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## Coatings for steel pile structures – Never Hot dip Galvanize Steel Pile

Galvanizing steel pile structures supplied by APE will void any warranties from APE

There are three significant problems with using hot-dip galvanized metal cladding to control corrosion on the new helical piles.

The First problem with any coating applied to a steel pile that is twisted into the ground as its installed is that the coating will scrape off. NO PILE CAN BE INSTALLED WITHOUT SOME COATING LOSS, this can contaminate surrounding soil and water and may effectively create hot spots that corrode faster than than an uncoated pile.

The second issue is that galvanizing is designed to control corrosion on carbon steel structures in the atmosphere. When a carbon steel structure is first dipped in molten zinc, it is bright silver. After a brief period of time, the outer surface of the galvanized structure turns a dull gray color. The change in color is due to the formation of a zinc oxide film. This film will resist further metal loss. When a galvanized conduit or pile is placed underground, it is no longer exposed to the air. The zinc will not form the protective oxide film. Within a couple of months, the buried surface of the galvanized structure is chalky-white. In a couple of years, the surface will be milky yellow with brown rust streaks. After as little 5 year's exposure, the zinc will be completely consumed and the conduits or piles will freely corrode. This explains why, when galvanized conduits are installed below grade, they must have a tape wrap or PVC coating. These wraps actually provide the corrosion control, not the galvanizing. If the piles are galvanized, the zinc will not provide any significant corrosion control and will be completely depleted within 2 to 5 years.

The third problem is one of embedding the galvanized piles, cap plates and brackets in the concrete footings. Zinc is an amphoteric metal. An amphoteric metal is subject to accelerated rates of corrosion when exposed to acidic or basic environments. The pH of the concrete in the footings can be expected to range from 12 to 14. This pH is in the strong base range. As soon as the piles are embedded in the concrete, the zinc will dissolve. This will leave bare steel in contact with the high pH concrete. When carbon steel is exposed to high pH concrete, it forms a gamma oxide which protects the embedded steel. This is good for the portion of each pile and the cap plate that are embedded. However a severe corrosion cell will develop between the steel embedded in the concrete and the steel pile exposed to the soil below the concrete.

The electro- chemical energy potential of the steel embedded in the concrete will be between -100 and -200 millivolts. This is about the same potential level as copper. The electro-chemical energy potential of the steel exposed to the soil will be in the -450 to -550 millivolt range. A natural battery cell will be created in which the steel exposed in the soil will corrode like an anode to protect the embedded steel. Over time, the piles would fail due to corrosion just below the foundation.

The piles should not be hot-dipped galvanized. There was an extensive study on pile corrosion conducted by Dr. Melvin Romanoff for the United States Department of Commerce and the National Bureau of Standards. The study was titled "Corrosion of Steel Pilings in Soil". It is available for Download at apedrilling.com in the engineering tab.

In this study, steel piles were driven into the soil at locations throughout the United States. The locations were selected to cover a variety of soil conditions. Piles were removed from each site on a set frequency and were examined for corrosion-related metal loss. The periods of exposure were up to 40 years. The extensive study concluded; "In general, no appreciable corrosion of steel piling was found in undisturbed soil below the water table regardless of the soil types or soil properties encountered. Above the water table and in fill soils, corrosion was found to be variable but not serious." This study and other similar studies have found the rate of corrosion on piles in undisturbed soils is very low.

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