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SYSTEMS AND METHODS FOR PILE REPAIR

Abstract

Disclosed herein are systems and methods for repairing and/or replacing a pile. In a specific embodiment, a system for repairing a pile includes: an elevating sleeve, where the elevating sleeve includes a top, a bottom, and a contiguous side wall spanning between the top and bottom, where the top is substantially closed, and the bottom is open, where the elevating sleeve is configured to fit over a top of a pile to be repaired, and where the elevating sleeve includes an input port and output port; one or more seals, where at least one seal includes an outer diameter shaped to fit within the elevating sleeve at or near the bottom of the elevating sleeve and an inner diameter to fit over the top of the pile to be repaired; one or more plugs; and a pump.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application claims the benefit of U.S. Provisional Patent Application No. 63/449,033, filed Feb. 28, 2023, which is incorporated by reference herein in its entirety.

BACKGROUND
Technical Field
[0002] Provided herein are systems and methods for repairing or replacing corrupted piles.
Description of the Related Art
[0003] A lot of land is not suitable on its own to support desired structures. Piles are known to provide structural support to buildings, piers, and other structures. This can particularly be the case in coastal environments. The use of piles is well known as a staple in an industry as one of the most cost-effective means to support structures. A pile foundation is defined as a series of beams or supports constructed or inserted into the ground to transmit loads to a lower level of subsoil. A pile is generally a long cylinder made up of a strong material, such as concrete. Piles are pushed into the ground to act as a steady support for structures built on top of them. Piles transfer the loads from structures to hard strata, rocks, or soil with high bearing capacity, typically higher bearing capacity than the strata or soil upon which the structure sits. The piles support the structure by remaining solidly placed in the soil. Piles are generally rigid supports, such as columns, which can be made of numerous materials, including wood, steel, fiberglass, composite, and concrete pilings.
[0004] Piles are first cast at ground level and then hammered or driven into the ground using a pile driver. A pile driver is a machine that holds the pile vertical and hammers it into the ground. Blows are repeated by lifting a heavy weight and dropping it on top of the pile. Piles should be hammered into the ground until the refusal point is reached, which is the point where a pile cannot be driven into the soil any farther. Installing a pile is a major consideration in the structural integrity of pile foundations. The driven-pile method is an ideal option because it least disturbs the supporting soil around the pile and results in the highest bearing capacity for each pile. Since every pile has a zone of influence on the soil around it, piles should be spaced far enough apart from each other so that the loads are distributed evenly.
[0005] Piles are commonly used to support structures which sits upon unsteady ground, an incline, over the water, or in other various environments. Piles are one of the most cost-effective means to create a foundation suitable for constructing a structure upon land which on its own cannot provide suitable support. However, because pile foundations are set in the soil or marine environment, they are more tolerant to erosion and scour. As such, the effectiveness of a pile diminishes over time, particularly in harsher environments (e.g., coastal uses) and must be replaced.
[0006] For example, many docks and wharves are supported by pilings. Over time, portions of the pile have transitioned to end of life cycle, while other portions remain intact and serviceable. Notably, the portion of the pile exposed to the water degrades more quickly, and the portion at or below the mud line can remain in viable condition for much longer. Systems exist to supplement the structure exposed to the water, typically providing a cover that extends around the exposed pile. Such systems provide some functionality, but they are limited in application, expensive in operation, and do not provide long term solutions. In other words, the systems in place today

bandage the existing area instead of curing the damages portion of the pile.

[0007] Consequently, there is a need for new pile repair systems and methods that can effectively repair and/or replace a pile.

SUMMARY

[0008] Systems and methods for repairing or replacing at least a portion of a pile are described. In a specific embodiment, a system for repairing a pile includes: an elevating sleeve, where the elevating sleeve includes a top, a bottom, and a contiguous side wall spanning between the top and bottom, where the top is substantially closed, and the bottom is open, where the elevating sleeve is configured to fit over a top of a pile to be repaired, and where the elevating sleeve includes an input port and output port; one or more seals, where at least one seal includes an outer diameter shaped to fit within the elevating sleeve at or near the bottom of the elevating sleeve and an inner diameter to fit over the top of the pile to be repaired; one or more plugs; and a pump.

[0009] In another specific embodiment, a method for repairing a pile includes: coupling a cap member to a surface of a pile this is to be repaired; positioning an elevating sleeve over the cap member and under a structure that is supported by the pile that is to be repaired to form an interior space, where the elevating sleeve has an input port and output port disposed thereon, where the output port has a first valve, and where the input port has a second valve; injecting one or more filler materials through the input port into the interior space of the elevating sleeve, where the injecting of the filler material is performed while the first valve of the output port is open; closing the first valve of the output port; injecting one or more filler materials through the input port into the interior space of the elevating sleeve to a desired pressure; stopping the injection of the filler material; and closing the second valve of the input port.

[0010] In yet another specific embodiment, a non-transitory computer readable medium including instructions which, when implemented by one or more computers, causes the one or more computers to: receive an input of data from a user; receive a signal from one or more sensors, where the sensors are selected from pressure sensors, flow rate sensors, weight sensors, temperature sensor, positioning sensors, accelerometers, magnetometers, gyroscopes; positioning an elevating sleeve over the cap member and under a structure that is supported by the pile that is to be repaired to form an interior space, where the elevating sleeve has an input port and output port disposed thereon; injecting one or more filler materials through the input port into the interior space of the elevating sleeve to a desired pressure; and stopping the injection of the filler material.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] For the purposes of promoting an understanding of the principles of the present disclosure, reference is now made to the embodiments illustrated in the drawings, which are described below. The embodiments disclosed herein are not intended to be exhaustive or limit the present disclosure to the precise form disclosed in the following detailed description. Rather, the embodiments are chosen and described so that others skilled in the art can utilize their teachings. Therefore, no limitation of the scope of the present disclosure is thereby intended.

[0012] FIG. **1** is a diagram of a front side view of an embodiment of the pile repair system.

[0013] FIG. **2** is a diagram of a front side view of an embodiment of the pile repair system, including cap members.

[0014] FIG. **3** is a diagram of a front side view of an embodiment of the pile repair system.

[0015] FIG. **4** is a flowchart for an embodiment of a method for repairing a pile.

[0016] FIG. **5** is a diagram of an embodiment of a system for pile repair system.

[0017] FIG. **6** is a software flowchart for an embodiment of a method for repairing a pile.

DETAILED DESCRIPTION

[0018] The pile repair system can repair or replace a portion of a pile, providing similar or even better bearing support as the rest of the pile. In one or more embodiments, a pile repair system for repairing or replacing at least a portion of a pile can include, but is not limited to: one or more elevating sleeves, one or more pumps, one or more inserts, one or more pipes, one or more tremie pipes, one or more cap members, one or more seals, one or more rings, one or more pile cap insert rings, one or more flanges, one or more dowels, one or more studs, one or more input ports, one or more output ports, one or more vents, one or more hoses, one or more conduits, one or more removable plugs, one or more valves, one or more sensors, one or more cameras, one or more memories, one or more computers, one or more central processing units, one or more network interfaces, one or more display units, one or more transceivers, one or more pumps, one or more filler materials, and combinations thereof. In one or more embodiments, the one or more components of the pile repair system can be coupled to and/or integrally formed with any other of the one or more components.

[0019] The pile repair system and any of its components can be made from one or more suitable materials. For example, the one or more components of the pile repair system can made from any one or more metals (such as aluminum, steel, stainless steel, brass, nickel), metal alloys, concretes, fiberglass, wood, composite materials (such as ceramics, wood/polymer blends, cloth/polymer blends, etc.), and plastics (such as polyethylene, polypropylene, polystyrene, polyurethane, polyethylethylketone (PEEK), polytetrafluoroethylene (PTFE), polyamide resins (such as nylon 6 (N6), nylon 66 (N66)), polyester resins (such as polybutylene terephthalate (PBT), polyethylene terephthalate (PET), polyethylene isophthalate (PEI), PET/PEI copolymer) polynitrile resins (such as polyacrylonitrile (PAN), polymethacrylonitrile, acrylonitrile-styrene copolymers (AS), methacrylonitrile-styrene copolymers, methacrylonitrile-styrene-butadiene copolymers; and acrylonitrile-butadiene-styrene (ABS)), polymethacrylate resins (such as polymethyl methacrylate and polyethylacrylate), cellulose resins (such as cellulose acetate and cellulose acetate butyrate); polyimide resins (such as aromatic polyimides), polycarbonates (PC), elastomers (such as ethylene-propylene rubber (EPR), ethylene propylene-diene monomer rubber (EPDM), styrenic block copolymers (SBC), polyisobutylene (PIB), butyl rubber, neoprene rubber, halobutyl rubber and the like)), and mixtures, blends, or copolymers of any and all of the foregoing materials.

[0020] FIGS. **1-3** depict embodiments of a pile repair system **100**. In FIGS. **1-3**, the pile repair system **100** includes an elevating sleeve **102**, an insert **104**, a cap member and/or seal **106**, input port **112**, output port **114**, flanges **108**, and dowels **110**. In the embodiment shown in FIG. **1**, the pile cap plate is configured to and positioned on the existing pile. The pile cap plate can be secured to the existing pile by attaching to one or more dowels **110**. The dowels can be coupled to the existing pile by drilling and inserting the dowels **110** into existing pile filling around the dowels with grout and/or concrete. A first end of the insert **104** can be configured to and positioned on the pile cap with a flange **108**. A second end of the insert **104** can be configured to and positioned on a surface of a pile. The one or more dowels **110** inserted into the pile. An elevating sleeve **102** can be inserted on and/or over the second end of the insert **104**. A first end of elevating sleeve **102** can be configured to and positioned underneath a building, deck, or structure that is being supported by the pile. In some embodiments, the elevating sleeve **102** can be coupled to the structure that is being supported by the pile by one or more dowels **110**. The dowels **110** can be inserted into the structure that is being supported by the pile and secured with one or more grouts, concretes, welds, epoxies, and threaded rods.

