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(54) **SYSTEM AND METHOD FOR FOUNDATIONS FOR ROADSIDE SIGNS AND STRUCTURES**

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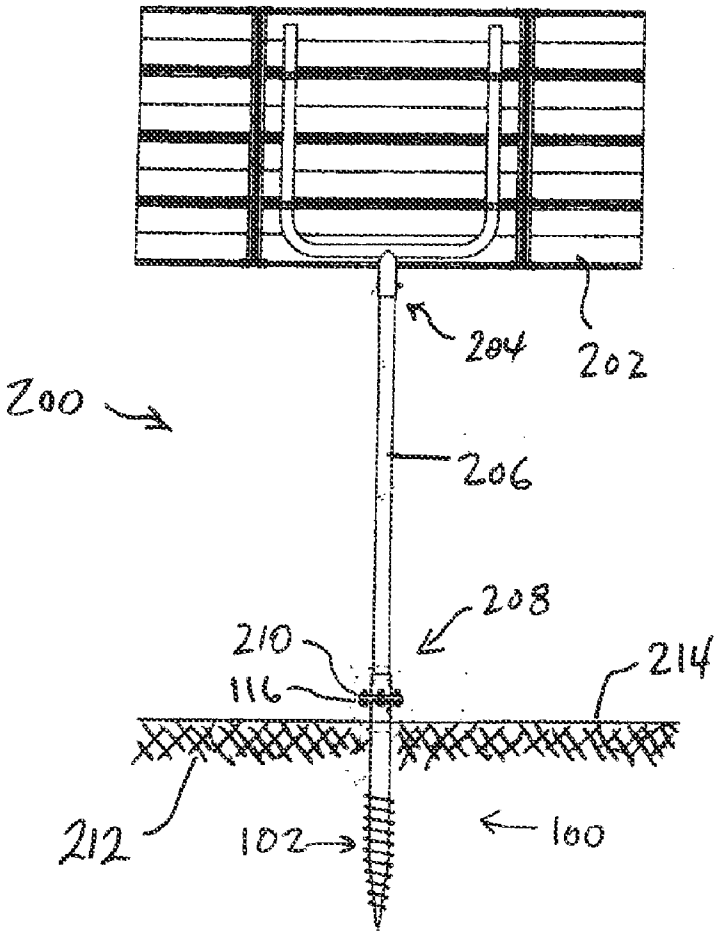
(57) **ABSTRACT**

A ground screw anchor foundation for a roadside sign comprises at least one elongated soil screw defining a longitudinal axis. The soil screw includes a barrel section having an upper end and a lower end and a substantially circular cross-section of a first diameter. A point section is connected to the lower end, the point section tapering from a second diameter at a position along the longitudinal axis proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section. A helical thread is disposed on an outer surface of at least a portion of the point section. A first component of a breakaway system is mounted on the upper end of the barrel section of the soil screw. The first component is adapted for releasable connection in a breakaway manner to a second component on a roadside sign.



