ONE-PIECE Z-SHAPED FLAT PLATE FOUNDATIONS AND METHOD OF FORMING SAME

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Division of application No. 14/708,608, filed on May 11, 2015, now Pat. No. 9,422,687, which is a division of application No. 14/346,656, filed on Mar. 21, 2014, now abandoned, filed as application No. PCT/US12/56699 on Sep. 21, 2012.


A one-piece, Z shaped steel plate foundation comprising a main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation, a single rear flange extending perpendicular to the main plate body in a first direction at a rear edge of the main plate body, wherein the single rear flange does not extend past the main plate body in the direction opposite the first direction, a single front flange extending perpendicular to the main plate body in the direction opposite the first direction at a front edge of the main plate body, wherein the single front flange does not extend past the main plate body in the first direction; and a plurality of mounting holes at the top of the one-piece metal plate foundation configured for attachment to the structure to be supported.
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RELATED APPLICATIONS


BACKGROUND INFORMATION

[0005] 1. Field of the Invention

[0006] The present invention relates to various flat-plate foundation supports that provide a foundation anchor for various ground supported structures.

[0007] 2. Background Information

[0008] The present invention relates to a foundation apparatus, a method of providing structural support, and method of making, using, and installing the foundation apparatus for structural support. For background consider U.S. Patent No. 4,882,891, which is incorporated herein by reference, which relates to an apparatus and method for installing a structural anchor or foundation in an earthen hole wherein the foundation includes radian vanes for resisting turning moments. For further similar background see U.S. Pat. No. 4,974,997, this is also incorporated herein by reference, and which discloses a hydraulic setting tool assembly that is particularly useful for installing a structural anchor or foundation in an earthen hole.

[0009] U.S. Pat. Pub. No. 2003-0085394, which is incorporated herein by reference, discloses a metal foundation or support post for a guardrail system having a plurality of the vertical support posts supporting a plurality of guardrail beams. Each post includes a pair of flanges having free edge portions with edge folds defining tubular beads on the free edge portions to provide reinforcement and desired to utilize a minimum amount of material usage for the posts.

[0010] U.S. Pat. Pub. Nos. 2014-0008594, 2012-0205603, and 2011-0186795, are incorporated herein by reference, disclose a metal foundation or highway guardrail post which comprises an elongated one-piece roll-formed metal body including a front wall defining an attachment face, a pair of opposing side walls orthogonal to the front wall, a first pair of inverted corners respectively connecting the pair of side walls to the front wall, and a second pair of inverted corners respectively extending from the pair of side walls and terminating in a pair of spaced rear edges to define a rear access opening opposite the front wall. The guardrail posts may be manufactured by roll-forming a metal sheet or coil and cutting the roll-formed metal sheet or coil into lengths.

[0011] There remains a need in the art for cost effective easy to install foundations. The foundations of the present invention reduces or eliminates the need for specialized installation equipment such as is the case for drilled foundations. The foundations of the present invention also substantially eliminate the expenses associated with the handling and disposal of excavation spoils, placing of concrete reinforcing rods, trucking and placement of concrete, and time delay associated with concrete curing before the foundation can be put in service.

SUMMARY OF THE INVENTION

[0012] This invention is directed to a flat-plate foundation support which includes a lower portion extending longitudinally along a central longitudinal axis of the support and adapted for insertion into a ground surface. The lower portion has a plurality of flat plates that are mutually connected along the central longitudinal axis of the support and extend laterally or radially from the central longitudinal axis. The flat plates are beveled and have a sharpened leading edge at a lower end of the lower portion. An upper portion of the support is attached to a top end of the lower portion. The upper portion of the support is attached to a ground supported apparatus to anchor the apparatus to the ground.

[0013] According to an embodiment of the present invention, the upper portion is a cylindrical pipe disposed over the top end of the lower portion and having an inner surface attached to the individual flat plates, which extend above the ground surface.

