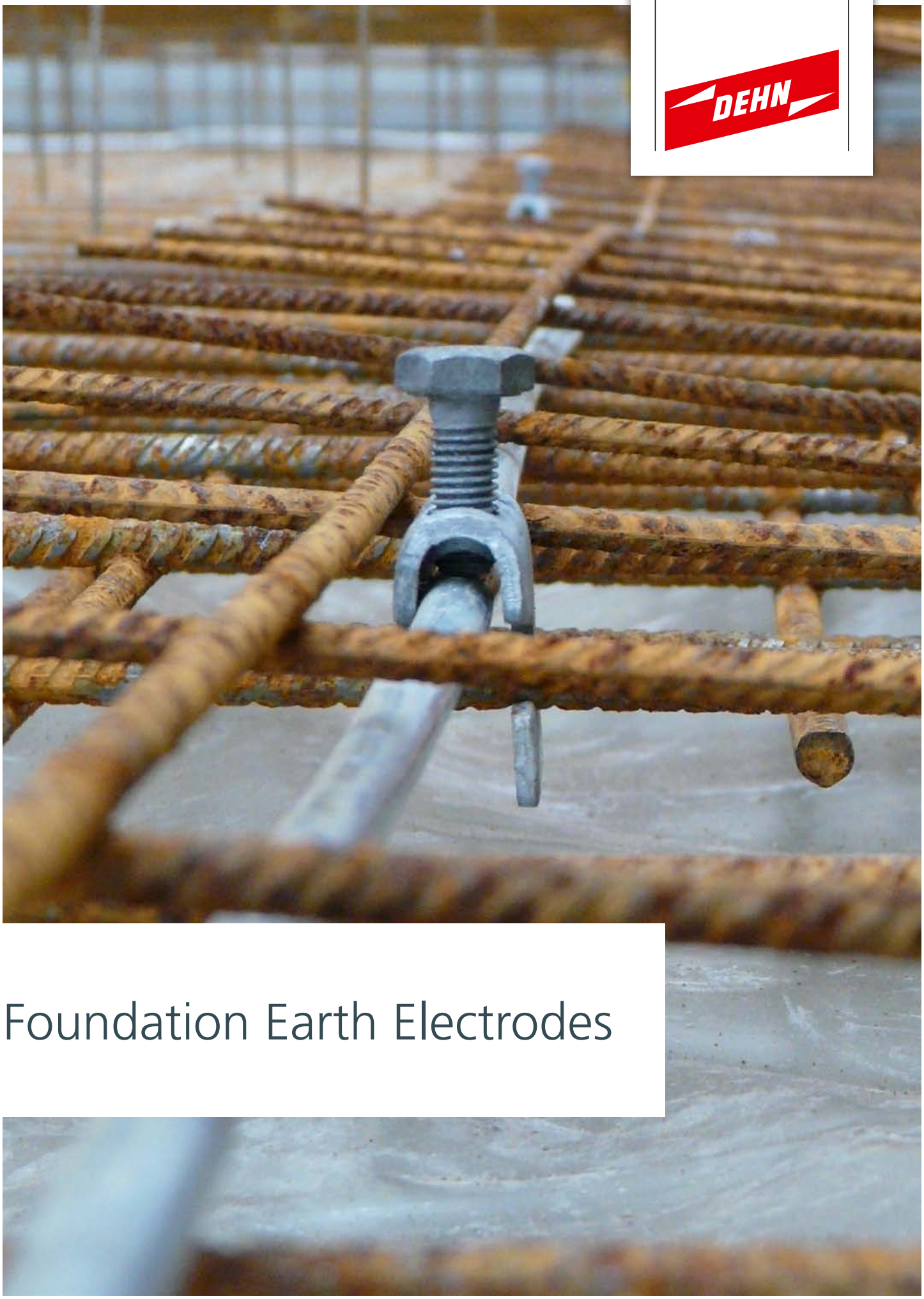


Foundation Earth Electrodes

www.dehn-international.com

Foundation earth electrodes

Foundation earth electrodes – Maintenance-free earth-termination systems

A functioning earth-termination system is an integral part of the electrical installations in all buildings. It forms an important basis for ensuring safety and functionality in buildings for

- Electrical systems (power supply) to protect persons (to ensure disconnection from supply and protective equipotential bonding, if required)
- Electronic systems (information and data systems) for functional equipotential bonding
- The lightning protection system
- Surge protection for devices
- Electromagnetic compatibility
- Antenna earthing

To ensure personal protection and safe operation, these installations must meet special requirements as specified in the individual regulations of the relevant systems.

Special attention must be paid to the design and installation of foundation earth electrodes since these electrical elements cannot be retrofitted when the concrete has set – Errors can then no longer be corrected. Therefore, close cooperation between the architects, building companies, electrical consultants and lightning protection / electrical companies is required even at the design stage of the object.

Function of foundation earth electrodes

With a foundation earth electrode, a functioning and maintenance-free earth-termination system is installed throughout the building's lifecycle. Foundation earth electrodes are embedded in the concrete foundation and covered by a concrete layer of at least 5 cm.

Consequently, two requirements are fulfilled:

- The concrete conserves the earthing material, corrosion effects are not to be expected
- The typically moist concrete on the outside of the foundation establishes a conductive connection between the systems mentioned above and the ground

However, another type of earthing was required since various structural measures no longer ensured conductive connection with the ground. A ring earth electrode installed outside the concrete foundation can be used to solve this problem.

Connection element of a fixed earthing terminal

Connection of the foundation earth electrode to the reinforcement

Normative requirements

IEC 60364-5-54[1], DIN 18015-1[2] and the technical connection conditions published by German network operators require that a foundation earth electrode be installed for every new building. DIN 18014[3] regulates the design, installation and documentation of foundation earth electrodes.

According to IEC 60364-5-54, a foundation earth electrode must be connected to the main earthing busbar via an earthing conductor. This connection serves as protective and functional earthing of the electrical installations and devices.

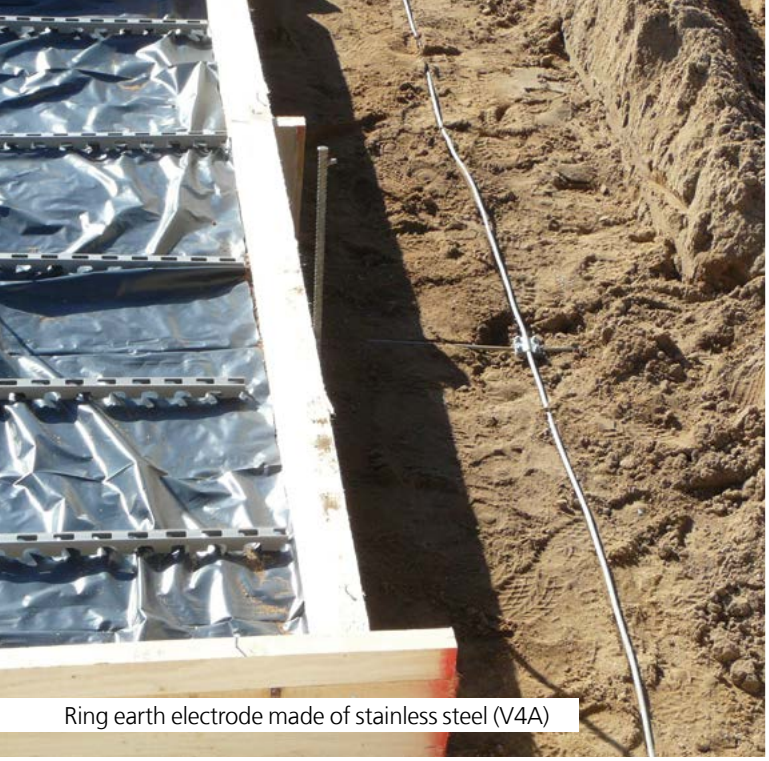
If a lightning protection system is installed on a structure, the extended requirements of EN 62305-3[4] and the requirements of EN 62305-4[5] concerning electromagnetic compatibility apply. According to the EN 50310[6] standard, the mesh size of the foundation earth electrode must be reduced if there are, for example, extended information technology systems in a building. The system provider's specifications (e.g. for telecommunication and data systems) concerning the earth contact resistance must also be observed and taken into account for the design of the earth-termination system.

EN 50522[7] additionally applies to buildings with integrated medium-voltage switchgear assembly (MV systems). Due to high short-circuit currents (50 Hz), larger earth electrode cross-sections and additional requirements for clamps and connectors may be required.

Installation of a foundation earth electrode system

A foundation earth electrode system fulfils essential safety functions and is an element of the electrical installation. Therefore, the earth-termination system must be installed by or under the supervision of an electrician or lightning protection specialist. Also the continuity measurement may only be performed by an electrician or lightning protection specialist.

[1] IEC 60364-5-54: Low-voltage electrical installations – Selection and erection of electrical equipment – Earthing arrangements and protective conductors
[2] DIN 18015-1: Electrical installations in residential buildings
[3] DIN 18014: Foundation earth electrode – Planning, execution and documentation
[4] EN 62305-3: Protection against lightning – Part 3: Physical damage to structures and life hazard
[5] EN 62305-4: Protection against lightning – Part 4: Electrical and electronic systems within structures
[6] EN 50310: Application of equipotential bonding and earthing in buildings with information technology equipment
[7] EN 50522: Earthing of power installations exceeding 1 kV a.c.



Ring earth electrode made of stainless steel (V4A)

Functional bonding conductor (FB)

Components and types of foundation earth electrode systems

Foundation earth electrodes

Foundation earth electrodes form a closed loop and are embedded in concrete along the outer edge of the building. They are conductively connected to the reinforcement of the foundation / floor slab at intervals of at least 2 metres by means of screwing, clamping or welding. In addition, cross connections with a maximum mesh size of 20 m x 20 m must be established for large buildings (page 14, figure 2). These connections ensure that all reinforcement mats and steel elements act as "surface earth electrode". Thus, maximum earth contact resistance is achieved and low-impedance protective and functional equipotential bonding is established.

If it is to be expected that the earth contact resistance of the foundation earth electrode is increased, for example in case of waterproof concrete, impact-resistant plastic roof sheetings (dimpled membranes) or blinding layers made of foam glass ballast, a ring earth electrode is installed outside the foundation. It carries out the function of the foundation earth electrode.