[0021] The pile repair system **100** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The pile repair system **100** can have a wide variety of shapes.

[0022] The length of the pile repair system **100** can vary widely. For example, the length of the pile repair system **100** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about

1 m, about 3 m, or about 300 m. In another example, the length of the pile repair system **100** can be from about 2 cm to about 10 m, about 3 cm to about 15 cm, about 15 cm to about 42 cm, about 20 cm to about 500 cm, about 100 cm to about 1 m, about 500 cm to about 1.5 m, about 750 cm to about 2 m, about 1 m to about 5 m, about 2 m to about 9 m, about 3 m to about 30 m, about 5 m to about 75 m, or about 3 m to about 300 m.

[0023] The width of the pile repair system **100** can vary widely. For example, the width of the pile repair system **100** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 1 m, about 10 m, or about 100 m. In another example, the width of the pile repair system **100** can be from about 2 cm to about 10 m, about 3 cm to about 15 cm, about 15 cm to about 42 cm, about 20 cm to about 500 cm, about 100 cm to about 1 m, about 500 cm to about 1.5 m, about 750 cm to about 2 m, about 1 m to about 5 m, about 2 m to about 9 m, about 3 m to about 30 m, about 5 m to about 75 m, or about 3 m to about 300 m.

[0024] The height of the pile repair system **100** can vary widely. For example, the height of the pile repair system **100** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 1 m, about 3 m, or about 100 m. In another example, the height of the pile repair system **100** can be from about 2 cm to about 100 m, about 3 cm to about 15 cm, about 15 cm to about 42 cm, about 20 cm to about 500 cm, about 100 cm to about 1 m, about 500 cm to about 1.5 m, about 750 cm to about 2 m, about 1 m to about 5 m, about 2 m to about 9 m, about 3 m to about 30 m, about 5 m to about 75 m, or about 3 m to about 300 m.

[0025] The radius of the pile repair system **100** can vary widely. For example, the radius of the pile repair system **100** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 5 m. In another example, the radius of the pile repair system **100** can be from about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, or about 1 m to about 2 m.

[0026] The weight of the pile repair system **100** can vary widely. For example, the weight of the pile repair system **100** can be from a low of about 5 kg, about 10 kg, or about 100 kg, to a high of about 2,000 kg, about 5,000 kg, or about 5,000,000 kg. In another example, the weight of the pile repair system **100** can be from about 5 kg to about 5,000,000 kg, about 10 kg to about 100 kg, about 20 kg to about 200 kg, about 50 kg to about 500 kg, about 100 kg to about 1,000 kg, about 500 kg to about 5,000 kg, about 5 kg to about 10,000 kg, about 5,000 kg to about 50,000 kg, about 2,000 kg to about 1,000,000 kg, or about 5,000 kg to about 5,000,000 kg.

[0027] The one or more elevating sleeves **102** can include, but are not limited to: a first elevating sleeve, a second elevating sleeve, a third elevating sleeve, a fourth elevating sleeve, a fifth elevating sleeve, a six elevating sleeve, and more elevating sleeves. The one or more elevating sleeves **102** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space.

[0028] The elevating sleeves can have a wide variety of shapes. For example, the elevating sleeves can be configured to fit on top of an existing pile in need of repair. In some embodiments, the elevating sleeve can be shaped commensurate with the shape of the existing pile. In another example, elevating sleeves can include an H-shape, cylindrical shape, cone shape, spherical shape, parallelepiped shape, cuboidal shape, and combinations thereof. For example, the elevating sleeve **102** can include a top and a bottom and have a length between the top and the bottom. The top can be closed. The top can be closed by a flange used to connect to the insert or to the support structure. The elevating sleeve **102** can be substantially open on the bottom. The elevating sleeve **102** can include, but is not limited to: one or more input ports and one or more output ports. In some embodiments, the elevating sleeve **102** can be configured to and/or positioned on top of the insert rings and/or cap members and/or seals **106**.

[0029] The one or more elevating sleeves **102** can include one or more openings. For example, the elevating sleeves **102** can include: a first opening, a second opening, a third opening, a fourth opening, a fifth opening, a six opening, and more opening. In some embodiments, a top of the elevating sleeve **102** can be closed. In some embodiments, a bottom of the elevating sleeve **102** can be open.
[0030] The one or more elevating sleeves **102** can include many shapes. In some embodiments, the elevating sleeve **102** can have a shape to provide an enclosed interior space that can be filled with a fluid to have a desired internal pressure to support a building or structure. For example, the elevating sleeve **102** and/or structure and/or pile to be repaired and/or rings, and/or plugs, and/or flanges can provide an enclosed interior space that can be filled with a fluid, where the fluid can harden to at least partially support the building or structure. In some embodiments, the elevating sleeves **102** can include, but is not limited to: a cylindrical shape, cone shape, spherical shape, parallelepiped shape, cuboidal shape, and combinations thereof. In some embodiments, the elevating sleeves **102** can hold a fluid to an internal pressure to support a build or structure.
[0031] In some embodiments, the elevating sleeve **102** can be substantially cylindrical in shape with an inner surface and an outer surface. The elevating sleeve **102** can include an inner surface diameter and an outer surface diameter. In some embodiments, the inner surface diameter can be larger than the outer diameter of the existing pile. It can also be other shapes, including a cylindrical shape, cone shape, spherical shape, parallelepiped shape, cuboidal shape, and combinations thereof. In some embodiments, the elevating sleeve **102** can include a top and a bottom with a substantially contiguous, elongated side walls between the top and bottom, where the top and bottom have one or more opening disposed thereon. In some embodiments, the top and/or the bottom of the elevating sleeve **102** can be substantially sealed and can include a flange that extends outwards from the side wall. The elevating sleeve **102** can be configured to accommodate the shape of the pile to be repaired.
[0032] The length of the elevating sleeve **102** can vary widely. For example, the length of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 10,000 cm. In another example, the length of the elevating sleeve **102** can be from about 2 cm to about 10,000 cm, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 5,000 cm, about 1,000 cm to about 9,500 cm, or about 50 cm to about 10,000 cm.
[0033] The width of the elevating sleeve **102** can vary widely. For example, the width of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 10,000 cm. In another example, the width of the elevating sleeve **102** can be from about 2 cm to about 1,000 cm, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 5,000 cm, about 1,000 cm to about 9,500 cm, or about 50 cm to about 10,000 cm, or about 10 cm to about 10,000 cm.
[0034] The height of the elevating sleeve **102** can vary widely. For example, the height of the elevating sleeve **102** can be from a low of about 10 cm, about 20 cm or about 50 cm, to a high of about 1 m, about 10 m, or about 200 m. In another example, the height of the elevating sleeve **102** can be from about 10 cm to about 2,000 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 1 m to about 10 m, about 1 m to about 10 m, about 2 m to about 20 m, about 2 m to about 60 m, or about 2 m to about 100 m, or about 2 m to about 200 m.

[0035] The radius of the elevating sleeve **102** can vary widely. For example, the radius of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 2 m, or about 200 m. In another example, the radius of the elevating sleeve **102** can be from about 2 cm to about 200 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 1 m to about 10 m, about 2 m to about 20 m, about 2 m to about 60 m, about 2 m to about 100 m, or about 2 m to about 200 m.

[0036] The weight of the elevating sleeve **102** can vary widely. For example, the weight of the elevating sleeve **102** can be from a low of about 5 kg, about 10 kg, or about 100 kg, to a high of about 2,000 kg, about 50,000 kg, or about 5,000,000 kg. In another example, the weight of the elevating sleeve **102** can be from about 5 kg to about 10,000 kg. In another example, the weight of the elevating sleeve **102** can be from about 5 kg to about 5,000,000 kg, about 10 kg to about 100 kg, about 20 kg to about 200 kg, about 50 kg to about 500 kg, about 100 kg to about 1,000 kg, about 500 kg to about 5,000 kg, about 2,000 kg to about 100,000 kg, about 2,000 kg to about 500,000 kg, about 10,000 kg to about 750,000 kg, about 5 kg to about 10,000 kg, about 5 kg to about 10,000 kg or about 50,000 kg to about 5,000,000 kg.

[0037] The elevating sleeve **102** can have an inner diameter that varies widely. For example, the inner diameter of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 5 m, or about 30,000 cm. In another example, the inner diameter of the elevating sleeve **102** can be from about 2 cm to about 30,000 cm, about 2 cm to about 5 cm, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 1 m to about 2 m, about 40 cm to about 49 m, or about 50 cm to about 30,000 cm.

[0038] The elevating sleeve **102** can have an outer diameter that varies widely. For example, the outer diameter of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 5 m. In another example, the outer diameter of the elevating sleeve **102** can be from about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 1 m to about 2 m, about 40 cm to about 49 m, or about 50 cm to about 30,000 cm.

[0039] The elevating sleeve **102** can have a thickness that varies widely. For example, the thickness of the elevating sleeve **102** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 5 m. In another example, the thickness of the elevating sleeve **102** can be from about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, or 100 cm to about 2,000 cm.

[0040] The elevating sleeve **102** can also include one or more output ports and/or one or more conduits. The output port and/or conduits can be positioned anywhere on the elevating sleeve. For example, the output port and/or conduits can be position at or substantially near the top end of the elevating sleeve. The output port can include, but is not limited to: a removable plug, valve, and a flange. The output port can include a controllably sealable aperture in the elevating sleeve.