[0014] According to another embodiment of the present invention, the upper portion is a top plate that is disposed on the top end of the lower portion such that the plate extends across the top edges flat plates of the lower portion, which are disposed flush with the ground surface such that the top plate is disposed on the ground surface.

[0015] According to another embodiment of the present invention, the lower portion of the support includes an elongated plate having a center portion that is beveled, with respect to the longitudinal axis of the lower portion, and a bottom portion that is beveled more sharply, with respect to the longitudinal axis. The leading edge of both the center and bottom portions of the elongated plate are sharpened. The lower portion also includes a pair of side plates disposed on either side of the elongated plate and connected to the elongated plate along the central longitudinal axis. The lower end of the side plates is beveled and includes a sharpened leading edge. The length of the side plates along the central longitudinal axis is shorter than the length of the elongated plate such that the side plates are buried in the ground surface while the top end of the elongated plate extends above the ground surface. The upper portion of the support includes a pair of support plates disposed on top of
opposing lateral ends of the elongated plate. The support plates may additionally be supported by one or more triangular gussets extending between the elongated plate and the support plate. One structure, such as an A-frame structure, or plural ground supported structures may be anchored according this embodiment.

[0016] According to another embodiment of the invention a one-piece, Z shaped steel plate foundation comprises a main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation, a single rear flange extending perpendicular to the main plate body in a first direction at a rear edge of the main plate body, wherein the single rear flange does not extend past the main plate body in the direction opposite the first direction, a single front flange extending perpendicular to the main plate body in the direction opposite the first direction at a front edge of the main plate body, wherein the single front flange does not extend past the main plate body in the first direction, and a plurality of mounting holes at the top of the one-piece metal plate foundation configured for attachment to the structure to be supported.

[0017] According to another embodiment of the invention a method of forming a one-piece metal plate foundation comprising the steps of: Providing a single flat steel plate wherein a central portion of the single flat plate forms a main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation; Bending a single rear flange extending at an angle from the main plate body in a first direction at a rear edge of the main plate body; and Bending a single front flange extending at an angle from the main plate body in the direction opposite the first direction at a front edge of the main plate body.

[0018] The features that characterize the present invention are pointed out with particularity in the claims which are part of this disclosure. These and other features of the invention, its operating advantages and the specific objects obtained by its use will be more fully understood from the following detailed description in connection with the attached figures.

BRIEF DESCRIPTION OF THE FIGURES

[0019] FIG. 1A is a side view of a flat plate foundation support according to one embodiment of the present invention.

[0020] FIG. 1B is an enlarged side view of a single fin of the flat plate foundation support shown in FIG. 1A.

[0021] FIG. 2 is a cross-sectional view of the foundation support taken along lines “A-A”, shown in FIG. 1A.

[0022] FIG. 3 is a cross-sectional view of the foundation support taken along lines “B-B”, shown in FIG. 1A.

[0023] FIG. 4A is a side view of a flat plate foundation support according to another embodiment of the present invention.

[0024] FIG. 4B is an enlarged side view of a single fin of the flat plate foundation support shown in FIG. 4A.

[0025] FIG. 5 is a cross-sectional view of the foundation support taken along lines “A-A”, shown in FIG. 4A.

[0026] FIG. 6 is a top plan view of the foundation support of FIG. 4A.

[0027] FIG. 7 is a detailed side view of the foundation support of FIG. 4A, illustrating a connection between the foundation support and a ground supported structure.

[0028] FIG. 8A is a front side view of a flat plate foundation support according to another embodiment of the present invention.

[0029] FIG. 8B is an enlarged side view of a single fin of the flat plate foundation support shown in FIG. 8A taken along lines D-D of FIG. 8A.

[0030] FIG. 9 is a left side view of the flat plate foundation of FIG. 8A.

[0031] FIG. 10 is a top plan view of the flat plate foundation of FIG. 8A.