Ring earth electrodes

Ring earth electrodes are installed in electrical contact with the ground and form a closed loop around the structure. In addition, cross connections with a maximum mesh size of 20 m x 20 m must be established for large buildings. If a lightning protection system is planned, the maximum mesh size is 10 x 10 m. It is advisable to use this reduced mesh size for each building to ensure that a lightning protection system can be installed at a later date. This is supposed to prevent puncture between the steel reinforcement of the floor slab / foundation and the ring earth electrode since this may negatively affect the statics of the building.

Functional bonding conductors (FB)

Functional bonding conductors are installed in concrete to form a closed loop along the outer edges of the building if a ring earth electrode is installed and are conductively connected to the reinforcement of the building at intervals of at least 2 metres. In addition, cross connections with a maximum mesh size of 20 m x 20 m must be established for large buildings. This conductor ensures functional equipotential bonding for electrical and electronic systems to prevent potential differences and excessive step or touch voltage inside the building in case of a lightning strike. A common bonding network is established by connecting the functional bonding conductor to the protective equipotential bonding.

To ensure that the functional bonding conductor assumes the earth potential and discharges fault currents, it must be connected to the ring earth electrode at regular intervals. If no lightning protection system is planned, a maximum distance of 20 m must be kept. If a lightning protection system is planned, a connection must be established for every down conductor.

Connection lug made of stainless steel (V4A)

Fixed earthing terminal

Connection components

To be able to use the earth electrodes and the functional bonding conductor, connection components such as connection lugs or fixed earthing terminals must be installed at certain points.

Connection components are typically installed at the following points:

- Main earthing busbar
- Additional equipotential bonding bars in technical equipment rooms
- Metal installations such as lift rails, steel columns, facade elements
- Electromagnetic compatibility measures such as building shields, ring equipotential bonding bars
- Cable routes or channels of other buildings
- Structural extensions
- Connections to the ring earth electrode / functional bonding conductor
- Down conductors of the external lightning protection system
- Downpipes
- Supplementary earthing measures, e.g. earth rods

Connection lugs inside the building should have a length of 1.5 m from the entrance point into the building and must reach out of the ground surface for 1.5 m. To ensure that connection lugs are not inadvertently cut off, they must be clearly marked during the construction phase, for example by means of a special protective cap which also serves to prevent injuries (e.g. by burrs).

When mounting the connection components, they have to be dimensioned and marked in the as-completed drawings.

Ring earth electrode, strip steel, stainless steel (V4A)

Ring earth electrode, round steel, stainless steel (V4A)

Materials

Conductor and connection materials should be basically selected according to IEC 62561-1[1)] and IEC 62561-2[2)] to ensure that a lightning protection system can be installed at a later date.

Foundation earth electrodes / functional bonding conductors

No corrosion effects are to be expected if the material is embedded in a concrete layer of at least 5 cm.

The following materials can be used:

- Round steel (minimum diameter of 10 mm) or
- Strip steel (minimum dimensions of 30 mm x 3.5 mm)

Galvanised or non-galvanised steel can be used. Structures with integrated transformer stations may require greater foundation earth electrode cross-sections (short-circuit currents of 50 Hz).

Stainless steel, for example V4A (material No. 316 Ti/316 L or similar), and copper materials with the specified minimum dimensions can be used in case of special requirements. When using these materials, electrochemical corrosion of structural steel must be observed. However, experience has shown that a material embedded in concrete is not subject to significant corrosion due to the air-tight seal and the high PH value of concrete.

Ring earth electrodes

Ring earth electrodes are buried in the ground and are thus subject to significant corrosion. For this reason, mainly stainless steel with a molybdenum content > 2%, for example V4A (material No. 316 Ti/316 L), or copper materials are used. Hot-dip galvanised materials are not permitted.

Ring earth electrodes may have the following dimensions:

- Round steel (min. diameter of 10 mm)
- Strip steel (min. dimensions of 30 mm x 3.5 mm)
- Stranded copper cable (bare or galvanised) with a minimum cross-section of 50 mm^2

Structures with integrated transformer stations may require greater ring earth electrode cross-sections (short-circuit currents of 50 Hz). Thanks to their high current carrying capability, copper materials are ideally suited for this purpose.

[1)] IEC 62561-1: Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components
[2)] IEC 62561-2: Lightning Protection System Components (LPSC) – Part 2: Requirements for conductors and earth electrodes

Cross connector

Fixed earthing terminal

Connection components and connectors
Connection components installed inside and outside the building are subject to significant corrosion. Therefore, it is no longer permitted to use hot-dip galvanised materials without additional sheath.

Suitable connection components are for example:

- Fixed earthing terminals
- Stainless steel with a molybdenum content > 2%, for example V4A (material No. 316 Ti/316 L), in the form of round steel (diameter of 10 mm) or strip steel (min. dimensions of 30 mm x 3.5 mm)
- Galvanised round steel (diameter of 10 mm) with a plastic sheath
- NYY copper cable with a min. cross-section of 50 mm²
- Stranded copper cable (bare or galvanised) with a min. cross-section of 50 mm²

Fixed earthing terminals with stainless steel (V4A) connecting plates have proven themselves in concrete buildings. Fitted into the formwork (flush with the wall), they ensure a safe connection to the foundation earth electrode system throughout the building's lifecycle. Special wall bushings which are tested with pressurised water are used to lead the earth electrodes through the wall.

If connection lugs are made of galvanised round steel with a plastic sheath, special care must be exercised during installation to prevent breakage of the plastic sheath. This must be particularly ensured at low temperatures and in case of possible mechanical stress when filling and compressing the excavation pit.

Therefore, stainless steel (V4A) round or strip steel is ideally suited for connection lugs.

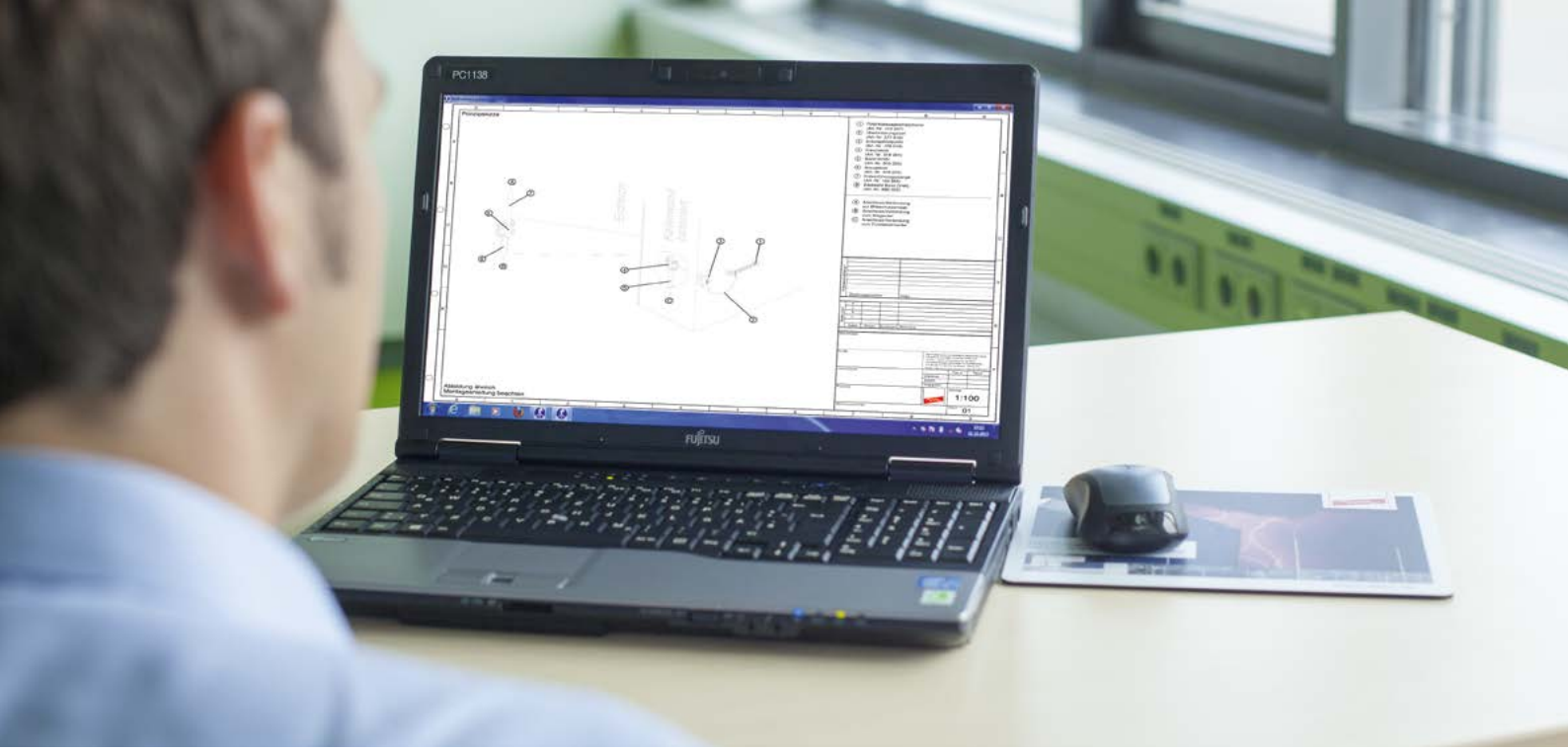
Connections can be made by screwing, clamping or welding. Particularly screwing has proven its worth for rational reasons. These connections are made according to IEC 62561-1[1)] in such a way that they can carry lightning currents. In our Lightning Protection / Earthing catalogue, the relevant clamps and connectors are labelled with a "tested" symbol. It is not allowed to use wedge connectors when mechanically compacting concrete.

If connections are made in the ground, these clamping points must be additionally covered by an anti-corrosion tape to ensure contact reliability.

When using clamps and connectors for earth-termination systems in systems exceeding 1 kV, they have to be capable of withstanding short-circuit currents of 50 Hz.

Welded connections are reliable connections and require the agreement of the responsible construction engineer and special knowledge of the installer. The welding seam must have a length of at least 50 mm.

