in it; declare a protrusion for anything taller than the roof it stands on.
- The structure's plan outline is re-entrant — it has a corner that turns back on itself. A_M generalises eq. A.8 as the area swept within r_M of that outline, which **over-states** it where the swept bands overlap inside such a corner. On the built-in plan shapes that was measured at roughly 1-2 % for a shallow notch and about 11 % where the offset closes a narrow gap; a drawn outline with a narrower or deeper re-entrant can exceed it. **The error is upward in every case**, whatever the shape — the bands are counted twice, never missed — so the assessed risk is conservative rather than optimistic. Where that margin matters, assess the wings as separate structures.
- The entered lines (power, telecom) are taken as the complete set of connected services. Any further metallic service — a second power feed, a data line between buildings — adds S3/S4 risk and would need its own line entry.
- No structure was modelled at the far end of any line (N_{DJ} = 0, §A.2.5) — each line is assumed to come directly from the network. Where a line arrives from an adjacent structure (e.g. a plant building housing the transformer), flashes to that structure add dangerous events on the line.
- No zone was set for the Clause 9 assessment, so the frequency of damage F for loss of service was not evaluated and the verdict above is R against R_T only. §9.1 judges F separately from R: a structure providing a service — power, water, gas, telecommunications, transport — can satisfy R and still need protection under §9.3. Set the service criticality on any zone whose loss of service matters.

Methodology notes (Ed. 3.0:2024)

- Risk is assembled per zone (§8.5.3) and judged against R_T by the §7.3 procedure. The 2010 edition's n_z/n_t population scaling no longer exists — a zone's risk is not diluted by its share of the structure's occupants.
- Loss values follow Table C.2; the former h_z hazard factor is absorbed into its rows. Physical-damage losses (R_{B2} , R_{V2} , ...) carry no time-of-presence weighting — property is at risk whether or not people are present. Results therefore differ from 2010-edition worked examples by design.
- Scope: risk R per Clause 8. The Clause 9 frequency of damage F is assessed only for zones whose service criticality is declared, and none was declared here — see the assumptions above.

56 × 38 m



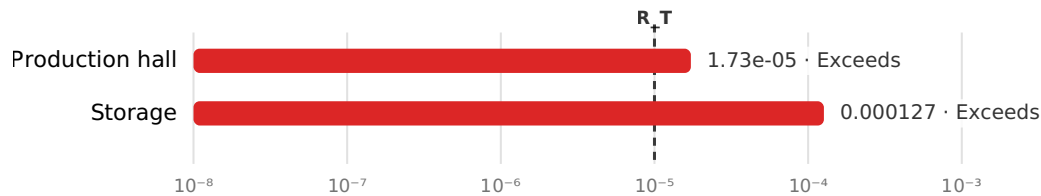
$A_M = 90\,927\text{ m}^2$ ($r_M = 140\text{ m}$)

$A_D = 14\,070\text{ m}^2$ — the ground within reach of a 1:3 slope from each roof, joined (§A.2.1.3, graphical method)
56 × 38 m

A_M (§A.3, eq. A.8) is the band out to $r_M = 350/U_W = 140\text{ m}$, within which a flash to ground can still damage internal systems. To scale, uniform on both axes.

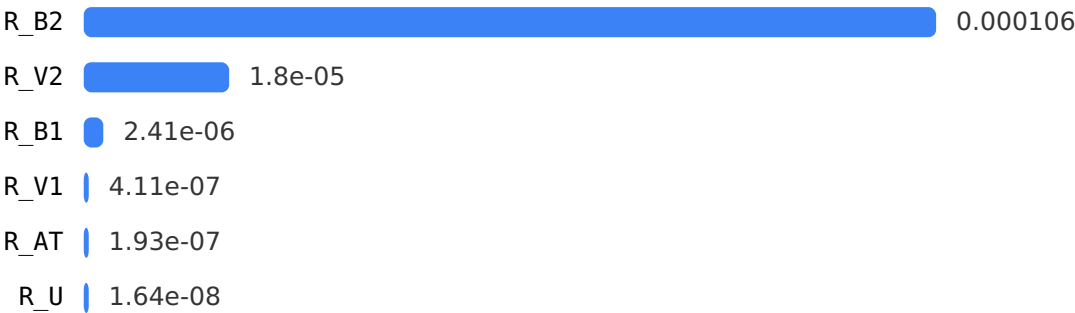
Risk zones

Risk is assessed for each risk zone and compared with the tolerable risk in that zone; protection is required unless every zone complies.



Zone	Risk R	R _{L1} (injury)	R _{L2} (damage)	Tolerable R _T	Verdict
Production hall	1.73e-05	4.91e-06	1.24e-05	1e-05	Exceeds
Storage	0.000127	3.03e-06	0.000124	1e-05	Exceeds

Risk component breakdown — governing zone



Component	Value	Description
R _{AT}	1.93e-07	Touch and step voltages — flash to the structure (S1)
R _{B1}	2.41e-06	Fire or explosion — injury to persons (S1)
R _{B2}	0.000106	Fire or explosion — physical damage (S1)
R _U	1.64e-08	Touch voltage via a connected line — injury to persons (S3)
R _{V1}	4.11e-07	Fire or explosion via a connected line — injury to persons (S3)
R _{V2}	1.8e-05	Fire or explosion via a connected line — physical damage (S3)

Recommended protection measures

- Install a class I LPS on the structure, including SPDs designed for LPL I for equipotential bonding of the connected lines (Tables B.3 and B.13)

With the recommended measures every risk zone satisfies $R \leq R_T$ (projected governing-zone risk $4.51 \times 10^{-6}/\text{yr}$).

Detailed calculation steps

The derivation chain shared by every risk zone, with the substituted values and the clause each step implements — check any step against the standard.

#	Step	Working	Result
1	Lightning ground strike-point density IEC 62305-2:2024, §A.1, eq. A.1	$N_{SG} = k \times N_G$ $k = 2, N_G = 3 / \text{km}^2/\text{yr}$	$N_{SG} = 6 / \text{km}^2/\text{yr}$

#	Step	Working	Result
2	Collection area of the structure (roofs at more than one height) IEC 62305-2:2024, §A.2.1.1 and §A.2.1.3, Figure A.3	A _D = the ground within 3H of each roof, joined roof at 20 m: plan 120 m ² , 3H = 60 m; roof at 12 m: plan 800 m ² , 3H = 36 m; roof at 8 m: plan 192 m ² , 3H = 24 m; roof at 8 m: plan 136 m ² , 3H = 24 m; roof at 8 m: plan 252 m ² , 3H = 24 m → joined, A = 14,069.7 m ² . §A.2.1.3 accepts an approximation in its place, the greater of eq. A.3 at H _{MIN} = 8 m and $\pi \cdot (3 \cdot H_P)^2$ at H _P = 20 m, which gives 11,309.7 m ² here; the graphical method, which the clause says should be used, is the one used	A_D = 14,069.7 m²
3	Flashes to the structure IEC 62305-2:2024, §A.2.4, eq. A.5; Table A.1	$N_D = N_{SG} \cdot A_D \cdot C_D \cdot 10^{-6}$ N _{SG} = 6, A _D = 14,069.7 m ² , C _D = 1 (isolated)	N_D = 0.0844184 / yr
4	Flashes near the structure IEC 62305-2:2024, §A.3, eqs. A.7/A.8	$r_M = 350/U_W$; $A_M = P \cdot r_M + \pi \cdot r_M^2$; $N_M = (1/k) \cdot N_{SG} \cdot A_M \cdot 10^{-6}$ U _W (min) = 2.5 kV → r _M = 140 m, P = 209.657 m (from the plan outline), A _M = 90,927.2 m ² , k = 2 (§A.1 NOTE 1 fallback — where N _{SG} comes from a lightning location system, k is supplied by that provider)	N_M = 0.272782 / yr
5	Flashes to line 'power' IEC 62305-2:2024, §A.4, eqs. A.9/A.10; Tables A.2-A.4	$A_L = 40 \cdot L_L$; $N_L = N_{SG} \cdot A_L \cdot C_I \cdot C_E \cdot C_T \cdot 10^{-6}$ L _L = 200 m → A _L = 8,000 m ² ; C _I = 0.3, C _E = 0.5, C _T = 1	N_L = 0.0072 / yr
6	Flashes near line 'power' IEC 62305-2:2024, §A.5, eqs. A.11/A.12	$r_I = 2000/U_W^{1.8}$; $A_I = 2 \cdot r_I \cdot L_L$; $N_I = (1/k) \cdot N_{SG} \cdot A_I \cdot C_I \cdot C_E \cdot C_T \cdot 10^{-6}$ U _W = 2.5 kV, L _L = 200 m → A _I = 153,744 m ² ; k = 2	N_I = 0.0691848 / yr
7	Flashes to line 'telecom' IEC 62305-2:2024, §A.4, eqs. A.9/A.10; Tables A.2-A.4	$A_L = 40 \cdot L_L$; $N_L = N_{SG} \cdot A_L \cdot C_I \cdot C_E \cdot C_T \cdot 10^{-6}$ L _L = 500 m → A _L = 20,000 m ² ; C _I = 1, C _E = 0.5, C _T = 1	N_L = 0.06 / yr
8	Flashes near line 'telecom' IEC 62305-2:2024, §A.5, eqs. A.11/A.12	$r_I = 2000/U_W^{1.8}$; $A_I = 2 \cdot r_I \cdot L_L$; $N_I = (1/k) \cdot N_{SG} \cdot A_I \cdot C_I \cdot C_E \cdot C_T \cdot 10^{-6}$ U _W = 1.5 kV, L _L = 500 m → A _I = 963,975 m ² ; k = 2	N_I = 1.44596 / yr
9	Per-zone risk and verdict IEC 62305-2:2024, eqs. 6-9, Table 3, §7.3	R = R _{L1} + R _{L2} ; each R _X = N _X · P _X · L _X (with P _P /P _e per Table 3) per-zone components and resolved factors in the tables below	protection required unless R ≤ R_T = 1e-05 / yr in every zone

Resolved factors — zone Production hall

Factor	Value	Derivation
P _P	0.228311	= t _z / 8760 (eq. B.14)
P _e	1	= 1 — time of exposure unknown (§B.12 NOTE 1)

Factor	Value	Derivation
P _{am}	1	Table B.1 (touch/step-voltage measures)
r _t	0.01	Table B.2 (surface of soil or floor)
r _f	0.01	Table B.6, fire load 'ordinary'
r _p	0.5	Table B.5 (fire-reducing provisions)
P _S	0.5	Table B.4 (construction material)
P _{LPS}	1	Table B.3 (class of LPS)
P _{AT}	0.01	$= P_{LPS} \cdot P_{am} \cdot r_t \cdot P_{TWS}$ (eq. B.2)
P _B	0.0025	$= P_S \cdot P_{LPS} \cdot r_f \cdot r_p$ (eq. B.4)
L _T	0.01	Table C.2 typical value
L _{F1}	0.05	Table C.2 typical value
L _{F2}	0.05	Table C.2 typical value
K _{S2}	1	zone shielding screen (§B.6, eq. B.9)
P _C	1	$= 1 - \Pi(1 - P_{SPD} \cdot C_{LD})$ over internal systems (eq. 10; eq. B.5)
P _M	1	$= 1 - \Pi(1 - P_{SPD} \cdot (K_{S1} \cdot K_{S2} \cdot K_{S3})^2)$ (eq. 11; eqs. B.6/B.7)
C _{LD} (power)	1	Table B.9 (line shielding/grounding/isolation)
C _{LI} (power)	1	Table B.9 (line shielding/grounding/isolation)
P _{EB} (power)	1	Table B.13 (line-entrance bonding SPDs)
P _{LD} (power)	1	Tables B.11/B.12 (line shielding vs U _W)
P _U (power)	0.01	$= P_{am} \cdot P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_t$ (eq. B.10)
P _V (power)	0.005	$= P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_f \cdot r_p$ (eq. B.11)
P _W (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot P_{LD} \cdot C_{LD}$ (eq. B.12)
P _Z (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot C_{LI}$ (eq. B.13)

Resolved factors — zone Storage

Factor	Value	Derivation
P _P	0.0228311	$= t_z / 8760$ (eq. B.14)
P _e	1	$= 1$ — time of exposure unknown (§B.12 NOTE 1)
P _{am}	1	Table B.1 (touch/step-voltage measures)
r _t	0.01	Table B.2 (surface of soil or floor)
r _f	0.1	Table B.6, fire load 'high'
r _p	0.5	Table B.5 (fire-reducing provisions)
P _S	0.5	Table B.4 (construction material)
P _{LPS}	1	Table B.3 (class of LPS)
P _{AT}	0.01	$= P_{LPS} \cdot P_{am} \cdot r_t \cdot P_{TWS}$ (eq. B.2)

Factor	Value	Derivation
P _B	0.025	$= P_S \cdot P_{LPS} \cdot r_f \cdot r_p$ (eq. B.4)
L _T	0.01	Table C.2 typical value
L _{F1}	0.05	Table C.2 typical value
L _{F2}	0.05	Table C.2 typical value
K _{S2}	1	zone shielding screen (§B.6, eq. B.9)
P _C	1	$= 1 - \Pi(1 - P_{SPD} \cdot C_{LD})$ over internal systems (eq. 10; eq. B.5)
P _M	1	$= 1 - \Pi(1 - P_{SPD} \cdot (K_{S1} \cdot K_{S2} \cdot K_{S3})^2)$ (eq. 11; eqs. B.6/B.7)
C _{LD} (power)	1	Table B.9 (line shielding/grounding/isolation)
C _{LI} (power)	1	Table B.9 (line shielding/grounding/isolation)
P _{EB} (power)	1	Table B.13 (line-entrance bonding SPDs)
P _{LD} (power)	1	Tables B.11/B.12 (line shielding vs U _W)
P _U (power)	0.01	$= P_{am} \cdot P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_t$ (eq. B.10)
P _V (power)	0.05	$= P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_f \cdot r_p$ (eq. B.11)
P _W (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot P_{LD} \cdot C_{LD}$ (eq. B.12)
P _Z (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot C_{LI}$ (eq. B.13)

Projected outcome with the recommended measures

The same assessment re-run with the recommended protection measures applied. The projected figures are reproducible from the post-measure factors below, exactly as the unprotected result is from the tables above.

Zone	Projected R	R _{L1} (injury)	R _{L2} (damage)	Tolerable R _T	Verdict
Production hall	5.81e-07	1.41e-07	4.4e-07	1e-05	Pass
Storage	4.51e-06	1.04e-07	4.4e-06	1e-05	Pass

Resolved factors with measures applied — zone Production hall

Factor	Value	Derivation
P _P	0.228311	$= t_z / 8760$ (eq. B.14)
P _e	1	$= 1$ — time of exposure unknown (§B.12 NOTE 1)
P _{am}	1	Table B.1 (touch/step-voltage measures)
r _t	0.01	Table B.2 (surface of soil or floor)
r _f	0.01	Table B.6, fire load 'ordinary'
r _p	0.5	Table B.5 (fire-reducing provisions)
P _S	1	$= 1$ with an LPS installed (Table B.4 NOTE 1)
P _{LPS}	0.02	Table B.3 (class of LPS)
P _{AT}	0.0002	$= P_{LPS} \cdot P_{am} \cdot r_t \cdot P_{TWS}$ (eq. B.2)

Factor	Value	Derivation
P_B	0.0001	$= P_S \cdot P_{LPS} \cdot r_f \cdot r_p$ (eq. B.4)
L_T	0.01	Table C.2 typical value
L_F1	0.05	Table C.2 typical value
L_F2	0.05	Table C.2 typical value
K_S2	1	zone shielding screen (§B.6, eq. B.9)
P_C	1	$= 1 - \Pi(1 - P_{SPD} \cdot C_{LD})$ over internal systems (eq. 10; eq. B.5)
P_M	1	$= 1 - \Pi(1 - P_{SPD} \cdot (K_{S1} \cdot K_{S2} \cdot K_{S3})^2)$ (eq. 11; eqs. B.6/B.7)
C_LD (power)	1	Table B.9 (line shielding/grounding/isolation)
C_LI (power)	1	Table B.9 (line shielding/grounding/isolation)
P_EB (power)	0.01	Table B.13 (line-entrance bonding SPDs)
P_LD (power)	1	Tables B.11/B.12 (line shielding vs U_W)
P_U (power)	0.0001	$= P_{am} \cdot P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_t$ (eq. B.10)
P_V (power)	5e-05	$= P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_f \cdot r_p$ (eq. B.11)
P_W (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot P_{LD} \cdot C_{LD}$ (eq. B.12)
P_Z (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot C_{LI}$ (eq. B.13)

Resolved factors with measures applied — zone Storage

Factor	Value	Derivation
P_P	0.0228311	$= t_z / 8760$ (eq. B.14)
P_e	1	$= 1$ — time of exposure unknown (§B.12 NOTE 1)
P_am	1	Table B.1 (touch/step-voltage measures)
r_t	0.01	Table B.2 (surface of soil or floor)
r_f	0.1	Table B.6, fire load 'high'
r_p	0.5	Table B.5 (fire-reducing provisions)
P_S	1	$= 1$ with an LPS installed (Table B.4 NOTE 1)
P_LPS	0.02	Table B.3 (class of LPS)
P_AT	0.0002	$= P_{LPS} \cdot P_{am} \cdot r_t \cdot P_{TWS}$ (eq. B.2)
P_B	0.001	$= P_S \cdot P_{LPS} \cdot r_f \cdot r_p$ (eq. B.4)
L_T	0.01	Table C.2 typical value
L_F1	0.05	Table C.2 typical value
L_F2	0.05	Table C.2 typical value
K_S2	1	zone shielding screen (§B.6, eq. B.9)
P_C	1	$= 1 - \Pi(1 - P_{SPD} \cdot C_{LD})$ over internal systems (eq. 10; eq. B.5)
P_M	1	$= 1 - \Pi(1 - P_{SPD} \cdot (K_{S1} \cdot K_{S2} \cdot K_{S3})^2)$ (eq. 11; eqs. B.6/B.7)