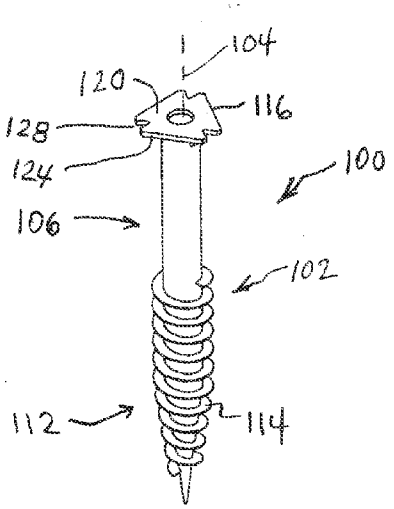


FIG. 1a

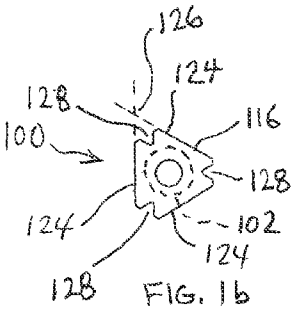


FIG. 1b

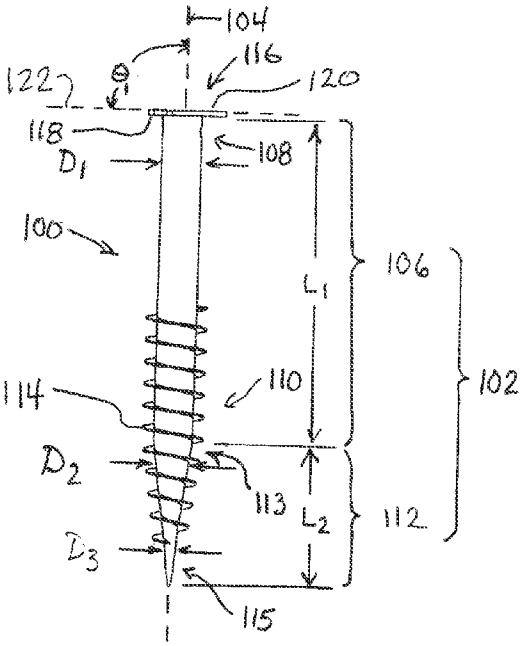


FIG. 1c

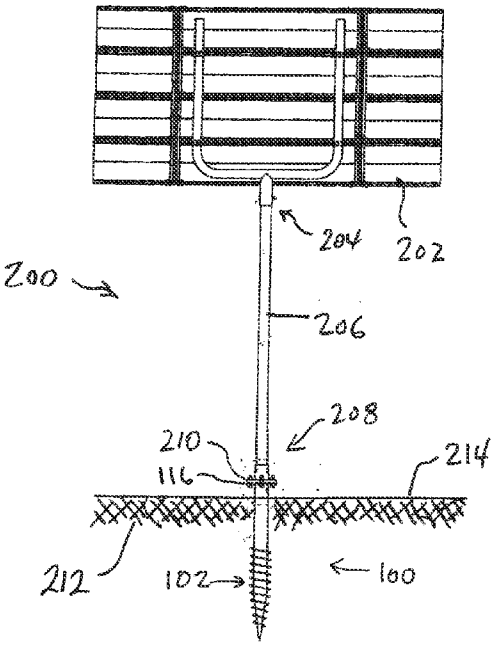


FIG. 2

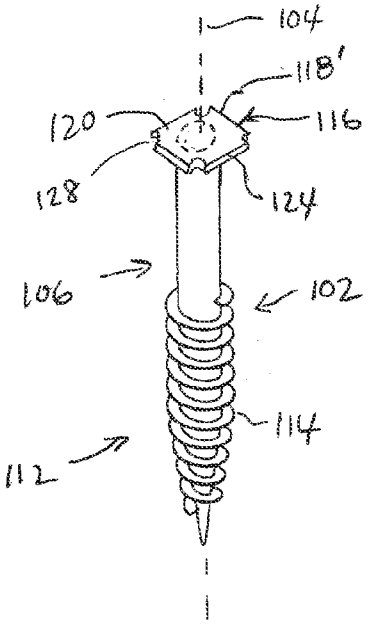


FIG. 1d

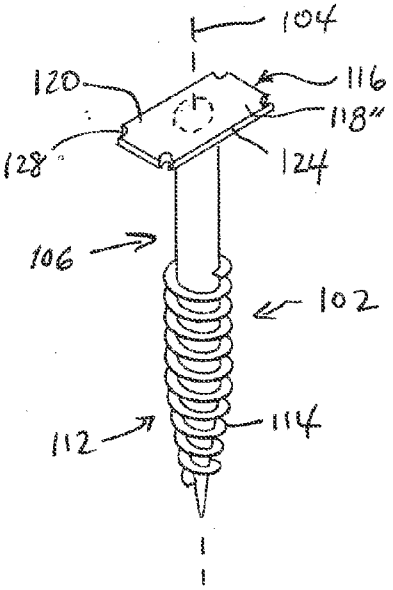


FIG. 1e

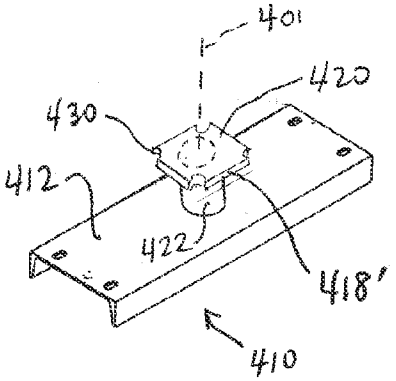


FIG. 5e

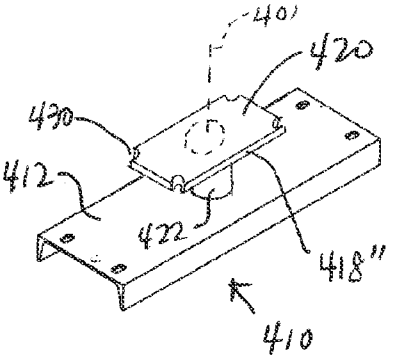


FIG. 5f

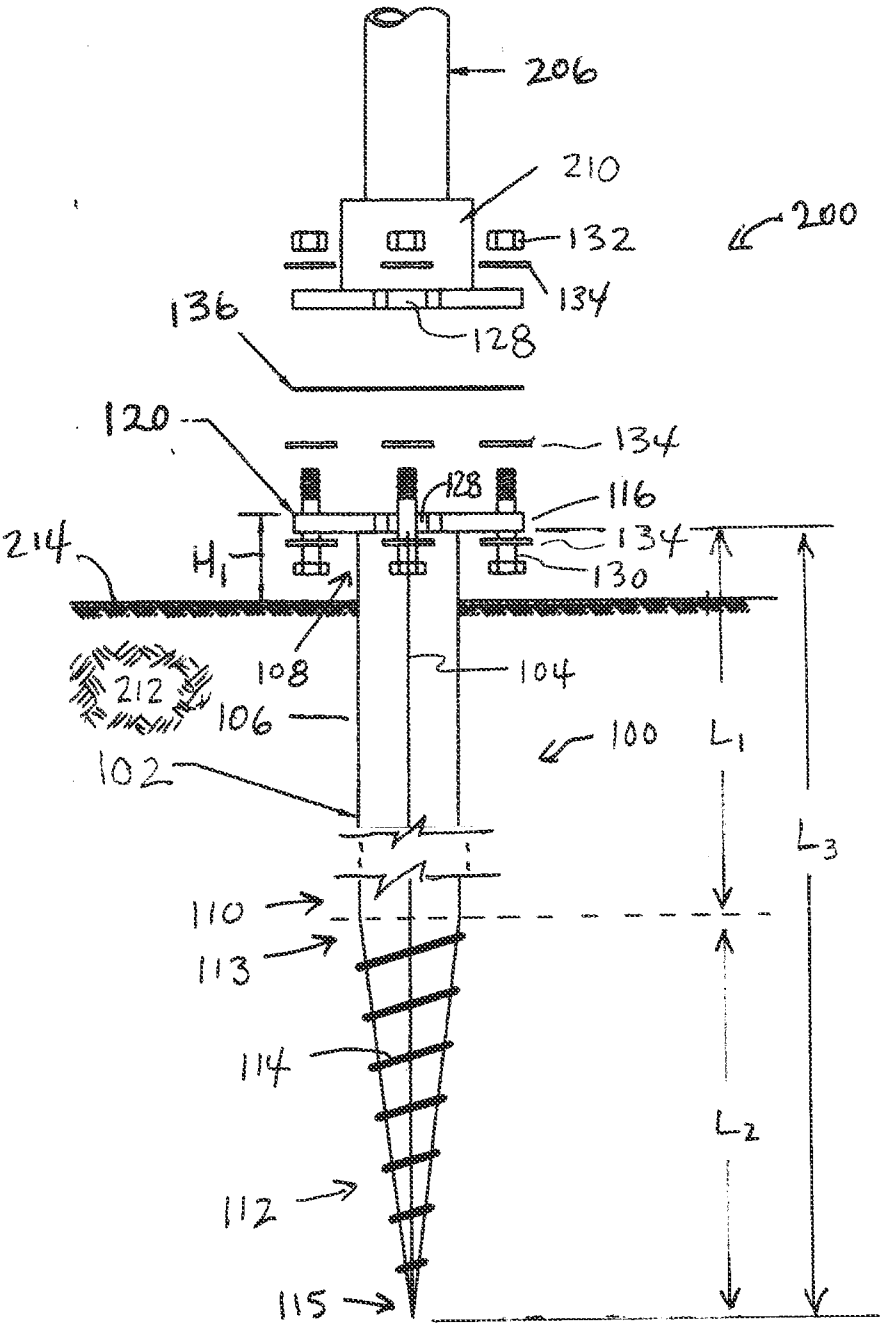

206
210
200
132
134
136
128
120
134
128
116
214
H_1
134
130
108
104
212
106
100
L_1
102
L_3
110
113
114
L_2
112
115

FIG. 3

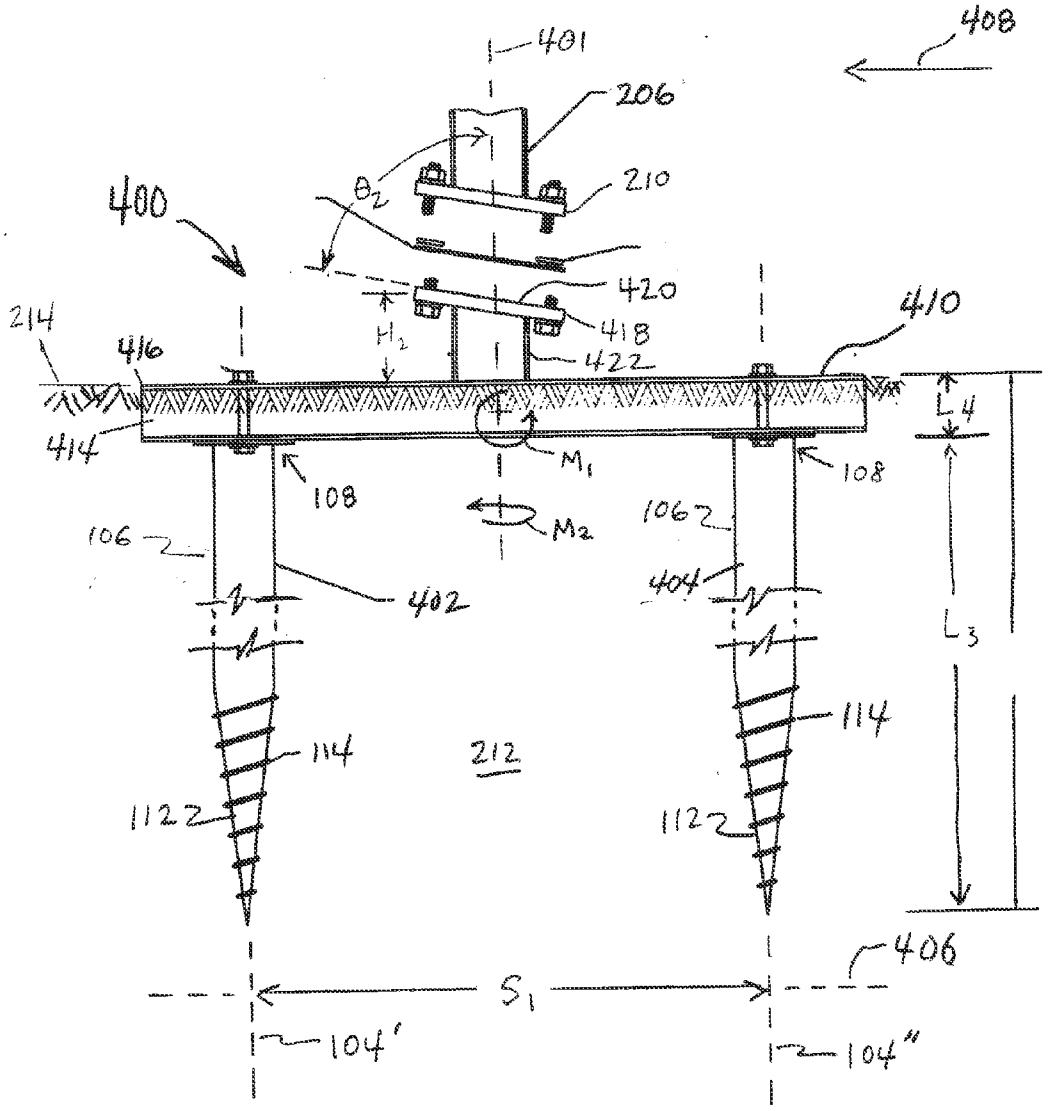

401
408
206
210
400
θ_2
420
418
422
H_2
214
416
410
414
L_4
M_1
108
108
M_2
106
106
402
404
L_3
114
114
212
1122
1122
406
S_1
104'
104"