[1)] IEC 62561-1: Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components



Design and installation

When designing a foundation earth electrode, it must be checked whether it is in electric contact with the ground. Since it is difficult to check this at the design stage, DIN 18014[1)] (section 5.7.1) lists the following points which show that the earth contact resistance is increased and thus the required electric contact with the ground is not ensured:

- Waterproof concrete according to DIN EN 2062) and DIN 1045-23)
- Bitumen sealing, e.g. bitumen sheeting, polymer modified bitumen coating
- Impact-resistant plastic sheeting (dimpled membrane)
- Heat insulation (perimeter insulation) at the lower and side walls of the foundations
- Additional soil layers (e.g. from recycled material) of poor electrical conductivity with impaired capillary effe

Sample document
A sample document (questionnaire) for architects or construction companies can be found on page 9.

The answered questions show whether a foundation or ring earth electrode can be used in conjunction with a functional bonding conductor (FB). Therefore, these questions should be basically clarified prior to design and should be documented in writing.

The flow chart on page 15 can also be used for design.

[1)] DIN 18014: Foundation earth electrode – Planning, execution and documentation
[2)] DIN EN 206: Concrete – Part 1: Specification, performance, production and conformity
[3)] DIN 1045-2: Concrete, reinforced and prestressed concrete structures – Part 2: Concrete – Specification, performance, production and conformity – Application rules for DIN EN 206

Sample document

Dear Mr. / Dear Mrs. _____

Thank you very much for your order about the design / installation of a foundation earth electrode system according to DIN 18014:2014-03 concerning the construction project

_____
Name / Place

To ensure proper and standard-compliant design / installation, please answer the following questions and fax them to: _____

How is the foundation constructed?

- ☐ Foundation slab
- ☐ Strip foundation
- ☐ Pad foundations
- ☐ Closed tank
- ☐ _____

Which material is used for the foundation?

- ☐ Concrete without special additives
- ☐ Waterproof concrete
- ☐ _____

Which material is used outside the foundation?

- ☐ Bitumen sealing
- ☐ Impact-resistant plastic sheeting as blinding layer
- ☐ Perimeter insulation at the lower and side walls of the foundation (full perimeter insulation)
- ☐ Additional soil layers from recycled material (e.g. foam glass ballast, recycling granulate) of poor electrical conductivity with impaired capillary effect
- ☐ _____

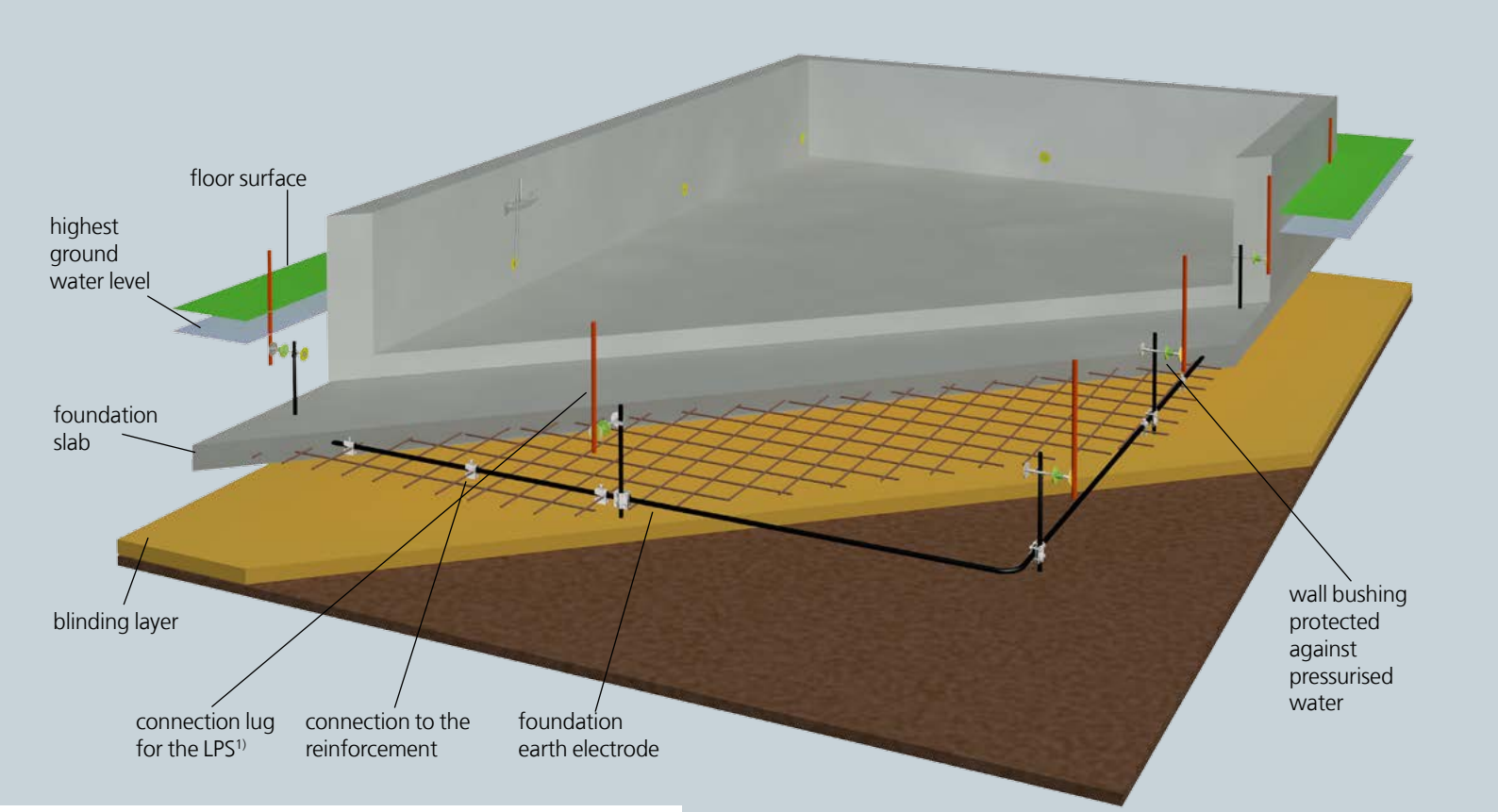
Questions answered by:

_____	_____	_____
First and last name	*Date*	*Stamp and signature*

This information allows us to design / install a foundation earth electrode system according to DIN 18014:2014-03.

Sample document for architects / construction companies required for designing the foundation earth electrode system according to DIN 18014[1)], available for download at www.dehn-international.com

[1)] DIN 18014: Foundation earth electrode – Planning, execution and documentation



Foundation earth electrode embedded in conventional concrete

Practical examples based on different types of foundations

Reinforced foundations / foundation slabs

A foundation earth electrode is installed in the form of a closed loop along the outer edges of the foundation slab and is conductively connected to the reinforcement at intervals of at least 2 metres by screwing, clamping or welding. In addition, cross connections with a maximum mesh size of 20 m x 20 m must be established for large buildings (see page 14, figure 2).

In case of terraced houses, the foundation earth electrode must be installed as a separate loop for each unit. The property lines must be observed (see page 14, figure 3).

Foundation earth electrodes cannot be passed across expansion joints. At these points, they can be led out near walls and connected with at least 50 mm² by means of fixed earthing terminals and bridging braids in case of e.g. concrete walls. If foundation slabs have large dimensions, the cross connections must also be considered for intermeshing the foundation earth electrode. In this case, the conductor normally cannot be led out of the wall. Special expansion straps, which are embedded in concrete by means of a styrofoam block, can be used to establish a flexible connection.

Installation notes for strip steel

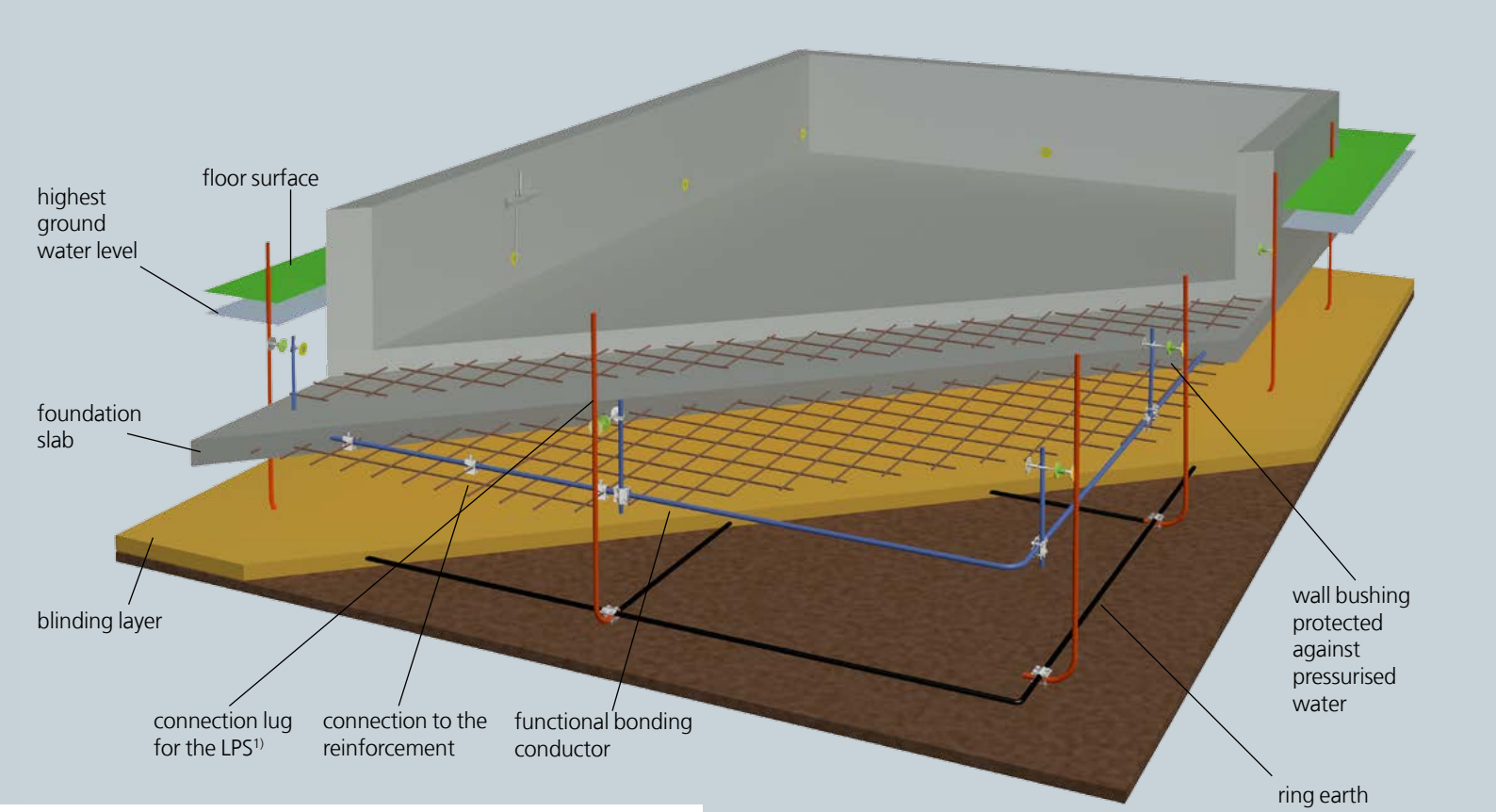
To ensure that strip steel is covered by a concrete layer of at least 5 cm on all sides, the strip material should be installed vertically in concrete. If this is not observed, the position of the strip may change when the concrete is laid. As a result, the required cover layer is not ensured or air bubbles may occur.