[0041] The elevating sleeve **102** can also include an input port. The input port can include one or more openings, one or more conduits, and/or apertures. Input port can be coupled to an injection valve exterior to the elevation sleeve to control the flow of filler material into the elevating sleeve. In some embodiments, the input port can be coupled to a tremie pipe. For example, the input port

can be coupled to a tremie pipe when the filler material to be used fix the pile is concrete.
[0042] The one or more inserts **104** can be used to provide support to a structure. For example, the insert **104** can be coupled to a pile that is to be repaired, elevating sleeve, and/or the structure, providing support like the pile before it was corrupted. In some embodiments, the inserts **104** can be coupled to the structure that is being supported by the pile by one or more dowels **110**. The dowels **110** can be inserted into the structure that is being supported by the pile and secured with one or more grouts, concrete, epoxies, and anchors.
[0043] In some embodiments, one or more inserts can be included in the pile repair system **100**. In some embodiments, the inserts are not included in the pile repair system **100**. In some embodiments, the insert **104** can hold a fluid to an internal pressure to support a building or structure. The one or more inserts **104** can include, but are not limited to: a first insert, a second insert, a third insert, a fourth insert, a fifth insert, a six insert, and more inserts. The one or more inserts **104** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The one or more inserts **104** can include one or more openings. For example, the inserts **104** can include: a first opening, a second opening, a third opening, a fourth opening, a fifth opening, a six opening, and more opening.
[0044] The one or more inserts **104** can include a wide variety of shapes. For example, the insert can include, but is not limited to: a cylindrical shape, a cone shape, spherical shape, parallelepiped shape, combinations thereof. In some embodiments, the insert **104** can include two opposing ends with a length between those ends. In some embodiments, the inserts **104** can be configured to fit on top of an existing pile in need of repair. In some embodiments, the insert **104** can include a top and a bottom and have a length between the top and the bottom. In some embodiments, a top of the insert **104** can be closed by the one or more cap members and sealed with a flange used to connect to the insert or to the support structure. In some embodiments, the insert **104** can include an opening disposed on at is bottom. In some embodiments, the top and/or the bottom of the insert **104** can be substantially sealed and can have a flange member that extends outwards from the side wall. The inserts **104** can include, but are not limited to: a pipe, pipe spool, conical member, and H-shaped member. The insert **104** can be configured to accommodate the shape of the pile to be repaired. In some embodiments, the insert **104** can be positioned above the elevating sleeve **102**. In some embodiments, the insert **104** can be positioned below the elevating sleeve **102**. In some embodiments, the insert **104** can remain in place as part of the repaired pile after a method of repairing a pile has been used. In other embodiments, the insert **104** can be removed after a method of repairing a pile has been completed.
[0045] In some embodiments, the insert **104** can include spool piece that can include enclosed filler material inside at one end for marine applications where the corrupted pile to be replaced is partially submerged and the ballast placed in the ballasted spool piece will enable the pile to be installed easier by using the buoyancy of the air inside the ballasted spool piece to support the pile vertically at an elevation per job specifications. In some embodiments, the insert **104** can be ballasted to provide stability to the pile being repaired. In some embodiments, the insert **104** can be ballasted with the filler material.
[0046] The length of the insert **104** can vary widely. For example, the length of the insert **104** can be from a low of about 2 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 50 m, or about 200 m. In another example, the length of the insert **104** can be from about 10 cm to about 200 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 1 m to about 10 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 80 m, or about 2 m to about 200 m.
[0047] The width of the insert **104** can vary widely. For example, the width of the insert **104** can be

from a low of about 2 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 50 m, or about 200 m. In another example, the width of the insert **104** can be from about 10 cm to about 10 m, about 10 cm to about 100 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 1 m to about 10 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 80 m, or about 5 m to about 200 m.

[0048] The height of the insert **104** can vary widely. For example, the height of the insert **104** can be from a low of about 2 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 50 m, or about 500 m. In another example, the height of the insert **104** can be from about 10 cm to about 500 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 80 m, or about 5 m to about 500 m.

[0049] The radius of the insert **104** can vary widely. For example, the radius of the insert **104** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 2 m, or about 200 m. In another example, the radius of the insert **104** can be from about 2 cm to about 200 m, about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 200 m.

[0050] The one or more inserts **104** can have an inner diameter that varies widely. For example, the inner diameter of the insert **104** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 2 m, or about 200 m. In another example, the inner diameter of the insert **104** can be from about 2 cm to about 200 m, about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, or about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 200 m.

[0051] The one or more inserts **104** can have an outer diameter that varies widely. For example, the outer diameter of the insert **104** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 50 m, or about 200 m. In another example, the outer diameter of the insert **104** can be from about 2 cm to about 500 m, about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 200 m.

[0052] The one or more inserts **104** can have a thickness that varies widely. For example, the thickness of the insert **104** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 2,000 cm, or about 5 m. In another example, the thickness of the insert **104** can be from about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, or about 2 cm to about 2,000 cm.

[0053] The weight of the insert **104** can vary widely. For example, the weight of the insert **104** can be from a low of about 5 kg, about 10 kg, or about 100 kg, to a high of about 2,000 kg, about

50,000 kg, or about 5,000,000 kg. In another example, the weight of the insert **104** can be from about 5 kg to about 5,000,000 kg, about 5 kg to about 10,000 kg, about 10 kg to about 100 kg, about 20 kg to about 200 kg, about 50 kg to about 500 kg, about 100 kg to about 1,000 kg, about 500 kg to about 5,000 kg, about 5 kg to about 10,000 kg, about 2,000 kg to about 100,000 kg, about 2,000 kg to about 500,000 kg, about 10,000 kg to about 750,000 kg, about 5 kg to about 10,000 kg, about 5 kg to about 10,000 kg or about 50,000 kg to about 5,000,000 kg

[0054] The one or more cap members and/or seals **106** can include, but are not limited to: a first cap member, a second cap member, a third cap member, a fourth cap member, a fifth cap member, a six cap member, and more cap members. The one or more cap members and/or seals **106** can include a wide variety of shapes. For example, the cap members and/or seals **106** can include, but is not limited to: a cylindrical shape, a cone shape, spherical shape, parallelepiped shape, disc shape, combinations thereof. The cap members and/or seals **106** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The cap member and/or seal **106** can include one or more openings. For example, the cap member and/or seal **106** can include: a first opening, a second opening, a third opening, a fourth opening, a fifth opening, a six opening, and more openings.

[0055] In some embodiments, the one or more cap members and/or seals **106** can be coupled to or integrally connected with one or more of the elevating sleeve, insert, insert rings, and combinations thereof. In some embodiments, the elevating sleeve **102**, insert **104**, cap member and/or seal **106**, structure, and pile can define an interior space so the filler material can be contained therein. In some embodiments, the cap member and/or seal **106** can be coupled to and/or positioned inside the elevating sleeve **102** at a top opening of the elevating sleeve **102**. In some embodiments, the cap member and/or seal **106** can be coupled to and/or positioned inside the elevating sleeve **102** at a bottom opening of the elevating sleeve **102**. In some embodiments, the cap member and/or seal **106** can be coupled to a surface of the pile to be replaced. In some embodiments, the cap member and/or seal **106** can be coupled to a surface of a structure that is supported by a pile that is to be replaced. In some embodiments, the cap member and/or seal **106** can include an outer diameter that can fit over the existing pile and capable of being positioned within the internal diameter of the elevating sleeve **102** to form an internal space in the elevating sleeve. In some embodiments, the cap member and/or seal **106** can be coupled to the structure.

[0056] The one or more cap members and/or seals **106** can have an outer diameter that varies widely. For example, the outer diameter of the cap members and/or seals **106** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 100 m, or about 300 m. In another example, the outer diameter of the cap members and/or seals **106** can be from about 2 cm to about 300 m, 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 300 m.

[0057] The one or more cap members and/or seals **106** can have a thickness that varies widely. For example, the thickness of the cap members and/or seals **106** can be from a low of about 2 cm, about 10 cm, or about 20 cm, to a high of about 75 cm, about 200 cm, or about 5 m. In another example, the thickness of the cap members and/or seals **106** can be from about 2 cm to about 5 m, about 3 cm to about 11 cm, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, or about 75 cm to about 750 cm.

[0058] The one or more insert rings can include, but are not limited to: a first insert ring, a second insert ring, a third insert ring, a fourth insert ring, a fifth insert ring, a six insert ring, and more insert ring. The one or more insert rings can include a wide variety of shapes. For example, an insert ring(s) can include, but is not limited to: a cylindrical shape, a cone shape, spherical shape, parallelepiped shape, combinations thereof. The insert rings can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The insert rings can include one or more openings. For example, the insert rings can include: a first opening, a second opening, a third opening, a fourth opening, a fifth opening, a six opening, and more openings.

[0059] In some embodiments, the one or more insert rings can be coupled to or integrally connected with one or more of the elevating sleeve, insert, seal, cap member, and combinations thereof. In some embodiments, the elevating sleeve **102**, insert **104**, seal **106**, insert rings, structure, and pile can form an interior space so the filler material can be contained therein. In some embodiments, the insert rings can be coupled to and/or positioned inside the elevating sleeve **102** at a top opening of the elevating sleeve **102**. In some embodiments, the insert rings can be coupled to and/or positioned inside the elevating sleeve **102** at a bottom opening of the elevating sleeve **102**. In some embodiments, the insert rings can be coupled to a surface of the pile to be replaced. In some embodiments, the cap insert rings can be coupled to a surface of a structure that is supported by a pile that is to be replaced. In some embodiments, the insert rings can include an outer diameter that can fit over the existing pile and capable of being positioned within the internal diameter of the elevating sleeve **102** to form an internal space in the elevating sleeve. In some embodiments, the insert rings can be couple to the structure.