FIG. 4

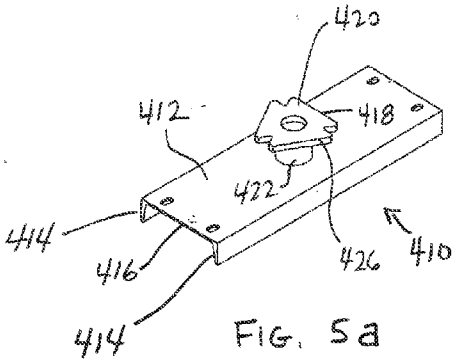


FIG. 5a

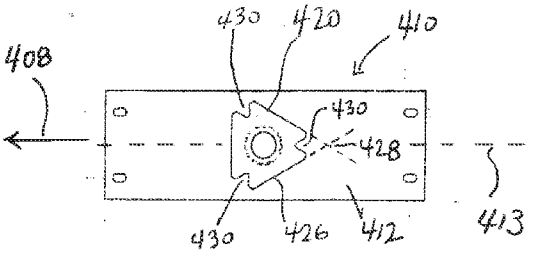


FIG. 5b

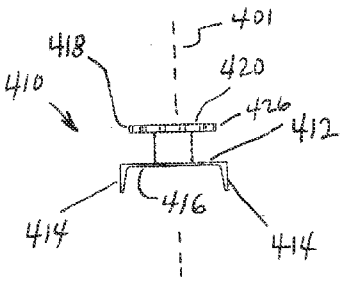


FIG. 5c

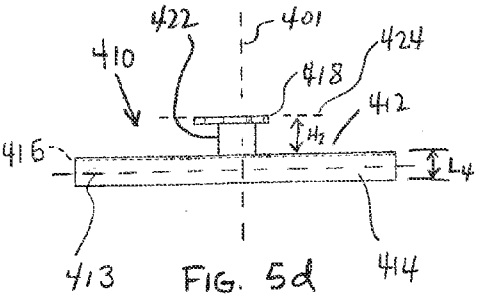


FIG. 5d

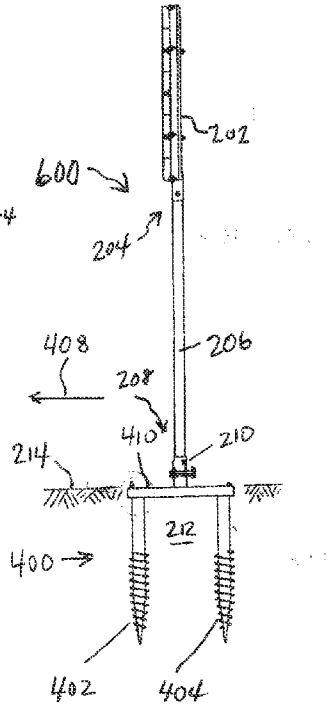


FIG. 6

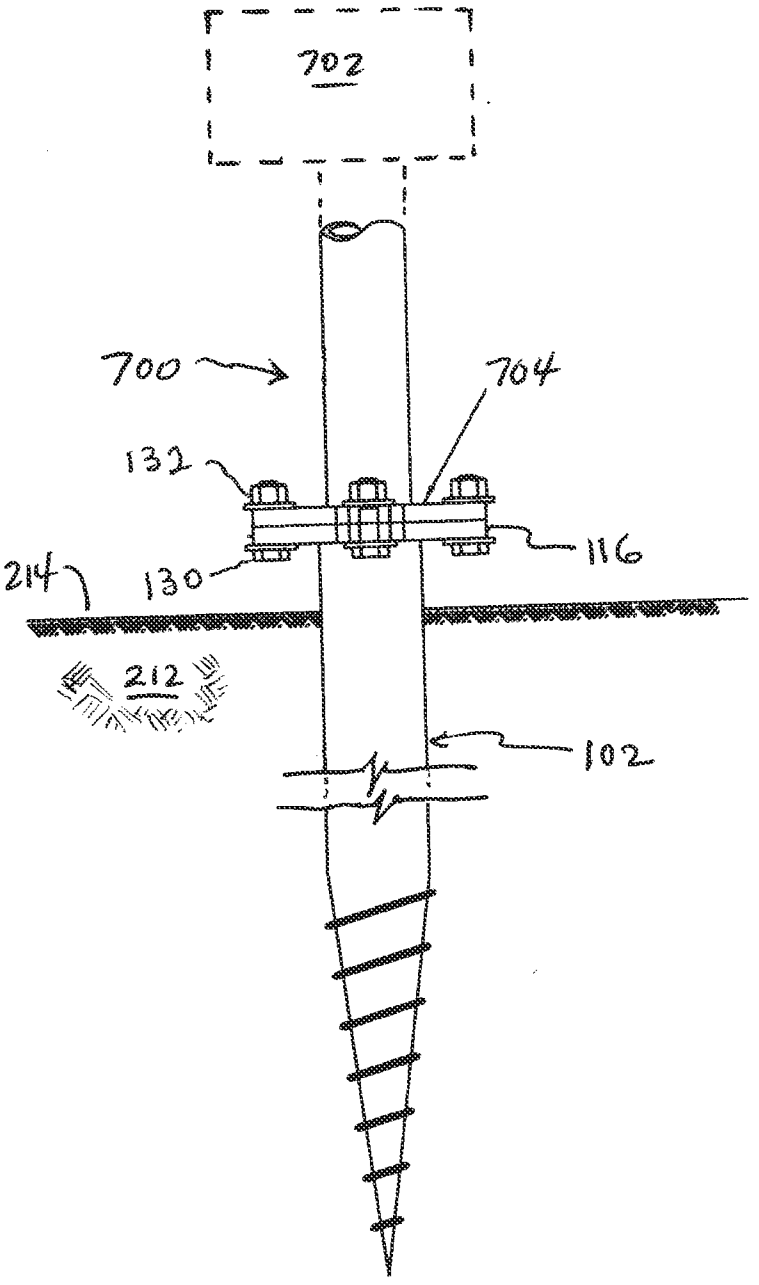


FIG. 7

SYSTEM AND METHOD FOR FOUNDATIONS FOR ROADSIDE SIGNS AND STRUCTURES

TECHNICAL FIELD

[0001] The following disclosure relates to systems for providing foundations for roadside signs, in particular for providing foundations including a ground screw and an integral slip base, such that the foundation can be installed in the ground without excavation, can be removed intact from the ground after use and/or can be reused in another location after removal.

BACKGROUND

[0002] Roadside safety is a controlling element within the roadway signing industry. The most widely accepted safety element for small roadside signs is a breakaway system. The Federal Highway Administration, numerous universities, private inventors, and numerous state Departments of Transportation have crash-tested numerous types of breakaway systems in the past 30 years. There are several breakaway systems approved for use on our national highway system. One of the commonly used breakaway systems is commonly known as the "triangular slip base." U.S. Pat. No. 4,926,592 to Nehls describes a breakaway sign post coupling comprising a triangular slip base. The entire disclosure of U.S. Pat. No. 4,926,592 is incorporated herein by reference.

