يەكێتی ئەندازیارانی كوردستان- لقی سلێمانی

تويَـــذينةوةيةك دةربـــارةى

"Deep Foundations-Piles"

كة لة لايـةن ئةندازيـارى ريَثيَـدراو

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يةكيَتى ئةندازيارانى كوردستان لقى سليَمانـى

بؤ بةدةسـتهيَنانى ثلةى (راويَذكاريى) لـــة

ئةندازياريى شـارستانيـــدا

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Deep Foundations:

Subsurface conditions, structural requirements, site location and features and economics generally dictate the type of foundation to employed for a given structure.

Deep foundations, such as piles, drilled shafts, and caissons, should be consider when:

Shallow foundations are inadequate and structural loads to transmitted to deeper, more competent soil or rock .Loads exert uplift or lateral forces on the foundations structures are required to be supported over water Functionality of the structure does not allow for differential settlements. Future adjacent excavations are expected.

Application of Piles:

Pile foundations are commonly installed for bridges, buildings, towers, tanks, and offshore structures. Piles are of two major types: prefabricated and installed with pile-driving hammer, or cast-in-place. In some cases pile may incorporate both prefabricated and cast-in-place elements. Driven piles may be made of wood, concrete, steel, or a combination of these materials. Cast-in-place piles are made of concrete that is placed into an auger drilled hole in the ground. When the diameter of a drilled or augured cast-in-place pile exceeds about (٢٤ inch),it is then generally classified as a drilled shaft, bored piles, or caisson.

The load-carrying capacity and behavior of a single pile is governed by the lesser of the structural strength of the pile shaft and the strength and deformation properties of the supporting soils. When the latter governs, piles derive their capacity from soil resistance along their shaft and under their toe. The contribution of each these two components is largely depended on subsurface conditions and pile type, shape, and method of installation. Piles in sand or clay deposits with shaft resistance predominant are commonly known as friction piles. Piles with toe resistance primary are known as end-bearing piles. In reality, however, most piles have both shaft and toe résistance, albeit to varying degrees. The sum of the ultimate resistance values of both shaft and toe in termed the piles capacity, which when divided by an appropriate safety factor yields the allowable load at the pile head.

The capacity of a laterally loaded pile is usually defined in terms of limiting lateral deflection of the pile head. The ratio of the ultimate lateral load defining structural or failure to the associated lateral design load represents the safety factor of the pile under load.

Piles are rarely utilized singly, but are typically installed in groups. The behavior of a pile in a group differs from that of the single pile. Often, the group effect dictates the overall behavior of the pile foundation system.

The following articles provide a general knowledge of pile design, analysis, construction, and testing methods. For major projects, it is advisable that the expertise of a geotechnical engineer with substantial experience with deep-foundations design, construction, and verification methods be employed.

Pile Types:

Piles that cause a significant displacement of soil during installation are termed displacement piles. For example, closed-end steel pipes and precast concrete piles are displacement piles, whereas open-end piles and- H- piles are generally limited displacement piles. They may plug during driving and cause significant soil displacement. Auger-cast piles are generally considered non-displacement piles since the soil is removed replaced with concrete during pile installation.

Piles are usually classified according to their method of installation and type of material. Pre-formed driven piles may be made of concrete, steel, timber, or a combination of these materials.

١-Precast Concrete Piles:

Reinforced or prestressed to resist handling and pile-driving stresses, precast concrete piles are usually constructed in a casting yard and transported to the jobsite. Pretensioned piles (commonly known as prestressed piles) are formed in very long casting beds, with dividers inserted to produce individual pile sections. Precast piles come in a variety of cross sections; for example, square, round, octagonal. They may be manufactured full length or in sections that are spliced during installation. They are suitable for use as friction piles for driving in sand or clay or as end-bearing piles for driving through soft soils to firm strata.

Prestressed concrete piles usually have solid sections between ١٠ and ٣٠ in square. Frequently, piles larger than ٢٤ in square and more than ١٠٠ ft long are cast with a hollow core to reduce pile weight and facilitate handling.

Splicing of precast concrete pile should generally be avoided. When it is necessary to extend pile length, however, any of several splicing methods may be used. Splicing can be accomplished, for instance, by installing dowel bars of sufficient length and then injecting grout or epoxy to bond them and the upper and lower pile sections. Oversize grouted sleeves may also be used. Alternatives of these bonding processes include welding of steel plates or pipes cast at pile ends. Some specialized systems employ mechanical jointing techniques using pins to make connection. These mechanical splices reduce filed splice time, but the connector must be incorporated in the pile sections at the time of casting.