Mechanically compacting concrete by means of a concrete vibrator ensures that the flat strip is enclosed by concrete on all sides even if the flat strip is installed horizontally. Consequently, vertical installation of the flat strip is not required.

Membranes underneath foundation slabs

Membranes made of polyethylene with a thickness of about 0.3 mm are often laid on the blinding layer as a separation layer. These membranes only slightly overlap and are not water-repellent. They typically only have little impact on the contact earth resistance and can thus be neglected.

[1)] LPS: Lightning Protection System



Ring earth electrode and functional bonding conductor

Foundations with an increased earth contact resistance

A ring earth electrode must be installed. If the foundation, foundation slab or closed tank is reinforced with steel, a functional bonding conductor must be additionally provided.

Ring earth electrodes

The ring earth electrode must be installed in electrical contact with the ground in the working area of the excavation pit or underneath the foundations. A mesh size of 20 m x 20 m must be observed. If a lightning protection system is planned, the maximum mesh size is 10 m x 10 m. It is advisable to use this reduced mesh size for each building to ensure that a lightning protection system can be installed at a later date. Smaller mesh sizes may also be required in case of special requirements resulting from the building's lifecycle. If a building with a lightning protection system in conformity with EN 62305-4[2)] is installed, a maximum mesh size of 5 m x 5 m is for example required.

If the ring earth electrode is installed close to the surface, a constant earth contact resistance must be ensured. Therefore, the earth electrode must be installed in the frost-free area, namely at a depth of at least 0.8 m. In this context, it must be ensured that the ground is sufficiently moist. Therefore, the ring earth electrode may have to be arranged outside this area in case of large roof overhangs.

Functional bonding conductors

The functional bonding conductor is installed in concrete to form a closed loop along the outer edges of the building and is conductively connected to the reinforcement of the building at intervals of at least 2 metres. In addition, cross connections with a maximum mesh size of 20 m x 20 m must be established for large buildings.

The functional bonding conductor must be connected to the ring earth electrode at regular intervals. If no lightning protection system is planned, a connection must be made maximum every 20 m, preferably starting from the corners of the building. If a lightning protection system is planned, a connection must be established for each down conductor, preferably at intervals of at least 10 m.

These connections must be led through the building. To prevent the ingress of water, wall bushings which are protected against pressurised water with fixed earthing terminals or sealing collars tested for connection lugs must be used. Special wall bushings can also be installed subsequently by means of a borehole.

[1)] LPS: Lightning Protection System
[2)] EN 62305-4: Protection against lightning - Part 4: Electrical and electronic systems within structures

Pad / bucket foundation

Source: W.Wettingfeld GmbH & Co.KG

Fibre concrete

Practical examples based on different types of foundations

Pad foundations / strip foundations

Every pad / strip foundation must be provided with a foundation earth electrode with a minimum length of 2.5 m and must be conductively connected to the reinforcement several times. To establish equipotential bonding between the individual pad / strip foundations, the earth electrodes must be connected via a conductor which meets the requirements of ring earth electrodes and may be in electrical contact with the ground. Since this conductor is an equipotential bonding conductor, it can also be isolated from the ground.

A meshed ring earth electrode must be installed if an increased earth contact resistance is to be expected during construction. In this case, a functional bonding conductor, which is connected to the ring earth electrode at least at one point, must be provided in pad / strip foundations.

Non-reinforced foundations

In non-reinforced foundations, the foundation earth electrode is installed on spacers to ensure that it is covered by a concrete layer of at least 5 cm. The maximum mesh sizes must be considered. When using strip materials, the installation notes described before must be observed.

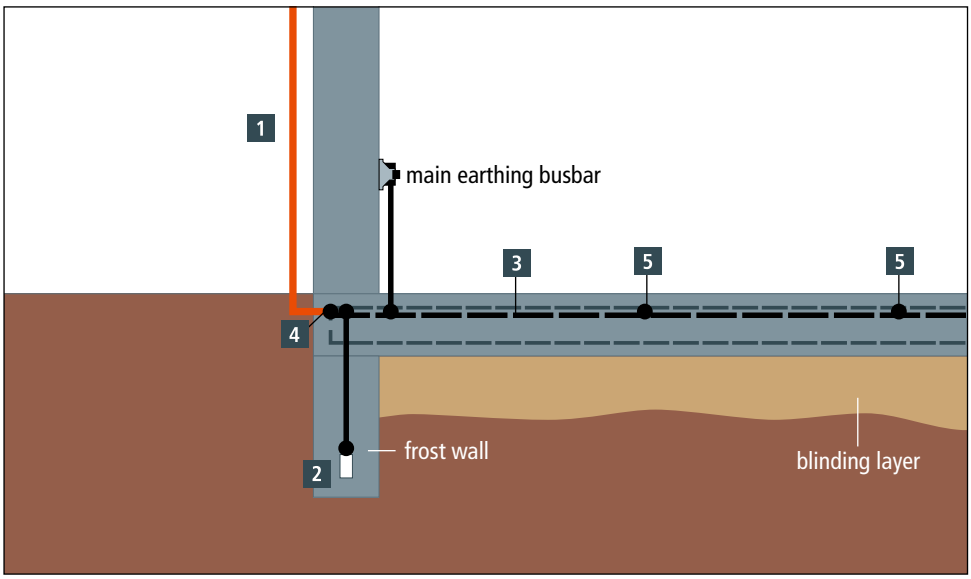
Fibre concrete foundations

If foundations are reinforced with steel fibres, it cannot be assumed that the steel fibres are conductively connected. These foundations, which are frequently used for large industrial buildings, are to be regarded as non-reinforced foundations. Fibre concrete is mostly filled in as bulk material by means of concrete mixer trucks. In these cases, a foundation earth electrode cannot be installed as described before. Therefore, it is advisable to install a ring earth electrode underneath the blinding layer which must be connected to the equipotential bonding of the building several times by means of connection components.

Ring earth electrode with spacer

Reinforced foundation slab with non-reinforced frost wall

If a non-reinforced frost wall is installed in addition to a steel reinforced foundation slab, the foundation earth electrode can be covered by a concrete layer of at least 5 cm in the frost wall. A functional bonding conductor must be additionally installed to meet the equipotential bonding requirements. This functional bonding conductor must be installed and connected to the foundation earth electrode as described for ring earth electrodes.



1 Connection lug for lightning protection system

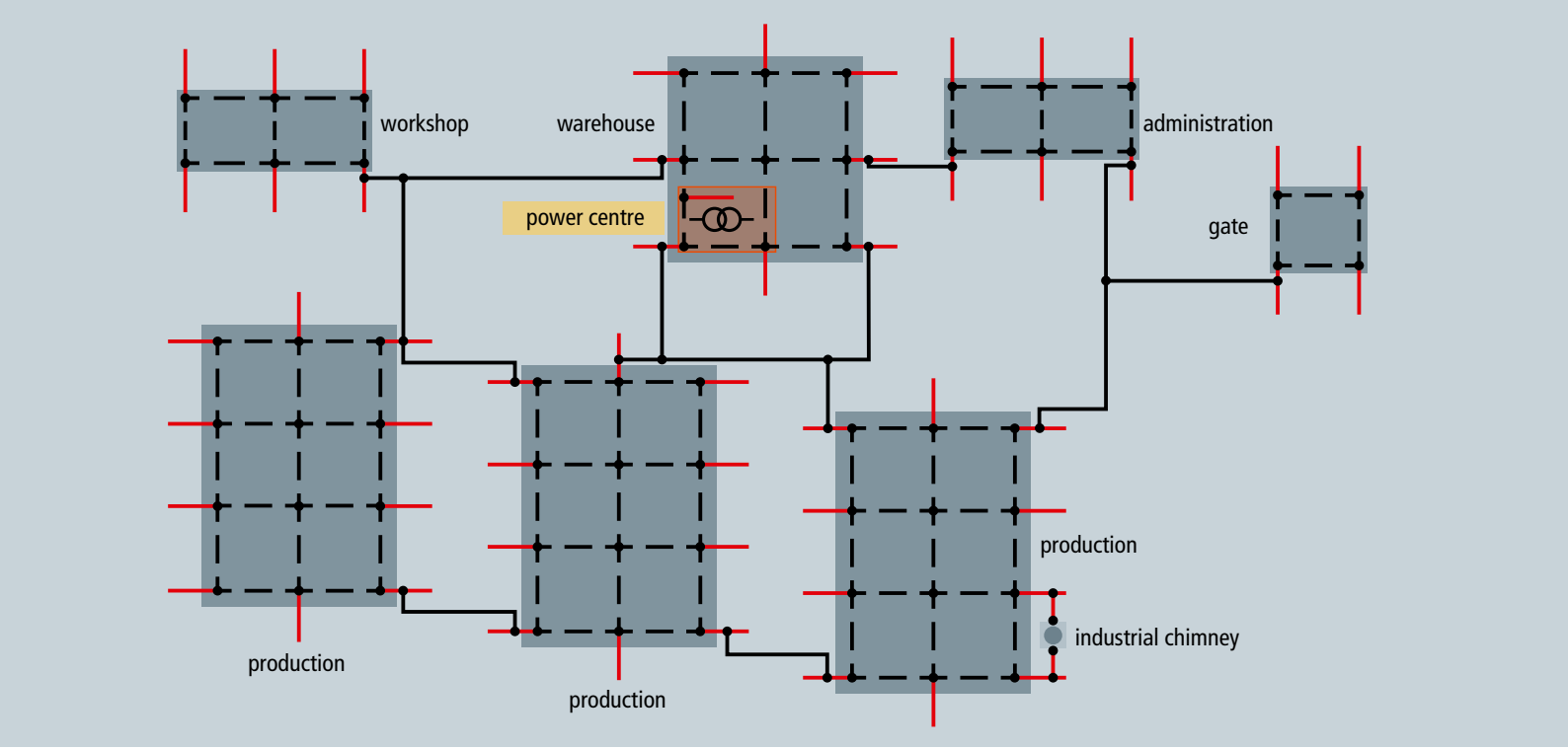
2 Foundation earth electrode

3 Functional bonding conductor
Mesh size ≤ 20 x 20 m

4 SV clamp

5 Connecting clamp
Connection at intervals of 2 m

Figure 1: Reinforced foundation slab with non-reinforced frost wall



Meshed earth-termination system for industrial buildings

If a large structure comprises more than one building and these buildings are connected by electrical and electronic connecting cables, the (total) earth resistance can be reduced by combining the individual earth-termination systems.