[0003] Conventionally, a foundation for a roadside sign includes a triangular slip base anchored to the ground with a 12" diameter×42" deep drilled shaft concrete foundation. As the name implies, the drilled shaft concrete foundation involves drilling a hole in the ground at the desired location and filling it with concrete. The slip base stub is mounted in the wet concrete before it sets up. This is a "one size fits all" roadside sign foundation that is used in every soil type.

[0004] Though widely used, there are several disadvantages to the conventional drilled shaft concrete foundation for roadside signs. One disadvantage is the amount of man hours and physical labor required for a complete sign installation. The typical installation of a sign with a drilled concrete foundation takes two trips by a work crew: one trip to drill and pour the foundation; and a second trip, no sooner than four days later, to install the sign after the concrete has cured. Also, the amount of equipment and physical labor to install the foundation is fairly exhaustive. For example, to install a typical 12" dia.×42" deep drilled shaft foundation requires a drilling truck and operator, a trailer or separate truck to haul water, dry concrete mix that will result in a 3,000 psi concrete, a wheel barrel, concrete mixing tools, hand tools to load or spread the spoils from drilling the shaft, and cones/barricades to keep vehicles or pedestrians away from the curing foundation and slip base stub extrusion. In all, the installation of a drilled shaft foundation is labor extensive and exhaustive. A need therefore exists, for an improved foundation system for installation of roadside signs that is more efficient of labor and materials.

[0005] Of course, if commercially-mixed (i.e., mixing truck delivered) concrete is used, no hand mixing or lifting is required, except possibly for hauling the concrete by wheel barrel if the foundation location cannot be reached with the concrete chute. However, commercial concrete suppliers typically cannot accurately batch less than a half a truck load of concrete, and typically have a minimum charge for delivery. Thus using commercially-mixed concrete can be extremely expensive when only a few signs are installed at time. A need therefore exists, for an improved foundation system for installation of roadside signs that is economical to use when installing only one sign or only a few signs.

[0006] Further, there are numerous locations along almost any roadway that require sign placements in location that are extremely difficult and costly to access with a drilling truck and hand- or commercially-mixed concrete. These locations include steep side slopes and areas protected/separated from the roadway by metal beam guard fence or concrete barrier. These locations can normally be easily accessed by foot but not by large trucks and drilling equipment. A need therefore exists, for an improved foundation system for installation of roadside signs that does not require access by large trucks and drilling equipment.

[0007] Another disadvantage of the conventional drilled shaft concrete foundation for roadside sign use is that, once in place, such foundations cannot be moved or reused. Thus, removing a sign installed with such a foundation requires either: pulling up the entire foundation, back-filling the void, and disposal of a 400 pound chunk of concrete; or breaking the existing foundation back to 2' below the existing ground elevation, removal and disposal of 225 pounds of concrete rubble, and then backfilling the void. Moving the sign requires installation of a new concrete foundation at the new location, in addition to the foundation removal process just described. A need therefore exists, for an improved foundation system for installation of roadside signs that allows removal and/or reuse of the foundation.

SUMMARY

[0008] In one aspect thereof, the invention comprises a foundation system that can be used for both permanent and temporary roadside sign installation. The foundation is reusable and meets national safety requirements. As compared to conventional concrete sign foundation systems, this foundation requires less manpower to install, expends less nonrenewable resources to install, is adaptable to all soil types, can be installed in hard to reach locations more easily, does not generate earthen spoils, and allows sign installation up to 350 times faster than conventional foundations.

[0009] In another aspect thereof, the invention comprises a ground screw anchor foundation including an anchor plate of a breakaway system and a soil screw foundation. In preferred embodiments, the soil screw is steel. Embodiments of this ground screw anchor foundation can be screwed into and out of the ground with equal ease, and thus are totally reusable; unlike conventional concrete foundations. Embodiments of this ground screw anchor foundation can be installed in any soil type. Embodiments of this ground screw anchor foundation can be installed and ready for sign placement in less than 15 minutes, compared to the 96 hours for a sign placed on a concrete foundation (including cure time for the concrete), i.e., over 350 times faster than concrete foundations.

[0010] In other aspects thereof, the invention comprises an installation device and installation methods that require only one piece of installation equipment to install a foundation for the roadside sign. Various embodiments of the installation device are a hand-held, truck-mountable and/or mountable on a compact utility vehicle (UTV) (e.g., "Bobcat" utility vehicle). Various embodiments of the installation device are hydraulic powered and/or electric powered. The UTV-mountable installation device and/or the hand-held installation device allow for easy access to those hard to access locations,

cutting down on the need for specialized equipment and the expense to access these locations with large cumbersome drilling equipment needed for drilled shaft foundations.

[0011] In still further aspects, the invention includes methods for installing foundations for roadside signs that do not require any heavy, exhaustive lifting and/or concrete mixing as required for the conventional concrete foundations. Embodiments of the invention require only the lifting of a ground screw anchor foundation that weighs, on average, within the range from 18 to 21 pounds (as compared to five, 80 pound bags of concrete and 30 pounds of water that must be loaded, unloaded, and mixed for every drilled shaft).

[0012] In another aspect thereof, the invention comprises systems for installing a roadside sign that do not produce earthen spoils like a drilled shaft foundation. Embodiments of the ground screw anchor foundation do not displace soil upward. Instead, as the screw portion of the ground screw anchor foundation is pulled into the soil by the screw threads, the surrounding soil is displaced outward (not upward), thereby compacting/densifying the surrounding soil. Since there are no spoils like a concrete foundation, there is not 350 pounds of earthen spoils to haul away or spread around every foundation location. Such embodiments may save time, money, and labor effort compared to using a conventional concrete foundation.

[0013] In still another aspect thereof, the invention comprises a foundation system that is conservative of natural- and nonrenewable-resources and is 100% recyclable. Whereas; no part of a conventional concrete shaft foundation can be economically recycled, embodiments of the invention may be formed from steel (a recyclable material). Preferred embodiments may be formed from recycled steel. Further embodiments conserve resources since a sign crew and equipment are only required to travel to a foundation site one time (instead of twice) to complete installation of a sign foundation and sign. Thus, with respect to the expenditure of non-renewable fuel resources, installation in accordance with these embodiments is twice as efficient as the installation of a conventional concrete foundation.

[0014] In yet another aspect thereof, a ground screw anchor foundation for a roadside sign comprises at least one elongated soil screw defining a longitudinal axis. Each soil screw includes a barrel section having an upper end and a lower end defining a first length therebetween, and a substantially circular cross-section of a first diameter, viewed along the longitudinal axis. Each soil screw further includes a point section connected to the lower end of the barrel section, the point section tapering from a second diameter at a position along the longitudinal axis proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section. A helical thread is disposed around the longitudinal axis on an outer surface of at least a portion of the point section. The ground screw anchor foundation further comprises a first component of a breakaway system is mounted on the upper end of the barrel section of the soil screw.

[0015] In another embodiment, the first component of the breakaway system further comprises a plate member having a substantially planar upper surface. The plate member is mounted on the upper end of the barrel section such that the plane of the upper surface forms an angle with the longitudinal axis, the angle being within the range from 60° to 90°.

[0016] In another embodiment, the plate member of the first component of the breakaway system includes three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

[0017] In yet another embodiment, the ground screw anchor foundation further comprises a second soil screw disposed in a spaced-apart relation to the first soil screw, the longitudinal axis of the second soil screw being substantially parallel to the longitudinal axis of the first soil screw. The first component of the breakaway system includes a channel member mounted to the respective upper ends of the barrel sections of the first and second soil screws and a plate member having a substantially planar upper surface mounted on the beam such that the plane of the upper surface of the plate member forms an angle with the longitudinal axes of the soil screws, the angle being within the range from 60° to 90°.