All of the preceding methods transfer some tension through the splice. There are, however, systems, usually involving external sleeves (or cans), that do not transfer tensile forces, this is a possible advantage for long piles in which tension stresses would not be high, but these systems are not applicable to piles subject to uplift loading. For prestressed piles, since the tendons require bond development length, the jointed ends of the pile sections should also be reinforced with steel bars to transfer the tensile forces across the spliced area.

Prestressed piles also may be posttensioned such piles are mostly cylindrical (typically up to ٦٦-in diameter and ٦-in wall thickness) and are centrifugally cast in sections and assembled to form the required length before driving. Stressing is achieved with the pile sections placed end to end by threading steel cables through precast ducts and then applying tension to the cables with hydraulic devices. Piles up to ٢٠٠ fit long have been thus driven.

Advantages of precast concrete piles include their ability to carry high axial and inclined loads and to resist large bending moments. Also, concrete piles can be used as structural columns when extended above ground level. Disadvantages include the extra care required during handling and installation, difficulties in extending and cutting off piles to required lengths, and possible transportation difficulties. Special machines, however, are available for pile cutting, such as saws and hydraulic crushing systems. Care, however, is necessary during all stages of pile casting, handling, transportation, and installation to avoid damaging the piles.

Precast concrete piles are generally installed with pile-driving hammers. For this purpose, pile heads should always be protected with cushioning material. Usually, sheets of plywood are used. Other precautions should also be taken to protect piles during and after driving. When driving is expected to be through hard soil layers or into rock, pile toes should generally be fitted with steel shoes for reinforcement and protection from damage. When piles are driven into soils and ground water containing destructive chemicals, special cement additives or containing should be used to protect concrete piles. Seawater may also cause damage to concrete piles by chemical reactions or mechanical forces.

Precast Concrete Piles

٢-Cast-in-Place Concrete Piles:

These are produced by forming holes in the ground and then filling them with concrete. A steel cage may be used for reinforcement. There are many methods for forming the holes, such as driving of a closed-end steel pipe, with or without a mandrel. Alternatively, moles may be formed with drills or continuous-flight augers. Two common methods of construction are: (١) a hole excavated by drilling before placement of concrete to form a bored pile, and (٢) a hole is formed with a continuous-flight auger (CFA) and grout is injected into the hole under pressure through the toe of the hollow auger stem during auger withdrawal. A modification of the CFA method is used to create a mixed-in-place concrete pile in clean granular sand. There are numerous other procedures used in constructing cast-in-place concrete piles, most of which are proprietary systems.

Advantages of cast-in-place concrete piles include: relatively low cost, fast execution, ease of adaptation to different lengths, capability for soil sampling during construction at each pile location, possibility of penetrating undesirable hard layers, high load-carrying capacity of large-size piles, and low vibration and noise levels during installation. Construction time is less than that needed for precast piles inasmuch as cast-in-place piles can be formed in place to required lengths and without having to wait for curing time before installation.

Pile foundations are normally employed where subsurface conditions are likely to be unfavorable for spread footings or mats. If cast-in-place concrete piles are used, such conditions may create concerns about the structural integrity, bearing capacity, and general performance of the pile foundation. The reason for this is that the constructed shape and structural integrity of such piles depend on subsurface conditions, concrete quality and method of placement, quality of work, and design and construction practices, all of which require tight control. Structural definicies may result from degraded or deboned concrete, necking, or inclusions or voids. Unlike pile driving, where the installation processes itself constitutes a crude qualitative pile-capacity test and hammer-pile-soil behavior may be evaluated form measurements made during driving, methods for evaluating cast-in-place piles during construction are generally not available. Good installation procedures and inspection are critical to the success of uncased augured drilled piles.

Cast-in-Place Concrete Piles

٣- Steel Piles:

Structural steel H and pipe and sections are often used as piles. Pipe piles may be driven open-or closed-end. After being driven, they may be filled with concrete. Common sizes of pipe piles range from (٨ to ٤٨ inch) in diameter. A special type of pipe pile is the Monotube, which has a longitudinally fluted wall, may be of constant section or tapered, and may be filled with concrete after being driven. Closed-end pipes have the advantage that they can be visually inspected after driving. Open-end pipes have the advantage that penetration of hard layers can be assisted by drilling through the open end.