Factor	Value	Derivation
C_LD (power)	1	Table B.9 (line shielding/grounding/isolation)
C_LI (power)	1	Table B.9 (line shielding/grounding/isolation)
P_EB (power)	0.01	Table B.13 (line-entrance bonding SPDs)
P_LD (power)	1	Tables B.11/B.12 (line shielding vs U_W)
P_U (power)	0.0001	$= P_{am} \cdot P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_t$ (eq. B.10)
P_V (power)	0.0005	$= P_{EB} \cdot P_{LD} \cdot P_{TWS} \cdot C_{LD} \cdot r_f \cdot r_p$ (eq. B.11)
P_W (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot P_{LD} \cdot C_{LD}$ (eq. B.12)
P_Z (power)	1	$= P_{SPD} \cdot P_{TWS} \cdot C_{LI}$ (eq. B.13)

- What this assessment does not cover.** Stated for every assessment, whether or not it applies to yours:
- National deviations. This assessment follows the IEC base document. The foreword of IEC 62305-2:2024 records differing practices in four places: in Germany $r_p = 1$ in all cases, $P_{TWS} = 1$ for R_B , R_C , R_M , R_V , R_W and R_Z , and the highest L_{F1} / L_{F2} of Table C.2 should be used; in Greece $P_{TWS} = 1$ in all cases; in Italy R_{L1} (eq. 7) and R_{L2} (eq. 8) must each be compared with the tolerable risk separately, where this assessment judges their sum $R = R_{L1} + R_{L2}$ (eq. 6) — both values are printed per zone, so the Italian comparison can be made by hand; in the Netherlands and South Africa Annex D and Annex E should not be applied to usual studies, which matches what is done here. Check the national annex that applies to the site.
 - Annex D — the graphical evaluation of P_{SPD} from the SPD's protection level and the system's withstand. P_{SPD} is taken from the Table B.3 lookup on the declared coordination level, and Annex D's method is not offered.
 - Annex E — the detailed investigation of additional losses L_E to surrounding structures and the environment. Annex E is for specific applications and E.1 says most structures need no environmental risk, but where one is needed it is not computed here.
 - Lines composed of several sections (different routing, shielding or installation along their length). Each line entered is taken as uniform end to end; a composite line has to be assessed section by section.
 - The lightning density used is a gridded climatology unless a value is entered directly. A national N_G map or a lightning location system to IEC 62858 is a better source wherever one is available, and N_{SG} drives every N term in the assessment.
 - The protection measures this assessment recommends are sized elsewhere: an LPS is designed to IEC 62305-3 and a coordinated SPD system to IEC 62305-4. This tool decides whether protection is needed and to which level, not what to install.
 - Economic risk. IEC 62305-2 Ed. 3.0 deleted the R4 economic-loss component and the cost-benefit annex of Ed. 2, so no cost comparison is part of this edition and none is produced here.

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Figures are computed by the pinned engine version named above; this snapshot is frozen for reproducibility. This report is an aid to a licensed engineer and is not, by itself, the engineer of record.

External LPS Design Basis of calculation: IEC 62305-3:2024 (Ed. 3.0)			Report	VB-SAMPLE-LPS-0001		
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Project	Meridian Works		Client	Meridian Works — fictional demonstration		
Site address	Illustrative site — not a real installation					
Prepared by	Demonstration Engineer, Fictional example practice					
Checked by	Example reviewer (fictional)		Approved by	Sample approver		
Dimensions	Taken from drawings — Illustrative drawings — not a real building					
Rev.	Date	Description	Prepared	Checked	Approved	
1	2026-09-28	First issue	Demonstration Engineer	Sample checker	Sample approver	
2	2026-09-28	Update the named checker for this demonstration issue.	Demonstration Engineer	Example reviewer (fictional)	Sample approver	

Air termination

LPS class	I
Method	Rolling sphere
Sphere radius	20 m
Rod height above the reference plane	3 m
Protected radius at the reference plane	10.5 m
Perimeter air-termination conductor (at 20 m)	44.0 m on the roof edge
Perimeter air-termination conductor (at 12 m)	120.0 m on the roof edge
Perimeter air-termination conductor (at 8 m)	56.0 m on the roof edge
Perimeter air-termination conductor (at 8 m)	45.7 m on the roof edge
Perimeter air-termination conductor (at 8 m)	64.0 m on the roof edge
Conductor minimum cross-section (Table 7)	50 mm² tape / 50 mm² round
Proposed air-termination rods (at 20 m)	2
Proposed air-termination rods (at 12 m)	2
Proposed air-termination rods (at 8 m)	2

Proposed air-termination rods (at 8 m)	none needed
Proposed air-termination rods (at 8 m)	2
Candidate positions considered (at 20 m)	4
Candidate positions considered (at 12 m)	12
Candidate positions considered (at 8 m)	6
Candidate positions considered (at 8 m)	6
Candidate lattice pitch (at 20 m)	12.0 m
Candidate lattice pitch (at 12 m)	13.3 m
Candidate lattice pitch (at 8 m)	12.0 m
Candidate lattice pitch (at 8 m)	14.0 m
Roof within a rod's protected radius (at 20 m)	100%
Roof within a rod's protected radius (at 12 m)	100%
Roof within a rod's protected radius (at 8 m)	100%
Roof within a rod's protected radius (at 8 m)	100%
Rod coverage proof (at 20 m)	exact – every point of the roof shown to lie within a rod's protected radius (no grid; see note)
Rod coverage proof (at 12 m)	exact – every point of the roof shown to lie within a rod's protected radius, or out of the sphere's reach behind a taller part of the structure (no grid; see note)
Rod coverage proof (at 8 m)	exact – every point of the roof shown to lie within a rod's protected radius, or out of the sphere's reach behind a taller part of the structure (no grid; see note)
Rod coverage proof (at 8 m)	exact – every point of the roof shown to lie within a rod's protected radius, or out of the sphere's reach behind a taller part of the structure (no grid; see note)
Lateral protection angle α (D. 5.2.3.3)	15°
Lateral protected width $w = r/$ 10	2 m

Rod height that best protects the roof edge (at 12 m)	8.0 m
Rod height that best protects the roof edge (at 8 m)	12.0 m
Rod height that best protects the roof edge (at 8 m)	12.0 m
Rod height that best protects the roof edge (at 8 m)	12.0 m
Rod spacing at the roof edge (d_edge) (at 12 m)	12.5 m
Rod spacing at the roof edge (d_edge) (at 8 m)	15.9 m
Rod spacing at the roof edge (d_edge) (at 8 m)	15.9 m
Rod spacing at the roof edge (d_edge) (at 8 m)	15.9 m
Roof the structure itself puts out of the sphere's reach (at 12 m)	at least 99.9%
Roof the structure itself puts out of the sphere's reach (at 8 m)	at least 75.0%
Roof the structure itself puts out of the sphere's reach (at 8 m)	100%
Roof the structure itself puts out of the sphere's reach (at 8 m)	at least 76.2%

§5.2.1: for all types of air terminals only the real physical dimensions of the metal air-termination systems shall be used for the determination of the volume protected. Every protected volume in this design is computed from the entered physical height alone — no enhanced or extended radius is claimed for any device. §5.2.1 also states that radioactive air terminals are not allowed.

§5.2.1: the individual air-termination rods should be connected together at roof level to ensure current division.

The rolling sphere always touches the roof edge. That is geometry — it holds for every building and nothing placed mid-roof changes it. D.5.2.2.2 makes a positioning adequate when the sphere touches only the ground and the air-termination system, so a conductor on the edge is what makes the contact there a contact with the air termination rather than with the structure.

It protects the **edge line only**. A conductor lying flush in the roof plane obstructs nothing above it: a sphere coming straight down touches it at one tangent point, and the roof inward of the edge is still the rods' job. Nor is it protected space — an air termination is where the strike is meant to land, not volume that is safe — so the protected volume drawn for this design is the same with the conductor as without it.

Minimum cross-sectional area, Table 7 (§5.6.2) for Copper / tin-plated copper: 50 mm² solid tape or 50 mm² solid round. The Materials section resolves the same table for every LPS conductor, including the stranded option where the table gives one.

The length is the perimeter of the roof outline this design was given, and nothing more: no allowance for laps, joints, fixings, down-conductor connections, upstands or roof plant, and no route around anything on the roof, because no design here knows what is on the roof. It is the geometry to take off from, not a cut length to order.

§5.2.3: lateral impacts of flashes to the side are considered negligible for structures up to 60 m measured from ground level, and this structure is 20 m. However, the same clause states that elements significantly protruding the facade can be endangered (e.g. balconies, cameras, antennas), and NOTE 2 adds that such elements on structures up to 60 m are rarely endangered. No air termination is required on the vertical surfaces at this height — the requirement in §5.2.3 is scoped to structures taller than 60 m — so this is a judgement for the designer, about protruding elements this design does not know about.

D.5.2.3.3 proposes a simple approach for those elements: the positioning is adequate if all parts of the element to be protected are below a surface generated by a straight line at $\alpha = 15^\circ$ to vertical (Figure D.6), with the horizontal width of the protected area limited to $w = r/10 = 2$ m at class I. α is independent of the class of LPS; only w moves with it. This design states those two quantities and positions nothing on the facade. w is a width limit rather than a facade solution — D.5.2.3.3 offers the method as a supplementary part of protected area, "especially useful just below the roof".

The air termination here stands 23 m above ground, at or above the class I rolling-sphere radius of 20 m — which is where D.5.2.3.3 says this method earns its place. At an air-termination height equal to the radius, the tangent to the arc of the sphere becomes vertical and the width of the area protected by the sphere becomes zero (Figure D.6); the lateral protection angle method then supplies a supplementary part of protected area, $w = 2$ m wide, which D.5.2.3.3 calls especially useful just below the roof. Above the radius the method stays suitable up to 60 m (Figure D.7).

This design does not lay out the lateral air termination. It carries no facade elevation, no balcony, camera or antenna position, and no facade conductor route — the quantities above size that work, they do not specify it.

The roof at 20 m.

An air-termination conductor runs around the roof edge, following the outline: 44.0 m. §5.2.2.1 requires air-termination components to be located at roof level on corners, exposed points and edges, and §5.2.1 requires the individual rods to be connected together at roof level to ensure current division — the roof edge is where both are satisfied at once, and where practice routes the connection. This is not additional material: it specifies a conductor the design already implied.

At 20 m this structure is at or above the class I rolling-sphere radius of 20 m, so there is no rod height with a roof-edge spacing: a ground-resting sphere reaches the edge from beyond any rod tip standing on the roof. The edge is the perimeter conductor's here, and §5.2.3's flashes to the side are sized separately below.

These rods carry the roof's interior and nothing else. §5.2.2.1 requires air-termination components on corners, exposed points and edges, and the perimeter conductor above passes through every corner and along every edge — so that requirement is met by the conductor, and the rods answer the one question left: bring every roof point within 10.5 m of a rod. Without the conductor the rods would have to hold the edge as well, and there would be 4 of them here instead of 2.

2 of the 4 lattice positions were kept. The selection is computed the same way for the same inputs, so re-running this design gives this layout again — but it is one covering layout, not the only one, and a rod moved to suit the roof is the engineer's call to make against the same criterion.

The layout is **proved** to cover rather than sampled for coverage. Any uncovered piece of roof would be an open region whose border is made of walls and of arcs of the rods' reach, and such a border can only change from one to the other at a corner of the outline, where a rod's reach crosses a wall, or where two rods' reaches cross. A piece with none of those would have to be ringed by a single unbroken circle, which cannot happen inside a closed outline. So that finite set of places decides the whole roof, and every one of them was tested — no grid is involved and nothing between the tested places is assumed. Two limits, stated because the claim is only worth what they leave: a point exactly at a rod's reach counts as **outside** it throughout, so a point on the boundary of the protected volume is treated as unprotected rather than protected; and where a tested place is a knife-edge contact rather than a gap, its surroundings are probed at a finite number of points to decide whether real area opens there, so a gap narrower than roughly a quarter-turn at that contact would not be reported. Both are properties of the layout as drawn: move or shorten any rod and neither this proof nor the coverage percentage applies until the design is recomputed. That percentage — the "Roof within a rod's protected radius" row above — is not a second proof. It answers the same question on a grid, by code that shares none with this argument, so where this proof closes it can only agree — read it as a check on the tool, not as further evidence about this roof. It is reported with its spacing because it is the number that says how far short a layout falls in the case this proof does not close.

The rod positions above are a **proposed** layout, computed from the LPS class, the plan outline and the rod height by the positioning rule of §5.2.2.1 — rods on corners, then edges, then the field, on a square grid no coarser than the spacing one rod's protected radius supports. They are not a survey and not an instruction: the engineer may move them, and the coverage figure is what any alternative should be judged against — but the coverage figure and the covering proof are both about the layout as drawn, and a rod moved, shortened or removed voids them until the design is recomputed against the positions actually adopted.

Natural air terminations are not counted. Metal parapets, copings, handrails, ladders and existing masts commonly protect a roof already, and §5.2.5 allows them; none of them is an input here, so the layout may put a rod where something on the roof already does the job. Check the layout against what is actually up there before pricing it.

The coverage figure is measured and not assumed: 120 roof points on a 1.00 m grid, each tested against the rolling-sphere criterion of §5.2.2 — a point is protected when the sphere resting on it cannot avoid touching the air termination, and every one of them is protected — so it reads 100% with no "at least" in front of it. Elsewhere the figure is a lower bound, because the only obstacles counted are the rods above and anything else on the roof can add protection but never remove it; here there is nothing left above it for a bound to allow for. What it remains is the grid's answer rather than the roof's: whether every point of the roof is covered is a different question, and the "Rod coverage proof" row above is what answers it.

The roof at 12 m.

An air-termination conductor runs around the roof edge, following the outline: 120.0 m. §5.2.2.1 requires air-termination components to be located at roof level on corners, exposed points and edges, and §5.2.1 requires the individual rods to be connected together at roof level to ensure current division — the roof edge is where both are satisfied at once, and where practice routes the connection. This is not additional material: it specifies a conductor the design already implied.

The roof edge is governed by a different figure from the interior. A sphere resting on the ground beside the building reaches the roof edge from 18.3 m away in plan; a rod tip at 15.0 m above ground is reached from 19.4 m. Rods on the edge keep that sphere off it while they are no more than $d_{\text{edge}} = 2 \cdot \sqrt{(a_1^2 - a_0^2)} = 12.5$ m apart — against the 10.5 m that governs the interior. The two are not the same number and neither substitutes for the other.

d_{edge} is largest at a rod height of exactly $R - H = 8.0$ m for this class and building, and falls away on both sides of it. Taller is not better at the roof edge: past 16.0 m a rod of that height protects the edge at no spacing at all, because the sphere that clears its tip clears the roof with it.

This roof stands beside a taller part of the same structure — the roof at 20 m — and that part obstructs the rolling sphere over at least 99.9% of it: the sphere rests on that roof's edge, where this design runs its edge conductor (§5.2.2.1), so what it touches there is air termination and not the structure (§5.2.2.2). The obstruction reaches 16.0 m out from the taller plan at this level — the same $\sqrt{d(2R - d)}$ that gives a rod its protected radius, with d the height the taller part stands above this roof. Those metres need no rod, and the layout above does not put one there. Nothing about it is an allowance: the covering proof is run against the obstruction and the rods together, and it is the same exact test the rods alone would have faced.

These rods carry the roof's interior and nothing else. §5.2.2.1 requires air-termination components on corners, exposed points and edges, and the perimeter conductor above passes through every corner and along every edge — so that requirement is met by the conductor, and the rods answer the one question left: bring every roof point within 10.5 m of a rod. Without the conductor the rods would have to hold the edge as well, and there would be 12 of them here instead of 2.

2 of the 12 lattice positions were kept. The selection is computed the same way for the same inputs, so re-running this design gives this layout again — but it is one covering layout, not the only one, and a rod moved to suit the roof is the engineer's call to make against the same criterion.

The layout is **proved** to cover rather than sampled for coverage. Any uncovered piece of roof would be an open region whose border is made of walls and of arcs of the rods' reach, and such a border can only change from one to the other at a corner of the outline, where a rod's reach crosses a wall, or where two rods' reaches cross. A piece with none of those would have to be ringed by a single unbroken circle, which cannot happen inside a closed outline. So that finite set of places decides the whole roof, and every one of them was tested — no grid is involved and nothing between the tested places is assumed. Two limits, stated because the claim is only worth what they leave: a point exactly at a rod's reach counts as **outside** it throughout, so a point on the boundary of the protected volume is treated as unprotected rather than protected; and where a tested place is a knife-edge contact rather than a gap, its surroundings are probed at a finite number of points to decide whether real area opens there, so a gap narrower than roughly a quarter-turn at that contact would not be reported. Both are properties of the layout as drawn: move or shorten any rod and neither this proof nor the coverage percentage applies until the design is recomputed. That percentage — the "Roof within a rod's protected radius" row above — is not a second proof. It answers the same question on a grid, by code that shares none with this argument, so where this proof closes it can only agree — read it as a check on the tool, not as further evidence about this roof. It is reported with its spacing because it is the number that says how far short a layout falls in the case this proof does not close.