[0018] In still another embodiment, the plate member of the first component of the breakaway system includes three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

[0019] In yet another aspect thereof, a method is provided for installing a ground screw anchor foundation for a roadside sign in a soil substrate, the foundation being adapted for supporting a roadside sign including a second component of a breakaway system, a sign post attached to an upper side of the second component, and a sign attached to the sign post. The method comprises the following steps: 1) providing a first elongated soil screw; 2) providing a first component of a breakaway system, the first component being cooperatively engageable in a breakaway manner to a second component of a breakaway system adapted for attachment to a roadside sign; 3) connecting the first component of the breakaway system to the upper end of the barrel section of the first soil screw; 4) releasably connecting a torque-supplying device to the first soil screw; 5) positioning the first soil screw such that the point section is disposed on a surface of a soil substrate and the longitudinal axis is oriented substantially perpendicular to the surface of the soil substrate; 6) rotating the first soil screw about its longitudinal axis with the torque supplying device until the helical thread on the point section engages the soil substrate and draws the point section a predetermined distance into the soil substrate; and 7) disconnecting the torque-supplying device from the first soil screw.

[0020] In another embodiment, the first component of the breakaway system further comprises a plate member mounted on the upper end of the barrel section of the soil screw, the plate member having a substantially planar upper surface, three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

[0021] In another embodiment, the first component of the breakaway system is connected to the soil screw before the soil screw is releasably connected to the torque-supplying device; and the torque-supplying device includes an adapter, the adapter being configured to releasably connect to the first component of the breakaway mounting member such that torque from the torque-supplying device is transmitted

through the adapter and through the first breakaway mounting member to rotate the soil screw around its longitudinal axis and into the soil.

[0022] In yet another embodiment, the torque-supplying device comprises an electric motor operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

[0023] In yet another embodiment, the torque-supplying device comprises a hydraulic motor operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

[0024] In still another embodiment, the torque-supplying device comprises an internal combustion engine operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

[0025] In a still further embodiment, the method further comprises the following steps: a) providing a second elongated soil screw; b) releasably connecting a torque-supplying device to the second soil screw; c) positioning the second soil screw such that the point section is disposed on the surface of the soil substrate and the longitudinal axis is oriented substantially perpendicular to the surface of the soil substrate; d) rotating the second soil screw about its longitudinal axis with the torque supplying device until the helical thread on the point section engages the soil substrate and draws the point section a predetermined distance into the soil substrate; e) disconnecting the torque-supplying device from the second soil screw; and attaching the first component of the breakaway system to the respective upper ends of the first and second soil screws

[0026] In another embodiment, the first component of the breakaway system further comprises a channel member connected to the respective upper ends of the first and second soil screws and a plate member mounted on the channel member. The plate member has a substantially planar upper surface and three lateral sides depending from the upper surface. The lateral sides are configured in the form of an equilateral triangle; and each lateral side is configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

[0027] In still another embodiment, the first component of the breakaway system further comprises a channel member connected to the respective upper ends of the first and second soil screws and a plate member mounted on the channel member. The plate member has a substantially planar upper surface and is mounted on the beam such that the plane of the upper surface of the plate member forms an angle with the longitudinal axes of the soil screws, the angle being within the range from 60° to 90°.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] For a more complete understanding, reference is now made to the following description taken in conjunction with the accompanying Drawings in which:

[0029] FIGS. **1***a*, **1***b* and **1***c* show a ground screw anchor foundation in accordance with a first embodiment having a triangular plate member, wherein FIG. **1***a* is a perspective view, FIG. **1***b* is a top view, and FIG. **1***c* is a side view;

[0030] FIG. **1***d* shows an alternative embodiment having a square plate member;

[0031] FIG. **1***e* shows an alternative embodiment having a rectangular plate member;

[0032] FIG. **2** shows a roadside sign mounted on the ground screw anchor foundation of FIGS. **1***a*, **1***b* and **1***c;*

[0033] FIG. **3** shows an enlarged partial view of a roadside sign assembly;

[0034] FIG. **4** shows a ground screw anchor foundation in accordance with another embodiment having multiple ground screw anchors and a triangular plate member;

[0035] FIGS. **5***a*, **5***b*, **5***c* and **5***d* show additional views of the first component of a breakaway system for the ground screw anchor foundation of FIG. **4**, wherein FIG. **5***a* is a perspective view, FIG. **5***b* is a top view, and FIG. **5***c* is an end view (i.e., viewed in the direction of line **408**) and FIG. **5***d* is a side view;

[0036] FIG. **5***e* shows an alternative embodiment having a square plate member;

[0037] FIG. **5***f* shows an alternative embodiment having a rectangular plate member;

[0038] FIG. **6** shows a roadside sign mounted on the ground screw anchor foundation of FIG. **4**; and

[0039] FIG. **7** shows installation of a ground screw anchor using a torque-supplying device and an adapter in accordance with another embodiment.

DETAILED DESCRIPTION

[0040] Referring now to FIGS. **1***a*, **1***b*, and **1***c*, there is illustrated a ground screw anchor foundation for a roadside sign in accordance with one embodiment. The ground screw anchor foundation **100** of this embodiment comprises an elongated soil screw **102** defining a longitudinal axis **104**. The soil screw **102** includes a barrel section **106** having an upper end **108** and a lower end **110** defining a first length (denoted L_1) therebetween. The barrel section **106** has a substantially circular cross-section of a first diameter (denoted D_1) when viewed along the longitudinal axis **104**. In some embodiments, the diameter D_1 of the barrel section **106** is within the range from 3.0 inches to 4.0 inches. In preferred embodiments, the diameter D_1 is within the range from 3.25 inches to 3.75 inches. In some embodiments, the diameter D_1 of the barrel section **106** is about 3.5 inches.

[0041] A point section **112** is connected to the lower end **110** of the barrel section **106**. The point section has an upper end **113** and a lower end **115** defining a second length (denoted L_2) therebetween. The point section **112** tapers from a second diameter (denoted D_2) at a position along the longitudinal axis **104** proximate to the barrel section **106** to a third diameter (denoted D_3) at a position along the longitudinal axis distal to the barrel section. In the illustrated embodiment, the taper of the point section **112** is a single, constant angle (i.e., conic taper); however, in other embodiments the taper of the point section may include two or more angles (i.e., bi-conic or multi-conic taper) or may change continuously (e.g., secant- or elliptical-ogive taper).

[0042] A helical thread **114** is disposed around the longitudinal axis **104** on an outer surface of at least a portion of the point section **112**. In some embodiments the thread **114** is disposed entirely on the point section **112**, while in other embodiments the helical thread may be disposed on portions of the barrel section **106** and the point section **112**. A first component **116** of a breakaway system mounted on the upper end **108** of the barrel section **106** of the soil screw **102**.

[0043] As best seen in FIG. **1***c*, in some embodiments, the first component **116** of the breakaway system may further comprise a plate member **118** having a substantially planar upper surface **120**. The plate member **118** is mounted on the upper end **108** of the barrel section **106** such that the plane **122** of the upper surface **120** forms an angle (denoted A_1) with the longitudinal axis **104**, the angle being within the range from

60° to 90°. Preferably, the plane **122** of the upper surface **120** forms an angle θ_1 with the longitudinal axis **104** within the range from 80° to 90°. In some embodiments, the upper surface **120** of the plate member **118** will be horizontal after installation of the foundation **100**.

[0044] As best seen in FIG. **1***b*, in some embodiments, the plate member **118** of the first component **116** of the breakaway system includes three lateral sides **124** depending from the upper surface **120**. The lateral sides **124** may be configured in the form of an equilateral triangle; with each lateral side being configured to terminate before reaching an apex **126** with an adjacent lateral side, thereby defining a notch **128** at each point of intersection (of the lines extending from the lateral sides). In other embodiments, the plate member **118** may be configured as a non-equilateral triangle.