[0032] FIG. 10A is an enlarged top plan view of an adjustable mounting hole configuration of the flat plate foundation of FIG. 10.

[0033] FIG. 11 is a detailed view of a gusset plate for use in the flat plate foundation support of FIG. 8.

[0034] FIG. 12 is a perspective view of a one-piece, z-shaped flat metal plate foundation support according to one embodiment of the present invention.

[0035] FIG. 13 is a front elevation view of the one-piece, z-shaped flat metal plate foundation support shown in FIG. 12.

[0036] FIG. 14 is a side elevation view of the one-piece, z-shaped flat metal plate foundation support shown in FIG. 12.

[0037] FIG. 15 is a top plan view of the one-piece, z-shaped flat metal plate foundation support shown in FIG. 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] For purposes of the description hereinafter, spatial orientation terms, if used, shall relate to the referenced embodiment as it is oriented in the accompanying drawing figures or otherwise described in the following detailed description. However, it is to be understood that the embodiments described hereinafter may assume many alternative variations and embodiments. It is also to be understood that the specific devices illustrated in the accompanying drawing figures and described herein are simply exemplary and should not be considered as limiting.

[0039] FIGS. 1-3 illustrate a flat plate foundation support 10, or anchor 10, for supporting and anchoring a ground supported structure according to one embodiment of the present invention. The foundation support 10 extends longitudinally along a central longitudinal axis. A lower portion of the support is adapted to be inserted into a ground surface below the grade 12. The lower portion of the support 10 includes a plurality of flat plates 14 and 16 that are mutually connected along the central longitudinal axis.

[0040] As shown in FIGS. 2 and 3, the lower portion is made up of two flat plates 14 and 16, a longer first plate 14 that is bent at an angle in the middle and a second flat plate 16 that is attached to the first plate 14 at the apex angle by a suitable method, such as welding. Each side of the single bent plate 14 forms a “flat” plate 14 extending radially from the center axis. Accordingly, the lower portion of the foundation support 10 is made up of three longitudinal fins (14 and 16) that extend laterally or radially from the central longitudinal axis (corresponding to the apex of the angle of the bent flat plate) and are equally spaced at angles of 120°. It is to be appreciated that the lower portion of the foundation support 10 may be of a variety of different configurations of flat plates having two or more fins.

[0041] As shown in FIG. 1A, the flat plates 14 and 16 making up the lower portion of the foundation support 10 are beveled at an angle of 60° at the lower end and as shown in
FIG. 1B have sharpened leading edges to facilitate placement of the foundation support 10 into the ground surface 12.

With further reference to FIG. 1, an upper portion of the foundation support 10 is provided for connecting to and supporting the ground supported structure. As shown, the upper portion is a cylindrical pipe 18 that is disposed over a top end of the lower portion so that the upper and lower portions are co-extensive along the central longitudinal axis for a certain length, such as 6 inches shown at 20. An inner surface of the cylindrical pipe 18 is connected to the lateral edges of the flat plates 14 and 16 by a suitable method, such as welding along the lateral edges of the fins in the longitudinal direction.

It is to be appreciated that the foundation support 10 may be of any longitudinal length and the upper and lower portions may be of varying relative longitudinal lengths depending on the conditions of use. Additionally, the flat plates 14 and 16 may also be of varying thickness and lateral lengths extending from the central longitudinal axis and the diameter of the cylindrical pipe of the upper portion may be of a corresponding diameter depending on the conditions of use.

