The Earthing is one of the first technical Installations on site and requires in the process plant a particular attention and an early finalization of the design. It is a challenge for the designer to recognize and receive in a early stage the position of the earthing connection points of electrical powered equipment, vessels or the steel construction in order to forward it on time to the civil contractor whilst the mechanical engineering is busy with preparing tendering documents and awarding and the arrangement of machines- and electro technical equipments isn’t defined yet.

Earthing in the plant construction is essentially in use as a functional earthing and lightning protection. The earthing resistance is the electrical resistance between the connection terminal and the ground earth. The earthing resistance is the characteristic value of the earthing system and shall be in general minimized.

**Types of earthing wires**
1. Galvanized band iron strap 30x3,5 mm is delivered on a spool and is connected with clamps
2. Flat round bars dm 10-12 mm delivered in bundles is employed within the concrete foundation. The bars will be cut on site to fit, bended and welded with each other. This type of earthing wire is often conducted to earthing connection plates (Pic. 1-3)
3. Copper wires have a seven times higher conductibility (or a seventh of the resistance) than iron based wires, are easier to place but also manifold more expensive than galvanized band iron strap or round bars (Pic. 4).

**Characteristics in the plant Construction**

**Earthing**
As the foundations in the plant construction are carried in most of the cases by deep foundations piles the earthing system has already in this phase to be taken into consideration. To install a deep earthing system conductive earthing rod then will be embedded in the reinforcement cage or the earthing will be connected directly with the reinforcement by welding.

If foundation piles are not used, bronze bars instead have to be driven into the soil. How deep a rod has to be placed depends on the conductivity of the ground.

In practice on site the bronze bars will be driven into the ground until the required conductivity has been reached. If a deep earthing system is due to ground conditions not to realize the ground electrode has to be arranged at the surface in grids. The conductivity will be measures constantly. The ideal earthing system of a building is arranged horizontal and vertical in mesh grids of smaller than 10m. Within the concrete foundation structure an inner earthing grid is designed horizontally and connected with rising structures, the outer grid and the deep conductor. The vertical connections are following the columns or walls and are then rising within the concrete or are conducted to steel columns at the bottom and the top Fig X and XI.
Lightning protection

The lightning protection system design requires a calculation in which the location and the height of the building have influence. Practically the lightning protection is collected with certified antennas and then routed in a grid outside at the building to the ground (Pic. 5.1 and 5.2). In order to avoid the lightning entering the inner of the building the lightning protection grid is conducted to the outer earthing grid not to the inner earthing grid.
**Execution**

Monitoring the execution and regular inspections of the good workmanship are essential. In the focus of inspections are connections between following structures, foundations with machines and equipment (Pic. 6.1), foundation slabs with steel members (Pic. 6.2), pre-cast concrete elements with each other and at least the outer and inner grid. In practice a connection between a concrete slab with a following concrete column or wall is realized by placing a starter rod or earthing bar.

Clear connection points to conduct the grids have to be defined by using earthing plates from steel or bronze with recessed threads. It is recommendable to measure and document regularly in defined sections the earthing resistance. The resistance measure shall approve that the grid is built so far without interruption.

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<td>Pic. 6.2 connection foundation with steel column</td>
<td>M. Hartmann</td>
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<td></td>
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<td>Pic. 6.1 Earthing connection between equipment and foundation upstand</td>
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