[0045] Referring now also to FIGS. **1***d* and **1***e*, in still other embodiments, the plate member **118** may be configured with its upper surface **120** in the shape of a square, a rectangle or yet another different shape. FIG. **1***d* illustrates an embodiment of a first component **116** having a plate member **118'** configured in a square shape. FIG. **1***e* illustrates an embodiment of a first component **116** having a plate member **118"** configured in a rectangular shape. Whether configured as a triangle, a square, a rectangle or other shape, the plate member **118** of some embodiments may include notches **128** formed at each point of intersection of the lateral sides (i.e., at the "corners" of the plate member), whereas the plate members of other embodiments may not include notches.

[0046] Referring now to FIG. **2**, there is illustrated a roadside sign assembly in accordance with another embodiment. The roadside sign assembly **200** includes a roadside sign **202** mounted on the upper end **204** of a sign post **206**. A ground screw anchor foundation as disclosed herein is connected to the lower end **208** of the sign post **206**. In the embodiment illustrated in FIG. **2**, the ground screw anchor foundation is a foundation **100** substantially identical to the foundation described in connection with FIGS. **1***a*, **1***b* and **1***c*, however, other ground screw anchor foundations as disclosed herein may also be used. The sign post **206** includes on the lower end **208** a second component **210** of a breakaway system. The ground screw anchor foundation **100** is installed such that a majority of the soil screw **102** is substantially engaged in the soil substrate **212** (also referred to as "soil", "ground" or "earth") below the ground surface **214** (also referred to as "grade"). For purposes of illustration, the soil substrate **212** is shown in the Figures extending only a short distance below the grade **214**; however, it will be appreciated that the soil actually extends downward a substantial distance past the lower end of the soil screw(s).

[0047] In preferred embodiments, the soil **212** at the installation site for the roadside sign assembly **200** is unexcavated prior to installation of the soil screw, i.e., the soil screw **102** may be driven directly into unexcavated soil. Alternatively, the soil screw **102** may be driven into compacted soil, loose soil, clay, gravel or other ground substrates. The second component **210** of the breakaway system mounted on the lower end **208** of the sign post **206** is connected to the first component **116** of the breakaway system mounted on the upper end **108** of the soil screw **102**. In this manner, the roadside sign **202** and post **206** are securely supported by the ground screw anchor foundation **100** to form the roadside sign assembly **200**.

[0048] Referring now to FIG. **3**, there is illustrated an enlarged partial view of a roadside sign assembly **200**. For purposes of illustration, the soil screw **102** is shown "interrupted" such that its overall length (denoted L_3) is not completely shown. In some embodiments, the overall length L_3 of the soil screw is within the range from 30 inches to 60 inches. In preferred embodiments, the overall length L_3 is within the range from 36 inches to 54 inches. In other preferred embodiments, the overall length L_3 is within the range from 39 inches to 52 inches. Selection of the length L_3 for a particular foundation **100** or sign assembly **200** may be dependent on factors such as type of soil substrate and/or size of the sign to be supported. In some embodiments, the overall length L_3 is about 39.37 inches. In some other embodiments, the overall length L_3 is about 51.18 inches. The height (denoted H_1) above the top of the soil level **214** (also called "grade") of the ground screw anchor foundation **100**, measured at the upper surface **120** of the first component **116**, is preferably in the range of 4.5 inches to 0.5 inches. In more preferred embodiments, the height H_1 is in the range of 3.9 inches to 4.1 inches. In some embodiments, the height H_1 is about 4 inches.

[0049] Referring still to FIG. **3**, in preferred embodiments, the first and second components **116**, **210** of the breakaway system are connected to one another in a breakaway manner such that the sign post **206** will shear off the ground screw anchor foundation **100** if struck by a vehicle that has left the road. In the illustrated embodiment, the first component **116** comprises a triangular slip base mounted on the ground screw **102**, and the second component **210** comprises a complementary triangular slip base. Each component **116**, **210** has a plurality of notches **128** that are configured to align with the notches on the counterpart so as to receive a bolt **130** therein. The two components **116**, **210** may be secured in a breakaway manner by the bolt **130**, nuts **132** and washers **134** as shown in FIG. **3**. A bolt keeper plate **136** may be used to hold the bolts **130** in position during installation.

[0050] Referring now to FIG. **4**, there is illustrated another embodiment of a ground screw anchor foundation for a roadside sign. The ground screw anchor foundation **400** comprises a plurality of spaced-apart soil screws and a first component of a breakaway system connected to the plurality of spaced apart soil screws. The ground screw anchor foundation **400** is adapted to provide improved resistance to twisting moments imposed on the foundation by the sign being supported. Such twisting moments may be moments (denoted M_1) perpendicular to the longitudinal axis **401** of the sign post **206** (e.g., produced by wind load against the face of the sign) and/or moments (denoted M_2) parallel to the longitudinal axis of the sign post (e.g., produced by the edge of the sign "weather-vaning" into the wind). For purposes of illustration, only the lower portion of the sign, namely, sign post **206** and second component **210** of the breakaway system are shown in FIG. **4**.

[0051] The ground screw anchor foundation **400** of this embodiment comprises a first soil screw **402** that may be substantially similar to soil screw **102** previously disclosed. The ground screw anchor foundation **400** further comprises a second soil screw **404** disposed in a spaced-apart relation at a distance (denoted S_1) to the first soil screw **402**. The second soil screw **404** may be identical to the first soil screw **402**, or it may be different. In some embodiments, the second soil screw **404** may have the same diameters D_1, D_2 and/or D_3 and/or the same lengths L_1, L_2 and/or L_3 as the first soil screw **402**. The longitudinal axis **104'** of the first soil screw **402** is preferably oriented parallel to the longitudinal axis **104"** of the second soil screw **404**. In preferred embodiments, the soil

screws **402** and **404** are disposed such that a horizontal line **406** between their respective longitudinal axes **104'** and **104"** is oriented parallel to the direction of travel (denoted by arrow **408**). It will be appreciated that the face of a roadside sign is typically oriented perpendicular to the direction of travel **408**, therefore, the maximum wind load against the face of the sign (for a given wind speed) will occur in the direction of travel.

[0052] Referring still to FIG. **4**, and now also to FIGS. **5***a*, **5***b*, **5***c*, **5***d*, **5***e* and **5***f*, the first component **410** of the breakaway system is connected to the plurality of soil screws **402** and **404**. The first component **410** includes an elongated channel member **412** defining a lateral axis **413** and having a vertical length (denoted L_4), a plate member **418** and a substantially planar upper surface **420**. The plate member **418** is mounted on the channel member **412** so as to position the plate member a predetermined distance (denoted H_2) above the upper surface of the channel member. In the illustrated embodiment, a stub pipe **422** is connected between the channel member **412** and the plate member **418** to mount the plate member at the desired height H_2. In preferred embodiments, the height H_2 is 4 inches or less. The channel member **412** is preferably installed such that its upper surface is no higher than, or preferably below, the prevailing grade **214**. In such installations, only the plate member **418** and any mounting components (such as stub pipe **422**) will project above the prevailing grade **214**.

[0053] The plate member **418** may be mounted on the channel member **412** such that the plane **424** of the upper surface **420** forms an angle (denoted θ_2) with the longitudinal axis of the sign post **401** (which will be vertical), the angle being within the range from 60° to 90°. Preferably, the plane **424** of the upper surface **420** forms an angle θ_2 within the range from 80° to 90°. In some embodiments, the upper surface **420** of the plate member **418** is parallel to the upper surface of the channel member **412** (see, e.g., FIG. **5***d*), such that the upper surface of the plate member will be horizontal after level installation of the foundation **400**.

[0054] In some embodiments (see, e.g., FIGS. **5***a*-**5***d*), the plate member **418** of the first component **410** of the breakaway system includes three lateral sides **426** depending from the upper surface **420**. The lateral sides **426** may be configured in the form of an equilateral triangle (see, e.g., FIG. **5***b*); with each lateral side being configured to terminate before reaching an apex **428** with an adjacent lateral side, thereby defining a notch **430** at each point of intersection (of the lines extending from the lateral sides). In other embodiments, the plate member **418** may be configured as a non-equilateral triangle.