[0060] The one or more flanges **108** can include, but are not limited to: a first flange member, a second flange member, a third flange member, a fourth flange member, a fifth flange member, a six flange member, and more flanges. The one or more flanges **108** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. In some embodiment, a flange **108** can be coupled to the pile to be repaired. In some embodiments, a flange **108** can be coupled to or integrally connected to the elevating sleeve **102**, insert **104**, cap members and/or seals **106**, insert rings, and combinations thereof. In some embodiments, a flange **108** can be used to couple the elevating sleeve **102**, insert **104**, cap members and/or seals **106**, insert rings or pile together.

[0061] The one or more input ports **112** can include, but are not limited to: a first input port, a second input port, a third input port, a fourth input port, a fifth input port, a six input port, and more input ports. The one or more input ports **112** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The one or more input ports **112** can provide a conduit from the exterior of the elevating sleeve **102** to the interior. In some embodiments, the input ports can include threading, flanges, and combinations thereof. In some embodiments, the input port can be coupled to a tremie pipe located interior to the elevating sleeve. The input port can also be coupled to a valve located exterior to the elevating sleeve **102** to control the flow rate of filler material pumped into the elevating sleeve and/or to contain the filler material.

[0062] The input ports **112** be disposed anywhere on the elevating sleeve **102**. For example, the input ports **112** can have a distance from the top of the elevating sleeve **102** that varies widely. For example, the input ports **112** can have a distance from the top of the elevating sleeve **102** from a low of about 2 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 50 m, or about 300 m. In another example, the input ports **112** can be have a distance from the top of the elevating sleeve **102** from about 10 cm to about 300 m, about 10 cm to about 10 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 300 m.

[0063] The one or more output ports **114** can include, but are not limited to: a first output port, a second output port, a third output port, a fourth output port, a fifth output port, a six output port, and more output ports. The one or more output ports **114** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space. The one or more output ports **114** can provide a conduit from the interior space of the elevating sleeve **102** to the exterior.

[0064] The output ports **114** be disposed anywhere on the elevating sleeve **102**. For example, the output ports **114** can have a distance from the top of the elevating sleeve **102** that varies widely. For example, the output ports **114** can have a distance from the top of the elevating sleeve **102** from a low of about 0 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 50 m, or about 300 m. In another example, the output ports **114** can be have a distance from the top of the elevating sleeve **102** from about 0.1 cm to about 300 m, about 10 cm to about 10 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 300 m.

[0065] The one or more input ports **112** and the one or more output ports **114** can have a height distance between them that varies widely. For example, the input ports **112** and the output ports **114** can be disposed on the elevating sleeve **102** with a height distance between the ports. For example, the input ports **112** and the output ports **114** can have a height distance between the ports from a low of about 0 cm, about 10 cm or about 20 cm, to a high of about 1 m, about 5 m, or about 10 m. In another example, the input ports **112** and the output ports **114** can have a height distance between the ports from about 0.1 cm to about 300 m, about 10 cm to about 10 m, about 12 cm to about 42 cm, about 13 cm to about 100 cm, about 15 cm to about 150 cm, 20 cm to about 500 cm, about 22 cm to about 250 cm, about 23 cm to about 750 cm, about 50 cm to about 850 cm, about 75 cm to about 750 cm, about 500 cm to about 1 m, about 1 m to about 2 m, about 1 m to about 10 m, about 500 cm to about 1 m, about 1 m to about 2 m, about 5 m to about 50 m, about 10 m to about 100 m, about 20 m to about 100 m, or about 5 m to about 300 m.

[0066] The one or more input ports **112** and the one or more output ports **114** can form an angle between the ports when viewed from the top side of the elevating sleeve **102**. The angle between the input port **112** and the output port **114** when viewed from the top side of the elevating sleeve **102** can vary widely. For example, the angle between the input port **112** and the output ports **114** when viewed from the top side of the elevating sleeve **102** can be from a low of about 0°, about 1° or about 10°, to a high of about 90°, about 180°, or about 360°. In another example, the angle between the input port **112** and the output ports **114** when viewed from the top side of the elevating sleeve **102** can be from about 0° to about 360°, about 0° to about 1°, about 0° to about 15°, about 1° to about 40°, about 0° to about 60°, about 0° to about 90°, about 0° to about 180°, about 0° to about 240°, or about 1° to about 359°.

[0067] The one or more plugs **116** can include, but are not limited to: a first plug, a second plug, a third plug, a fourth plug, a fifth plug, a six plug, and more plugs. The one or more plugs **116** can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space.

[0068] In some embodiments, the plug **116** can be inserted into the one or more input ports and/or the one or more output ports. In some embodiments, the plug **116** can be inserted into the one or more openings of the elevating sleeve **102** and/or the insert **104**.

[0069] The one or more valves can include, but is not limited to, a pressure relief valve, plug valve, ball valve, butterfly valve, check valve, gate valve, knife valve, glove valve, needle valve, pinch valve, combinations thereof. The one or more valves can include, but are not limited to: a first valve, a second valve, a third valve, a fourth valve, a fifth valve, a six valve, and more valve. The one or more valves can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space.

[0070] In some embodiments, the valve can be coupled to the output port **114** on the external side of the elevating sleeve. In some embodiments, the valve can be coupled to the one or more input ports and/or the one or more output ports. In some embodiments, the value can regulate flow of the filler material into the internal space of the elevating sleeve **102**. In some embodiments, the value can regulate flow of the filler material into the internal space of the elevating sleeve **102**. In some embodiments, the value can maintain pressure of the internal space of the elevating sleeve **102**. In some embodiments, pressure can be released on pump side of valve with relief valve, the pump hose can be disconnected, and the process can start anew with a different piling.

[0071] The one or more tremie pipes can include, but are not limited to: a first tremie pipe, a second tremie pipe, a third tremie pipe, a fourth tremie pipe, a fifth tremie pipe, a six tremie pipe, and more tremie pipes. The one or more tremie pipes can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space.

[0072] The one or more pumps can include, but are not limited to: a first pump, a second pump, a third pump, a fourth pump, a fifth pump, a six pump, and more pumps. The one or more pumps can include, but is not limited to: a dynamic pump, positive displacement pump, centrifugal pump, submersible pump, diaphragm pump, gear pump, rotary vane pump, peristaltic pump, cam pump, piston pump, and combinations thereof. In some embodiments, the pumps can be in fluid communication with the conduit, elevating sleeve, insert, input port, and/or output port. In some embodiments, the pile repair system **100** can include a first conduit, a second conduit, a third conduit, a fourth conduit, a fifth conduit, a six conduit, and more conduit s. In some embodiments, the conduit(s) can be a fluid conduit, an electrical conduit, an optical fiber conduit, or a combination thereof.

[0073] The one or more filler materials, can include, but are not limited to: one or more gravels, one or more pea gravels, one or more sands, one or more grouts, one or more cements, one or more aggregates, or mixtures thereof. In some embodiments, the pile repair system **100** can provide filler material to the damaged and/or removed part of the pile thereby repairing it. In some embodiments, the systems and methods for pile repair can be used in marine environments or dry land environments.

[0074] The one or more filler materials can include, but is not limited to: concrete, cementitious grout, pea gravel, gravel, aggregates, Portland cements, sand, concrete admixtures, epoxies, plasticizers, fluids, foams, and mixtures thereof.

[0075] In some embodiments, the filler material can be pumped into the input port. In some embodiments, the filler material can be pumped into the elevating sleeve **102** to act as a piston to push the system into place against the structure it is providing support to. In some embodiments, the filler material can be pumped into the interior space while the elevating sleeve **102** held in place via pressure.

[0076] The pile repair system **100** can be pumped to a pressure that varies widely. For example, the pile repair system **100** can have a pressure from a low of about 1 KPa, about 14.7 KPa, or about 20 KPa, to a high of about 10,000 KPa, about 50,000 KPa, or about 1,000,000 KPa. In another example, the pile repair system **100** can have a pressure from about 1 KPa to about 1,000,000 KPa, about 1 KPa to about 50,000 KPa, about 1 KPa to about 10,000 KPa, about 10 KPa to about 10,000 KPa, about 50 KPa to about 1,000 KPa, about 6 KPa to about 10,000 KPa, about 6 KPa to about 10,000 KPa, about 10,000 KPa to about 100,000 KPa, about 100,000 KPa to about 500,000 KPa, or about 500,000 KPa to about 1,000,000 KPa. In some embodiments, the pile repair system **100** can be pumped to one or more pressures. For example, the pile repair system **100** can be pumped to a first pressure, a second pressure, a third pressure, a fourth pressure, a fifth pressure, a six pressure, and more pressures.

[0077] The weight of the filler material injected into the elevating sleeve **102** of the pile repair system **100** when repairing a pile can vary widely. For example, the weight of the filler material injected into the elevating sleeve **102** of the pile repair system **100** when repairing a pile can be from a low of about 5 kg, about 10 kg, or about 100 kg, to a high of about 2,000 kg, about 50,000 kg, or about 150,000 kg. In another example, the weight of the filler material injected into the elevating sleeve **102** of the pile repair system **100** can be from about 5 kg to about 500,000 kg, about 5 kg to about 10,000 kg, about 10 kg to about 100 kg, about 20 kg to about 200 kg, about 50 kg to about 500 kg, about 100 kg to about 1,000 kg, about 500 kg to about 5,000 kg, about 5 kg to about 10,000 kg, about 15 kg to about 70,000 kg, about 20 kg to about 100,000 kg, about 50 kg to about 120,000 kg, about 75,000 kg to about 150,000 kg,

[0078] The systems and methods of pile repair can be used to repair wide variety of piles. For example, the systems and methods of pile repair can be used to repair a steel pipe pile, steel H-pile, fiberglass pile, composite pile, steel pile, concrete pile, and a timber pile. The systems and methods of pile repair can be used for replacing either a portion of a pile or the entirety of the pile. In some embodiments, replace all corrupted or damaged portions of the pile.