It is also to be appreciated that individual foundation supports may be pre-assembled and then shipped to a construction site for installation. In particular, the individual foundation supports 10 may be inserted into the ground surface individually by using a vibrator or push-it machine to apply vibration to the lower portion of the foundation support 10 while pushing downward on the top end in order to insert the foundation support into the ground 12 beginning with the beveled lower end. It is also to be appreciated that, depending on the application and conditions of the ground surface 12, the foundation support 10 may be inserted into the ground surface 12 without the necessity of pre-drilling a hole in the ground surface 12. Alternatively, the foundation support 10 may be installed in a pre-drilled hole depending on the conditions of the ground surface 12. Additionally, use of the foundation support 10 according to this embodiment substantially eliminates the need for backfilling of soil and/or concrete to complete the foundation, thus saving substantial construction time and costs. A ground supported structure may then be attached to the top of the cylindrical pipe. In operation, one or more foundation supports 10 may be provided to support a single structure.

FIGS. 4-7 illustrate a flat plate foundation support 30, or anchor 30 according to another embodiment of the present invention. As shown, the lower portion of the foundation support 30 is substantially the same as the embodiment of support 10 discussed above with reference to FIGS. 1-3.

The upper portion is distinct and comprises a top plate 32 that is disposed on the top end of the lower portion such that the top plate 32 extends across the top edges of the flat plates 14 and 16 of the lower portion, which are disposed flush with the ground surface 12 such that the top plate 32 is disposed on or near the ground surface 12. A ground supported structure is then attached to the top plate. Typically, the ground supported structure will include a mounting plate 34 having a corresponding structure to the top plate 32 of the support foundation 30. The two plates 32 and 34 may then be connected by known methods, such as bolt fasteners 36, as best shown in FIG. 7.

FIGS. 8-11 illustrate another flat plate foundation support 50, or anchor according to an embodiment of the present invention. As shown in FIGS. 8-10, the lower portion of the foundation support 50 includes an elongated flat plate 54 having two beveled portions. A center portion of the elongated plate 54 is beveled at 56, with respect to the longitudinal axis of the lower portion, at a relatively shallow angle. A bottom portion of the plate 54 is more sharply beveled at 58 with respect to the longitudinal axis. The leading edges of both the center and bottom portions of the elongated plate are sharpened.

The lower portion of the foundation support 50 also includes a pair of side plates 60, or side fins 60, disposed on opposing sides of the elongated plate 54 and connected to the elongated plate 54 along the central longitudinal axis by known methods, such as welding of the plates 60 along the central longitudinal axis. The lower ends of the side plates 60 are also beveled and include sharpened leading edges. It is to be appreciated that the beveled portions and sharpened edges are provided to facilitate the installation of the lower portion of the foundation support 50 without the necessity of pre-drilling or digging of a hole in the ground surface. The length of the side plates 60 along the central longitudinal axis is shorter than the length of the elongated plate 54, such that the side plates 60 are buried in the ground surface 12, while the top end of the elongated plate 54 extends above the ground surface 12.

As shown in FIGS. 8-10, the upper portion of the support includes a pair of support plates 62 disposed on top of opposing lateral ends of the elongated plate 54. As shown in FIG. 10, the support plates 62 include adjustable mounting holes 64 to facilitate attachment of varying configuration of mounting plates of the ground supported structure. Each support plate 62 may additionally be supported by one or more triangular gussets 66 (four are shown for each plate 62) extending between the elongated plate 54 and the support plate 62, as shown in FIGS. 9 and 11. One structure, such as an A-frame structure 70 shown in FIG. 8, or plural ground supported structures may be anchored by a single foundation support 50 according this embodiment. In particular, each of the legs of the A-frame structure 70 shown in FIG. 8 includes a mounting plate 72 attached to the top plate 62 of the foundation support 50 by one or more fasteners. The A-frame structure supports a solar collector array.

It is to be appreciated that the foundation support 50 shown in FIGS. 8-11 may be of any longitudinal length and the elongated and side plates 54 and 60 may be of varying lateral widths extending from the central longitudinal axis. Additionally, the top plates 62 may also be of varying thickness depending on the conditions of use.