The rod positions above are a **proposed** layout, computed from the LPS class, the plan outline and the rod height by the positioning rule of §5.2.2.1 — rods on corners, then edges, then the field, on a square grid no coarser than the spacing one rod's protected radius supports. They are not a survey and not an instruction: the engineer may move them, and the coverage figure is what any alternative should be judged against — but the coverage figure and the covering proof are both about the layout as drawn, and a rod moved, shortened or removed voids them until the design is recomputed against the positions actually adopted.

Natural air terminations are not counted. Metal parapets, copings, handrails, ladders and existing masts commonly protect a roof already, and §5.2.5 allows them; none of them is an input here, so the layout may put a rod where something on the roof already does the job. Check the layout against what is actually up there before pricing it.

The coverage figure is measured and not assumed: 680 roof points on a 1.00 m grid, each tested against the rolling-sphere criterion of §5.2.2 — a point is protected when the sphere resting on it

cannot avoid touching the air termination, and every one of them is protected — so it reads 100% with no "at least" in front of it. Elsewhere the figure is a lower bound, because the only obstacles counted are the rods above and anything else on the roof can add protection but never remove it; here there is nothing left above it for a bound to allow for. What it remains is the grid's answer rather than the roof's: whether every point of the roof is covered is a different question, and the "Rod coverage proof" row above is what answers it.

The roof at 8 m.

An air-termination conductor runs around the roof edge, following the outline: 56.0 m. §5.2.2.1 requires air-termination components to be located at roof level on corners, exposed points and edges, and §5.2.1 requires the individual rods to be connected together at roof level to ensure current division — the roof edge is where both are satisfied at once, and where practice routes the connection. This is not additional material: it specifies a conductor the design already implied.

The roof edge is governed by a different figure from the interior. A sphere resting on the ground beside the building reaches the roof edge from 16.0 m away in plan; a rod tip at 11.0 m above ground is reached from 17.9 m. Rods on the edge keep that sphere off it while they are no more than $d_{\text{edge}} = 2 \cdot \sqrt{(a_1^2 - a_0^2)} = 15.9 \text{ m}$ apart — against the 10.5 m that governs the interior. The two are not the same number and neither substitutes for the other.

d_{edge} is largest at a rod height of exactly $R - H = 12.0 \text{ m}$ for this class and building, and falls away on both sides of it. Taller is not better at the roof edge: past 24.0 m a rod of that height protects the edge at no spacing at all, because the sphere that clears its tip clears the roof with it.

This roof stands beside a taller part of the same structure — the roofs at 20 and 12 m — and that part obstructs the rolling sphere over at least 75.0% of it: the sphere rests on that roof's edge, where this design runs its edge conductor (§5.2.2.1), so what it touches there is air termination and not the structure (§5.2.2.2). The obstruction reaches 18.3 m out from the taller plan at this level — the same $\sqrt{d(2R - d)}$ that gives a rod its protected radius, with d the height the taller part stands above this roof. Those metres need no rod, and the layout above does not put one there. Nothing about it is an allowance: the covering proof is run against the obstruction and the rods together, and it is the same exact test the rods alone would have faced.

These rods carry the roof's interior and nothing else. §5.2.2.1 requires air-termination components on corners, exposed points and edges, and the perimeter conductor above passes through every corner and along every edge — so that requirement is met by the conductor, and the rods answer the one question left: bring every roof point within 10.5 m of a rod. Without the conductor the rods would have to hold the edge as well, and there would be 6 of them here instead of 2.

2 of the 6 lattice positions were kept. The selection is computed the same way for the same inputs, so re-running this design gives this layout again — but it is one covering layout, not the only one, and a rod moved to suit the roof is the engineer's call to make against the same criterion.

The layout is **proved** to cover rather than sampled for coverage. Any uncovered piece of roof would be an open region whose border is made of walls and of arcs of the rods' reach, and such a border can only change from one to the other at a corner of the outline, where a rod's reach crosses a wall, or where two rods' reaches cross. A piece with none of those would have to be ringed by a single unbroken circle, which cannot happen inside a closed outline. So that finite set of places decides the whole roof, and every one of them was tested — no grid is involved and nothing between the tested places is assumed. Two limits, stated because the claim is only worth what they leave: a point exactly at a rod's reach counts as **outside** it throughout, so a point on the boundary of the protected volume is treated as unprotected rather than protected; and where a tested place is a knife-edge contact rather than a gap, its surroundings are probed at a finite number of points to decide whether real area opens there, so a gap narrower than roughly a quarter-turn at that contact would not be reported. Both are properties of the layout as drawn: move or shorten any rod and neither this proof

nor the coverage percentage applies until the design is recomputed. That percentage — the "Roof within a rod's protected radius" row above — is not a second proof. It answers the same question on a grid, by code that shares none with this argument, so where this proof closes it can only agree — read it as a check on the tool, not as further evidence about this roof. It is reported with its spacing because it is the number that says how far short a layout falls in the case this proof does not close.

The rod positions above are a **proposed** layout, computed from the LPS class, the plan outline and the rod height by the positioning rule of §5.2.2.1 — rods on corners, then edges, then the field, on a square grid no coarser than the spacing one rod's protected radius supports. They are not a survey and not an instruction: the engineer may move them, and the coverage figure is what any alternative should be judged against — but the coverage figure and the covering proof are both about the layout as drawn, and a rod moved, shortened or removed voids them until the design is recomputed against the positions actually adopted.

Natural air terminations are not counted. Metal parapets, copings, handrails, ladders and existing masts commonly protect a roof already, and §5.2.5 allows them; none of them is an input here, so the layout may put a rod where something on the roof already does the job. Check the layout against what is actually up there before pricing it.

The coverage figure is measured and not assumed: 192 roof points on a 1.00 m grid, each tested against the rolling-sphere criterion of §5.2.2 — a point is protected when the sphere resting on it cannot avoid touching the air termination, and every one of them is protected — so it reads 100% with no "at least" in front of it. Elsewhere the figure is a lower bound, because the only obstacles counted are the rods above and anything else on the roof can add protection but never remove it; here there is nothing left above it for a bound to allow for. What it remains is the grid's answer rather than the roof's: whether every point of the roof is covered is a different question, and the "Rod coverage proof" row above is what answers it.

The roof at 8 m.

An air-termination conductor runs around the roof edge, following the outline: 45.7 m. §5.2.2.1 requires air-termination components to be located at roof level on corners, exposed points and edges, and §5.2.1 requires the individual rods to be connected together at roof level to ensure current division — the roof edge is where both are satisfied at once, and where practice routes the connection. This is not additional material: it specifies a conductor the design already implied.

The roof edge is governed by a different figure from the interior. A sphere resting on the ground beside the building reaches the roof edge from 16.0 m away in plan; a rod tip at 11.0 m above ground is reached from 17.9 m. Rods on the edge keep that sphere off it while they are no more than $d_{\text{edge}} = 2 \cdot \sqrt{(a_1^2 - a_0^2)} = 15.9$ m apart — against the 10.5 m that governs the interior. The two are not the same number and neither substitutes for the other.

d_{edge} is largest at a rod height of exactly $R - H = 12.0$ m for this class and building, and falls away on both sides of it. Taller is not better at the roof edge: past 24.0 m a rod of that height protects the edge at no spacing at all, because the sphere that clears its tip clears the roof with it.

This roof needs no air-termination rods. A taller part of the same structure — the roofs at 20 and 12 m — obstructs the rolling sphere over the whole of it: the sphere rests on that roof's edge, where this design runs its edge conductor (§5.2.2.1), which the sphere method treats exactly as a rod would — proved, not sampled, by the same test every other layout in this design is held to. The perimeter air-termination conductor and the down conductors are unaffected: §5.2.2.1 puts air-termination components on the roof's corners and edges whatever stands over it, and §5.3 brings the current down regardless.

This roof stands beside a taller part of the same structure — the roofs at 20 and 12 m — and that part obstructs the rolling sphere over 100% of it: the sphere rests on that roof's edge, where this design

runs its edge conductor (§5.2.2.1), so what it touches there is air termination and not the structure (§5.2.2.2). The obstruction reaches 18.3 m out from the taller plan at this level — the same $\sqrt{d(2R - d)}$ that gives a rod its protected radius, with d the height the taller part stands above this roof. Those metres need no rod, and the layout above does not put one there. Nothing about it is an allowance: the covering proof is run against the obstruction and the rods together, and it is the same exact test the rods alone would have faced.

The roof at 8 m.

An air-termination conductor runs around the roof edge, following the outline: 64.0 m. §5.2.2.1 requires air-termination components to be located at roof level on corners, exposed points and edges, and §5.2.1 requires the individual rods to be connected together at roof level to ensure current division — the roof edge is where both are satisfied at once, and where practice routes the connection. This is not additional material: it specifies a conductor the design already implied.

The roof edge is governed by a different figure from the interior. A sphere resting on the ground beside the building reaches the roof edge from 16.0 m away in plan; a rod tip at 11.0 m above ground is reached from 17.9 m. Rods on the edge keep that sphere off it while they are no more than $d_{\text{edge}} = 2 \cdot \sqrt{(a_1^2 - a_0^2)} = 15.9$ m apart — against the 10.5 m that governs the interior. The two are not the same number and neither substitutes for the other.

d_{edge} is largest at a rod height of exactly $R - H = 12.0$ m for this class and building, and falls away on both sides of it. Taller is not better at the roof edge: past 24.0 m a rod of that height protects the edge at no spacing at all, because the sphere that clears its tip clears the roof with it.

This roof stands beside a taller part of the same structure — the roofs at 20 and 12 m — and that part obstructs the rolling sphere over at least 76.2% of it: the sphere rests on that roof's edge, where this design runs its edge conductor (§5.2.2.1), so what it touches there is air termination and not the structure (§5.2.2.2). The obstruction reaches 18.3 m out from the taller plan at this level — the same $\sqrt{d(2R - d)}$ that gives a rod its protected radius, with d the height the taller part stands above this roof. Those metres need no rod, and the layout above does not put one there. Nothing about it is an allowance: the covering proof is run against the obstruction and the rods together, and it is the same exact test the rods alone would have faced.

These rods carry the roof's interior and nothing else. §5.2.2.1 requires air-termination components on corners, exposed points and edges, and the perimeter conductor above passes through every corner and along every edge — so that requirement is met by the conductor, and the rods answer the one question left: bring every roof point within 10.5 m of a rod. Without the conductor the rods would have to hold the edge as well, and there would be 6 of them here instead of 2.

2 of the 6 lattice positions were kept. The selection is computed the same way for the same inputs, so re-running this design gives this layout again — but it is one covering layout, not the only one, and a rod moved to suit the roof is the engineer's call to make against the same criterion.

The layout is **proved** to cover rather than sampled for coverage. Any uncovered piece of roof would be an open region whose border is made of walls and of arcs of the rods' reach, and such a border can only change from one to the other at a corner of the outline, where a rod's reach crosses a wall, or where two rods' reaches cross. A piece with none of those would have to be ringed by a single unbroken circle, which cannot happen inside a closed outline. So that finite set of places decides the whole roof, and every one of them was tested — no grid is involved and nothing between the tested places is assumed. Two limits, stated because the claim is only worth what they leave: a point exactly at a rod's reach counts as **outside** it throughout, so a point on the boundary of the protected volume is treated as unprotected rather than protected; and where a tested place is a knife-edge contact rather than a gap, its surroundings are probed at a finite number of points to decide whether real area opens there, so a gap narrower than roughly a quarter-turn at that contact would not be reported. Both are properties of the layout as drawn: move or shorten any rod and neither this proof

nor the coverage percentage applies until the design is recomputed. That percentage — the "Roof within a rod's protected radius" row above — is not a second proof. It answers the same question on a grid, by code that shares none with this argument, so where this proof closes it can only agree — read it as a check on the tool, not as further evidence about this roof. It is reported with its spacing because it is the number that says how far short a layout falls in the case this proof does not close.

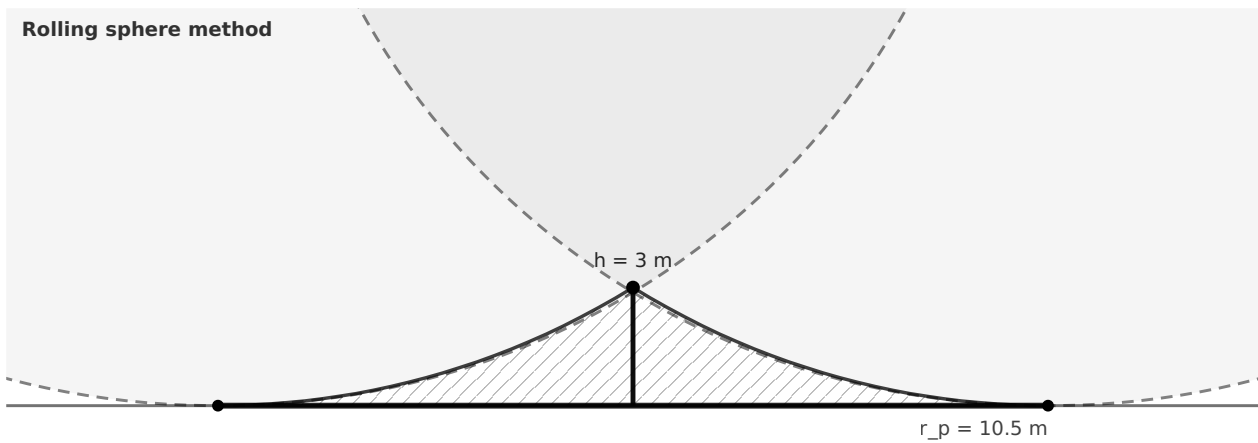
The rod positions above are a **proposed** layout, computed from the LPS class, the plan outline and the rod height by the positioning rule of §5.2.2.1 — rods on corners, then edges, then the field, on a square grid no coarser than the spacing one rod's protected radius supports. They are not a survey and not an instruction: the engineer may move them, and the coverage figure is what any alternative should be judged against — but the coverage figure and the covering proof are both about the layout as drawn, and a rod moved, shortened or removed voids them until the design is recomputed against the positions actually adopted.

Natural air terminations are not counted. Metal parapets, copings, handrails, ladders and existing masts commonly protect a roof already, and §5.2.5 allows them; none of them is an input here, so the layout may put a rod where something on the roof already does the job. Check the layout against what is actually up there before pricing it.

The coverage figure is measured and not assumed: 252 roof points on a 1.00 m grid, each tested against the rolling-sphere criterion of §5.2.2 — a point is protected when the sphere resting on it cannot avoid touching the air termination, and every one of them is protected — so it reads 100% with no "at least" in front of it. Elsewhere the figure is a lower bound, because the only obstacles counted are the rods above and anything else on the roof can add protection but never remove it; here there is nothing left above it for a bound to allow for. What it remains is the grid's answer rather than the roof's: whether every point of the roof is covered is a different question, and the "Rod coverage proof" row above is what answers it.

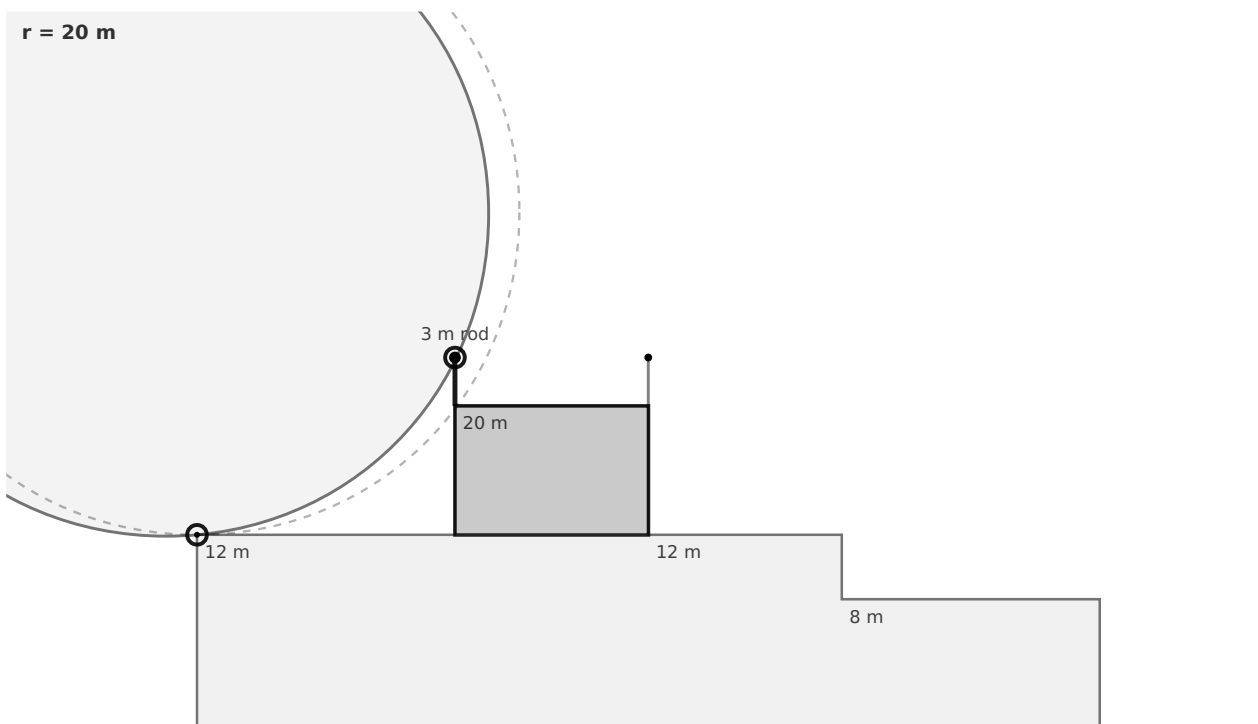
Rod	Roof	x (m)	y (m)	h (m)	r_p (m)
1	at 20 m	16.00	5.00	3.00	10.54
2	at 20 m	28.00	15.00	3.00	10.54
3	at 12 m	0.00	0.00	3.00	10.54
4	at 12 m	0.00	20.00	3.00	10.54
5	at 8 m	56.00	0.00	3.00	10.54
6	at 8 m	56.00	12.00	3.00	10.54
7	at 8 m	0.00	38.00	3.00	10.54
8	at 8 m	14.00	38.00	3.00	10.54

The 8 rods this layout proposes, with x and y measured from the 0, 0 marked on the roof plan, as the model in the workspace gives them, with the height each one stands at and the protected radius that height buys it. Heights are above the roof named beside each rod, which is the reference plane its design was run at (§5.2.2.3.1). The covering proof and the coverage figure are about these positions: a rod moved, shortened or removed voids them until the design is recomputed.