[0079] The one or more sensors can include, but are not limited to: one or more pressure sensors, one or more flow rate sensors, one or more weight sensors, one or more temperature sensors, one or more sonar sensors, one or more light detection and ranging sensors, one or more infrared sensors, one or more positioning sensors, one or more accelerometers, one or more magnetometers, one or more gyroscopes, and combinations thereof. The one or more sensors can include, but are not limited to: a first sensor, a second sensor, a third sensor, a fourth sensor, a fifth sensor, a six sensor, and more sensor. The one or more sensors can include, but are not limited to: a length, height, width, radius, first end, front side, second end, back side, right side, left side, top side, bottom side, outer surface, inner surface, and interior space.

[0080] In some embodiments, the system for repairing a pile supporting a structure includes a pipe spool piece; an elevating sleeve **102** includes a top and a bottom and a contiguous side wall spanning between the top and bottom, where the top is substantially closed and the bottom is opened, and where the side wall includes an input port and an exhaust port; a pile cap insert has an outer diameter shaped to fit within the elevating sleeve **102** at or near the bottom of the elevating sleeve **102** and an inner diameter shaped to fit over a preexisting pile; where filler material is pumped via pressure into the input port causing air, debris or water to escape from the exhaust port; where the pressure and fill of the filler material causes the elevating sleeve **102** to move upwards forming a replacement pile out of the filler material; where the material will continue to be pumped into the elevating sleeve **102** until the replacement pile is of the desired length, and where the elevating pile is coupled to the structure via the pipe spool piece. The system can further include an insert, said insert is coupled to the top of the elevating sleeve **102** and is placed between the elevating sleeve **102** and the structure, where when said replacement pile is of sufficient length, the insert will be bearing on the structure and be coupled thereto.

[0081] In one or more embodiments, a method of repairing and/or replacing a pile can include, but is not limited to: removing the corrupted piling; pumping concrete in cutoff pile; inserting the pile cap on the cut off piling; inserting the pipe spool piece with compressed elevating sleeve; elevating sleeve **102** and mate the flanges; pumping filler material into the elevating sleeve **102** until at least a portion of the air, water, and loose material has been expelled from the discharge hole near the top of the elevating sleeve; stopping pumping; closing discharge port; pumping filler material into elevating sleeve **102** until desired pressure reached; stopping pumping; closing valve; and disconnecting pump hose. FIG. **4** shows a flowchart for an embodiment of a method for repairing a pile.

[0082] In some embodiments, the method of repairing a pile can include, but is not limited to: removing at least a portion of the corrupted piling; inserting the pile cap insert ring on the piling; lowering the elevating sleeve **102** on to the existing pile; inserting the pipe spool piece and mate the flange to the elevating sleeve **102** to per job-based design criteria and torque specifications; pumping filler material into the elevating sleeve **102** until all air, water, and loose material has been expelled from the threaded discharge hole near the top of the elevating sleeve; stopping pump; clean threads; and installing threaded plug in to discharge port; start pumping filler material into elevating sleeve **102** until the ballasted spool piece is in bearing on the structure to be supported; closing valve and stopping pumping; attaching ballasted spool piece to existing structure per design criteria; relieve pressure on pump side of valve with relief valve; disconnecting pump hose and continue to next pumping location.

[0083] In some embodiments, the method of repairing a pile can include, but is not limited to: removing the corrupted piling; pumping concrete into cutoff pile area; inserting the pile cap on the cut off piling; inserting the pipe spool piece with compressed elevating sleeve; elevating sleeve **102** and mate the flanges **108**; pumping filler material into the elevating sleeve **102** until at least a portion of the air, water, and loose material has been expelled from the discharge hole near the top of the elevating sleeve; stopping pumping; closing discharge port; pumping filler material into elevating sleeve **102** until desired pressure reached; stopping pumping; closing valve; if needed, opening release valve to at least partially reduce pressure; and disconnecting pump hose. In some embodiments, the methods of using a pile repair system can include, but are not limited to: removing at least a portion of the pile to be repaired; pumping and/or injection a filler material to the interior space of the elevating sleeve **102**.

[0084] In some embodiments, at least a portion of the preexisting pile can be used and coupled to the newly made portion. In some embodiments, a prefabricated insert can be used in repairing the pile. In some embodiments, at least a portion of the preexisting pile can be used and coupled to the newly made portion. In some embodiments, the pile repair system **100** can function as a hydraulic pump, pushing the elevating sleeve, filler material, and/or insert into place under the structure to provide support and repair the pile. In some embodiments, at least a portion of the preexisting pile can be used and coupled to the newly made portion. In some embodiments, a prefabricated insert can be used to repair the pile. In some embodiments, at least a portion of the preexisting pile can be used and coupled to the newly made portion.

[0085] In some embodiments, the method of using the pile repair system **100** can be conducted with no live load on the pile repair system **100** and/or structure. In some embodiments, the method of using the pile repair system **100** can include, but is not limited to: removing at least a portion of the pile to be repaired, mounting a pile cap insert ring can be mounted or otherwise coupled to the cut off piling. The elevation sleeve is then lowered onto the existing pile. Care should be made to not damage the tremie pipe in the elevating sleeve. Next, the pipe spool piece is inserted, and the flange can be mated to the elevating sleeve **102** to per job-based design criteria and torque specifications. Once the system is secure, filler material is pumped into the elevating sleeve **102** through the input port. A substantial amount of filler is pumped to allow displace and push all air, water, and loose materials through the discharge hole in the elevating sleeve.

[0086] When substantially most of the air, water, and loose materials are discharged, the pumping can cease, and a threaded plug can be inserted into the discharge port. Next, the pumping can continue to pump filler material in the elevating sleeve, causing the sleeve to elevate from its prior position. In one or more embodiments, the elevating sleeve **102** is design of a significant length such that when the elevating sleeve **102** is elevated, exposing the filler material at the bottom to the environment, the filler material has substantially hardened. Such should be repeated or continued until the ballasted spool piece is bearing on the structure to be supported. When adequately load bearing, the pumping can be stopped, and the valve closed. The pile should be substantially shaped at this time.

[0087] A system for repairing a pile can include supporting a building or other structure, such as a deck. In some embodiments, a load can be introduced back onto the repaired pile, restoring it to its original or desired capacity. In some embodiments, the method of using the pile repair system **100** is conducted with no live load on the pile repair system **100** and/or structure.

[0088] In one or more embodiments, a method of repairing and/or replacing a pile can be implemented on a computer. FIG. **5** is a schematic of a computer system for repairing and/or replacing a pile. The method of pile repair can be implemented on a computer in one or more software modules. FIG. **6** shows a software flowchart for an embodiment of a method for repairing a pile. The one or more software modules of a method of repairing and/or replacing a pile can include, but is not limited to: receive an input of data from a user; receive a signal from one or more sensors; positioning an elevating sleeve over the cap member and under a structure that is supported by the pile that is to be repaired to form an interior space, where the elevating sleeve has an input port and output port disposed thereon; injecting one or more filler materials through the input port into the interior space of the elevating sleeve to a desired pressure; and stopping the injection of the filler material.

[0089] In some embodiments, the one or more software modules can include, but is not limited to: generating a deck platform parameters; generating a deck weight on column to be removed and/or replaced; generating a dead load; generating an equivalent point load; generating a beam capacity; generating a tension force of a beam; generating a concrete stress at failure over depth; generating a net tensile strength; checking a net tensile strength; generating an instantaneous beam deflection; generating a deadload unit deck platform; generating a factored load unit deck platform; generating a modulus of elasticity for concrete; generating a moment of inertia cracking; generating a value for a pressure for the pump to inject the filler material into the interior space of the elevating sleeve **102**; and combination thereof.

[0090] In some embodiments, the software modules can include, but are not limited to: positioning elevating sleeve on pile that is to be replaced; positioning insert on pile that is to be replaced; pumping filler material into the elevating sleeve **102** until at least a portion of the air, water, and loose material has been expelled from the output port of the elevating sleeve; stopping pump; closing output port; pumping filler material into elevating sleeve **102** until desired pressure reached; closing valve; opening valve to at least partially reduce pressure.

[0091] In some embodiments, the software modules of a method of repairing and/or replacing a pile can include, but are not limited to: positioning elevating sleeve on pile that is to be replaced; positioning insert on pile that is to be replaced; pumping filler material into the elevating sleeve **102** until at least a portion of the air, water, and loose material has been expelled from the output port of the elevating sleeve; stopping pump; closing output port; pumping filler material into elevating sleeve **102** until desired pressure reached; closing valve; opening valve to at least partially reduce pressure; and generating a value for a pressure for the pump to inject the filler material into the interior space of the elevating sleeve **102**.

[0092] In some embodiments, the software modules of a method of repairing and/or replacing a pile can include, but are not limited to: generating whether the pile can be removed from the deck structure for a temporary repair without shoring. In some embodiments, the software modules of a method of repairing and/or replacing a pile can include using an existing structure to calculate the design strength of the piles. In some embodiments, the software modules of a method of repairing and/or replacing a pile can include exerting constant linear expansion.

[0093] In some embodiments, the methods of using a pile repair system **100** can include, but are not limited to: generate a range for how much upward force can be applied at each pile repair location; generating the deck parameters using multiple 12″ wide beams according to the American Concrete Institute (ACI) standards, American Society for Testing Materials (ASTM) standards, or American Society of Mechanical Engineers (ASME); generating the shear and the moment of these beams for the worst-case scenarios; and generating a pound per square inch (psi) of filler material injected into the elevating sleeve **102**; generating a slab capacity, dead and live loads, and combination thereof. In some embodiments, the method of repairing a pile can be used with no live loads on tributary load pilings during the repair process.