It is also to be appreciated that individual foundation supports 50 may be pre-assembled and then shipped to a construction site for installation. In particular, the individual foundation supports 50 may be inserted into the ground surface individually by using a vibrator or push-it machine to apply vibration to the foundation support 50 while pushing downward on the top end in order to insert the foundation support 50 into the ground 12 beginning with the beveled lower end 58. It is also to be appreciated that, depending on the application and conditions of the ground surface 12, the foundation support 50 may be inserted into the ground surface 12 without the necessity of pre-drilling a hole in the ground surface 12. Alternatively, the foundation support 50 may be installed in a pre-drilled hole depending
on the conditions of the ground surface. Additionally, use of the foundation support 50 according to this embodiment eliminates the need for backfilling of soil and/or concrete to complete the foundation, thus saving substantial construction time and costs. A ground supported structure, such as 70, may then be attached to the top plates 62 at the lateral ends of the elongated plate 54, as discussed above.

[0052] FIGS. 12-13 illustrate another flat plate foundation support 80, or anchor according to an embodiment of the present invention. Specifically, the support 80 is a one-piece, Z shaped steel plate foundation 80. The foundation 80 includes a main plate body 82 extending the longitudinal length of the foundation 80 from a top to a bottom of the foundation 80.

[0053] The foundation 80 includes a single rear flange 84 extending at an angle, preferably perpendicular, to the main plate body 82 in a first direction at a rear edge of the main plate body 82, wherein the single rear flange 84 does not extend past the main plate body 82 in the direction opposite the first direction.

[0054] The foundation 80 includes a single front flange 86 extending at an angle, preferably perpendicular, to the main plate body 82 in the direction opposite the first direction at a front edge of the main plate body 82, wherein the single front flange 86 does not extend past the main plate body 82 in the first direction.

[0055] The foundation 80 includes a plurality of mounting holes 88 at the top of the one-piece metal plate foundation 80 configured for attachment to the structure 100 to be supported. A pair of elongated oval shaped mounting holes in the main body 82 extending at an angle relative to elongated mounting holes on the associated structure 100 give adjustment in two directions for the coupling of the foundation 80 to the structure 100 (i.e., horizontal adjustment along mounting holes 88 and vertical adjustment along mounting holes in the structure 100).

[0056] In the one piece metal plate foundation 80 according to FIGS. 12-15, it is preferred that the rear flange 84 and the front flange 86 extend substantially parallel to each other and having them extend substantially perpendicular to the main plate body 82 is preferred.

[0057] The one-piece metal plate foundation 80 according to FIGS. 12-15 preferably provides a bottom of the main plate body 82 which is beveled and wherein a bottom of the rear flange 84 and the front flange 86 are beveled. This construction assists in installation of the foundation 80.

[0058] It is to be appreciated that the above-described embodiments of a flat plate foundation supports 10, 30 and 50 may be manufactured according to any technique known to be suitable to those having ordinary skill in the art and may be made from any material known to be suitable to those having ordinary skill in the art. According to one embodiment of the present invention, the flat plate foundation supports 10, 30 and/or 50 are made from steel and individual steel pieces of the foundation support are connected by welding and are pre-assembled and shipped to a construction site ready for installation.

[0059] A preferred method of forming the one-piece Z-shaped steel plate foundation 80 of FIGS. 12-15 comprising the steps of: providing a single flat steel plate wherein a central portion of the single flat plate forms the main plate body 82 extending the longitudinal length of the foundation 80 from a top to a bottom of the foundation 80; bending the single rear flange 84 extending at an angle from the main plate body 82 in a first direction at a rear edge of the main plate body; and bending the single front flange 86 extending at an angle from the main plate body 82 in the direction opposite the first direction at a front edge of the main plate body 82. As noted above, preferably the rear flange 84 and the front flange 86 are bent to extend substantially parallel to each other and to extend substantially perpendicular to the main plate body 82. The method of forming the one-piece metal plate foundation 80 according to FIGS. 12-15 may further include the step of hot dip galvanizing the one-piece metal plate foundation. The method of forming the one-piece metal plate foundation 80 according to FIGS. 12-15 may further include the step of beveling a bottom of the main plate body and of beveling a bottom of both the rear flange 84 and the front flange 86.