- ┆ Air-termination rod, 3 m above the plane
- ▨ Protected space, $r_p = 10.5 \text{ m}$
- The two spheres that generate it, $r = 20 \text{ m}$

The space the tallest of this design's rods — 3 m — protects at the reference plane. Rolling-sphere construction: each sphere of $r = 20 \text{ m}$ rests on the reference plane 10.5 m from the rod and touches its tip. The shaded region is their underside — what a sphere of that radius cannot reach. Drawn to scale on both axes. The plane is drawn rather than a roof because this figure is about the geometry one rod makes, not about where it stands — the layout is the roof plan below.

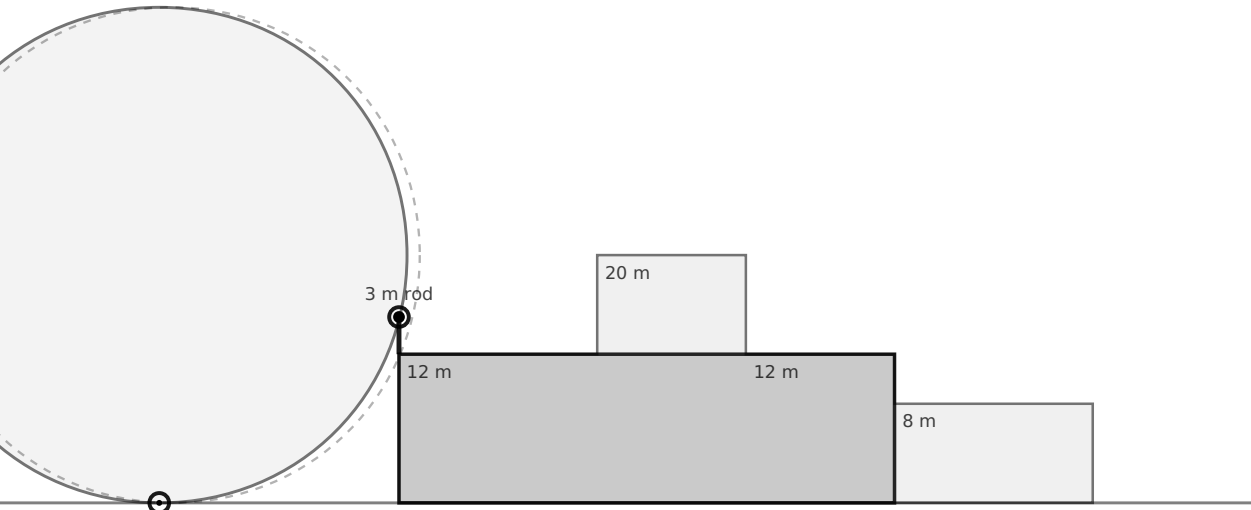


- Rolling sphere, $r = 20 \text{ m}$ — resting on this design
- ▨ The building in section at $y = 10.0 \text{ m}$ — roofs at 8 m and 12 m and 20 m; this figure is about the roof at 20 m
- ⊙ Where the sphere touches — a strike point
- ⋯ The same sphere on the bare structure
- ┆ The design's air-termination rods, 3 m

The roof at 20 m. Rolling sphere $r = 20 \text{ m}$, rolled from the left in a section through this roof at $y = 10.0 \text{ m}$, with every part the section crosses drawn where it stands. Where it first reaches this roof it rests on the edge of the roof at 12 m, not

on the ground: in this section the building is in the way. This design's own rods hold the sphere off the roof edge; the dashed sphere is the same sphere on the bare structure. Marked points are where the sphere touches, which is where lightning can strike — they are what an air termination has to answer. No protected zone is shaded here: this figure shows where the sphere rests, not what that leaves protected. Drawn to scale on both axes; the sphere is clipped to the frame.

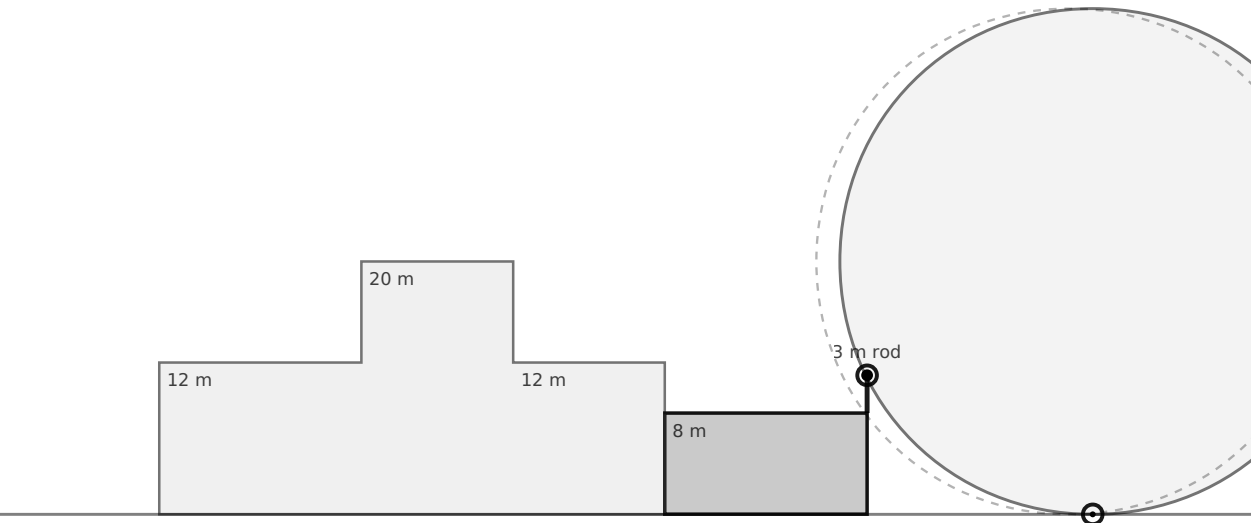
$r = 20\text{ m}$



- Rolling sphere, $r = 20\text{ m}$ — resting on this design
- ▭ The building in section at $y = 10.0\text{ m}$ — roofs at 8 m and 12 m and 20 m ; this figure is about the roof at 12 m
- ⊙ Where the sphere touches — a strike point
- ⋯ The same sphere on the bare structure
- ! The design's air-termination rods, 3 m

The roof at 12 m . Rolling sphere $r = 20\text{ m}$, rolled from the left in a section through this roof at $y = 10.0\text{ m}$, with every part the section crosses drawn where it stands. Where it first reaches this roof it rests on the ground 19.4 m from the wall. This design's own rods hold the sphere off the roof edge; the dashed sphere is the same sphere on the bare structure. Marked points are where the sphere touches, which is where lightning can strike — they are what an air termination has to answer. No protected zone is shaded here: this figure shows where the sphere rests, not what that leaves protected. Drawn to scale on both axes; the sphere is clipped to the frame.

$r = 20\text{ m}$



Rolling sphere, $r = 20\text{ m}$ — resting on this design

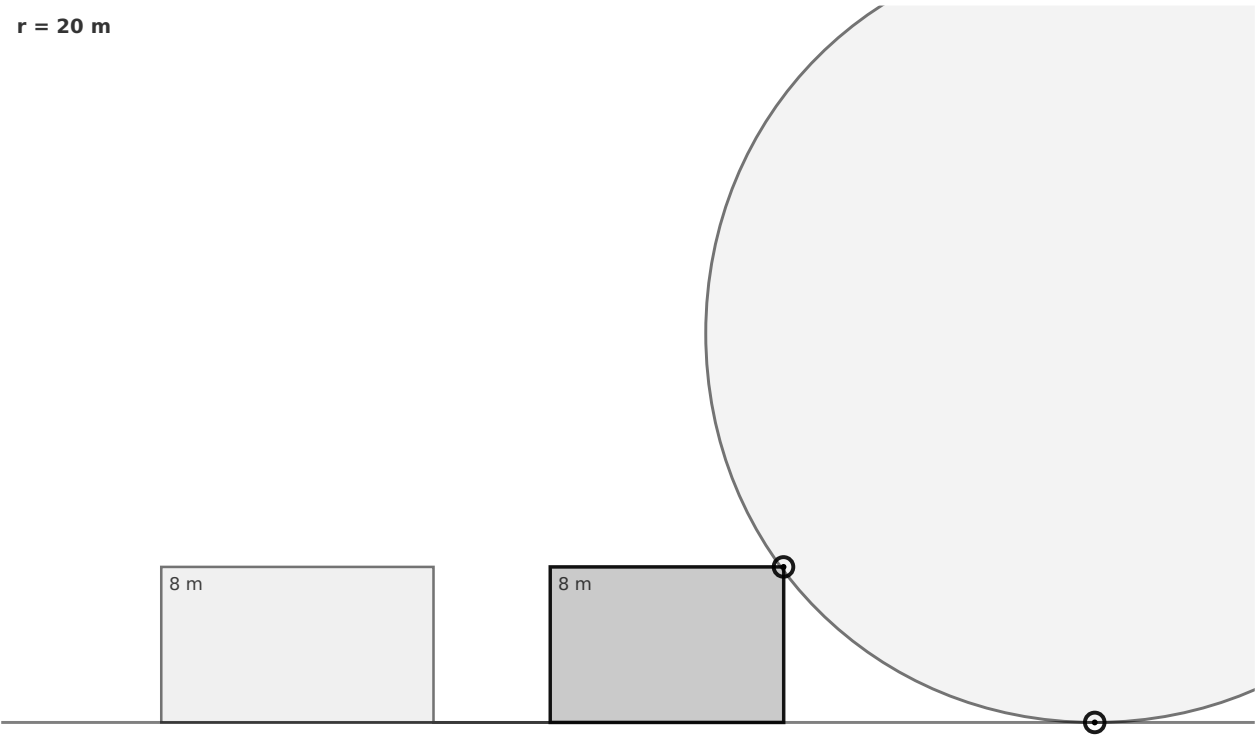
The building in section at $y = 6.0\text{ m}$ — roofs at 8 m and 12 m and 20 m ; this figure is about the roof at 8 m

Where the sphere touches — a strike point

The same sphere on the bare structure

The design's air-termination rods, 3 m

The roof at 8 m. Rolling sphere $r = 20\text{ m}$, rolled from the right in a section through this roof at $y = 6.0\text{ m}$, with every part the section crosses drawn where it stands. Where it first reaches this roof it rests on the ground 17.9 m from the wall. This design's own rods hold the sphere off the roof edge; the dashed sphere is the same sphere on the bare structure. Marked points are where the sphere touches, which is where lightning can strike — they are what an air termination has to answer. No protected zone is shaded here: this figure shows where the sphere rests, not what that leaves protected. Drawn to scale on both axes; the sphere is clipped to the frame.

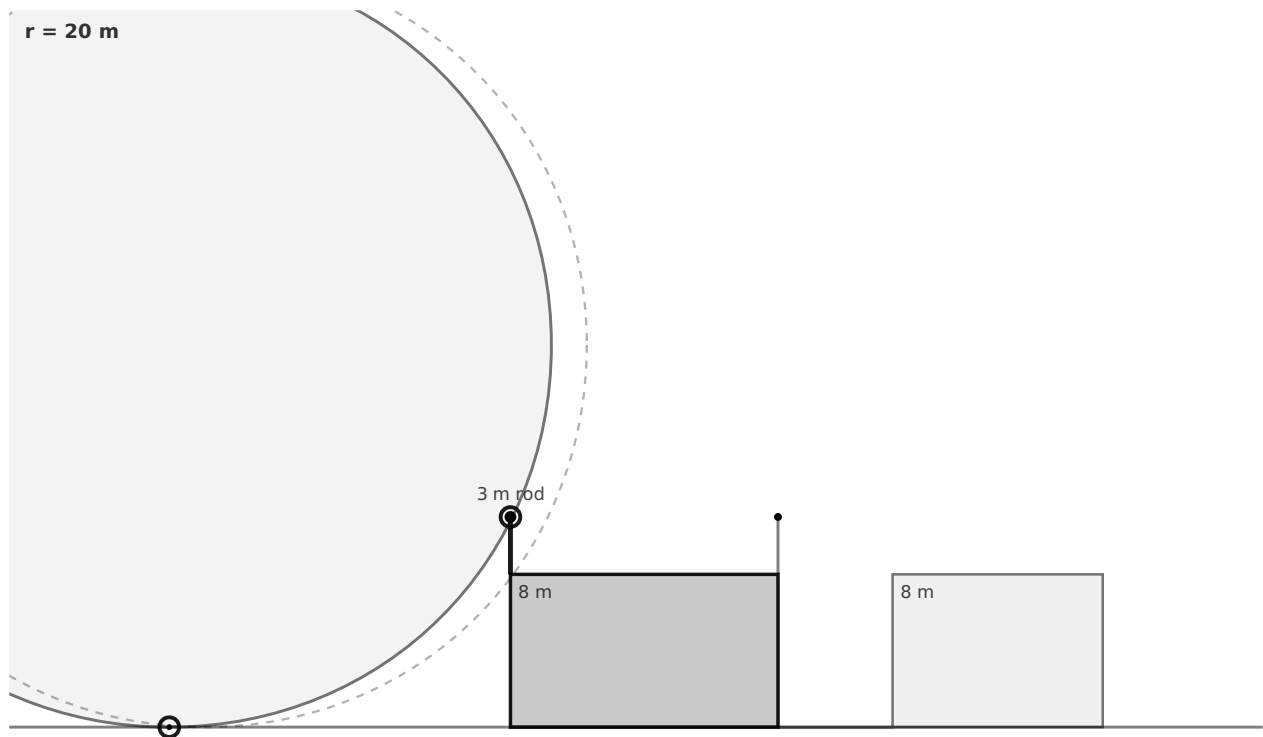


Rolling sphere, $r = 20\text{ m}$

The building in section at $y = 25.9\text{ m}$ — roofs at 8 m ; this figure is about the roof at 8 m

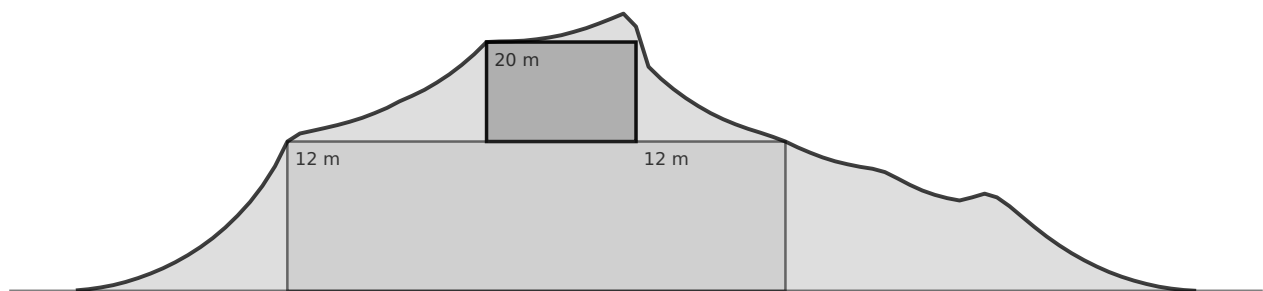
Where the sphere touches — a strike point

The roof at 8 m. Rolling sphere $r = 20\text{ m}$, rolled from the right in a section through this roof at $y = 25.9\text{ m}$, with every part the section crosses drawn where it stands. Where it first reaches this roof it rests on the ground 16.0 m from the wall. Marked points are where the sphere touches, which is where lightning can strike — they are what an air termination has to answer. No protected zone is shaded here: this figure shows where the sphere rests, not what that leaves protected. Drawn to scale on both axes; the sphere is clipped to the frame.