Examples

[0094] To provide a better understanding of the foregoing discussion, the following non-limiting examples are offered. Although the examples can be directed to specific embodiments, they are not to be viewed as limiting the invention in any specific respect.

[0095] Numerous design criteria can need to be determined in preparing a job site or project. In some embodiments, the materials and components must be selected for the particular job. In some embodiments, it can be preferrable to provide materials similar to the existing shape and size of the in-place piling. The flanges **108** used can be selected to take advantage of premanufactured pieces from industry standard pipe sizes. Variations in pile can be addressed in the manufacture of the pile cap insert ring.

[0096] The components of the system can need to be modified or designed to fit job specific criteria. These criteria can include the material chosen (wood, concrete, fiberglass, steel, etc.), spool piece size and diameter, thickness and length of the pre-existing pile and/or the to-be-formed replacement pile (which can also affect the size of the elongating piece and/or the insert), required bearing capacity, means of connecting the pile to the structure, coating system, and environmental factors, to name a few.

[0097] Once the design criteria are determined, the method can include the steps of first removing the corrupted piling. Either the entirety of the piling or only a portion of the piling can be removed. In some embodiments, at least the corrupted portion is removed. Such piling can be cut or otherwise removed as known in the art. Prior to removing a corrupted piling, design parameters should be checked, and it should be confirmed that the remainder of the pilings in the vicinity of the to-be-removed piling are capable of adequately supporting the structure without shoring at least for the duration of the repair. In some embodiments, no live loads are allowed over the repaired piling during the repair or replacement method.

Generating a Deck Platform Parameters

[0098] In one or more software modules, the method of pile repair can include, but is not limited to: generating deck platform parameters, including one foot unit deck platform weight. For example, Table 1 shows deck platform parameters generated from the one or more sensors and/or user's inputs.

TABLE-US-00001 TABLE 1 Example of Generated Values and Parameters for a Method of Pile Repair per 1′ unit ø = 0.90 Rebar = #10 Diameter = 1.27 Area = 1.27 in.sup.2 Weight = 4.303 per linear foot Cover = 3″ Unit length = 31′ span conc = f′c 4,000 KPa steel = GR. 60 1 ft unit deck platform (udp) weight (W.sub.udp)

Generating an Area (A.sub.udp) and a Pressure (W.sub.udp) for a Unit Deck Platform

[0099] In one or more software modules, the method of pile repair can generate an area (A.sub.udp) and a pressure (W.sub.udp) for the unit deck platform. For example, Table 2 shows generating an area for the one unit deck platform (A.sub.udp) and a pressure for the one unit deck platform (W.sub.udp) from the one or more sensors and/or user's inputs.

TABLE-US-00002 TABLE 2 Example of Generating an Area (A.sub.udp) and a pressure (W.sub.udp) A.sub.udp = (15″) (1 ft/12″) = 1.25 lb/ft.sup.3 Reinforced conconcrete = 150 lb/ft.sup.3 W.sub.udp = (1.25 ft) (150 lb/ft.sup.3) W.sub.udp = 187.5 lb/ft.sup.2 ACI W.sub.udp 20 psf W.sub.udp = 187.5 lb/ft.sup.2 + 20 psf W.sub.udp = 207.5 psf

Generating a Deck Weight on Column to be Removed and/or Replaced

[0100] In one or more software modules, the method of pile repair can generate a one foot unit deck platform weight. For example, Table 3 shows generating generate a one foot unit deck platform weight from the one or more sensors and/or user's inputs.

TABLE-US-00003 TABLE 3 Example of Generating a One Foot Unit Deck Platform Weight Reinforced Conc. = 150 lb/ft.sup.3 A.sub.conc = (15.5′) × (12.75′) = 197.63 ft.sup.2 W.sub.conc = (197.63 ft.sup.3) × (150 lb/ft.sup.3) W.sub.conc = 29,644.50 lbs

Generating a Dead Load

[0101] In one or more software modules, the method of pile repair can generate a dead load. For example, Table 4 shows generating generate a one foot unit deck platform weight from the one or more sensors and/or user's inputs.

TABLE-US-00004 TABLE 4 Example of Generating a Dead Load W.sub.udp = 207.5 lb/ft.sup.2 × (1.4.sub.D) W.sub.udp = 290.5 lb/ft.sup.2 ≈ 300 lb/ft.sup.2 Consider ift strip beam 300 lb/ft.sup.2 × (1′) = 300 lb/ft

Generating an Equivalent Point Load

[0102] In one or more software modules, the method of pile repair can generate an equivalent point load. For example, Table 5 shows generating an equivalent point load from the one or more sensors and/or user's inputs.

TABLE-US-00005 TABLE 5 Example of Generating an Equivalent Point Load EPL = W.sub.udp x ln [00001]EPL = $(300\frac{\mathrm{lb}}{\mathrm{ft}})(31\mathrm{ft})$ EPL = 9,300 lbs

Generating a Beam Capacity

[0103] In one or more software modules, the method of pile repair can generate a beam capacity from the one or more sensors and/or user's inputs. The beam capacity can be based on a worst-case scenario for shear and moment. For example, Table 6 shows generating a beam capacity from the one or more sensors and/or user's inputs.

TABLE-US-00006 TABLE 6 Example of Generating a Beam Capacity [00002]

shear = $V = \frac{1.15W\ \mathrm{ln}}{2}$ [00003]moment$_{\mathrm{twospans}}$ $= M = \frac{W\ \mathrm{ln}^2}{9}$

Generating a Shear Capacity

[0104] In one or more software modules, the method of pile repair can generate a shear capacity. For example, Table 7 shows generating a shear capacity from the one or more sensors and/or user's inputs.

TABLE-US-00007 TABLE 7 Example of Generating a Shear Capacity ØV.sub.n = 0.75 V.sub.c V.sub.c = 2{square root over (/f'c)}(b)(d) V.sub.c = 2{square root over (4,000 psi)} (12″)(13″) f′c = 4,000 KPa b = slab width = 12″ d = assumed 2″ = 15″-2″ = 13″ [00004]$V_c = \frac{19732.61\mathrm{lb}}{1000\mathrm{lb}/K_{\mathrm{ips}}}$ V.sub.c = 19.732.61 K.sub.ips

Generating a Shear Capacity Check

[0105] In one or more software modules, the method of pile repair can generate a shear check. For example, Table 8 shows the generating a shear capacity from the one or more sensors and/or user's inputs.

TABLE-US-00008 TABLE 8 Example of Generating a Shear Check ØV.sub.n must exceed V.sub.μ,max W.sub.udp = 300 1b/ft ln = 31′ [00005]$V = \frac{1.15(300\mathrm{lb}/\mathrm{ft})(31')}{2}$ [00006]$V = \frac{5,347.5\mathrm{lbs}}{1,000\mathrm{lb}/K_{\mathrm{ip}}}$ V.sub.μ = 5,347.5 K.sub.ips = shear max Factor: ØV.sub.n = 0.75 (V.sub.c) = (0.75) (19.73 K.sub.ips) ØV.sub.n = 14.799 (K.sub.ips) > 5.3475 K.sub.ips hence the beam is acceptable for shear V

Generating Parameters for a Beam

[0106] In one or more software modules, the method of pile repair can generate parameters for a beam. For example, Table 9 shows generating parameters for a beam from the one or more sensors and/or user's inputs.

TABLE-US-00009 TABLE 9 Example of Generating Parameters for a Beam Rebar #8 @ 9 inch O.C. Diameter 13 inch F′c 4,000 KPa F.sub.y 60 Ksi steel Area A.sub.s = 0.79 in.sup.2 A.sub.s of Beam (0.79 in.sup.2)(12 in/9 in O.C.) = 1.053 in.sup.2

[0107] In one or more software modules, the method of pile repair can generate a moment capacity. For example, Table 10 shows generating a moment capacity from the one or more sensors and/or user's inputs.

TABLE-US-00010 TABLE 10 Example of Generating a Moment Capacity [00007]

moment$_{\mathrm{twospans}}$ $= M = \frac{W\ \mathrm{ln}^2}{9}$ W.sub.udp = 300 1b/ft ln = 31′ [00008]$M = \frac{(300\mathrm{lb}/\mathrm{ft})(31')^2}{9}$ [00009]

$M = \frac{32033.33 K_{ip} \text{ .Math. ft}}{9 \text{lb} / K_{ip}}$ [00010] $M = \frac{32033.33 K_{ip} \text{ .Math. ft}}{9 \text{lb} / K_{ip}}$ = maxmoment

Generating a Tension Force of Beam Steel

[0108] In one or more software modules, the method of pile repair can generate a tension force of beam steel. For example, Table 11 shows generating a tension force of beam steel from the one or more sensors and/or user's inputs.

TABLE-US-00011 TABLE 11 Example of Generating a Tension Force of Beam Steel T = (A.sub.s)(F.sub.y) = (.053 in.sup.2)(60 Ksi) = 63.2 K.sub.ips = compression (must offset)

Generating a Concrete Stress at Failure Over Depth (a)

[0109] In one or more software modules, the method of pile repair can generate a concrete stress at failure over depth. For example, Table 12 shows generating a concrete stress at failure over depth from the one or more sensors and/or user's inputs.

TABLE-US-00012 TABLE 12 Example of Generating a Concrete Stress at Failure Over Depth (a) 0.85 f′c = 0.85 (4,000 KPa) = 3,400 KPa ≈ 3.4 Ksi Area of Compression Block (A.sub.c) [00011] $A_c = \frac{C_{\text{force}}}{3.4 \text{Ksi}} = \frac{63.2 \text{Ksi}}{3.4 K_{\text{ip}} / \text{in}^2}$ A.sub.c= 18.59 in.sup.2 Depth of Compression Block (a) [00012] $a = \frac{A_c}{b} = \frac{18.59 \text{in}^2}{12 \text{in}}$ = 1.55in Distance from Compression Face to Neutral Axis (c) [00013] $c = \frac{a}{B_1} = \frac{1.55 \text{in}}{0.85}$ c = 1.824 in

Generating a Net Tensile Strength (E.SUB.T.)