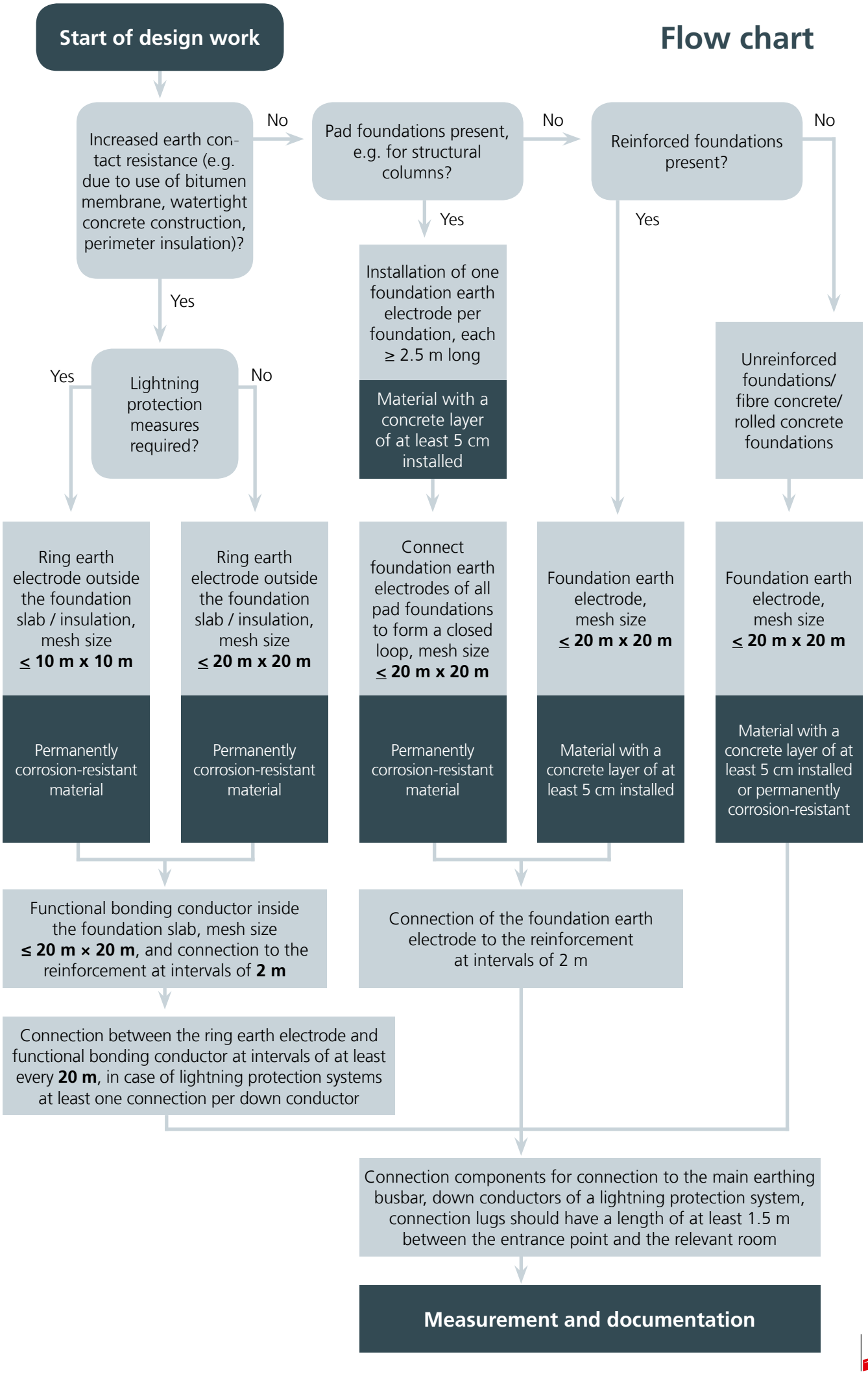
In addition, the potential differences between the buildings are also considerably reduced. This significantly reduces the voltage load on the electrical and information technology connecting cables.

The individual earth-termination systems of the buildings should be interconnected to form a meshed network. This meshed earthing network should be designed such that it contacts the earth-termination systems at the point where the vertical down conductors of the lightning protection system are connected.

The smaller the mesh size of the earthing network, the lower the potential differences between the buildings in the event of a lightning strike. This depends on the total area of the structure. Mesh sizes of 20 m x 20 m up to 40 m x 40 m have proven to be cost-effective.

If, for example, high industrial chimneys (preferred points of strike) are installed, the connection components around the relevant part of the installation should be closer, and, if possible, arranged radially with circular cross connections (potential control). Corrosion must be observed when choosing the material for the conductors of the meshed earthing network. Therefore, it is advisable to use galvanised steel in concrete (for example in the connection channel) and stainless steel such as V4A (material No. 316 Ti/316 L) in the ground.

Flow chart


Start of design work
Increased earth contact resistance (e.g. due to use of bitumen membrane, watertight concrete construction, perimeter insulation)?
No
Pad foundations present, e.g. for structural columns?
No
Reinforced foundations present?
No
Yes
Yes
Yes
Lightning protection measures required?
Yes
No
Installation of one foundation earth electrode per foundation, each ≥ 2.5 m long
Material with a concrete layer of at least 5 cm installed
Unreinforced foundations/ fibre concrete/ rolled concrete foundations
Ring earth electrode outside the foundation slab / insulation, mesh size ≤ 10 m x 10 m
Permanently corrosion-resistant material
Ring earth electrode outside the foundation slab / insulation, mesh size ≤ 20 m x 20 m
Permanently corrosion-resistant material
Connect foundation earth electrodes of all pad foundations to form a closed loop, mesh size ≤ 20 m x 20 m
Permanently corrosion-resistant material
Foundation earth electrode, mesh size ≤ 20 m x 20 m
Material with a concrete layer of at least 5 cm installed
Foundation earth electrode, mesh size ≤ 20 m x 20 m
Material with a concrete layer of at least 5 cm installed or permanently corrosion-resistant
Functional bonding conductor inside the foundation slab, mesh size ≤ 20 m × 20 m, and connection to the reinforcement at intervals of 2 m
Connection of the foundation earth electrode to the reinforcement at intervals of 2 m
Connection between the ring earth electrode and functional bonding conductor at intervals of at least every 20 m, in case of lightning protection systems at least one connection per down conductor
Connection components for connection to the main earthing busbar, down conductors of a lightning protection system, connection lugs should have a length of at least 1.5 m between the entrance point and the relevant room
Measurement and documentation