[0055] Referring now also to FIGS. **5***e* and **5***f*, in still other embodiments, the plate member **418** may be configured with its upper surface **420** in the shape of a square, a rectangular or yet another different shape. FIG. **5***e* illustrates an embodiment of a first component **410** having a plate member **418'** configured in a square shape. FIG. **5***f* illustrates an embodiment of a first component **410** having a plate member **418"** configured in a rectangular shape. Whether configured as a triangle, a square, a rectangle or other shape, the plate member **418** of some embodiments may include notches **430** formed at each point of intersection of the lateral sides (i.e., at the "corners" of the plate member), whereas the plate members of other embodiments may not include notches.

[0056] As best seen in FIGS. **5***a* and **5***c*, the channel member **412** may include a pair of side plates **414** connected to either side of a connecting web **416**. The side plates **414** preferably project from the connecting web **416** in the opposite direction from the plate member **418**. For example, when oriented for installation on the ground, the plate member **418** is positioned above the connecting web **416** and the side plates **414** are positioned below the plate member. This configuration allows the side plates **414** to more easily penetrate into the ground to a lower level than the connecting web **416** when the foundation is installed.

[0057] Referring now to FIG. **6**, there is illustrated a roadside sign assembly in accordance with another embodiment. The roadside sign assembly **600** includes a roadside sign **202** mounted on the upper end **204** of a sign post **206**. A ground screw anchor foundation **400** having multiple soil screws as disclosed herein is connected to the lower end **208** of the sign post **206**. In the embodiment illustrated in FIG. **6**, the ground screw anchor foundation **400** is substantially identical to the foundation described in connection with FIGS. **4**, **5***a*, **5***b*, **5***c* and **5***d*, however, other ground screw anchor foundations as disclosed herein may also be used. The sign post **206** includes a second component **210** of a breakaway system connected to the lower end **208**. The ground screw anchor foundation **400** is installed such that the soil screws **402** and **404** are substantially completely engaged in the soil substrate **212** below the ground surface **214**. The ground screw anchor foundation **400** comprises a plurality of spaced-apart soil screws **402**, **404** and a first component **410** of a breakaway system connected to the plurality of spaced apart soil screws. The roadside sign assembly **600** is adapted to provide improved resistance to wind loads.

[0058] A ground screw anchor foundation for a roadside sign, for example, a foundation **100** according to the embodiment of FIGS. **1***a*-**1***c* or FIG. **3**, may be installed in a soil substrate **212** in accordance with the following procedure: 1) providing a first elongated soil screw **102**; 2) providing a first component **116** of a breakaway system, the first component being cooperatively engageable in a breakaway manner to a second component of a breakaway system adapted for attachment to a roadside sign; 3) connecting the first component **116** of the breakaway system to the upper end **108** of the first soil screw **102**; 4) releasably connecting a torque-supplying device (**702**, FIG. **7**) to the first soil screw **102**; 5) positioning the first soil screw **102** such that the point section **112** is disposed on a surface of a soil substrate **212** and the longitudinal axis **104** is oriented substantially perpendicular to the surface **214** (i.e., grade) of the soil substrate; 6) rotating the first soil screw **102** about its longitudinal axis **104** with the torque supplying device **702** until the helical thread **114** on the point section **112** engages the soil substrate **212** and draws the point section a predetermined distance (e.g., a distance equal to L_3 minus H_1 in FIG. **3**) into the soil substrate; and 7) disconnecting the torque-supplying device **702** from the first soil screw **102**. Following this installation of the foundation, a sign assembly having a second component **210** of the breakaway system can be attached to the first component **116**.

[0059] Connection of the first component **116** to the soil screw **102** is typically performed using a permanent joining method such as welding, brazing, soldering or the like. In some embodiments, however, non-permanent connection methods such as threading or bolting may be used. In preferred embodiments of the installation method just described, the first component **116** is connected to the soil screw **102** prior to installing the soil screw in the ground; however, this is not required. In some embodiments, the first component

116 may be connected to the soil screw 102 after installation of the soil screw in the ground.

[0060] In some embodiments, the torque-supplying device 702 described herein may comprise an electric motor operatively connected to the soil screw 102 for rotating the soil screw around its longitudinal axis 104. In other embodiments, the torque-supplying device 702 may comprise a hydraulic motor or internal combustion engine operatively connected to the soil screw 102 for rotating the soil screw around its longitudinal axis 104. In preferred embodiments, the torque-supplying device 702 is a hydraulic- or electric-powered auger attachment mounted on a small utility vehicle (e.g., a Bobcat® utility vehicle) or utility truck (not shown). However, in other cases the torque-supplying device 702 may be a hand-held (motor-driven) auger drive, or even hand tools such as wrenches equipped with suitable torque-enhancing handles (i.e., "cheater bars").

[0061] In another embodiment of the installation method, the first component 116 of the breakaway system further comprises a plate member 118 mounted on the upper end of the barrel section 106 of the soil screw 102. In preferred embodiments, the plate member 118 may have a substantially planar upper surface 120 and three lateral sides 124 depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle. In some such embodiments, each lateral side 124 may be configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch 128 at each point of intersection.

[0062] Referring now to FIG. 7, in another embodiment, the first component 116 of the breakaway system is connected to the soil screw 102 before the soil screw is releasably connected to the torque-supplying device 702; and the torque-supplying device includes an adapter 700. The adapter 700 may be configured to releasably connect to the first component 116 such that torque from the torque-supplying device 702 is transmitted through the adapter and through the first breakaway mounting member to rotate the soil screw 102 around its longitudinal axis 104 and into the soil 212. The adapter 700 may include a drive plate 704 that is configured to be releasably connectable to the first component 116 using removable fasteners such as bolts 130 and nuts 132.

[0063] A ground screw anchor foundation for a roadside sign, for example, a foundation 400 having multiple soil screws according to the embodiments shown in FIGS. 4, 5*a*-5*d* and 6, may be installed in a soil substrate 212 in accordance with the following procedure: 1) providing a first elongated soil screw 402; 2) releasably connecting a torque-supplying device 702 to the first soil screw 402; 3) positioning the first soil screw 402 such that the point section 112 is disposed on a surface of a soil substrate 212 and the longitudinal axis 104 is oriented substantially perpendicular to the surface 214 (i.e., grade) of the soil substrate; 4) rotating the first soil screw 402 about its longitudinal axis 104 with the torque supplying device 702 until the helical thread 114 on the point section 112 engages the soil substrate 212 and draws the point section a predetermined distance (e.g., a distance equal to L_3 plus L_4) into the soil substrate; 5) disconnecting the torque-supplying device 702 from the first soil screw 402; 6) providing a second elongated soil screw 404; 7) releasably connecting a torque-supplying device 702 to the second soil screw 404; 8) positioning the second soil screw 404 such that the point section 112 is disposed on the surface 214 of the soil substrate 212 and the longitudinal axis 104 is oriented substantially perpendicular to the surface of the soil substrate and spaced-apart from the longitudinal axis of the first soil screw; 9) rotating the second soil screw 404 about its longitudinal axis 104 with the torque supplying device 702 until the helical thread 114 on the point section 112 engages the soil substrate 212 and draws the point section a predetermined distance into the soil substrate; 10) disconnecting the torque-supplying device 702 from the second soil screw 404; 11) providing a first component 410 of a breakaway system, the first component being cooperatively engageable in a breakaway manner to a second component of a breakaway system adapted for attachment to a roadside sign; 12) connecting the first component 410 to the upper end 108 of the first soil screw 402; and 13) connecting the first component 410 to the upper end 108 of the second soil screw 404.

[0064] In one embodiment of the method just described, the first component 410 of the breakaway system further comprises a channel member 412 connected to the respective upper ends 108 of the first and second soil screws 402 and 404 and a plate member 418 mounted on the channel member. The plate member 418 may have a substantially planar upper surface 420 and three lateral sides 426 depending from the upper surface. The lateral sides 426 may be configured in the form of an equilateral triangle; and each lateral side may be configured to terminate before reaching an apex 428 with an adjacent lateral side, thereby defining a notch 430 at each point of intersection.