[0110] In one or more software modules, the method of pile repair can generate a net tensile strength (E.sub.T). For example, Table 13 shows generating a net tensile strength from the one or more sensors and/or user's inputs.

TABLE-US-00013 TABLE 13 Example of Generating a Net Tensile Strength (E.sub.T) [00014] $\frac{E_c}{c} = \frac{E_T}{d - c} = \frac{0.003}{0.01824 \text{in}} = \frac{E_T}{(13 - 1.824'')}$ E.sub.T = 0.0184 Checking a net tensile strength per ACI E.sub.T = 0.0184 > 0.005 Ø = 0.9 factor

[0111] Therefore, removing a pile section for installation of the pile repair system **100** based on parameters and values generated within, the deck capacity retains sufficient.

Generating a Moment Capacity

[0112] In one or more software modules, the method of pile repair can generate a moment capacity. For example, Table 14 shows generating a moment capacity from the one or more sensors and/or user's inputs.

TABLE-US-00014 TABLE 14 Example of Generating a Moment Capacity ØM.sub.n = 0.9 (T)(d-c) ØM.sub.n = 0.9 (63.2 K.sub.ips)(13″ − 1.824″) [00015] $\varnothing M_n = \frac{635.691 K_{ip} \text{ .Math. in}}{12 \text{in} / \text{ft}}$ M.sub.μ max 32.033 K.sub.ip .Math. ft Moment capacity should exceed actual moment M.sub.μ max. ØM.sub.n = 52.974 K.sub.ip .Math. ft > 32.033 K.sub.ip .Math. ft Beam okay in moment. Therefore, removing a pile section for installation of the elevating pile repair system based on parameters within, the deck capacity retains sufficient

Generating an Instantaneous Beam Deflection

[0113] In one or more software modules, the method of pile repair can generate an instantaneous beam deflection. For example, Table 15 shows generating an instantaneous beam deflection from the one or more sensors and/or user's inputs.

TABLE-US-00015 TABLE 15 Example of Generating an Instantaneous Beam Deflection [00016] $I_g = \frac{bh^3}{12} = \frac{(12'')(15'')^3}{12}$ Beam cross section area steel: A#8 = 0.79 in.sup.2 A#10 = 1.23 in.sup.2 For beam 9″ O.C.: A#8 = 1.053 in.sup.2 A#10 = 1.64 in.sup.2

Generating a Max Moment of Inertia for a Structure (M.SUB.D.)

[0114] In one or more software modules, the method of pile repair can generate a max moment of inertia for a structure (M.sub.D). For example, Table 16 shows generating a max moment of inertia for a structure from the one or more sensors and/or user's inputs.

TABLE-US-00016 TABLE 16 Example of Generating a Max Moment of Inertia for a Structure

No live load added to calculate just deflection of beam (slab). live load = 0 [00017]$M_D = \frac{(W_d)L^2}{8}$ [00018]$M_D = \frac{(27.5\text{lb}/\text{ft})(31')^2}{8}$ [00019]$M_D = \frac{(207.5\text{lb}/\text{ft})(31')^2}{8}$ M.sub.D = 24,925.93 lb .Math. ft M.sub.D = 25 K.sub.ip .Math. ft f.sub.r = 7.5{square root over (f′c)}   = 7.5{square root over (4,000 psi)} f.sub.r = 474.3 lb/ft.sup.2

Generating a Moment of Inertia for Cracking (M.SUB.cr.)

[0115] In one or more software modules, the method of pile repair can generate a moment inertia for cracking (M.sub.cr). For example, Table 17 shows generating a moment of inertia for cracking for a structure from the one or more sensors and/or user's inputs.

TABLE-US-00017 TABLE 17 Example of Generating Moment of Inertia for Cracking [00020] $M_{\text{cr}} = \frac{(f_r)(I_g)}{y_b}$ [00021]$y_b = \frac{h}{2} = \frac{15''}{2} = 7.5''$ [00022]$M_{\text{cr}} = \frac{(474.3\text{lb}/\text{ft}^2)(3.375\text{in}^4)}{(7.5'')(1,000\text{lb}/K_{ip})(12''/\text{ft})}$ [00023] $M_{\text{cr}} = \frac{(474.3\text{lb}/\text{ft}^2)(3.375\text{in}^4)}{(7.5'')(1,000\text{lb}/K_{ip})(12''/\text{ft})}$

Generating a Deadload for a Unit Deck of Platform

[0116] In one or more software modules, the method of pile repair can generate a deadload for a unit of deck platform. For example, Table 18 shows generating a deadload for a unit of deck platform for a structure from the one or more sensors and/or user's inputs.

TABLE-US-00018 TABLE 18 Example of Generating Deadload for a Unit of Deck Platform Reinforced conc = 150 lb/f.sup.3 [00024]$\text{per1ftunit} = \frac{(12'')}{(12'')} \times \frac{(15'')}{(12'')} = 1.25\text{ft}$ [00025]$\frac{(\text{weightofUDP1ftunit})}{(\text{conc.} = 150\text{lb}/f^3)}$ [00026]$W_{\text{UDP}} = 150\frac{\text{lb}}{\text{ft}^3} \times 1.25\text{ft} = 187.5\frac{\text{lb}}{\text{ft}^2}$ [00027]$\text{Factorin}20\frac{\text{lb}}{\text{ft}^2}$ [00028]$W_{\text{UDP}} = 187.5\frac{\text{lb}}{\text{ft}^3} \times 20\frac{\text{lb}}{\text{ft}^2}$ [00029]$W_{\text{UDP}} = 207.5\frac{\text{lb}}{\text{ft}^2}$

Generating a Factored Load Unit Deck Platform

[0117] In one or more software modules, the method of pile repair can generate a factored load for a unit deck platform. For example, Table 19 shows generating a factored load for a unit deck platform for a structure from the one or more sensors and/or user's inputs.

TABLE-US-00019 TABLE 19 Example of Generating a Factored Load for a Unit of Deck Platform [00030]$W_{\text{UDP}} = 27.5\frac{\text{lb}}{\text{ft}^2}, \text{basedonparametersabove}$ [00031]$(\frac{M_{\text{cr}}}{M_D})^3 = (\frac{18K_{ip}\ .\text{Math. ft}}{25K_{ip}\ .\text{Math. ft}})^3 = 0.373248$

Generating a Modulus of Elasticity for Concrete (E.SUB.c.)

[0118] In one or more software modules, the method of pile repair can generate a modulus of elasticity for the concrete (E.sub.c). For example, Table 20 shows generating a modulus of elasticity for the concrete (E.sub.c) from the one or more sensors and/or user's inputs.

TABLE-US-00020 TABLE 20 Example of Generating a Factored Load for a Unit of Deck Platform conc. at 150 lb/f .sup.3 conc. at 4,000 KPa E.sub.c = w.sup.1.5 .Math. 33{square root over (f'c)} E.sub.c = (150 lb/f3).sup.1.5 .Math. 33{square root over (4,000 lb/in.sup.2)} E.sub.c = 3,834253.513 KPa n for E.sub.concrete and E.sub.steel [00032]$n = \frac{E_{\text{steel}}}{E_{\text{conc}}} = \frac{29,000,000\text{KPa}}{3,834,253.513\text{KPa}}$ n = 7.5634 ≈ 8.0 area #10 bars @ 9″ O.C. = 1.64 in.sup.2 [00033]$p = \frac{A_s}{bd} = \frac{1.64\text{in}^2}{(12'')(13'')}$ [00034] $K_{\text{cr}} = \sqrt{(pn)^2 + 2(pn)} - (\text{pn}) = \sqrt{(0.0105 + 8.0)^2 + 2(0.0105 + 8.0)} - (0.0105 \times 8.)$ Find X.sub.cr d = 13″ X.sub.cr = K.sub.crd X.sub.cr = (0.3260)(13″) X.sub.cr = 4.24 in

Generating a Moment of Inertia Cracking

[0119] In one or more software modules, the method of pile repair can generate a moment of inertia for cracking. For example, Table 21 shows generating moment of inertia for cracking from the one or more sensors and/or user's inputs.

TABLE-US-00021 TABLE 21 Example of Generating a Moment of Inertia for Cracking [00035] $I_{\text{cr}} = \frac{bx^3}{3} + (d - x)^2$

[0120] The above-described features and applications can be implemented as software processes that are specified as a set of instructions recorded on a computer readable storage medium (also referred to as computer readable medium). When these instructions are executed by one or more processing unit(s) (e.g., one or more processors, cores of processors, or other processing units), they cause the processing unit(s) to perform the actions indicated in the instructions. Examples of computer readable media include, but are not limited to, CD-ROMs, flash drives, RAM chips, hard drives, EPROMs, etc. Some implementations include electronic components, for example microprocessors, storage and memory that store computer program instructions in a machine-readable or computer-readable medium (alternatively referred to as computer-readable storage media, machine-readable media, or machine-readable storage media, any or all of which can be non-transitory). Some examples of such computer-readable media include RAM, ROM, read-only compact discs (CD-ROM), recordable compact discs (CD-R), rewritable compact discs (CD-RW), read-only digital versatile discs (e.g., DVD-ROM, dual-layer DVD-ROM), a variety of recordable/rewritable DVDs (e.g., DVD-RAM, DVD-RW, DVD+RW, etc.), flash memory (e.g., SD cards, mini-SD cards, micro-SD cards, etc.), magnetic or solid state hard drives, read-only and recordable Blu-Ray® discs, ultra-density optical discs, any other optical or magnetic media, and floppy disks. The computer-readable media can store a computer program that is executable by at least one processing unit and includes sets of instructions for performing various operations. Examples of computer programs or computer code include machine code, for example is produced by a compiler, and files including higher-level code that are executed by a computer, an electronic component, or a microprocessor using an interpreter.