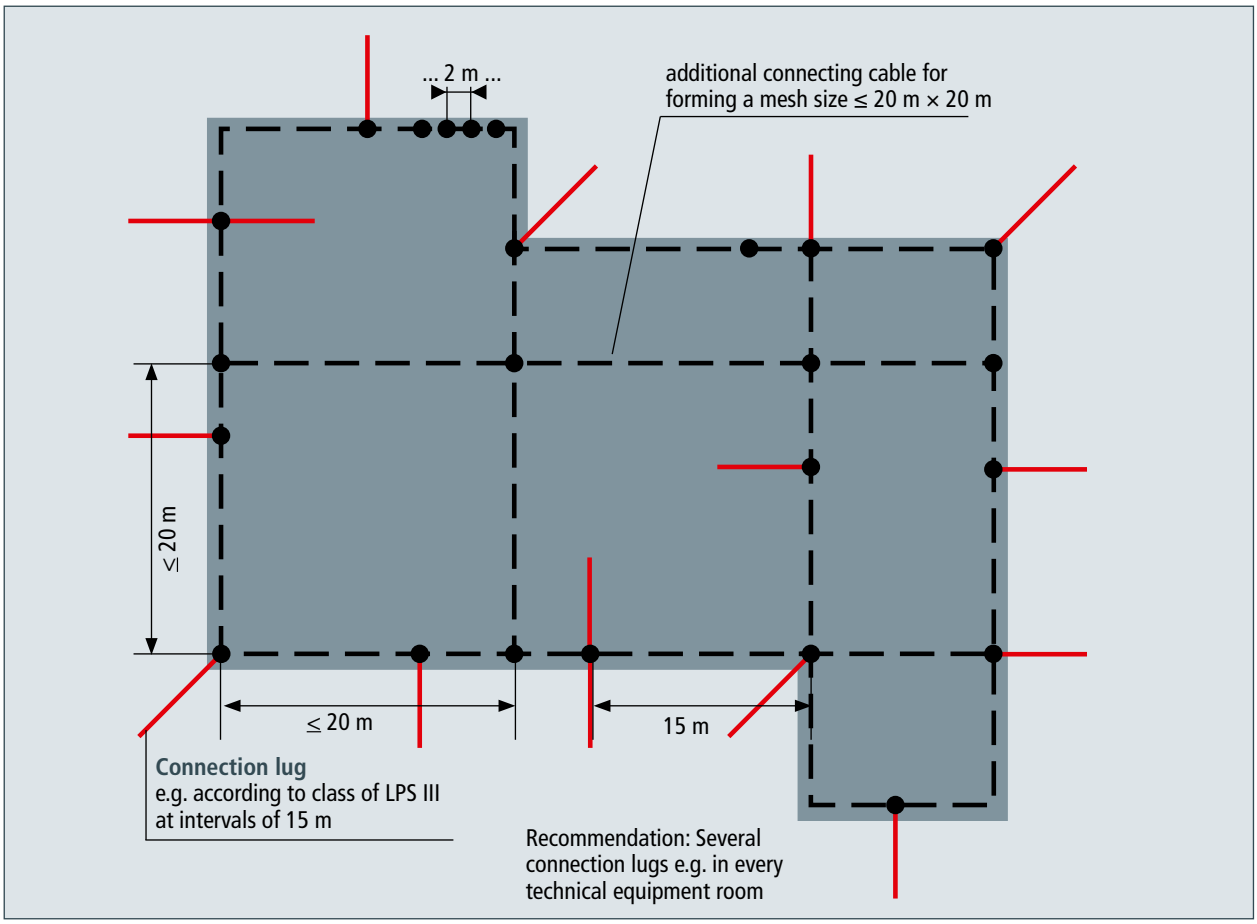


Figure 2: Meshed foundation earth electrode in case of a large building

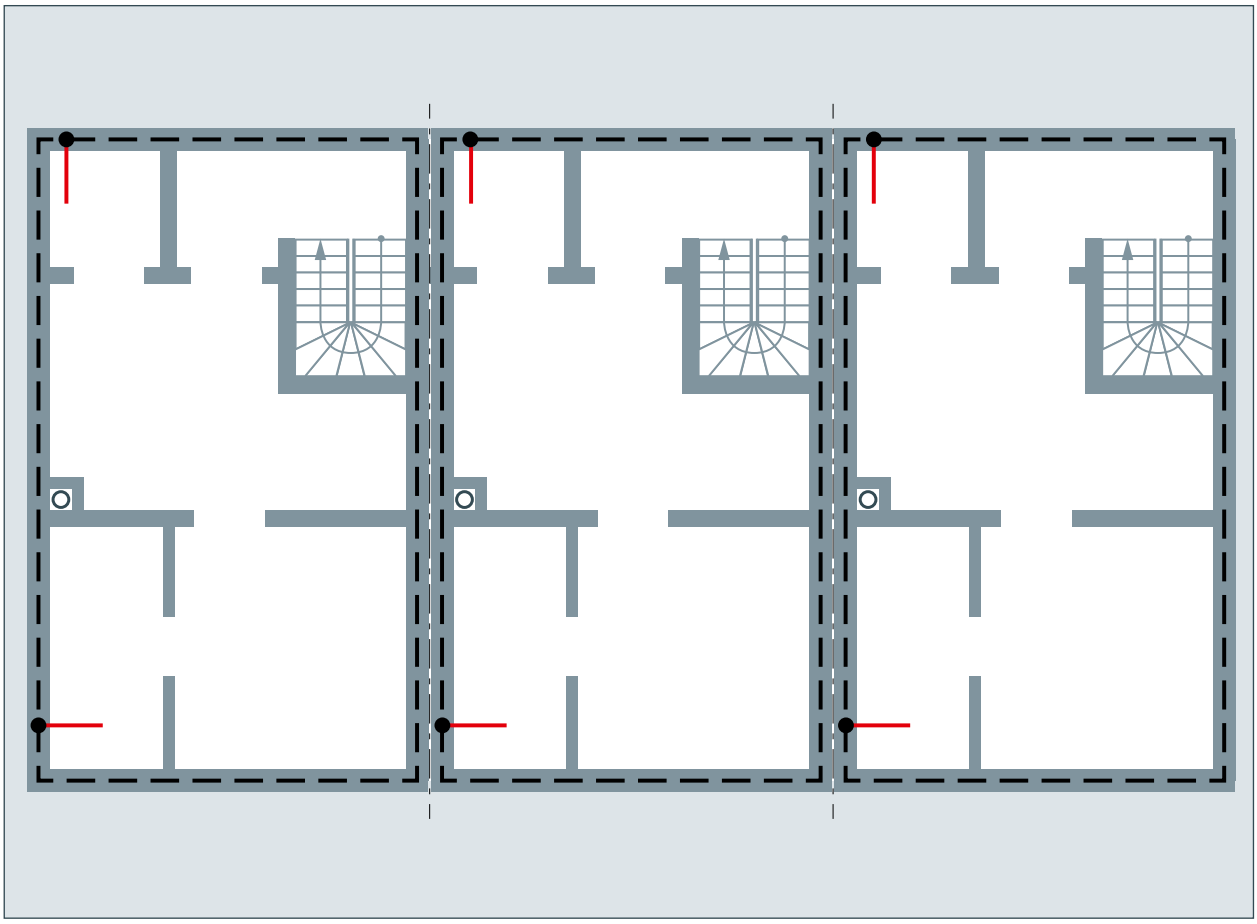
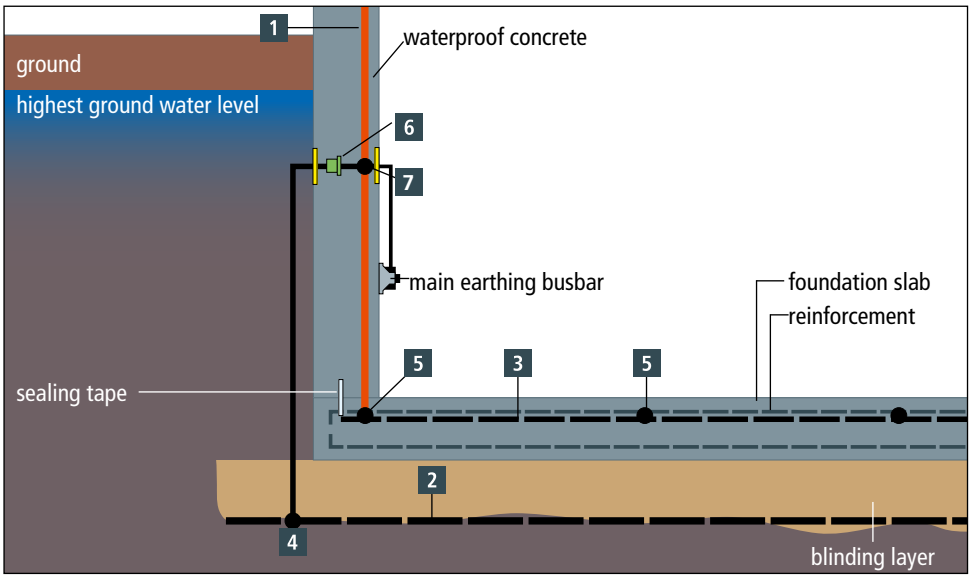


Figure 3: Foundation earth electrodes for terraced houses



1 Connection lug for LPS

2 Corrosion-resistant ring earth electrode
Mesh size ≤ 10 x 10 m

3 Functional bonding conductor
Mesh size ≤ 20 x 20 m

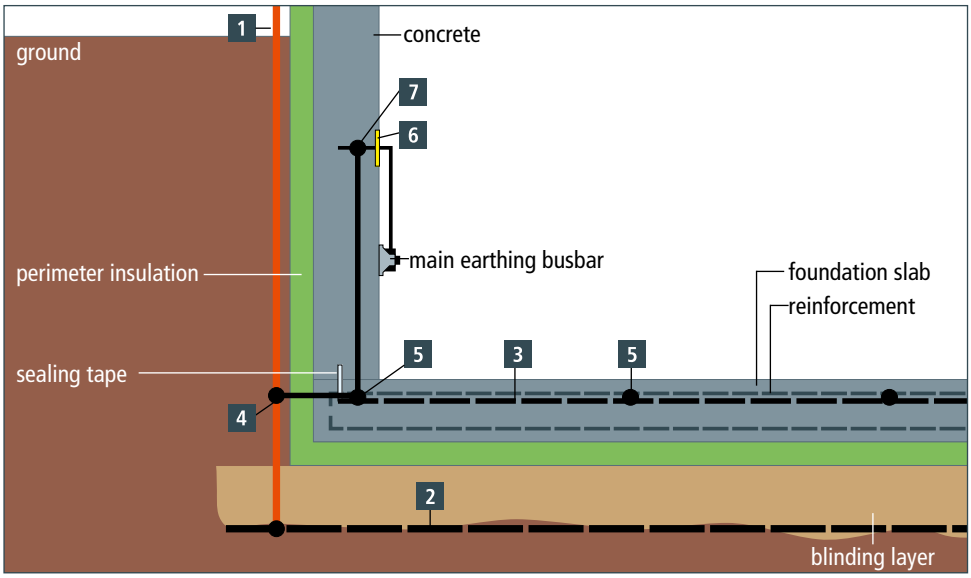
4 Cross unit

5 Connecting clamp
Connection at intervals of 2 m

6 Wall bushing
Protected against pressurised water

7 MV clamp

Figure 4: Installation example according to DIN 18014 in case of a waterproof concrete construction (according to DIN 18014).



