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New Life for the Ufer Ground

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Effective, reliable grounding electrodes or grounding electrode systems are required for all electrical services and systems. This presented a problem for Herbert Ufer. During WWII, he served as an Army consultant overseeing the building of bomb storage vaults in the vicinity of Tucson and Flagstaff, Ariz. Ufer found the high-Ohm resistance of the dry, sandy Arizona desert presented a grounding challenge. Conventional ground rods were unable to meet the required low-ground resistance requirements. He addressed the challenge by developing a concrete-encased ground, which now carries his name, the Ufer ground.

Properties of concrete provide the key

The Ufer ground takes advantage of the properties of concrete. Essentially, concrete absorbs and retains moisture quickly, but loses it slowly over time. In addition, the composition and pH of concrete is such that it allows ionic transfer, which means that it has available ions to conduct electric currents. Furthermore, the soil around the concrete becomes "doped" by the presence of the concrete. As a result, the pH of the soil rises and consequently reduces what would normally be high-Ohm resistance conditions.

Ufer fond that a concrete-encased ground provides a safe, elegant and practical alternative to the exterior metal-driven rod system we all are familiar with and which we know can be subject to damage or tampering.

NEC Amendment provides the opportunity

Amendments to the 2008 NEC, National Electric Code have clarified some provisions of previous concrete encased electrode language. Although the word "Ufer" is not used in the text of the code, NEC Section 250.52(A)(3) addresses Ufer grounds.

The 2008 NEC – Section 250.52(A)(3), reads as follows:

Electrodes permitted for grounding.

Concrete Encased Electrode. An electrode encased by at least 50 mm, (2 inches) of concrete, located horizontally near the bottom or vertically, and within that portion of a concrete foundation or footing that is in direct contact with the earth, consisting of at last 6.0 m (20 ft.) of one or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars of not less than 13mm (1/2 in) in diameter, or consisting of at least 6.0 m (20ft.) of bare copper conductor not smaller than 4 AWG. Reinforcing bars shall be permitted to be bonded together by the usual steel tie wires or other effective means. Where multiple concrete encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

The amendments to the code allow homebuilders and electricians to use the concrete-encased Ufer ground in place of the ubiquitous driven rod, or multiple rods that home inspectors are familiar with, and both builders and electricians are taking advantage of this new cost-effective NEC provision.

Ufer Ground being used in Puget Sound area

Here in the Puget Sound area of Western Washington, most Jurisdictions having authority (JHA) have adopted the NEC. In general, based on NEC provisions, the typical service ground for newer homes with the standard 200-AMP service consists of two driven metal rods and a bonding jumper that connects them, which, in most cases, consists of a #4 copper AWG.

Mr. Ufer experimented with various lengths of wire in concrete. Today, however, the rebar required in the concrete foundation provides a much-improved grounding system, especially in soils with higher moisture content. Numerous studies have proved that a properly installed concrete-encased electrode system will maintain a resistance of four Ohms or less to ground for the life of the foundation.

As a result, the use of UFER grounds is becoming more prevalent in new construction and in many places, UFER grounds are replacing the typical driven-rod grounding systems.

In my area, a home's gas and metal water lines, as well as cable TV and phone lines, are required to be bonded to the grounding electrode. It's always wise to check with the local JHA to determine which grounding methods, including Ufer grounds, are approved in the local jurisdictions.

Step by step: Ufer grounds in new construction

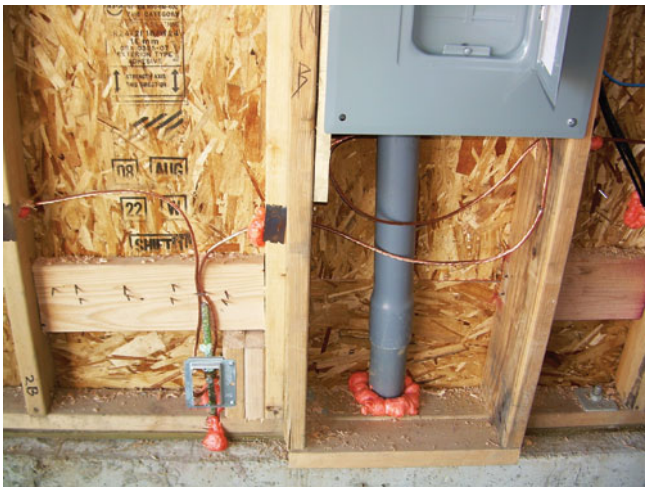
The following photographs show Ufer grounds being used in homes built north of Seattle in November of 2008.

1.Installation of an approved electrode: The footing forms and the required rebar steel are set, and the top of the #4 rebar that will serve as the electrode has been painted bright green. This identifies the electrode location for the electrician and also allows the code inspector to inspect the electrode installation.

2.The formwork is complete and the spray-painted electrode can be seen protruding above the form panel. The location of the electrode is determined by the proposed location of the entrance conductors and the home's service panel.

3. The foundation has been poured, the walls have been framed and the rebar electrode can be seen protruding through the mud sill. The electrician has sealed the hole around the electrode. The acorn clamp and the #4 AWG grounding wire coming from the panel have been connected to the rebar electrode.

In addition, a mud ring has been installed in front of the clamp in order to provide an inspection access after the drywall is installed. Note the paper label attached to the rebar electrode. This is the code inspector's proof of inspection and approval prior to pouring the foundation.

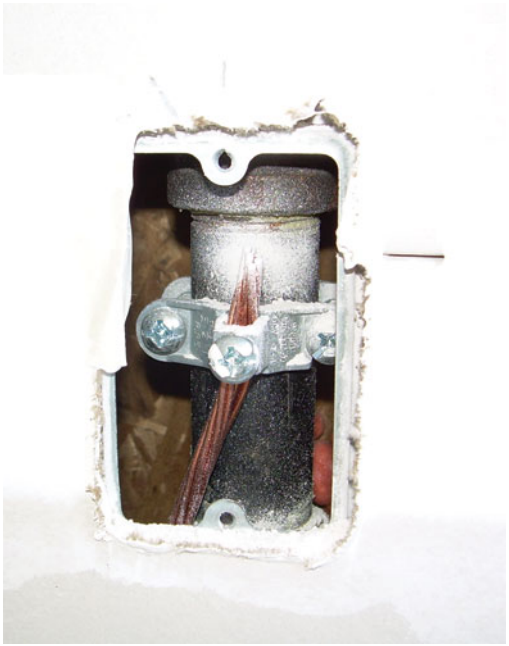


4. The panel has been installed. The #4 AWG wire is connected to the rebar electrode. Note the various runs of #4 AWG that will be used to bond the gas line, water lines, cable TV, phone service, etc.

5. One of the #4 AWG wires is used to bond the gas line coming from the meter. Note the mud ring, which allows access for inspecting the bond.

6. The other #4 AWG is used to ground the cable TV and phone service. The cable TV has been bonded, but the phone service box has not been installed yet.

7. After the drywall is installed, the mud ring provides satisfactory access for visual inspection of the grounding assembly. A blank plate will cover the mud ring.



8. The bonded gas line from picture 5 is pictured with the finished drywall. A blank plate will cover the mud ring.

9. After the drywall is hung, but before fire taping, the panel and ground electrode access plates are still
visible. In this house, the drywall taper will have to do some custom taping because the rebar electrode protrudes beyond the plane of the drywall.