[0121] While the above discussion primarily refers to microprocessor or multi-core processors that execute software, some implementations are performed by one or more integrated circuits, for example application specific integrated circuits (ASICs) or field programmable gate arrays (FPGAs). In some implementations, such integrated circuits execute instructions that are stored on the circuit itself.

[0122] To provide for interaction with a user, implementations of the subject matter described in this specification can be implemented on a computer having a display device, e.g., a CRT (cathode ray tube) or LCD (liquid crystal display) monitor, for displaying information to the user and a keyboard and a pointing device, e.g., a mouse or a trackball, by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory feedback, e.g., visual feedback, auditory feedback, or tactile feedback; and input from the user can be received in any form, including acoustic, speech, or tactile input. In addition, a computer can interact with a user by sending documents to and receiving documents from a device that is used by the user; for example, by sending web pages to a web browser on a user's client device in response to requests received from the web browser.

[0123] In this specification, the term “software” is meant to include, but is not limited to, firmware residing in read-only memory or applications stored in magnetic storage or flash storage, for example, a solid-state drive, which can be read into memory for processing by a processor. Also, in some implementations, multiple software technologies can be implemented as sub-parts of a larger program while remaining distinct software technologies. In some implementations, multiple software technologies can also be implemented as separate programs. Finally, any combination of separate programs that together implement a software technology described here is within the scope of the subject technology. In some implementations, the software programs, when installed to operate on one or more electronic systems, define one or more specific machine implementations that execute and perform the operations of the software programs.

[0124] A computer program (also known as a program, software, software application, script, or code) can be written in any form of programming language, including compiled or interpreted languages, declarative or procedural languages, and it can be deployed in any form, including as a standalone program or as a module, component, subroutine, object, or other unit suitable for use in a computing environment. A computer program may, but need not, correspond to a file in a file system. A program can be stored in a portion of a file that holds other programs or data (e.g., one or more scripts stored in a markup language document), in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub programs, or portions of code). A computer program can be deployed to be executed on one computer or on multiple computers that are located at one site or distributed across multiple sites and interconnected by a communication network.

[0125] These functions described above can be implemented in digital electronic circuitry, in computer software, firmware or hardware. The techniques can be implemented using one or more computer program products. Programmable processors and computers can be included in or packaged as mobile devices. The processes and logic flows can be performed by one or more programmable processors and by one or more programmable logic circuitry. General and special purpose computing devices and storage devices can be interconnected through communication networks.

[0126] As used in this specification and any claims of this application, the terms “computer”, “server”, “processor”, and “memory” all refer to electronic or other technological devices. These terms exclude people or groups of people. For the purposes of the specification, the terms display or displaying means displaying on an electronic device. As used in this specification and any claims of this application, the terms “computer readable medium” and “computer readable media” are entirely restricted to tangible, physical objects that store information in a form that is readable by a computer. These terms exclude any wireless signals, wired download signals, and any other ephemeral signals.

[0127] The subject matter described in this specification can be implemented in a computing system that includes a back end component, e.g., as a data server, or that includes a middleware component, e.g., an application server, or that includes a front end component, e.g., a client computer having a graphical user interface or a Web browser through which a user can interact with an implementation of the subject matter described in this specification, or any combination of one or more such back end, middleware, or front end components. The components of the system can be interconnected by any form or medium of digital data communication, e.g., a communication network. Examples of communication networks include a local area network (“LAN”) and a wide area network (“WAN”), an inter-network (e.g., the Internet), and peer-to-peer networks (e.g., ad hoc peer-to-peer networks).

[0128] The computing system can include clients and servers. A client and server are generally remote from each other and typically interact through a communication network. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other. In some aspects of the disclosed subject matter, a server transmits data (e.g., an HTML page) to a client device (e.g., for purposes of displaying data to and receiving user input from a user interacting with the client device). Data generated at the client device (e.g., a result of the user interaction) can be received from the client device at the server.

[0129] It is understood that any specific order or hierarchy of steps in the processes disclosed is an illustration of example approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged, or that all illustrated steps be performed. Some of the steps may be performed simultaneously. For example, in certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components illustrated above should not be understood as requiring such separation, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

[0130] One of ordinary skill in the art will readily appreciate that alternative but functionally equivalent components, materials, designs, and equipment can be used. The inclusion of additional elements can be deemed readily apparent and obvious to one of ordinary skill in the art. Specific

elements disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for teaching one of ordinary skill in the art to employ the present invention.
[0131] Various modifications to these aspects will be readily apparent, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language claims, where reference to an element in the singular is not intended to mean “one and only one” unless specifically so stated, but rather “one or more.” Unless specifically stated otherwise, the term “some” refers to one or more. Headings and subheadings, if any, are used for convenience only and do not limit the subject technology.
[0132] As used herein, the singular forms “a”, “an”, and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. Furthermore, to the extent that the terms “including”, “includes”, “having”, “has”, “with”, or variants thereof are used in either the detailed description and/or the claims, such terms are intended to be inclusive in a manner similar to the term “comprising”. As used herein, use of the term “including” as well as other forms, such as “includes,” and “included,” is not limiting.
[0133] The terms “couples”, “coupled”, “coupler”, and variations thereof are used to include both arrangements wherein the two or more components are in direct physical contact and arrangements wherein the two or more components are not in direct contact with each other (e.g., the components are “coupled” via at least a third component), but yet still cooperate or interact with each other.
[0134] Various terms have been defined above. To the extent a term used in a claim is not defined above, it should be given the broadest definition persons in the pertinent art have given that term as reflected in at least one printed publication or issued patent. Furthermore, all patents, test procedures, and other documents cited in this application are fully incorporated by reference to the extent such disclosure is not inconsistent with this application.
[0135] Certain embodiments and features have been described using a set of numerical upper limits and a set of numerical lower limits. It should be appreciated that ranges including the combination of any two values, e.g., the combination of any lower value with any upper value, the combination of any two lower values, and/or the combination of any two upper values are contemplated unless otherwise indicated. It should also be appreciated that the numerical limits can be the values from the examples. Certain lower limits, upper limits and ranges appear in at least one claims below. All numerical values are “about” or “approximately” the indicated value, and consider experimental error and variations that would be expected by a person having ordinary skill in the art.
[0136] Various modifications to these aspects will be readily apparent, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language claims, where reference to an element in the singular is not intended to mean “one and only one” unless specifically so stated, but rather “one or more.”
[0137] All patents, patent applications, provisional applications, and publications referred to or cited herein are incorporated by reference in their entirety, including all figures and tables, to the extent they are not inconsistent with the explicit teachings of this specification.

Claims

1. A system for repairing a pile comprising: an elevating sleeve, wherein the elevating sleeve comprises a top, a bottom, and a contiguous side wall spanning between the top and bottom, wherein the top is substantially closed, and the bottom is open, wherein the elevating sleeve is configured to fit over a top of a pile to be repaired, and wherein the elevating sleeve comprises an input port and output port; one or more seals, wherein at least one seal comprises an outer diameter shaped to fit within the elevating sleeve at or near the bottom of the elevating sleeve and an inner

diameter to fit over the top of the pile to be repaired; one or more plugs; and a pump.
2. The system of claim 1 further comprising filler material, wherein the filler material is selected from grout and cement.
3. The system of claim 1 further comprising an insert, wherein the insert comprises: a top and a bottom and a side wall spanning between the top and bottom, wherein the top is substantially closed, and the bottom is opened, wherein the insert is configured to fit over a top of a pile to be repaired, and wherein when said replacement pile is of sufficient length that the insert is coupled to the building structure.
4. The system of claim 1 further comprising a sensor, wherein the sensor is a pressure sensor.
5. The system of claim 1 further comprising a valve, wherein the valve is coupled to the input port, and wherein the valve is positioned exterior the elevating sleeve.
6. A method of repairing a pile comprising: coupling a cap member to a surface of a pile this is to be repaired; positioning an elevating sleeve over the cap member and under a structure that is supported by the pile that is to be repaired to form an interior space, wherein the elevating sleeve has an input port and output port disposed thereon, wherein the output port has a first valve, and wherein the input port has a second valve; injecting one or more filler materials through the input port into the interior space of the elevating sleeve, wherein the injecting of the filler material is performed while the first valve of the output port is open; closing the first valve of the output port; injecting one or more filler materials through the input port into the interior space of the elevating sleeve to a desired pressure; stopping the injection of the filler material; and closing the second valve of the input port.
7. The system of claim 6, wherein the method provides a constant linear expansion between a pile to be repaired and a structure that the pile is supporting.
8. The system of claim 6, wherein the filler material is selected from grout and cement.
9. A non-transitory computer readable medium comprising instructions which, when implemented by one or more computers, causes the one or more computers to: receive an input of data from a user; receive a signal from one or more sensors, wherein the sensors are selected from pressure sensors, flow rate sensors, weight sensors, temperature sensor, positioning sensors, accelerometers, magnetometers, gyroscopes; positioning an elevating sleeve over the cap member and under a structure that is supported by the pile that is to be repaired to form an interior space, wherein the elevating sleeve has an input port and output port disposed thereon; injecting one or more filler materials through the input port into the interior space of the elevating sleeve to a desired pressure; and stopping the injection of the filler material.
10. The non-transitory computer readable medium of claim 9, further comprising sending a value of a pressure of the internal space to a display unit.
11. The non-transitory computer readable medium of claim 9, wherein the filler material is selected from grout and cement.