1 Connection lug for LPS

2 Corrosion-resistant ring earth electrode
Mesh size ≤ 10 x 10 m

3 Functional bonding conductor
Mesh size ≤ 20 x 20 m

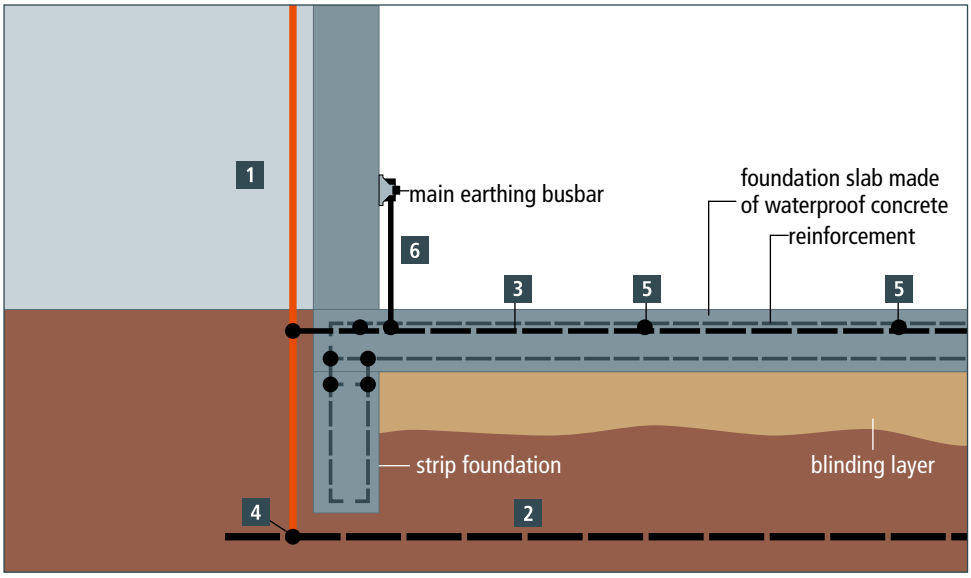
4 SV clamp

5 Connecting clamp
Connection at intervals of 2 m

6 Fixed earthing terminal

7 MV clamp

Figure 5: Installation example in case of full perimeter insulation (according to DIN 18014).



1 Connection lug for LPS

2 Corrosion-resistant ring earth electrode
Mesh size ≤ 10 x 10 m

3 Functional bonding conductor
Mesh size ≤ 20 x 20 m

4 SV clamp

5 Connecting clamp
Connection at intervals of 2 m

6 Connection lug

Figure 6: Installation example in case of reinforced floor slab and reinforced strip foundation made of waterproof concrete

Documentation and measurement

After installing the foundation earth electrode system and before laying the concrete, documentation should be drawn up and the continuity should be measured by an electrician or lightning protection specialist.

Documentation

The documentation should comprise the following:

- Layout drawings of the foundation earth electrode system
- Photos of the complete installation
- Detailed pictures of the most important connections e.g. connection to the main earthing busbar, connection to the lightning protection system
- Results of the continuity measurement

Measurement

Continuity should be measured between the connection components and must not exceed 0.2 ohms. The resistance value is measured with a measuring current of 0.2 A. Measuring instruments which are used for testing the electrical installation are normally suited for this purpose.

Forms which are supplemented with the relevant installations can be used for documentation.

On pages 17 and 18 you will find an example of a form for the documentation. To receive the form as writable pdf file, please contact info@dehn.de

Documentation and continuity test for the earth-termination system

As per DIN 18014

Provider:	Date:	Report No.:

General Information

Proprietor of the building

Name:	
Contact / Address:	

Details on the building

Location:	
Use:	
Type of construction:	
Type of foundation:	
Contractor:	
Built in (year):	

Designer of the earth-termination system

Name:	
Contact / Address:	

Installer of the earth-termination

☐ Specialised company for electrical installation	☐ Specialised company for lightning protection	☐ Contractor supported by electrical installation/lightning protection specialist
Company:		
Name:		
Contact / Address:		

Purpose of the earth-termination system

☐ Protective earthing for electrical safety			
Functional earthing for: ☐	☐ Lightning protection system	☐ Antenna system	
Are there further requirements on the earth-termination system e.g. installations exceeding 1 kV (DIN VDE 0101-2/0141)		☐ Yes	☐ No

Type of earth-termination system / combined equipotential bonding system

Type of earth-termination system:	☐ Foundation earth electrode	☐ Ring earth electrode	
Material of the foundation earth electrode / functional equipotential bonding conductor:	☐ Steel bare	☐ Steel galvanised	
Material of ring earth electrode:	☐ Stainless steel (V4A)	☐	
Material, according to DIN EN 62561-2 (VDE 0185-561-2)	☐ Round material	☐ Strip material	☐
	Dimensions:		
Connecting elements meet the requirements according to DIN EN 62561-1 (VDE 0185-561-1):		☐ Yes	☐ No
Internal connecting elements:	☐ Stainless steel (V4A)	☐ Fixed earthing terminal	
	☐ St/tZn with plastic coating	☐	
External connecting elements:	☐ Stainless steel (V4A)	☐ Fixed earthing terminal	
	☐ St/tZn with plastic coating	☐	

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Provider:	Date:	Report No.:

Drawings, photos			
☐ Implementation plans, drawing No.:	☐ Photos of the overall earth-termination system	☐ Sample photos of connection points	☐

Purpose of documentation		
☐ Acceptance / Completion	☐ Repeat test	☐

Continuity test		
Test result of the continuity test between the connection parts ≤ 0,2 Ω achieved?	☐ Yes	☐ No

Test result		
The system is according to the existing plans:	☐ Yes	☐ No
The system is without deficiencies with regard to the requirements of DIN 18014:2014-03:	☐ Yes	☐ No
The test revealed the following deficiencies:		

Location

Date

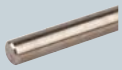
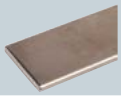
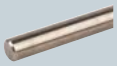
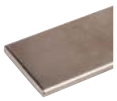
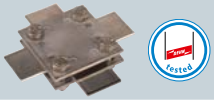
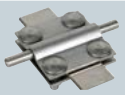
Signature of the electrician / lightning protection expert

Stamp

Notes for the proprietor of the building
The proprietor has to remedy the deficiencies.
In case of structural alteration or alteration of use immediately contact the service company.

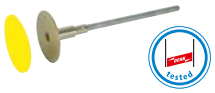
Product overview

Material excerpt with all components for foundation earth electrodes

Wires and strips	Description	Material	Conductor dimensions	Approx. ring weight / length	Part No.
	Steel wire with zinc coating ≥ 50 µs average (about 350 g/m²)	St/tZn	Ø 10 mm	50 kg / 81 m 18 kg / 30 m	**800 010** **800 310**
	Stainless steel wire: According to DIN VDE 0151 stainless steel (V4A, e.g. AISI/ASTM 316 Ti) should be used in the ground. Molybdenum content ≥ 2%	StSt (V4A)	Ø 10 mm	50 kg / 81 m 12 kg / 18 m 31 kg / 50 m	**860 010** **860 020** **860 050**
	Steel strip: According to IEC 62561-2, for earth-termination systems, lightning protection systems and ring equipotential bonding	St/tZn	30 x 3.5 mm	42 kg / 50 m 21 kg / 25 m	**810 335** **852 335**
	Stainless steel strip: According to DIN VDE 0151 stainless steel (V4A, e.g. AISI/ASTM 316 Ti) should be used in the ground. Molybdenum content ≥ 2%	StSt (V4A)	30 x 3.5 mm	21 kg / 25 m 50 kg / 60 m	**860 325** **860 335**
Connection lugs	**Description**	**Material**	**Conductor dimensions**	**Approx. ring weight / length**	**Part No.**
	Steel wire with zinc coating ≥ 50 µs average (about 350 g/m²) with plastic coating	St/tZn	Ø 10 mm / 13 mm (conductor / outer)	34 kg / 50 m	**800 110**
	Straightened connection lug made of stainless steel (V4A) for connecting the down conductor to the earth-termination system	StSt (V4A)	Ø 10 mm length 1500 mm Ø 10 mm length 3000 mm	–	**860 115** **860 130**
	Flat strip	StSt (V4A)	30 x 3.5 mm length 1500 mm 30 x 3.5 mm length 3000 mm	–	**860 215** **860 230**
	Protective cap for connection lugs, to be plugged onto round wires or strips	PVC	For Rd 10 mm Fl 30 x 3.5 mm	–	**478 099**
Clamps	**Description**	**Clamp Material**	**Clamping range in mm**	**PU**	**Part No.**
Cross units for aboveground and underground connection					
	For connecting conductors in cross and T arrangement, with intermediate plate for Rd and Fl	St/tZn StSt (V4A)	Rd / Rd 8-10 Rd / Fl 8-10 / 30 Fl / Fl 30 / 30	25	**319 201** **319 209**
	Without intermediate plate	St/tZn StSt (V4A) St/tZn StSt (V4A)	Rd / Fl 8-10 / 30 Fl / Fl 30 / 30 Rd / Rd 8-10 Rd / Fl 8-10 / 30 Fl / Fl 30 / 30	25	**318 201** **318 209** **318 251** **318 219**
	Without intermediate plate	St/tZn StSt (V4A	Fl / Fl 30 / 30	25	**318 033** **318 233**
Cross unit with flat screws					
	Without intermediate plate	St/tZn StSt (V4A)	Rd / Fl 8-10 / 30 Fl / Fl 30 / 30	25	**318 205** **318 239**
SV clamp for aboveground and underground connection					
	For cross and T arrangement, with anti-rotation lock for flat and round conductors	St/tZn StSt (V4A)	Rd / Rd 7-10 Rd / Fl 7-10 / 30 Fl / Fl 30/ 30	25	**308 220** **308 229**
	For cross and parallel connection, with slotted top part, without intermediate plate	St/tZn	Rd / Rd 8-10 Rd / Fl 8-10 / 30 Fl / Fl 30 / 30	50	**308 060**
Connecting clamp for foundation earth electrodes					
	For connecting round and flat conductors in concrete foundations; for T, cross and parallel connection, without feeding in the conductors	St/tZn StSt (V4A)	Rd / Fl (+) 10 / 30 mm Fl / Fl (+ / II) 30 / 30 mm	25	**308 120** **308 129**

Material excerpt with all components for foundation earth electrodes

Spacer	Description	Support Fl	Support Rd	Length	PU	Part No.
Spacer for installing earthing conductors in the foundation base; with tab for preventing the conductor from becoming loose						
	Angled version, reinforced	40 mm	8-10 mm	300 mm	25	**290 001**
	Straight version	40 mm	8-10 mm	280 mm	50	**290 002**