- Rolling sphere, $r = 20\text{ m}$ — resting on this design
- The building in section at $y = 29.0\text{ m}$ — roofs at 8 m ; this figure is about the roof at 8 m
- ⊙ Where the sphere touches — a strike point
- ⋯ The same sphere on the bare structure
- ! The design's air-termination rods, 3 m

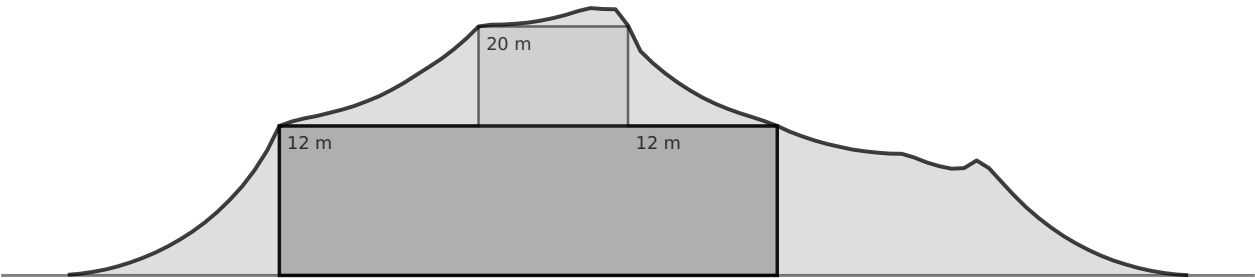
The roof at 8 m . Rolling sphere $r = 20\text{ m}$, rolled from the left in a section through this roof at $y = 29.0\text{ m}$, with every part the section crosses drawn where it stands. Where it first reaches this roof it rests on the ground 17.9 m from the wall. This design's own rods hold the sphere off the roof edge; the dashed sphere is the same sphere on the bare structure. Marked points are where the sphere touches, which is where lightning can strike — they are what an air termination has to answer. No protected zone is shaded here: this figure shows where the sphere rests, not what that leaves protected. Drawn to scale on both axes; the sphere is clipped to the frame.



- The building in section at $y = 14.0\text{ m}$ — roofs at 12 m and 20 m ; this figure is about the roof at 20 m
- ⋯ Protected volume — one surface for the whole structure

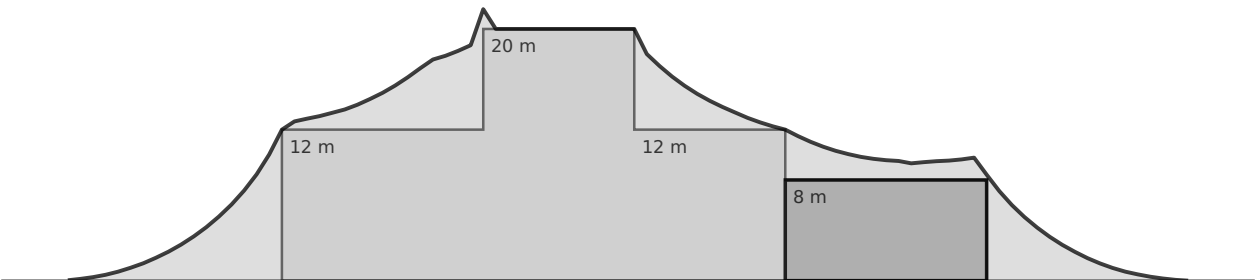
The roof at 20 m . Protected volume in section at $y = 14\text{ m}$, to scale on both axes. **One surface for the whole structure**, not one per roof or per rod: a rolling sphere of $r = 20\text{ m}$ cannot reach anywhere inside it. The design solves it once, for every roof and every rod together, and this cut runs through it along this roof's section line on the roof plan;

every part the cut crosses is drawn where it stands, and this roof is shaded. It climbs the flank beside the structure — where the building's own bulk does the shielding, and a rod on the roof edge deepens it — crosses the roof sagging between the rods, and falls away beyond. The cut is taken through the roof's **deepest point** — where a rolling sphere lowered over the roof comes to rest lowest — so no rod stands on this line. Sampled at 1 m, the pitch of the grid the design publishes the surface on: where the cut falls between two rows of that grid the lower is drawn, and over a roof never lower than the roof itself, which no sphere can pass through. The roof edge it climbs over is where this design runs its edge conductor (§5.2.2.1), so the sphere touches air termination there. Natural air terminations are not counted, so the real surface is at least this high.



- The building in section at $y = 12.6$ m — roofs at 12 m and 20 m; this figure is about the roof at 12 m
- Protected volume — one surface for the whole structure

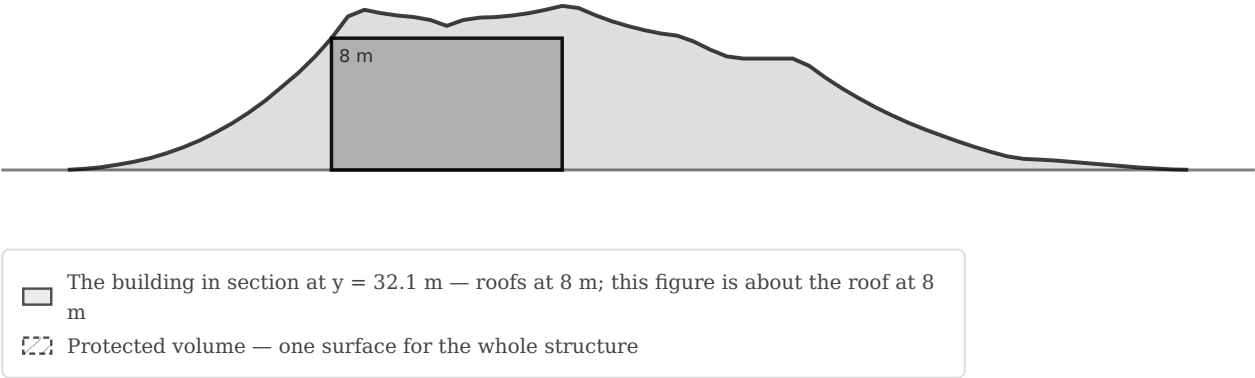
The roof at 12 m. Protected volume in section at $y = 12.635$ m, to scale on both axes. **One surface for the whole structure**, not one per roof or per rod: a rolling sphere of $r = 20$ m cannot reach anywhere inside it. The design solves it once, for every roof and every rod together, and this cut runs through it along this roof's section line on the roof plan; every part the cut crosses is drawn where it stands, and this roof is shaded. It climbs the flank beside the structure — where the building's own bulk does the shielding, and a rod on the roof edge deepens it — crosses the roof sagging between the rods, and falls away beyond. The cut is taken through the roof's **deepest point** — where a rolling sphere lowered over the roof comes to rest lowest — so no rod stands on this line. Sampled at 1 m, the pitch of the grid the design publishes the surface on: where the cut falls between two rows of that grid the lower is drawn, and over a roof never lower than the roof itself, which no sphere can pass through. The roof edge it climbs over is where this design runs its edge conductor (§5.2.2.1), so the sphere touches air termination there. Natural air terminations are not counted, so the real surface is at least this high.



- The building in section at $y = 5.1$ m — roofs at 8 m and 12 m and 20 m; this figure is about the roof at 8 m
- Protected volume — one surface for the whole structure

The roof at 8 m. Protected volume in section at $y = 5.139$ m, to scale on both axes. **One surface for the whole structure**, not one per roof or per rod: a rolling sphere of $r = 20$ m cannot reach anywhere inside it. The design solves it once, for every roof and every rod together, and this cut runs through it along this roof's section line on the roof plan; every part the cut crosses is drawn where it stands, and this roof is shaded. It climbs the flank beside the structure — where the building's own bulk does the shielding, and a rod on the roof edge deepens it — crosses the roof sagging

between the rods, and falls away beyond. The cut is taken through the roof's **deepest point** — where a rolling sphere lowered over the roof comes to rest lowest — so no rod stands on this line. Sampled at 1 m, the pitch of the grid the design publishes the surface on: where the cut falls between two rows of that grid the lower is drawn, and over a roof never lower than the roof itself, which no sphere can pass through. The roof edge it climbs over is where this design runs its edge conductor (§5.2.2.1), so the sphere touches air termination there. Natural air terminations are not counted, so the real surface is at least this high.



The roof at 8 m. Protected volume in section at $y = 32.139$ m, to scale on both axes. **One surface for the whole structure**, not one per roof or per rod: a rolling sphere of $r = 20$ m cannot reach anywhere inside it. The design solves it once, for every roof and every rod together, and this cut runs through it along this roof's section line on the roof plan; every part the cut crosses is drawn where it stands, and this roof is shaded. It climbs the flank beside the structure — where the building's own bulk does the shielding, and a rod on the roof edge deepens it — crosses the roof sagging between the rods, and falls away beyond. The cut is taken through the roof's **deepest point** — where a rolling sphere lowered over the roof comes to rest lowest — so no rod stands on this line. Sampled at 1 m, the pitch of the grid the design publishes the surface on: where the cut falls between two rows of that grid the lower is drawn, and over a roof never lower than the roof itself, which no sphere can pass through. The roof edge it climbs over is where this design runs its edge conductor (§5.2.2.1), so the sphere touches air termination there. Natural air terminations are not counted, so the real surface is at least this high.

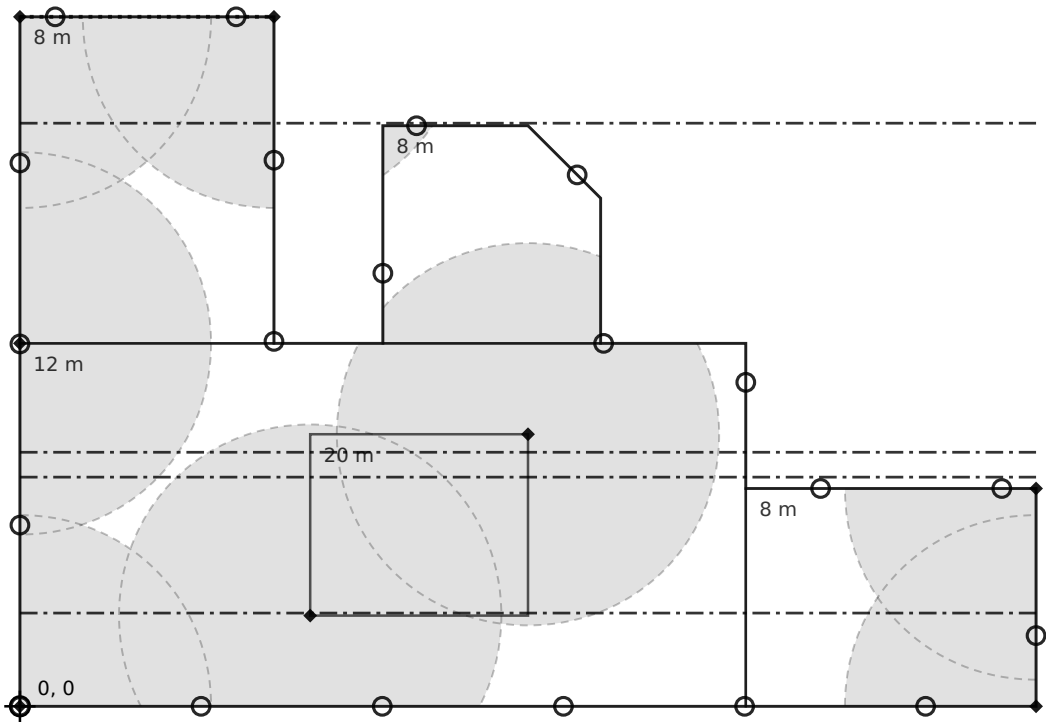
Down conductors

Perimeter	209.657 m (from the plan outline)
Preferred distance between down conductors	10 m
Down conductors	21
Largest gap between adjacent conductors	9.98 m (of the even spacing this design proposes)

IEC 62305-3:2024 §5.3.3 requires only that an attached LPS have not fewer than two down conductors. Distributing them around the perimeter is stated as a recommendation, explicitly subject to architectural and practical constraints, and both equal spacing and the Table 5 distances are preferred values rather than limits. The count above is derived from the preferred distance for this class, which is the conservative reading; a layout that departs from it is a departure from a preference, and the design records it as one.

Fit a test joint on each of the 21 down conductors at its connection to the earth termination, openable for measurement and closed in normal use (§5.3.6).

56 m × 38 m



- Roof outline — 13 sides, 209.657 m perimeter, within 56 m × 38 m; roofs at 8 m and 8 m and 8 m and 12 m and 20 m, each outlined with its height
- Down conductors (21), equal spacing
- Proposed air-termination rods (8), $r_p = 10.5$ m each
- Where each section below is cut (4 roofs)
- 0, 0: every position in this document is measured from here

Roof plan, to scale. Positions are measured from 0, 0, marked on the plan. Each roof is outlined at its own height, marked on it. Rings mark the 21 down conductors at the equal spacing §5.3.3 requires — indicative positions, not a layout: on site they follow corners and downpipes. Diamonds are the 8 **proposed** rods, on corners and edges first and then the field, on a square grid no coarser than one rod's reach supports. The faint circles are that reach, $r_p = 10.5$ m each, clipped to the roof — a rod on the edge reaches past the wall, and that is not roof to cover. The dotted line joins the two rods the rolling sphere rests on at the roof's deepest point. The protected ceiling's lowest point anywhere on the roof at 8 m is 3.00 m below the rod tips, on the section line marked below. Measured: 100% of the least covered roof, at 20 m, lies within a rod's protected radius, at the positions drawn. The engineer may move any of them; this figure is what an alternative should be judged against, and an alternative has to be recomputed — moving a rod voids the figure rather than carrying it along.

Separation distance

k_i (class)	0.08
k_c (current division)	0.44 – 21 down conductor(s)
k_m (material)	1 – Air
Length l	20 m
Required separation s at the air-termination tip	0.944 m
Required separation s	0.704 m

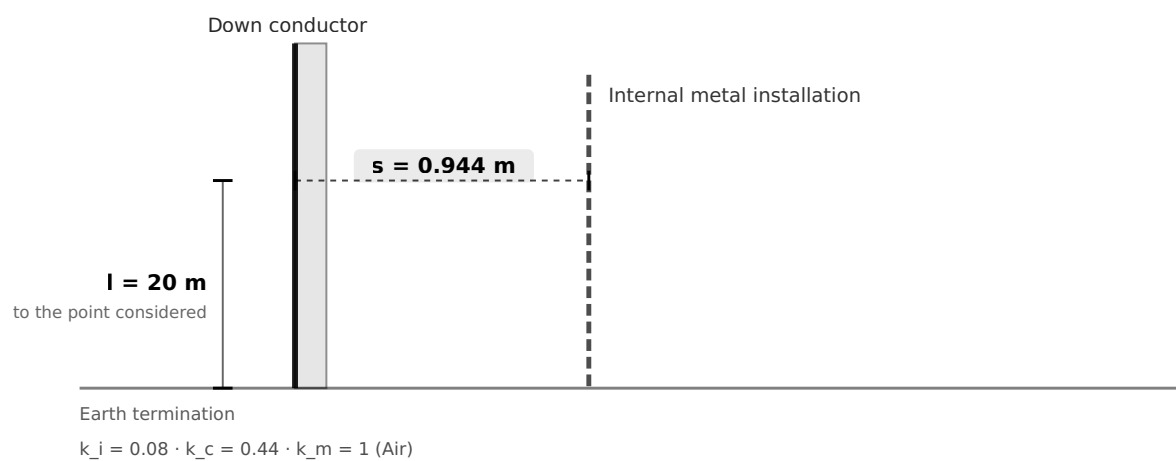
s is a distance at a point, and this design has two worth quoting. §6.3.1 measures l from the point where the separation distance is to be considered, along the air termination and the down conductor. The figure above is for the down-conductor run; at the tip of the rod the path is longer and

the current has not yet divided among the down conductors, so $k_c = 1$ over the rod (Annex B, Figure B.4 a) — the values of k_c are considered from the point of strike). Separate any metal installation by the figure for its own elevation; this design carries no position for any metal installation, so it cannot say which applies where — a proposed rod layout locates the air termination and nothing else. The governing figure below is the larger of the two, because a single distance applied everywhere has to be the worst case.

Every internal metal installation closer than s to a down conductor must be bonded or the distance increased.

This separation distance is **not altitude-corrected**. §6.3.2 requires a correction for an LPS installed at high elevations, following IEC 60071-2. Site elevation is not an input to this tool and no correction has been applied, so where the site is at elevation, read §6.3.2 against it and adjust s accordingly.

s is the one figure in this design that the finished drawing can correct. Everything else above is fixed by the class and the building; s is computed from the conductor run length and, on the general approach, from the down-conductor and ring spacings — and the values used here for those are stated defaults, not measurements of a layout. Two of them can move s the wrong way: k_{c1} grows with the down-conductor spacing c , and rings further apart than assumed make the computed s non-conservative. Once the layout is drawn, re-run this design with the measured figures.



Separation distance by the simplified (§6.3.2, eq. 6), with 21 down conductors. **Schematic — s and l are not to a common scale**; at typical values s would render as a hairline beside l . The figures on it are the computed ones. Any internal metal installation closer than s must be bonded instead, or the distance increased.

Earth termination

Arrangement	Type B (ring electrode)
Soil resistivity ρ	350 $\Omega \cdot m$
Minimum length l_1	5.0 m
Ring requirement	effective radius of the enclosed area $r_e \geq 5.0 \text{ m}$
Effective ring radius r_e	22.5 m (from footprint, ring $\approx 1 \text{ m}$ out)
Ring criterion	met – $r_e \geq l_1$, no additional electrodes required

The minimum lengths may be disregarded where an earthing resistance of the Type A arrangement below 10 Ω is achieved — measured at a frequency different from the power frequency and its multiples, to avoid interference (§5.4.2.2).