[0060] According to another embodiment of the present invention, the flat plate foundation supports 10, 30, 50 and/or 80 may be installed by a metal foundation push-it and installation apparatus of the type disclosed in U.S. Pat. Nos. 5,660,504, 5,733,068, and 5,944,452, all of which are incorporated herein by reference.

[0061] While several embodiments of a flat plate foundation support were described in the foregoing detailed description, those skilled in the art may make modifications and alterations to these embodiments without departing from the scope and spirit of the invention. Accordingly, the foregoing description is intended to be illustrative rather than restrictive. The invention described hereinabove is defined by the appended claims and all changes to the invention that fall within the meaning and the range of equivalency of the claims are embraced within their scope.

What is claimed is:

1. A one-piece metal plate foundation comprising:
   A main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation;
   A single rear flange extending at an angle from the main plate body in a first direction at a rear edge of the main plate body, wherein the single rear flange does not extend past the main plate body in the direction opposite the first direction; and
   A single front flange extending at an angle from the main plate body in the direction opposite the first direction at a front edge of the main plate body, wherein the single front flange does not extend past the main plate body in the first direction.

2. The one-piece metal plate foundation according to claim 1 wherein the rear flange and the front flange extend substantially parallel to each other.

3. The one-piece metal plate foundation according to claim 2 wherein the rear flange and the front flange extend substantially perpendicular to the main plate body.

4. The one-piece metal plate foundation according to claim 3 wherein the one piece metal plate foundation is formed from a single flat steel plate bent to form the rear flange and the front flange.

5. The one-piece metal plate foundation according to claim 4 wherein the one-piece metal plate foundation is galvanized.

6. The one-piece metal plate foundation according to claim 5 wherein a bottom of the main plate body is beveled.

7. The one-piece metal plate foundation according to claim 6 further including at least one mounting hole at the top of the one-piece metal plate foundation configured for attachment to the structure to be supported.
8. The one-piece metal plate foundation according to claim 7 wherein a plurality of mounting holes are provided.

9. The one-piece metal plate foundation according to claim 8 wherein each mounting hole is an elongated oval shaped mounting hole.

10. The one-piece metal plate foundation according to claim 8 wherein each mounting hole is an elongated oval shaped mounting hole.

11. A method of forming a one-piece metal plate foundation comprising the steps of:

Providing a single flat steel plate wherein a central portion of the single flat plate forms a main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation.

12. The method of forming the one-piece metal plate foundation according to claim 11 wherein the rear flange and the front flange are bent to extend substantially parallel to each other.

13. The method of forming the one-piece metal plate foundation according to claim 12 wherein the rear flange and the front flange are bent to extend substantially parallel to the main plate body.

14. The method of forming the one-piece metal plate foundation according to claim 13 further including the step of hot dip galvanizing the one-piece metal plate foundation.

15. The method of forming the one-piece metal plate foundation according to claim 14 further including the step of beveling a bottom of the main plate body.

16. The method of forming the one-piece metal plate foundation according to claim 15 further including the step of forming a plurality of mounting holes at the top of the one-piece metal plate foundation configured for attachment to the structure to be supported.

17. The method of forming the one-piece metal plate foundation according to claim 16 further including the step of beveling a bottom of both the rear flange and the front flange.

18. The method of forming the one-piece metal plate foundation according to claim 17 wherein each mounting hole is an elongated oval shaped mounting hole.

19. A one-piece, Z shaped steel plate foundation comprising:

A main plate body extending the longitudinal length of the foundation from a top to a bottom of the foundation;

20. The one-piece, Z shaped steel plate foundation according to claim 19 wherein each mounting hole is an elongated oval shaped mounting hole and wherein the bottom of the main plate body is beveled.

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