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16. Abstract

This provides specific design recommendations, design considerations, and construction techniques for the construction of lateral support systems and underpinning. The design considerations are presented for each technique or method (soldier piles, steel sheeting, diaphragm walls, internal bracing, tiebacks, underpinning, grouting, and freezing). The factors affecting the design or implementation of these schemes are discussed. Construction techniques are presented, and literature references are provided for those seeking even greater detail. An overview of the construction methods compares the applicability of the techniques and the construction costs of each.

Other reports developed from the study are FHWA-RD-128, Volume I, Design and Construction; FHWA-RD-129, Volume II, Design Fundamentals; and FHWA-RD-131, Concepts for Improved Lateral Support Systems.

See pg 47 + 48

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of the hole. However, it is believed that properly placed lean concrete can be just as effective below the level of excavation at the pile. Surely, lean concrete is at least equivalent in strength to most natural soil formations. Pouring concrete through water is totally unacceptable if ground loss during the course of future excavation is of concern; therefore, placement must be by tremie. Dry holes can be poured through a funnel that regulates placement rate. Rapid discharge without a funnel is discouraged because the concrete may "hang-up" by arching between the pile and outer wall, unless of course the concrete is placed first.

Lean concrete must be sufficiently strong to prevent collapse of the hole, yet weak enough to be excavated easily. A lean concrete mix is normally about 1 to 2 sacks of cement per cubic yard.

2.42 INSTALLATION OF LAGGING

Typical procedure is to dig below the last section of installed lagging, to remove the soil carefully, and then to slide the lagging boards in place.

To minimize over cut, hand tools should be used to shape the soil and to fit the lagging board in place. If necessary, wedges can be used to tighten up between the lagging board and its bearing area.

Depth of exposure below the last placed lagging may be as little as 1 foot, as in the case of saturated silts, or as much as 4 or 5 feet in cohesive hardpan. The German code (DIN 4124, 1972) allows an exposure of only 1/2 meter except in stiff cohesive soil where 1 meter is allowed.

In circumstances of adverse soil conditions, proper cutting of the soil bank, backpacking of soil behind the lagging, and filling the vertical space between lagging boards with a proper filtering and drainage material are all important details. Open, or louvered lagging, ensures proper drainage and at the same time, when properly installed, aids in preventing ground loss.

2.43 REMOVAL

There is a divergence of opinion among practitioners as to whether or not untreated wood can be left in place permanently above the ground water table. Some claim that deterioration of the wood leads to lateral movement of soil and therefore ground settlement. Others point to many examples of the wood remaining intact. If decay has occurred, it has been observed that the fabric of the wood remains strong enough to provide the necessary resistance to prevent closing the space occupied by the wood.

Given these diverse opinions, one has no alternative other than to be conservative when adjoining structures must be protected. Therefore, the viable options are to remove lagging that would be permanently above the ground water level or to treat with chemicals to prevent future deterioration.

When lagging is removed, the process should be in stages of a few feet at a time. Concurrently, backfill should be compacted. Soldier piles may be removed if it is practical to do so and provided that voids are not created below ground.

Treatment standards are shown in Table 3.