Ring in contact with the soil for at least 80 % of its length, buried $\geq 0,5$ m deep, about 1 m from the external walls (§5.4.3).

Materials & minimum dimensions

LPS conductor material	Copper / tin-plated copper
Solid tape, minimum	50 mm ²
Solid round, minimum	50 mm ²
Stranded, minimum	50 mm ²
Air-termination rods	176 mm ² solid round
Earth-electrode material	Copper / tin-plated copper
Earth rod (solid round)	Ø 15 mm
Earth rod (tubular)	Ø 20 mm
Buried earth conductor	50 mm ²
Earth plate	500 × 500 mm

All LPS components (conductors, rods, electrodes, clamps) shall meet IEC 62561-2 mechanical/electrical/corrosion requirements (Table 7/8 note a).

Air-termination rods where mechanical stress such as wind loading is not critical may be reduced to 9,5 mm diameter, 1 m long (Table 7 note c).

Copper solid round 50 mm² (8 mm Ø) may be reduced to 28 mm² (6 mm Ø) where mechanical strength is not essential; reduce fastener spacing accordingly (Table 7 note b).

A buried copper earth electrode shall not be used in contact with the structure's steel members, pipes or piles — corrosion (Table 8 note g).

Equipotential bonding (internal LPS)

Bonding conductor material	Copper
Bars ↔ bars / bar ↔ earth termination	16 mm ² (Table 9)
Internal installations ↔ bonding bar	6 mm ² (Table 10)

Install the main bonding bar in the basement or at ground level, accessible for inspection, and connect it to the earth-termination system (§6.2.2 a).

Structure length 56 m exceeds 20 m — use a ring bonding bar or several interconnected bonding bars (§6.2.2 a).

Bond additionally at every point where the separation distance *s* of the section above cannot be kept (§6.2.2 b). Keep bonding connections as direct and straight as possible.

Live conductors of internal systems are bonded via SPDs — coordinate per IEC 62305-4.

Touch & step voltages

People within 3 m of down conductors	yes (assumed)
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Assessment	Protection measures required
Touch-voltage measures	Insulate exposed down conductors to 100 kV, 1,2/50 μ s impulse withstand (e.g. ≥ 3 mm cross-linked polyethylene), or apply physical restrictions / warning notices
Step-voltage measures	Equipotentialize with a meshed earth-termination system, or apply physical restrictions / warning notices within 3 m of the down conductors

The insulation withstand voltage should be considered in wet conditions (§8.1). Signage shall conform to ISO 3864-1.

Alternative exemption: a measured contact resistance within 3 m of the down conductors of at least 100 k Ω also brings the hazard to a tolerable level. §8.1 c) sets that over the area of a typical footprint (0,02 m²) for touch voltage; §8.2 c) states the 100 k Ω for the soil surface layer without giving an area. A 5 cm layer of insulating material, e.g. asphalt, generally achieves it (§8.1 NOTE 2 / §8.2 NOTE 1).

Inspection & maintenance

Site environment	Ordinary structure
Visual inspection	every year
Complete inspection (incl. electrical testing)	every 3 years (every 2 years if no yearly visual)

Also inspect: during construction (components that become concealed), after LPS installation, after alterations or repairs, and after a known or suspected lightning strike to the structure (§7.4).

Periodic checks: deterioration and corrosion of air-termination elements, conductors and connections; earthing resistance of the earth-termination system; condition of connections, equipotential bonding and fixings (§7.4).

Testing on a 14–15-month cycle is acceptable where earth-resistance readings across different seasons are wanted (D.7.2.2). Consider improving the earthing system when measured resistance rises over successive inspections.

Record all inspection and test results and keep them with the LPS design documentation for the property manager (§7.4).

Assumptions for missing inputs

- Separation length l not entered — the structure height (20 m) is used per §6.3.2 NOTE 1 (valid while the smaller plan dimension $\leq 3 \cdot H$), i.e. bonding at ground level only. Enter the length to the nearest bonding point to refine.
- Bonding-conductor material taken as copper to match the LPS conductor material family (Tables 9/10).
- People are assumed present near the down conductors under normal conditions (Clause 8) — mark the site as non-accessible in the Materials & site step if that is not the case.
- Inspection intervals assume an ordinary structure (no severe weather exposure, explosion risk or high occupancy) — set the site environment in the Materials & site step to refine.

Calculation trace

Step	Formula	Values	Result	Reference
Rolling-sphere radius	$r = r(\text{class})$	class I	20 m	IEC 62305-3:2024 §5.2.2, Table 2
Rod protected radius (rolling sphere geometry)	$d = \sqrt{h \cdot (2r - h)}$	$h = 3 \text{ m}, r = 20 \text{ m}$	10.5 m	Rolling-sphere geometry, IEC 62305-3:2024 §5.2.2
Perimeter air-termination conductor (at 20 m)	$l = \text{perimeter of the roof outline}$	4-sided outline	44.0 m	IEC 62305-3:2024 §5.2.1, §5.2.2.1
Proposed rod layout (at 20 m)	$s \leq s_{\text{max}} = \sqrt{2} \cdot r_p$; rods on corners, edges, then the field	$r_p = 10.54 \text{ m}, s_{\text{max}} = 14.90 \text{ m}$	2 rods selected from 4 lattice positions at 12.0 m	IEC 62305-3:2024 §5.2.2.1; rolling-sphere geometry
Measured coverage of the rod layout (at 20 m)	$\text{protected} \Leftrightarrow \text{dist}((x, y, H + r), \text{air termination}) < r$	120 roof points at 1.00 m spacing	100% protected	Rolling-sphere criterion, IEC 62305-3:2024 §5.2.2
Rod height needed to match the class mesh on a square grid (at 20 m)	$h = r - \sqrt{(r^2 - (w_m/\sqrt{2})^2)}$	$w_m = 5 \text{ m}, r = 20 \text{ m}$	0.31 m	Rolling-sphere geometry, IEC 62305-3:2024 §5.2.2
Lateral protected width	$w = r / 10$	class I, $r = 20 \text{ m}$	2 m	IEC 62305-3:2024 D.5.2.3.3, Figure D.6
Perimeter air-termination conductor (at 12 m)	$l = \text{perimeter of the roof outline}$	4-sided outline	120.0 m	IEC 62305-3:2024 §5.2.1, §5.2.2.1
Rod spacing that protects the roof edge (at 12 m)	$d_{\text{edge}} = 2 \cdot \sqrt{h(2R - 2H - h)}$; best at $h = R - H$	$R = 20 \text{ m}, H = 12 \text{ m}, h = 3 \text{ m}$	12.5 m (best height 8.0 m)	Rolling-sphere geometry at the roof edge, IEC 62305-3:2024 §5.2.2
Proposed rod layout (at 12 m)	$s \leq s_{\text{max}} = \sqrt{2} \cdot r_p$; rods on corners, edges, then the field	$r_p = 10.54 \text{ m}, s_{\text{max}} = 14.90 \text{ m}$	2 rods selected from 12 lattice positions at 13.3 m	IEC 62305-3:2024 §5.2.2.1; rolling-sphere geometry
Measured coverage of the rod layout (at 12 m)	$\text{protected} \Leftrightarrow \text{dist}((x, y, H + r), \text{air termination}) < r$	680 roof points at 1.00 m spacing	100% protected	Rolling-sphere criterion, IEC 62305-3:2024 §5.2.2

Step	Formula	Values	Result	Reference
Rod height needed to match the class mesh on a square grid (at 12 m)	$h = r - \sqrt{(r^2 - (w_m/\sqrt{2})^2)}$	$w_m = 5 \text{ m}, r = 20 \text{ m}$	0.31 m	Rolling-sphere geometry, IEC 62305-3:2024 §5.2.2
Perimeter air-termination conductor (at 8 m)	$l = \text{perimeter of the roof outline}$	4-sided outline	56.0 m	IEC 62305-3:2024 §5.2.1, §5.2.2.1
Rod spacing that protects the roof edge (at 8 m)	$d_{\text{edge}} = 2 \cdot \sqrt{(h(2R - 2H - h))}$; best at $h = R - H$	$R = 20 \text{ m}, H = 8 \text{ m}, h = 3 \text{ m}$	15.9 m (best height 12.0 m)	Rolling-sphere geometry at the roof edge, IEC 62305-3:2024 §5.2.2
Proposed rod layout (at 8 m)	$s \leq s_{\text{max}} = \sqrt{2} \cdot r_p$; rods on corners, edges, then the field	$r_p = 10.54 \text{ m}, s_{\text{max}} = 14.90 \text{ m}$	2 rods selected from 6 lattice positions at 12.0 m	IEC 62305-3:2024 §5.2.2.1; rolling-sphere geometry
Measured coverage of the rod layout (at 8 m)	$\text{protected} \Leftrightarrow \text{dist}((x, y, H + r), \text{air termination}) < r$	192 roof points at 1.00 m spacing	100% protected	Rolling-sphere criterion, IEC 62305-3:2024 §5.2.2
Rod height needed to match the class mesh on a square grid (at 8 m)	$h = r - \sqrt{(r^2 - (w_m/\sqrt{2})^2)}$	$w_m = 5 \text{ m}, r = 20 \text{ m}$	0.31 m	Rolling-sphere geometry, IEC 62305-3:2024 §5.2.2
Perimeter air-termination conductor (at 8 m)	$l = \text{perimeter of the roof outline}$	5-sided outline	45.7 m	IEC 62305-3:2024 §5.2.1, §5.2.2.1
Rod spacing that protects the roof edge (at 8 m)	$d_{\text{edge}} = 2 \cdot \sqrt{(h(2R - 2H - h))}$; best at $h = R - H$	$R = 20 \text{ m}, H = 8 \text{ m}, h = 3 \text{ m}$	15.9 m (best height 12.0 m)	Rolling-sphere geometry at the roof edge, IEC 62305-3:2024 §5.2.2
Perimeter air-termination conductor (at 8 m)	$l = \text{perimeter of the roof outline}$	4-sided outline	64.0 m	IEC 62305-3:2024 §5.2.1, §5.2.2.1
Rod spacing that protects the roof edge (at 8 m)	$d_{\text{edge}} = 2 \cdot \sqrt{(h(2R - 2H - h))}$; best at $h = R - H$	$R = 20 \text{ m}, H = 8 \text{ m}, h = 3 \text{ m}$	15.9 m (best height 12.0 m)	Rolling-sphere geometry at the roof edge, IEC 62305-3:2024 §5.2.2
Proposed rod layout (at 8 m)	$s \leq s_{\text{max}} = \sqrt{2} \cdot r_p$; rods on corners, edges, then the field	$r_p = 10.54 \text{ m}, s_{\text{max}} = 14.90 \text{ m}$	2 rods selected from 6 lattice positions at 14.0 m	IEC 62305-3:2024 §5.2.2.1; rolling-sphere geometry

Step	Formula	Values	Result	Reference
Measured coverage of the rod layout (at 8 m)	$\text{protected} \Leftrightarrow \text{dist}((x, y, H + r), \text{air termination}) < r$	252 roof points at 1.00 m spacing	100% protected	Rolling-sphere criterion, IEC 62305-3:2024 §5.2.2
Rod height needed to match the class mesh on a square grid (at 8 m)	$h = r - \sqrt{(r^2 - (w_m/\sqrt{2})^2)}$	$w_m = 5 \text{ m}$, $r = 20 \text{ m}$	0.31 m	Rolling-sphere geometry, IEC 62305-3:2024 §5.2.2
Down-conductor count	$n = \max(2, \lceil \text{perimeter} / \text{spacing} \rceil)$	perimeter = 209.657 m (from the plan outline), spacing = 10 m (class I)	$n = 21$	IEC 62305-3:2024 §5.3.3, Table 5
Separation distance (simplified)	$s = k_i \cdot k_c \cdot l / k_m$	$k_i = 0.08$, $k_c = 0.44$, $l = 20 \text{ m}$, $k_m = 1$	$s = 0.704 \text{ m}$	IEC 62305-3:2024 §6.3.2, eq. (6), Table 13
Separation distance at the air-termination tip	$s = k_i / k_m \cdot (1 \cdot h_{\text{rod}} + k_c \cdot l)$	$k_i = 0.08$, $k_m = 1$; $k_c = 1$ over the 3 m rod (the current has not divided at the point of strike), then $k_c = 0.44$ over $l = 20 \text{ m}$	$s = 0.944 \text{ m}$	IEC 62305-3:2024 §6.3.1, eq. (5); Annex B, Figure B.4 a)
Minimum electrode length	$l_1 = l_1(\text{class}, \rho)$	class I, $\rho = 350 \Omega \cdot \text{m}$	$l_1 = 5.0 \text{ m}$	IEC 62305-3:2024 §5.4.2, Figure 5
Type B ring criterion	$r_e \geq l_1$	$l_1 = 5.0 \text{ m}$	$r_e \geq 5.0 \text{ m}$	IEC 62305-3:2024 §5.4.2.3, eq. (1)
Effective ring radius	$r_e = \sqrt{(A/\pi)}$, $A = \text{plan area} + \text{perimeter} \cdot 1 \text{ m} + \pi \cdot (1 \text{ m})^2$	plan outline, $A = 1591.9 \text{ m}^2$	$r_e = 22.5 \text{ m}$	IEC 62305-3:2024 §5.4.2.3 (r_e of the enclosed area)

Installation notes

- Bond every internal metal installation that cannot keep the separation distance s from LPS conductors.
- Connect the earth termination to the equipotential bonding bar; coordinate SPDs per IEC 62305-4.

What this report does not cover. Stated for every design, whether or not it applies to yours:

- Structures with a risk of explosion. IEC 62305-3:2024 Annex C is normative and adds requirements for earthing, bonding, clearances to hazardous zones and zone-graded protection that this tool does not apply. Hazardous-area classification to IEC 60079-10-1 / -10-2 is a precondition of that annex (C.2.2) and is not an input here.
- Isolated LPS built on masts or catenary wires — the geometry of Annex D. The tool sizes a non-isolated external LPS on the structure itself; the separation distance s it computes is the criterion an isolated design is judged against, not a design of one.
- Green roofs, facades and other construction specials covered by Annex D prose.
- SPD selection and sizing, which belongs to IEC 62305-4 — use the SPM tool for the coordinated SPD system.
- Rooftop plant, parapets and penetrations. A rolling-sphere or protection-angle design with a rod height carries a proposed rod layout and the coverage it measures; a mesh design carries the conductor network — routes and length, roof edge included. On those methods the layout is the design's rather than the drawing's; everything else in a figure is still chosen by the drawing, and says so. Nothing on the roof is an input, so no design here knows about a chiller, a parapet or a vent, and no route is taken around one.
- A bill of materials, and the layout of the lateral air termination. The protected volume is solved and drawn around the whole structure — over the roof and down the flanks to the ground — but not to one standard throughout: over the roof

its underside is a closed form evaluated point by point, so the drawing's resolution costs it nothing, while down the flanks it is read off a grid at the pitch published with the section and carries that grid's bias. It is a depth over the plan rather than a full three-dimensional boundary, so nothing is represented beneath an overhang. The section figure is one cut through that solved field, not the extent of what was solved. The published coverage percentage is the roof, measured exactly. §5.2.3 is now sized rather than described: the facade band the requirement covers, the Table 2 cell size for it, and D.5.2.3.3's α and w . What is not designed is where any of that goes — no facade elevation, no protrusion positions, no facade conductor routes. Natural components are still not counted as obstacles, so the real protected volume is at least the one drawn, and no quantity, length or fixing schedule is produced.

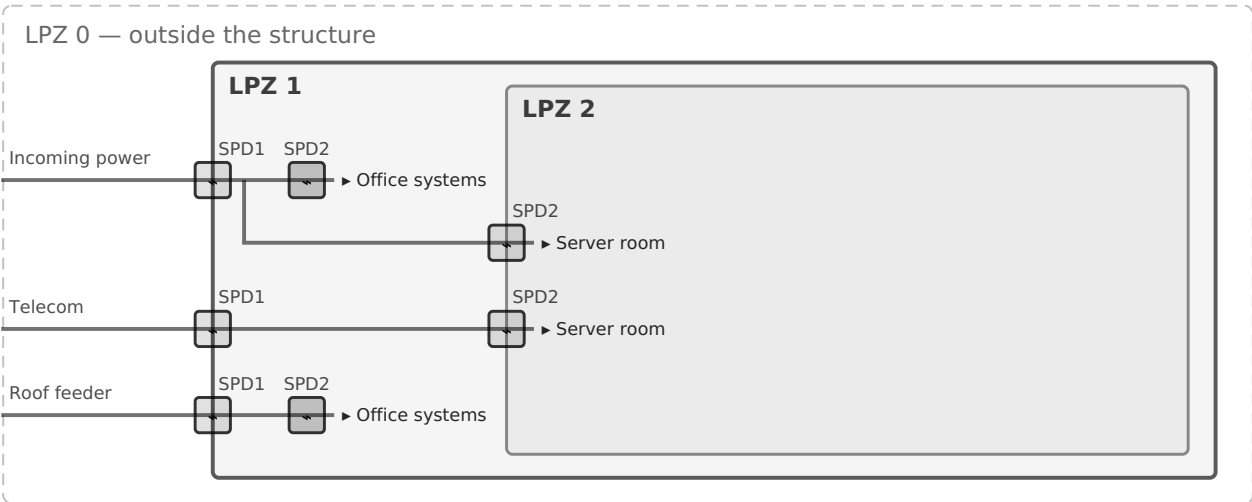
Report VB-SAMPLE-LPS-0001 · Revision 2 · issued 2026-09-28 09:30 UTC · Voltbench · engine lps-1.43.0-iec2024 · schema v1.

