

PRECAST PILE ASSEMBLY WITH UNITARY SOCKET MODULE

FIELD OF THE INVENTION

[0001] This invention relates to precast piles, and more particularly to a joint to connect precast piles together.

BACKGROUND OF THE INVENTION

[0002] Pre-cast reinforced concrete piles are common structural foundation elements used to support structures such as buildings, bridges, oil rigs, etc. These pre-cast concrete piles may be fabricated off-site and delivered into project sites. The precast pile is a long section of reinforced concrete that is driven or jacked into the ground to act as a steady support for structures built on top of it.

[0003] Precast piles are installed via percussion hammers or jacked-in under reaction counterweights. Often more than one pile (sometimes of varying lengths) needs to be used and a various mechanisms have been developed to connect precast piles together. Joining concrete piles presents several challenges, such as proper alignment of the pile sections. Alignment is critical to prevent slippage, bending stresses, and other problems associated with pile splices. In the conventional method of installation, pre-qualified welders are appointed for welding the precast

piles together. On completion of welding, any weld slag will be chipped off and wire brushed. The completed weld joint will be subjected to cooling followed by visual inspection, prior to resumption of installation. Welding equipment and accessories are often required to be shifted in-between various piling locations. Also welding equipment also needs to be regularly inspected and serviced-maintained, with cables elevated from the ground for safety reasons, and welding electrodes need to be properly stored. Further, welding works emit high heat and toxic fumes and requires good workmanship to produce a quality splice and the welding process can be relatively time-consuming.

[0004] It is important to align such precast piles together accurately so that each pile efficiently transmits load to the pile below it. One solution is disclosed in Singapore Patent Application SG 10202111812P which shows a joint design connecting two pile sections together which eliminates the need for welding to connect a pair of piles together. It would be desirable to provide an improved precast concrete pile which can be assembled quickly and reduce the risks associated with welding components together, while still being relatively easy to install, connect together and align.

SUMMARY OF THE INVENTION

[0005] In accordance with one aspect, a precast pile assembly is formed from at least a first precast pile and a second precast pile and comprises a first end plate attached

to the first precast pile and a first collar plate, wherein the first end plate defines at least one opening, a second end plate attached to the second precast pile and a second collar plate, and a projection which extends from the first precast pile through a corresponding one of the at least one openings, wherein the second end plate defines a hole adapted to receive one of the corresponding projections from the first end plate wherein each projection defines a channel extending through the projection, and a bolt and a unitary socket module. The unitary socket module defines a bolt passageway and a projection passageway, with the projection passageway adapted to receive one of the corresponding projections, and the bolt passageway is adapted to receive the bolt. The bolt extends through the channel of the corresponding projection such that the bolt cooperates with the corresponding projection to hold the corresponding projection with respect to the bolt.

[0006] From the foregoing disclosure and the following more detailed description of various embodiments it will be apparent to those skilled in the art that the present invention provides a significant advancement in the technology of precast piles.

Particularly significant in this regard is the potential the invention affords for providing a relatively quick to manufacture and assemble precast pile for use in many different types of buildings. Additional elements and advantages of various embodiments will be better understood in view of the detailed description provided below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 is an isometric view of a precast pile assembly formed from a pair of piles locked together with a joint in accordance with one embodiment.

[0008] Fig. 2 is a close-up view of the joint of Fig. 1 (Portion A).

[0009] Fig. 3 is a close-up view of a side opening of a collar plate of Fig. 2 (Portion B) adapted to receive a bolt.

[0010] Fig. 4 is an exploded isometric view of the precast piles of Fig. 1.

[0011] Fig. 5 is an exploded view of collar plates, end plates and unitary socket modules.

[0012] Fig. 6 is an underside isolated isometric view of a top end plate and a top collar plate.

[0013] Fig. 7 is an underside isolated isometric view of a bottom end plate and a bottom collar plate, along with the unitary socket modules.

[0014] Fig. 8 is an isolated isometric view of one of the unitary socket modules, showing in phantom passageways for one of the projections and for one of the securing bolts.

[0015] Fig. 9 is a view from the underside of the bottom plate, showing the unitary socket modules.

[0016] Fig. 10 is a cross section view of the bottom plate, taken through line A-A in Fig. 9.