[0065] Although the preferred embodiment has been described in detail, it should be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A ground screw anchor foundation for a roadside sign having a second component of a breakaway system, the ground screw anchor foundation comprising:

at least one elongated soil screw defining a longitudinal axis, each soil screw including

a barrel section having an upper end and a lower end defining a first length therebetween, and a substantially circular cross-section of a first diameter, viewed along the longitudinal axis,

a point section connected to the lower end of the barrel section, the point section tapering from a second diameter at a position along the longitudinal axis proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section; and

a helical thread disposed around the longitudinal axis on an outer surface of at least a portion of the point section; and

a first component of a breakaway system mounted on the upper end of the barrel section of the soil screw, the first component being adapted for releasable connection in a breakaway manner to a second component on a roadside sign.

2. A ground screw anchor foundation in accordance with claim 1, wherein the first component of the breakaway system further comprises:

a plate member having a substantially planar upper surface; and

wherein the plate member is mounted on the upper end of the barrel section such that the plane of the upper surface forms an angle with the longitudinal axis, the angle being within the range from 60° to 90°.

3. A ground screw anchor foundation in accordance with claim 2, wherein the plate member of the first component of the breakaway system includes:

three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and

each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

4. A ground screw anchor foundation in accordance with claim 1, further comprising:

a second soil screw disposed in a spaced-apart relation to the first soil screw, the longitudinal axis of the second soil screw being substantially parallel to the longitudinal axis of the first soil screw; and

wherein the first component of the breakaway system includes

a channel member mounted to the respective upper ends of the barrel sections of the first and second soil screws and

a plate member having a substantially planar upper surface mounted on the beam such that the plane of the upper surface of the plate member forms an angle with the longitudinal axes of the soil screws, the angle being within the range from 60° to 90°.

5. A ground screw anchor foundation in accordance with claim 4, wherein the plate member of the first component of the breakaway system includes:

three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and

each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

6. A method for installing a ground screw anchor foundation for a roadside sign in a soil substrate, the foundation adapted for supporting a roadside sign including a second component of a breakaway system, a sign post attached to an upper side of the second component, and a sign attached to the sign post, the method comprising the following steps:

providing a first elongated soil screw defining a longitudinal axis, the first soil screw including

a barrel section having an upper end and a lower end defining a first length therebetween, and a substantially circular cross-section of a first diameter, viewed along the longitudinal axis,

a point section connected to the lower end of the barrel section, the point section tapering from a second diameter at a position along the longitudinal axis proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section; and

a helical thread disposed around the longitudinal axis on an outer surface of at least a portion of the point section; and

providing a first component of a breakaway system, the first component being cooperatively engageable in a breakaway manner to a second component of a breakaway system adapted for attachment to a roadside sign;

connecting the first component of the breakaway system to the upper end of the barrel section of the first soil screw;

releasably connecting a torque-supplying device to the first soil screw;

positioning the first soil screw such that the point section is disposed on a surface of a soil substrate and the longitudinal axis is oriented substantially perpendicular to the surface of the soil substrate;

rotating the first soil screw about its longitudinal axis with the torque supplying device until the helical thread on the point section engages the soil substrate and draws the point section a predetermined distance into the soil substrate; and

disconnecting the torque-supplying device from the first soil screw.

7. A method for installing a ground screw anchor foundation in accordance with claim 6, wherein the first component of the breakaway system further comprises:

a plate member mounted on the upper end of the barrel section of the soil screw, the plate member having

a substantially planar upper surface,

three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and

each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

8. A method for installing a ground screw anchor foundation in accordance with claim 6, wherein:

the first component of the breakaway system is connected to the soil screw before the soil screw is releasably connected to the torque-supplying device; and

the torque-supplying device includes an adapter, the adapter being configured to releasably connect to the first component of the breakaway mounting member such that torque from the torque-supplying device is transmitted through the adapter and through the first breakaway mounting member to rotate the soil screw around its longitudinal axis and into the soil.

9. A method for installing a ground screw anchor foundation in accordance with claim 7, wherein the torque-supplying device comprises an electric motor operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

10. A method for installing a ground screw anchor foundation in accordance with claim 7, wherein the torque-supplying device comprises a hydraulic motor operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

11. A method for installing a ground screw anchor foundation in accordance with claim 7, wherein the torque-supplying device comprises an internal combustion engine operatively connected to the soil screw for rotating the soil screw around its longitudinal axis.

12. A method for installing a ground screw anchor foundation in accordance with claim 6, wherein the method further comprises:

providing a second elongated soil screw defining a longitudinal axis, the second soil screw including

a barrel section having an upper end and a lower end defining a first length therebetween, and a substantially circular cross-section of a first diameter, viewed along the longitudinal axis,

a point section connected to the lower end of the barrel section, the point section tapering from a second diameter at a position along the longitudinal axis

proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section; and

a helical thread disposed around the longitudinal axis on an outer surface of at least a portion of the point section;

releasably connecting a torque-supplying device to the second soil screw;

positioning the second soil screw such that the point section is disposed on the surface of the soil substrate and the longitudinal axis is oriented substantially perpendicular to the surface of the soil substrate;

rotating the second soil screw about its longitudinal axis with the torque supplying device until the helical thread on the point section engages the soil substrate and draws the point section a predetermined distance into the soil substrate;

disconnecting the torque-supplying device from the second soil screw;

wherein the first component of the breakaway system is attached to the respective upper ends of the first and second soil screws

13. A method for installing a ground screw anchor foundation in accordance with claim **12**, wherein the first component of the breakaway system further comprises:

a channel member connected to the respective upper ends of the first and second soil screws; and

a plate member mounted on the channel member, the plate member having

a substantially planar upper surface,

three lateral sides depending from the upper surface, the lateral sides being configured in the form of an equilateral triangle; and

each lateral side being configured to terminate before reaching an apex with an adjacent lateral side, thereby defining a notch at each point of intersection.

14. A method for installing a ground screw anchor foundation in accordance with claim **12**, wherein the first component of the breakaway system further comprises:

a channel member connected to the respective upper ends of the first and second soil screws; and

a plate member mounted on the channel member, the plate member having a substantially planar upper surface and being mounted on the beam such that the plane of the upper surface of the plate member forms an angle with the longitudinal axes of the soil screws, the angle being within the range from 60° to 90°.

15. A ground screw anchor foundation for a roadside sign having a second component of a breakaway system, the ground screw anchor foundation comprising:

a first elongated soil screw defining a first longitudinal axis;

a second elongated soil screw defining a second longitudinal axis;

each soil screw including

a barrel section extending along the longitudinal axis and having an upper end and a lower end defining a first length therebetween, and a substantially circular cross-section of a first diameter, viewed along the longitudinal axis,

a point section connected to the lower end of the barrel section, the point section tapering from a second diameter at a position along the longitudinal axis proximate to the barrel section to a third diameter at a position along the longitudinal axis distal to the barrel section; and

a helical thread disposed around the longitudinal axis on an outer surface of at least a portion of the point section;

an elongated channel member defining a lateral axis and mounted to the upper ends of the first and second soil screws such that the respective longitudinal axes of the soil screws are oriented substantially parallel to one another, substantially perpendicular to the lateral axis of the channel member and spaced apart from one another along the lateral axis; and

a plate member having a substantially planar upper surface, the plate member rigidly connected to an upper surface of the channel member such that the planar upper surface is disposed at a predetermined height above the channel member;

wherein the plate member is configured as a first component of a breakaway system, the first component being adapted for releasable connection in a breakaway manner to a second component on a roadside sign.

16. A ground screw anchor foundation in accordance with claim **15**, wherein the channel member further comprises:

a connecting web;

a pair of side plates connected to either side of the connecting web;

wherein the side plates project from the connecting web in the opposite direction from the plate member.

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