Method per IEC 62305-3 Ed. 3.0 (2024). Separation distance per the approach stated in its section — simplified (§6.3.2, Table 13) or general (§6.3.1 eq. (5) with Annex B per-level current division). **The simplified result is not a conservative envelope for this design.** That holds where the whole path is down conductor, and this design specifies an air-termination rod: the current is undivided over the rod ($k_c = 1$ from the point of strike, Annex B Figure B.4 a)) where Table 13's value assumes it has already divided among the down conductors. eq. (5) therefore gives a larger separation distance at high level than eq. (6) does, not a smaller one. See the separation section for the figure at the rod tip. · Voltbench is a calculation aid intended for use by, or under the supervision of, a qualified engineer; results support and do not replace professional judgement.

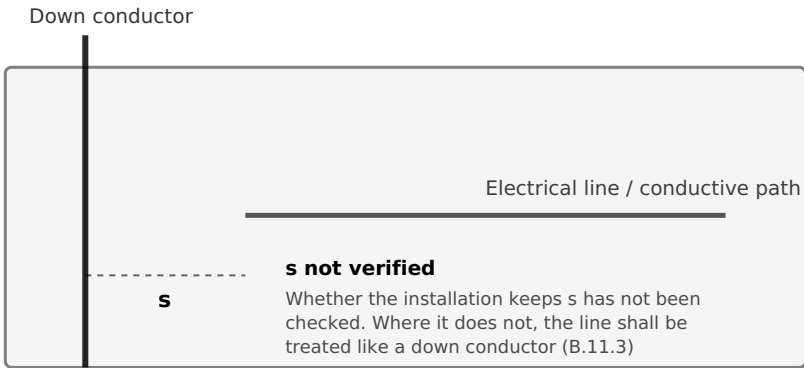
Surge Protection Measures (SPM) Design Basis of calculation: IEC 62305-4:2024 (Ed. 3.0)			Report	VB-SAMPLE-SPM-0001	
			Revision	2	
			Issued	2026-09-28 09:30 UTC	
			This copy	printed 2026-10-19 17:28 UTC	
Project	Meridian Works		Client	Meridian Works — fictional demonstration	
Site address	Illustrative site — not a real installation				
Prepared by	Demonstration Engineer, Fictional example practice				
Checked by	Example reviewer (fictional)		Approved by	Sample approver	
Dimensions	Taken from drawings — Illustrative drawings — not a real building				
Rev.	Date	Description	Prepared	Checked	Approved
1	2026-09-28	First issue	Demonstration Engineer	Sample checker	Sample approver
2	2026-09-28	Update the named checker for this demonstration issue.	Demonstration Engineer	Example reviewer (fictional)	Sample approver

This document specifies the surge protection measures for the structure: the lightning protection zones, the earthing and bonding network, and a coordinated SPD system for every incoming service. The SPD specification is **manufacturer-neutral** — it states the required test class, discharge current and voltage protection level, and can be issued to any supplier.

Lightning protection zones



Lightning protection zones and the SPD positions of the computed schedule: one where each service crosses into an inner zone (IEC 62305-4:2024, Clause 7), and one at the equipment where its route puts it there (shaded). A service feeding several equipment groups branches after its entrance SPD, one row per group. Drawn from the entered services and equipment, not to scale. LPZ 0 is shown undivided: whether a point outside is LPZ 0A (a direct flash can reach it) or LPZ 0B (an air termination protects it) is a rolling-sphere question about the real geometry, which the LPS design answers for the roof and this figure does not assume.



Separation distance *s* between the LPS and the conductive paths entering the structure — not verified: whether the installation keeps *s* has not been stated, so neither case is asserted (IEC 62305-4:2024, Figure B.6, B.11.3). Schematic, not to scale; *s* itself is computed by the IEC 62305-3 LPS design, not here.

Office systems	LPZ 0A → LPZ 1
Server room	LPZ 0A → LPZ 1 → LPZ 2

An LPZ 1 created by a normal external LPS in accordance with IEC 62305-3 has mesh widths and typical distances greater than 5 m, so its spatial shielding effect is negligible (IEC 62305-4:2024, B.14.5). Effective spatial shielding requires a mesh width typically below 5 m.

Equipotential bonding SPDs are always required at the entrance of an LPZ to bond incoming lines connected to internal systems within that zone. Using an interconnected or extended LPZ can reduce the number of SPDs required (IEC 62305-4:2024, 5.5).

IEC 62305-4:2024, 4.3.2 divides the region outside the structure into LPZ 0A and LPZ 0B, and which applies at a given point is decided by the rolling sphere against the real geometry (IEC 62305-3:2024, 5.2.2) — for the roof, by the LPS design; for a service's route outside the structure, by nothing modelled here. This design therefore assumes LPZ 0A at every line entrance, which is the more severe of the two: the threat is the direct flash and the full surge current. Where an air termination is shown to cover a line's approach, LPZ 0B applies instead and this design does not determine that. The assumption changes no SPD specified here — the test class required at the entrance is resolved from C.2.2 and does not depend on it — but the threat the installation is stated to be exposed to does.

This structure has more than one roof, and the protected height above a roof is a property of that roof rather than of the building — so the LPS design states it roof by roof, and there is no single figure for the structure. Whether each externally installed item's exposure was answered at its own position against the air-termination layout, or taken as declared, is stated with that item under B.11. Treat roof-mounted equipment as LPZ 0A wherever its exposure was not answered — one that carries no position, or stands where no rod gives a protected volume to answer it against (IEC 62305-3:2024, 5.2.2).

LPZ 0A — IEC 62305-4:2024, 4.3.2 defines this zone as: "Zone where the threat is due to the direct lightning flash and the full lightning electromagnetic field. The internal systems can be subjected to full lightning surge current."

LPZ 0B — IEC 62305-4:2024, 4.3.2 defines this zone as: "Zone protected against direct lightning flashes but where the threat is the full lightning electromagnetic field. The internal systems can be subjected to partial lightning surge currents."

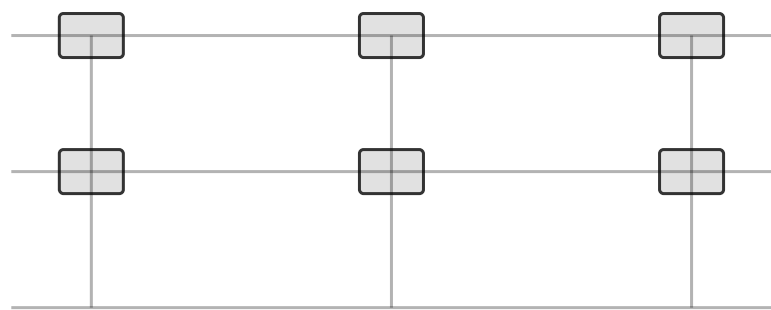
LPZ 1 — IEC 62305-4:2024, 4.3.3 defines this zone as: "Zone where the surge current is limited by current sharing and isolating interfaces and/or by SPDs at the boundary. Spatial shielding can attenuate the lightning electromagnetic field."

LPZ 2 — IEC 62305-4:2024, 4.3.3 defines LPZ 2...n as: "Zone where the surge current may be further limited by current sharing, isolating interfaces and/or by additional SPDs at the boundary. Additional spatial shielding may be used to further attenuate the lightning electromagnetic field."

Whether the separation distance *s* of IEC 62305-3 is maintained has not been verified for this installation. Where it is not, electrical lines carrying partial lightning currents shall be treated like down conductors (IEC 62305-4:2024, B.11.3), and where a ring conductor is bonded to each down conductor for this reason, class I tested SPDs are required (B.3). State it on the basis of design once it has been checked.

Earthing and bonding network

MM



Configuration MM — internal systems integrated into the meshed bonding network at multiple points.

Earth-termination arrangement	Type B
Bonding network configuration	MM
Bonding network mesh width	5 m
Bonding bars	Cu / Fe 50 mm ²
Conductors linking a bonding bar to the earthing system, or one bonding bar to another (carrying the full lightning current or a significant share of it)	Cu 16 mm ²
Connecting conductors from internal metal installations to bonding bars (partial lightning current)	Cu 6 mm ²
Earthing conductor to SPD tested to class I	Cu 16 mm ²
Conductors connecting a class I SPD and its overcurrent protective device to live conductors	Cu 6 mm ²
Earthing conductor to SPD tested to class II	Cu 6 mm ²
Conductors connecting a class II SPD and its overcurrent protective device to live conductors	Cu 2.5 mm ²

A Type B (ring or foundation) arrangement is used, as 5.2 recommends.

Meshed, integrated by multiple bonding points; metal components are not isolated from the earthing system. Preferred where internal systems extend over wide zones or many lines enter at several points.

Do not isolate the internal systems' metal parts from the earthing system; tie them into it at several points instead.

One earthing system serves the whole site. Giving the LPS, the SPDs, the power installation and the telecommunications installation an earth each is not an acceptable arrangement for lightning and surge protection; they must form a single integrated system (IEC 62305-4:2024, 5.2).

Bonding bars shall be installed for bonding of: all conductive services entering an LPZ, directly or via suitable SPDs; the protective earth conductor PE; metal components of the internal systems (cabinets, enclosures, racks); the magnetic shields of the LPZ, at the periphery and inside the structure (IEC 62305-4:2024, 5.4).

Where possible, incoming services should enter the LPZ at the same location and connect to the same bonding bar. Where services enter at different locations, each shall connect to a bonding bar and those bonding bars shall be interconnected — bonding to a ring bonding bar is recommended (IEC 62305-4:2024, 5.5).

Treat the bonding network as a protective path only: it should carry no power or signal return current. On that basis the PE conductor is tied into the bonding network and the PEN conductor is kept out of it, along with any metalwork connected to the PEN. A functional earthing conductor may be bonded straight to the low-impedance network. Keeping the PEN separate is what stops power-frequency current finding a way into the electronic systems (IEC 62305-4:2024, B.7 — Annex B is informative, so these are conditions of following its method rather than requirements standing on their own).

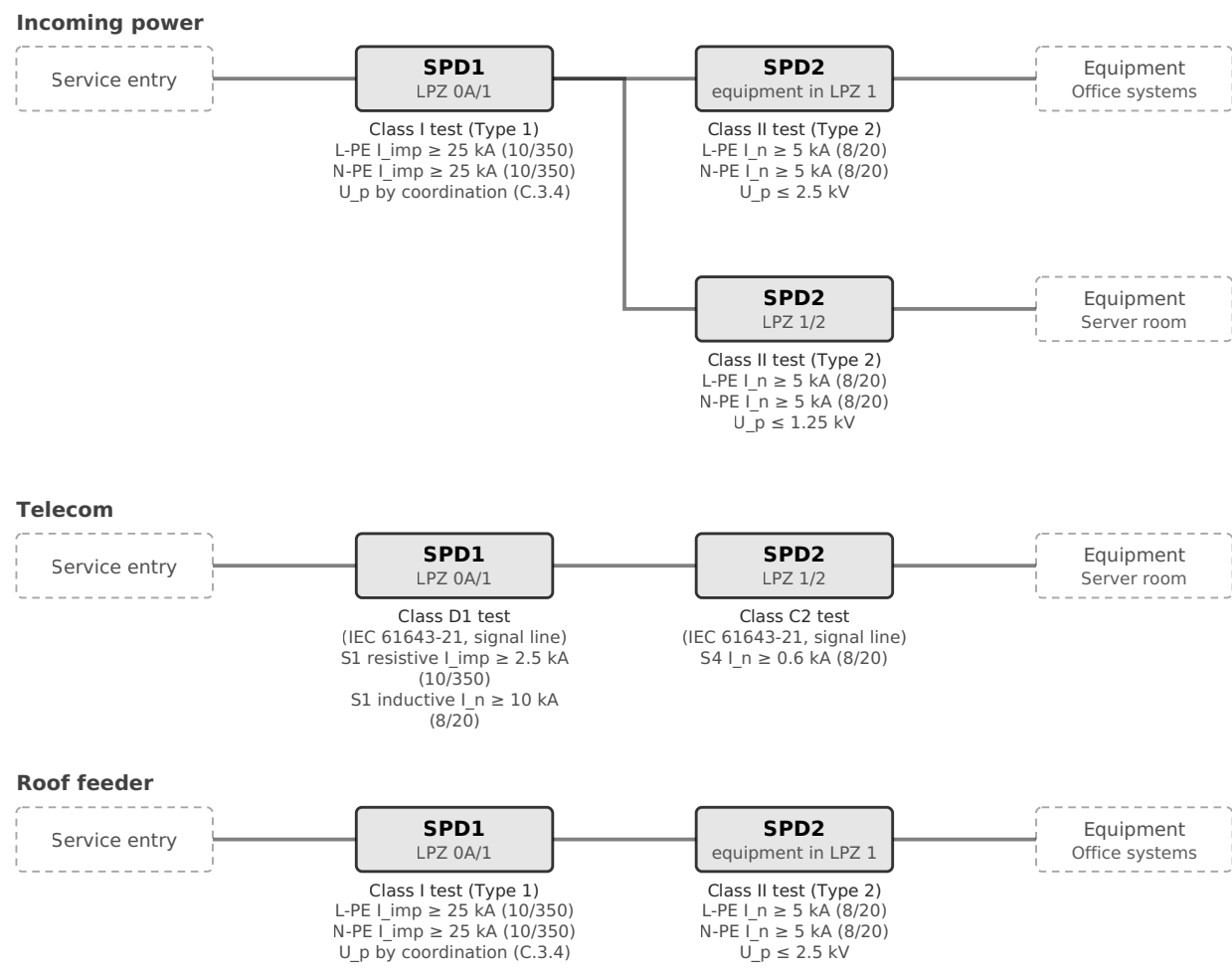
For efficient bonding the following installation rules are important: the basis for all bonding measures is a low impedance bonding network; run each bonding bar back to the earthing system by the most direct route the building allows; SPDs should be installed with the shortest possible connections to the bonding bar and to the live conductors, minimising inductive voltage drops; downstream of an SPD, mutual induction should be minimised by reducing the loop area or by using shielded cables or ducts earthed at both ends (IEC 62305-4:2024, 5.4).

Smaller cross-sections are permitted in some countries where the thermal and mechanical requirements of IEC 62305-1:2024, Annex D are satisfied (IEC 62305-4:2024, Table 1, footnote b). That verification is outside this tool's scope, so the tabulated minimum is applied.

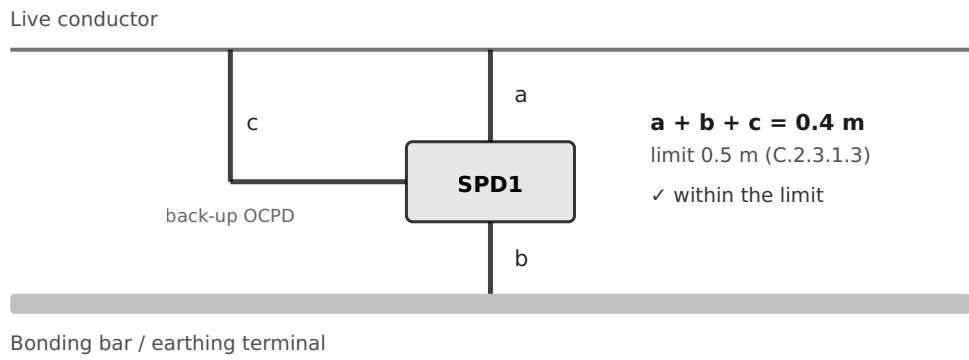
For SPDs in power applications the connecting conductors shall also be dimensioned according to IEC 60364-5-53 and IEC 61643-12 (IEC 62305-4:2024, Table 1, footnote c).

Earthing and bonding are required in every design — there is no case in which they can be left out. Every conductive service must be tied to earth where it enters the structure: directly where that is possible, and otherwise through an equipotential bonding SPD (IEC 62305-4:2024, Clause 4.4).

Coordinated SPD schedule



The coordinated SPD system for each service, from the entrance to the equipment, with the required test class and duty at each position (IEC 62305-4:2024, Annex C). A service feeding several equipment groups branches after its entrance SPD, one row per group. Manufacturer-neutral: any device meeting the stated duty at that position is acceptable.



Connecting-lead lengths at SPD1 on Incoming power. The 0,5 m limit applies to the **sum** of the legs, not to any single one (IEC 62305-4:2024, C.2.3.1.3). Individual legs are not to scale — only the declared total is known.