H-piles may be rolled or built-up steel sections with wide flanges. Pile toes may be reinforced with special shoes for driving through soils with obstructions, such as boulders, or for driving to rock. If splicing is necessary, steel pipe lengths may be connected with complete-penetration welds or commercially available special fittings. H piles, bung low- displacement piles, are advantageous in situations where ground heave and lateral movement must be kept to a minimum.

Steel piles have the advantage of being rugged, strong, and easy to handle. They can be driven through hard layers. They can carry high compressive loads and withstand tensile loading. Because of the relative ease of splicing and cutting to length, steel piles are advantageous for use in sites where the depth of the bearing layers varies. Disadvantages of steel piles include small cross-sectional area and susceptibility to corrosion, which can cause a significant reduction in load-carrying capacity. Measures that may be taken when pile corrosion in anticipated include the use of larger pile sections than otherwise needed, use of surface-coating materials, or cathodic protection. In these cases, the pipes are usually encased in or filled with concrete.

Steel Piles

٤- Timber Piles:

Any of variety of wood species but usually southern pine of Douglas fir, and occasionally red or white oak, can be used as piles. Kept below the groundwater table, timber piles cab serve in a preserved state for a long time. Untreated piles that extend above the water table, however, may be exposed to damaging marine organisms and service life prolonged by treating timber piles with preservatives. Preservatives treatment should match the type of wood.

Timber piles are commonly available in lengths of up to ٧٥ft.They should be as straight as possible and should have a relatively uniform taper. Timber piles are usually used to carry light to moderate loads or in marine construction as dolphins and fender systems.

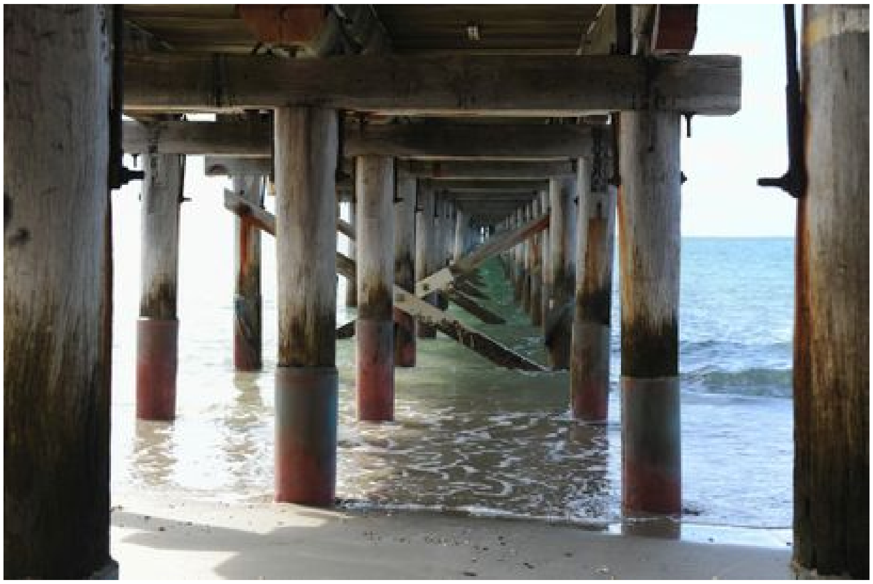
Advantages of timber piles include their relatively low cost, high strength-to-weight ratio, and ease of handling. They can be cut to length after driving relatively easily. Their naturally tapered shape (about ١inch in diameter per ١٠ft of length) is advantageous in situations where pile capacities derive mostly from shaft resistance. Disadvantages include their susceptibility to damage during hard driving and difficulty in spacing.

Timber piles should be driven with care to avoid damage. Hammers with high impact velocities should not be used. Protective accessories should be utilized, when hard driving is expected, especially at the head and toe of the pile.

Timber Piles

٥- Composite Piles:

This type of pile includes those made of more than one major material or pile type, such as thick-walled, concrete-filled, steel pipe piles, precast concrete piles with steel (pipe or H section) extensions, and timber piles with cast-in-place concrete extensions.



Composite Piles

Selection of Pile Type:

The choice of an appropriate pile type for a particular application is essential for satisfactory foundation functioning. Factors that must be considered in the selection process include subsurface conditions, nature and magnitude of loads, local experience, and availability of materials and experienced labor, applicable codes, and cost. Pile drivability, strength, and serviceability should also be taken into account. Actual loads that can carried by a given pile in particular situation should be assessed in accordance with the general methods and procedure presented in the preceding and those described in more specialized geotechnical engineering books.