Fixed earthing terminals	Description	Plate material	Axle material	Thread	PU	Part No.
Connecting the down conductor • e.g. to the reinforcement of buildings • Connection to the earth-termination system for main and / or supplementary equipotential bonding • Use as test joint for continuity or resistance tests, type M with axle (l = 195 mm, Ø 10 mm)						
	Type M with axle (l = 180 mm, Ø 10 mm)	StSt (V4A) StSt (V4A)	St/tZn StSt	M10 / 12 M10 / 12	10	**478 011** **478 019**
	Type M without axle	StSt (V4A)	–	M10 / 12	10	**478 012**
	Type K with plastic ring and axle (l = 180 mm, Ø 10 mm)	StSt (V4A)	St/tZn	M10 / 12	10	**478 200**
	Type M with compressed axle (l = 180 mm, Ø 10 mm) Part No. 478 049 with UL approval	StSt (V4A) StSt (V4A)	St/tZn StSt	M10 / 12 M10 / 12	10	**478 041** **478 049**
	Type M with MV clamp for round conductors 8-10 mm, design with low space requirements in the formwork	StSt (V4A)	–	M10 / 12	10	**478 112**
	Type M with compressed axle and additional water barrier to prevent ingress of water along the axle into the wall (tested with compressed air of 5 bars according to IEC 62561-5)	StSt (V4A)	St/tZn	M10 / 12	1	**478 051**

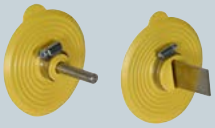
Connecting clamps	Description	Clamping range Rd / Fl	Clamp material	PU	Part No.
Connecting clamps with threaded bolt for connecting Rd and Fl conductors to fixed earthing terminals with M10/12 thread. Also suited for installation on the rear side of the fixed earthing terminal without axle e.g. for flat strips, M10/12 thread					
	Heavy version, M10 Heavy version, M12	7-10 / 30-40 mm 7-10 / 30-40 mm	St/tZn/StSt StSt (V4A)	10 10	**478 141** **478 149**
	Light version	8-10 / 30 mm	StSt (V4A)	10	**478 129**

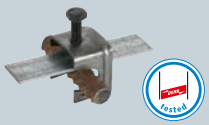
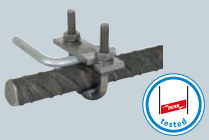
Material excerpt with all components for foundation earth electrodes

Threaded adapter	Description	Female / male thread	Material	PU	Part No.
	Threaded adapter with M10 thread, l = 130 mm	M10x25 mm / M10x80 mm	StSt (V4A)	10	**478 699**

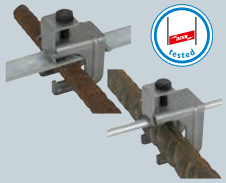
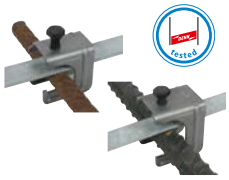
M16 fixed earthing terminals	Description	Plate / cable material	Cross-section of the connecting cable	PU	Part No.
With M16 thread for high current loads (50 Hz) e.g. for connecting the ring equipotential bonding to the earth-termination systems of power installations with a.c. nominal voltages exceeding 1 kV (transformer earthing).					
	Fixed earthing terminal with M16 thread	StSt (V4A) / Cu/gal Sn	70 mm	1	**478 027**

Wall bushing protected against pressurised water	Description	Material	Bushing length	PU	Part No.
Earth electrode and wall bushing with MV clamp made of stainless steel (V4A) for round conductors 8-10 mm for leading earthing / equipotential bonding conductors through walls; with M10 threaded rod made of stainless steel. Version for subsequent installation with borehole (Ø 14 cm) or in the spacer of the formwork. **Pressurised water test up to 1 bar which represents an installation situation up to a depth of 10 m against standing water.**					
	Earth electrode and wall bushing	Disc: StSt (V4A) Threaded rod: StSt (V4A)	100 – 300 mm 300 – 500 mm 500 – 700 mm	1	**478 410** **478 430** **478 450**
Water-tight wall bushing for waterproof concrete constructions suitable for pressurised-water-tight penetration of walls e.g. for connecting the ring earth electrode to the equipotential bonding bar or equipotential bonding conductor in the foundation. **Version for installation into the formwork. Pressurised water test with 1 bar which represents an installation situation of a building with a depth of 10 m against standing water. Tested according to IEC 62561-5 with compressed air of 5 bars.**					
	Water-tight wall bushing for waterproof concrete constructions	Disc: StSt (V4A) Axle: St/tZn	200 – 300 mm 300 – 400 mm 400 – 500 mm	1	**478 530** **478 540** **478 550**

Sealing collar for connection lugs	Description	Material	Diameter / bushing Rd	PU	Part No.
	For round conductors For flat conductors	Thermoplastic Elastomer Thermoplastic Elastomer	105 mm / 10 mm 119 mm / 30x3.5 mm	10	**478 598** **478 599**

Connecting clamps	Description	Material	Clamping range	PU	Part No.
Connecting clamps for reinforcements For connecting concrete steel mats or reinforcements with round and flat connectors, arrangement (II) = parallel / (+) = cross					
	For T, cross and parallel connection	St/tZn	Rd / Rd (+) 6-10 / 6-10 Rd / Fl (+) 6-10 / 30 Fl / Fl (II) 30 / 30	50	**308 025**
	For T, cross and parallel connection	St/tZn	Rd / Fl (+) 6-10 / 30 Fl / Fl (+ / II) 30 / 30	25	**308 026**
	For T and cross connection	St/bare	Rd / Fl (+) 6-22 / 40	25	**308 030**
	MAXI MV clamps for T, cross and parallel connection Part No. 308 040 with UL approval	St/tZn St/bare	Rd / Rd (+/II) 8-16 / 15-25 Rd / Rd (+/II) 8-16 / 15-25	20	**308 041** **308 040**
	U-clamp for large diameters	St/bare	Rd / Rd (II) 16-48 / 6-10 Rd / Fl (II) 16-48 / 30-40	25	**308 045**

Material excerpt with all components for foundation earth electrodes

Pressure U-clamps	Description	Material	Clamping range mm	PU	Part No.
Pressure U-clamps for foundation earth electrodes and reinforcements for connecting round and flat conductors in the concrete foundation or concrete steel mats and reinforcements with round and flat conductors					
	For T, cross and parallel connection	St/tZn	Rd / Rd 6-20 / 6-10 Rd / Fl 6-20 / 30x3-4 Fl / Fl 30x3-4 / 30x3-4	25	**308 031**
	MAXI for large diameters		Rd / Rd 20-32 / 6-10 Rd / Fl 20-32 / 40x4-5	25	**308 036**
	Without pressure clamp	St/bare	Rd / Fl (+) 6-20 / 30x3-4 mm Fl / Fl (+) 30x3-4 / 30x3-4 mm		**308 032**
	MAXI without pressure clamp		Rd / Fl (+) 20-32 / 30x3-40x5 mm		**308 037**

Connecting clamps	Description	Material	Clamping range mm	PU	Part No.
Connecting clamps for fixed earthing terminals and reinforcements: With clamping frame for connecting the reinforcement: For round conductors or fixed earthing terminals and simultaneous fixing in the formwork.					
	For small diameters	St/bare	Rd / Rd (+/II) 6-22 / 6-10 Rd / Fl (+) 6-22 / 40	25	**308 035**
	U-clamp for large diameters	St/bare	Rd / Rd (+/II) 16-48 / 6-10 Rd / Fl (II) 16-48 / 30-40	25	**308 046**

Bridging braids	Description	Material	Dimensions of the braid (l x w x d)		PU	Part No.
Bridging braid for foundation earth electrodes						
	For leading the foundation earth electrode in extended foundations (several sections) through the expansion joints without leading the earth electrode out of the floor slab.	StSt braid Styrofoam block	about 700 x 30 x (4 x 1) mm		1	**308 150**

Bridging braids	Description	Length	Fixing holes Ø	Centre holes Ø	PU	Part No.
Bridging braid						
	With centre hole for connection to fixed earthing terminals; aluminium	300 mm	1 x 10.5 / 4 x 5.2 mm	10.5 mm	10	**377 115**

Corrosion protection	Description	Material	Width	PU	Part No.
Anti-corrosion tape					
	For covering aboveground and underground connections in the ground according to DIN 30672; 10 m long reel, UV-stabilised	Petrolatum	50 mm 100 mm	24 12	**556 125** **556 130**

Test according to IEC 62561-1, further standards are available at **www.dehn-international.com**

DEHNclip® – The new rebar clip

The new rebar clip DEHNclip® allows fast connection of the earth electrode to the rebar without tools. DEHNclip® offers the following benefits:

Increased safety

DEHNclip® meets the requirements for foundation earth electrodes[1)] and lightning protection systems[2)]. Forgotten screw connections and tightening torques for clamps are a thing of the past. This ensures increased installation safety.

Suitable for the upper reinforcement

DEHNclip® takes up little space. Thus it can be used for installing earth electrode materials on upper reinforcements even in case of a small concrete cover. The compact clip is also an ideal solution for places which are difficult to access.

Tested technology

The conditions of use for DEHNclip® were tested in close cooperation with building industry experts. A lightning current capability of 50 kA (10/350 µs) according to IEC 62561-1[3)] is proven for DEHNclip®.

Wide range of applications

Different types of DEHNclip® are available for various clamping ranges and rebar diameters.

[1)] DIN 18014: Foundation earth electrode - Planning, execution and documentation
[2)] IEC 62305-3: Protection against lightning - Part 3: Physical damage to structures and life hazard
[3)] IEC 62561-1: Lightning Protection System Components (LPSC)

Installation of DEHNclip® without tools saves time and money

Efficient and time-saving
With DEHNclip®, the installation time is considerably reduced compared to conventional clamps. This results in cost advantages particularly in the case of large construction sites.

Compact, light-weight and resource-saving
DEHNclip® is smaller and lighter than comparable conventional clamps. This saves space and weight in assembly vehicles and at the construction site. Natural resources are conserved due to the materials used.

Fast and safe
The innovative spring steel clip DEHNclip® consists of an upper and lower part. The snap-in mechanism allows the earth electrode to be safely connected to the rebar without tools.

Part No.	Clamping range	Material
308 130	Rd 6* / Rd 10	St/bright
308 131	Rd 8* / Rd 10	St/bright
308 132	Rd 10* / Rd 10	St/bright
308 133	Rd 12* / Rd 10	St/bright

Part No.	Clamping range	Material
308 140	Rd 6* / Fl 30 x 3-4	St/bright
308 141	Rd 8* / Fl 30 x 3-4	St/bright
308 142	Rd 10* / Fl 30 x 3-4	St/bright
308 143	Rd 12* / Fl 30 x 3-4	St/bright

*nominal rebar diameter d_s

www.dehn-international.com/partners

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