Position / parameter	Requirement
Incoming power — SPD1 at LPZ 0A/1	Class I test (Type 1)

Position / parameter	Requirement
L-PE I _{imp}	≥ 25 kA (10/350)
N-PE I _{imp}	≥ 25 kA (10/350)
U _p	set by coordination with the SPDs downstream (C.3.4)
Incoming power — SPD2 (Office systems, at the equipment) in LPZ 1	Class II test (Type 2)
L-PE I _n	≥ 5 kA (8/20)
N-PE I _n	≥ 5 kA (8/20)
U _p	≤ 2.5 kV
Incoming power — SPD2 (Server room) at LPZ 1/2	Class II test (Type 2)
L-PE I _n	≥ 5 kA (8/20)
N-PE I _n	≥ 5 kA (8/20)
U _p	≤ 1.25 kV
Telecom — SPD1 at LPZ 0A/1	Class D1 test (IEC 61643-21, signal line)
S1 resistive I _{imp}	≥ 2.5 kA (10/350)
S1 inductive I _n	≥ 10 kA (8/20)
Telecom — SPD2 at LPZ 1/2	Class C2 test (IEC 61643-21, signal line)
S4 I _n	≥ 0.6 kA (8/20)
Roof feeder — SPD1 at LPZ 0A/1	Class I test (Type 1)
L-PE I _{imp}	≥ 25 kA (10/350)
N-PE I _{imp}	≥ 25 kA (10/350)
U _p	set by coordination with the SPD downstream (C.3.4)
Roof feeder — SPD2 (at the equipment) in LPZ 1	Class II test (Type 2)
L-PE I _n	≥ 5 kA (8/20)
N-PE I _n	≥ 5 kA (8/20)
U _p	≤ 2.5 kV

Cascaded SPDs shall be energy coordinated in accordance with IEC 61643-12 and IEC 61643-22; the SPD manufacturer should provide the information needed to achieve energy and voltage protection level coordination between the devices (IEC 62305-4:2024, C.3.4). This tool states the requirement but does not compute the coordination.

This is a telecommunication or signal line, so its discharge currents are not taken from Annex C: Tables C.3, C.4 and C.5 are keyed on the supply system and its modes of protection, and describe power lines only. IEC 62305-4:2024, C.2.2 provides the required current for a signal line in IEC 62305-2:2024, Annex B (Table B.8), and classifies the device under IEC 61643-21 — class D1 where a power SPD would be class I tested, and class C2 where it would be class II. Each source of damage carries its own waveform, so a device at this boundary has both a 10/350 and an 8/20 duty.

These currents are per line conductor, not the total through the cable (IEC 62305-1:2024, Table E.2: "All values refer to each line conductor"). A multi-core cable carries the sum, so a device protecting n cores must carry n times the figure above in total, and manufacturers' data sheets state both a per-line and a total rating. Check which one you are reading before comparing.

The figures above are those IEC 62305-2:2024, Table B.8 gives for overhead unshielded lines, which is its worst case. Its NOTE 3 permits the currents to be halved for a buried line, and halved for a shielded line. This design applies neither reduction, so the requirement stated here is conservative for a line that is buried, shielded, or both.

No voltage protection level is stated for this signal line. Every U_p ceiling in this schedule is a fraction of the equipment's rated impulse withstand U_W , and U_W is resolved from Table C.1, whose rows are line-to-neutral voltages of the power supply. The withstand of a telecommunication or signal port is a property of that interface and is declared by its manufacturer; select U_p against it, and against IEC 61643-21, rather than against the value used for the power lines here.

The voltage drop in the SPD connecting leads is computed from the approximation of IEC 62305-4:2024, eq. C.4 — $0,1 \times I_{SPD}$ kV per metre. The standard notes that the true value depends on the current waveform, the conductor arrangement and the loop geometry; published manufacturer figures for the same case run up to about 20 % higher. The margin this consumes is small only while the leads are kept within 0,5 m, which is why that limit is a requirement and not a recommendation.

SPD selection and installation requirements

U_c , the maximum continuous operating voltage of each SPD, shall be equal to or higher than the value IEC 60364-5-53:2019+AMD1:2020, Table 2 gives for its mode of protection and the earthing arrangement, and the device shall withstand the temporary overvoltages of IEC 61643-11 for the same combination. Both are checked against a candidate's data sheet in the verification section, which needs the line-to-line voltage U of the supply — the Table C.1 band above does not fix it, since its 300 V row covers 230/400 V and 277/480 V alike.

Where SPDs are cascaded, a decoupling element or a minimum line length between them is required for correct energy coordination (IEC 62305-4:2024, Figure D.1). The required value is given in IEC 61643-12 and by the SPD manufacturer; a combined device may be used instead.

The back-up overcurrent protective device shall be the maximum permissible type specified by the SPD manufacturer, and shall be coordinated with the upstream system OCPD; where those two requirements conflict, the lower rating is generally the safer choice (IEC 62305-4:2024, C.2.8). That coordination is not computed here. The SPD's own short-circuit current rating I_{SCCR} shall not be lower than the maximum prospective short-circuit current at its connection points (IEC 60364-5-53:2019+AMD1:2020, 534.4.4.6), and the same holds for the follow current interrupting rating I_{fi} where the manufacturer declares one (534.4.4.7). Neither requirement applies to an SPD connected between the neutral conductor and PE in a TN or TT system — both clauses exempt that case, as the product standard IEC 61643-11 already covers it. Both are checked in the verification section against a prospective current you state, since it is a property of the installation rather than of the lightning protection design.

The behaviour of the back-up overcurrent protective device under partial lightning current or high impulse current should be considered as one of three cases (IEC 62305-4:2024, C.2.8.1). Case 1 — No melting and no tripping. The OCPD withstands the expected surge current through the SPD without tripping or melting. Case 2 — Melting and tripping permissible. The lightning impulse energy is enough to operate the OCPD. Case 3 — Mechanical destruction permissible. The impulse energy exceeds the OCPD's withstand level.

In cases 2 and 3 the installation is no longer protected against subsequent strokes within the same flash; additional SPDs on specific downstream circuits can maintain protection. Take care before

replacing a blown OCPD or re-closing a tripped MCB, since the SPD may have failed into a short circuit. Because lightning behaves as an ideal current source, operation or destruction of the back-up OCPD does not reduce the impulse current the SPD must carry (IEC 62305-4:2024, C.2.8).

Where the circuit between the SPD and the equipment is long, propagation can lead to oscillation raising the overvoltage at an open circuit to as much as $2 \times U_{p/f}$, even where $U_{p/f} \leq U_W$ is satisfied (IEC 62305-4:2024, C.2.3.4). The effect is negligible where the SPD is installed at the equipment input.

Services connected to different ports of the same equipment shall not be connected to different points on the earthing system, except where those points are equipotential bonded (a densely meshed foundation electrode of the order of 1 m x 1 m, or a ring electrode welded or bolted to the steel reinforcement), or the internal services are shielded or in a metallic duct bonded at both ends, or a multiservice SPD able to withstand S1/S3 stress is provided between the ports (IEC 62305-4:2024, C.2.6).

Externally installed equipment

Roof ventilation unit (other)	LPZ 0A – declared; a position is given but no height above the roof, so nothing here checked it – separation distance not maintained
Air termination – Roof ventilation unit	A direct flash can reach this equipment and no local air termination is provided. Bring it into LPZ 0B with one wherever that is possible – handrails, ladders and pipework already on the structure often serve. On a tall structure, use the rolling sphere of IEC 62305-3 to decide whether the position is exposed. Some aerials must stay in the clear to work, and for those the feeder requirements below are the protection.
Bonding – Roof ventilation unit	The structure has an external LPS, so this equipment's supports shall be bonded to it.
Separation distance – Roof ventilation unit	The separation distance to the LPS is not maintained here, so the lines serving this equipment shall be treated like down conductors: they carry partial lightning current into the structure. Either restore s locally (or use an isolated LPS), or size the entry device for that current.
Feeder SPD – Roof ventilation unit	This equipment's feeder carries partial lightning current into the structure, so it needs a device rated for the 10/350 duty where it enters – class I for a power feeder, class D1 for a signal or coaxial one. Its feeder is the incoming service “Roof feeder”, scheduled with that device where it enters.
Feeder routing – Roof ventilation unit	Run the feeder in bonded ducting, trunking or metal tube to hold down induced voltages, and bring all cables to this equipment out of the duct at a single point. Where a duct is impractical, run cables close to the structure and use its own metalwork as a shield – inside the corner of an L-girder on a lattice mast, or beside bonded ladders and pipes on a vessel.

Externally installed equipment – aerials, meteorological sensors, cameras and exposed process sensors – is assessed to IEC 62305-4:2024, B.11. Positions are given here, but no item's exposure could be answered against this building's air-termination layout (IEC 62305-3), so every exposure is taken as declared and nothing here has checked it – each item says on its own row why. Complete what it names, or confirm each declared exposure against the installation.

Assumptions and qualifications for this design

- The voltage protection levels in this schedule were selected under Rule no. 1, the simple analysis for general applications of IEC 62305-4:2024, C.2.3.1. The detailed analysis of Rule no. 2 (C.2.3.2), which evaluates $U_{p/f} = (U_W - U_i) / k_r$ by eq. C.1, has not been carried out:

the induced voltage U_i of C.2.3.5 and Annex H depends on the routing of each protected circuit, its distance from the down conductors and the shielding around it, none of which this tool collects. Where a protected circuit is neither shielded nor routed clear of the down conductors, U_i consumes part of the margin these ceilings assume, and the detailed analysis shall be carried out separately. Any spatial shielding, mesh width or down-conductor count entered above is recorded for the design record only and has not influenced these values.

- Where no specific current-sharing calculation is carried out, 50 % of the lightning current is assumed to be conducted to the structure's earthing system and 50 % to return via the equipotential bonding SPDs (IEC 62305-4:2024, D.3.2). A specific calculation — which requires the current-sharing model of IEC 62305-1:2024, Clause E.2 — can give a lower value, for example where three metallic services supply the structure.
- That detailed analysis is IEC 62305-4:2024, Annex E — it applies the IEC 62305-1 current-sharing model and generally requires numerical simulation — and it is outside this tool's scope.
- The exposure of every externally installed item is taken as declared: nothing here checked it (see “Externally installed equipment” for why). Confirm each against the installation.
- No candidate device figures were entered, so nothing was verified. The specification above is manufacturer-neutral and can be issued for quotation as it stands; the verification step is for checking what comes back.

Calculation trace

Every requirement above, with the clause that governs it — check any step against the standard.

Step	Formula	Values	Result	Reference
Incoming power — SPD1 at LPZ 0A/1: L-PE I_{imp}	I_{imp} from the LPL, supply system and connection type	LPL I, three-phase, CT1, L-PE	$I_{imp} \geq 25 \text{ kA}$ — preferred rating 25 kA (Table D.1)	IEC 62305-4:2024, Table C.3
Incoming power — SPD1 at LPZ 0A/1: N-PE I_{imp}	I_{imp} from the LPL, supply system and connection type	LPL I, three-phase, CT1, N-PE	$I_{imp} \geq 25 \text{ kA}$ — preferred rating 25 kA (Table D.1)	IEC 62305-4:2024, Table C.3
Incoming power — SPD2 (Office systems, at the equipment) in LPZ 1: L-PE I_n	I_n from the LPL, supply system and connection type	LPL I, three-phase, CT1, L-PE	$I_n \geq 5 \text{ kA}$ — Table D.1 tabulates preferred values of I_{imp} for class I tested SPDs; it does not apply to I_n	IEC 62305-4:2024, Table C.4
Incoming power — SPD2 (Office systems, at the equipment) in LPZ 1: N-PE I_n	I_n from the LPL, supply system and connection type	LPL I, three-phase, CT1, N-PE	$I_n \geq 5 \text{ kA}$ — Table D.1 tabulates preferred values of I_{imp} for class I tested SPDs; it does not apply to I_n	IEC 62305-4:2024, Table C.4

Step	Formula	Values	Result	Reference
Incoming power — SPD2 (Server room) at LPZ 1/2: L-PE I_n	I_n from the LPL, supply system and connection type	LPL I, three-phase, CT1, L-PE	$I_n \geq 5 \text{ kA}$ — Table D.1 tabulates preferred values of I_{imp} for class I tested SPDs; it does not apply to I_n	IEC 62305-4:2024, Table C.4
Incoming power — SPD2 (Server room) at LPZ 1/2: N-PE I_n	I_n from the LPL, supply system and connection type	LPL I, three-phase, CT1, N-PE	$I_n \geq 5 \text{ kA}$ — Table D.1 tabulates preferred values of I_{imp} for class I tested SPDs; it does not apply to I_n	IEC 62305-4:2024, Table C.4
Telecom — SPD1 at LPZ 0A/1: S1 resistive I_{imp}	I_{imp} from the LPL and the source of damage	LPL I, signal line, source S1 resistive	$I_{imp} \geq 2.5 \text{ kA}$ — flash to the structure, resistive coupling; Table D.1's preferred ratings are reproduced from IEC 61643-11 and refer to SPDs connected line to neutral, so they do not apply to a telecommunication or signal line; rate this device from IEC 61643-21	IEC 62305-2:2024, Table B.8 (via IEC 62305-4:2024, C.2.2)
Telecom — SPD1 at LPZ 0A/1: S1 inductive I_n	I_n from the LPL and the source of damage	LPL I, signal line, source S1 inductive	$I_n \geq 10 \text{ kA}$ — flash to the structure, inductive coupling; Table D.1's preferred ratings are reproduced from IEC 61643-11 and refer to SPDs connected line to neutral, so they do not apply to a telecommunication or signal line; rate this device from IEC 61643-21	IEC 62305-2:2024, Table B.8 (via IEC 62305-4:2024, C.2.2)
Telecom — SPD2 at LPZ 1/2: S4 I_n	I_n from the LPL and the source of damage	LPL I, signal line, source S4	$I_n \geq 0.6 \text{ kA}$ — indirect flash to the line; Table D.1's preferred ratings are reproduced from IEC 61643-11 and refer to SPDs connected line to neutral, so they do not apply to a telecommunication or signal line; rate this device from IEC 61643-21	IEC 62305-2:2024, Table B.8 (via IEC 62305-4:2024, C.2.2)
Roof feeder — SPD1 at LPZ 0A/1: L-PE I_{imp}	I_{imp} from the LPL, supply system and connection type	LPL I, three-phase, CT1, L-PE	$I_{imp} \geq 25 \text{ kA}$ — preferred rating 25 kA (Table D.1)	IEC 62305-4:2024, Table C.3
Roof feeder — SPD1 at LPZ 0A/1: N-PE I_{imp}	I_{imp} from the LPL, supply system and connection type	LPL I, three-phase, CT1, N-PE	$I_{imp} \geq 25 \text{ kA}$ — preferred rating 25 kA (Table D.1)	IEC 62305-4:2024, Table C.3

Step	Formula	Values	Result	Reference
Roof feeder — SPD2 (at the equipment) in LPZ 1: L-PE I _n	I _n from the LPL, supply system and connection type	LPL I, three-phase, CT1, L-PE	I _n ≥ 5 kA – Table D.1 tabulates preferred values of I _{imp} for class I tested SPDs; it does not apply to I _n	IEC 62305-4:2024, Table C.4
Roof feeder — SPD2 (at the equipment) in LPZ 1: N-PE I _n	I _n from the LPL, supply system and connection type	LPL I, three-phase, CT1, N-PE	I _n ≥ 5 kA – Table D.1 tabulates preferred values of I _{imp} for class I tested SPDs; it does not apply to I _n	IEC 62305-4:2024, Table C.4
Simplified lightning current sharing	$I_{imp} = I_0 / \text{MAX} \times 0,5 / n$	LPL I -> I0/MAX = 200 kA; 50 % to the earthing system, 50 % via the bonding SPDs; n = 4 conductors (three-phase plus neutral)	I _{imp} = 25 kA per SPD	IEC 62305-4:2024, D.3.2 and Table C.3

- What this specification does not cover.** Stated for every design, whether or not it applies to yours:
- Photovoltaic installations. Clause 7 requires SPDs for PV systems to comply with IEC 61643-31 and their selection and installation with IEC 61643-32, and Annex F gives the current sharing for roof-mounted and ground-mounted PV. None of that is implemented, and a PV array is not an input here — a site with one needs its DC side designed separately.
 - The detailed analysis of Rule no. 2 (C.2.3.2) and the induced voltage U_i of C.2.3.5 and Annex H. Voltage protection levels come from Rule no. 1 (C.2.3.1) throughout; the caveat above says what that means for the shielding and down-conductor count entered on this design.
 - Lightning current sharing by simulation modelling (Annex E). The schedule uses the simplified sharing of D.3.2.
 - Isolation interfaces built on surge isolation transformers (Annex I). Where a service is declared as entering via an isolating interface the C.2.6 exemption and its Clause 8 limits are applied, but the interface itself is not designed here.
 - Computation of the electromagnetic field inside a zone from shield geometry (Annex A), and system-level testing under lightning discharge conditions (Annex G).
 - Electromagnetic interference causing malfunction rather than permanent failure. Part 4's own scope (Clause 1) puts this outside the document — it is covered by IEC 60364-4-44 and the IEC 61000 series — so a compliant SPM is not by itself an answer to a disturbance problem.
 - Detailed design of the electrical and electronic systems being protected (Clause 1), and the LPS itself, which is IEC 62305-3 — use the LPS tool.
 - Hazardous areas (explosive atmospheres). IEC 62305-3:2024, C.4.1.2 requires SPDs to be positioned outside a hazardous area where practicable, and any SPD inside one to be adequate for the zone it is installed in, with IEC 60079-14 governing its selection and installation; C.3 applies an explosives area's own requirements for electrical equipment to SPDs too, and Part 4 notes (4.1) that SPDs for explosive environments can need special approvals. None of that is applied here; hazardous areas are not an input, and this schedule neither places SPDs relative to one nor selects devices for use inside one.

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