[0017] It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various features illustrative of the basic principles of the invention. The specific design features of the joint as disclosed here, including, for example, the specific dimensions of the unitary socket module, will be determined in part by the particular intended application and use environment. Certain features of the illustrated embodiments have been enlarged or distorted relative to others to help provide clear understanding. In particular, thin features may be thickened, for example, for clarity of illustration. All references to direction and position, unless otherwise indicated, refer to the orientation illustrated in the drawings.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

[0018] It will be apparent to those skilled in the art, that is, to those who have knowledge or experience in this area of technology, that many uses and design variations are possible for the precast piles disclosed here. The following detailed discussion of various alternate elements and embodiments will illustrate the general principles of the invention with reference to a precast pile with a unitary socket module suitable for large construction projects. Other embodiments suitable for other applications will be apparent to those skilled in the art given the benefit of this disclosure.

[0019] Turning now to the drawings, Fig. 1 shows a portion of a precast pile assembly 100 comprising a first precast pile 20 and a second precast pile 30 adjacent and below the first precast pile, and locked together to form a joint. The joint is formed by endplates, collar plates, a unitary socket module and corresponding bolts as described in greater detail below. The close-up view of Fig. 2 shows a first endplate 40 is located at one end/bottom of the first pile 20, along with a first collar plate 70. In a similar manner a second endplate 50 and corresponding second collar plate 80 are located at another end/top of precast pile 30 such that when the two precast piles are assembled the bottom of the first precast pile 20 abuts against the top of the second, adjacent precast pile 30. Typically, the precast piles are made of

reinforced concrete, and the endplates/collar plates are made of a metal such as steel. The first end plates 40 and the second end plate 50 can be held in place with rebars and cast in concrete. Advantageously each precast pile would be formed essentially the same as the other, with the top side and bottom sides formed the same (with projections extending from the bottom side in each instance), as described in greater detail below, allowing for ease of off construction-site manufacturing. In this embodiment the precast piles have a square cross section, and the collar plates 70, 80 have four sides, one for each side of the precast pile. The pile can also have other cross sections, such as round, hexagonal, etc.

[0020] Fig. 2 is a close-up of the joint connecting the two piles 20, 30 of the embodiment of Fig. 1 (portion A). When assembled the first end plate 40 abuts against the second end plate 50. The first collar plate 70 wraps around a bottom of the first precast pile and the second collar plate wraps around a top of the second precast pile. Fig. 3 is a close-up view of the second collar plate 80. Second collar plate 80 may be provided with a side opening 82 on one or more side walls of the second collar plate. When assembled a bolt passageway 62 receives a bolt 64, and the bolt passageway 62 is aligned with the side opening 82. Fig. 4 shows the first precast pile 20 separated from the second precast pile 30, and shows a series of four bolts 64, one for each side wall of the second collar plate 80.

[0021] Fig. 5 is an exploded isometric view of the first end plate 40 and the second end plate 50. Four projections 45 are shown extending downward away from the first precast pile and through corresponding openings 47 in the first end plate 40. Four projections and four openings are shown in the embodiment in the Figs. More or fewer projections may be used as needed, depending on loading constraints. In accordance with a highly advantageous element, each projection 45 can be provided with a channel 46, preferably a threaded opening. Preferably each threaded opening/channel 46 has a radial axis which extends generally perpendicular to an elongate axis of each corresponding projection 45, and when the piles are assembled together each projection 45 is positioned such that the radial axis extends in a direction perpendicular to a plane of a corresponding side of the collar plates 70, 80. The second collar plate 80 may be provided with four side walls and each side wall has the side opening 82 adapted to allow a bolt 64 to pass through to releasably secure one of the projections 45 to the second pile by having the bolt extend into the corresponding channel 46. The channel 46 need not extend entirely through the projection 45, although the opening is shown to extend entirely through the projection in the embodiments shown in the Figs. The second end plate 50 may be provided with holes 57 which allow the corresponding (adjacent) projection to extend through the second end plate 50 and into the corresponding unitary socket module 60.

[0022] Fig. 6 is an isometric isolated underside view of the first end plate 40 and first side wall 70, showing four projections 45 extending through the end plate for engagement with the second end plate and unitary socket module. Fig. 7 is an isometric isolated underside view of the second end plate 50, second collar plate 80 and unitary socket modules 60, one for each of the projections.

[0023] Fig. 8 is an isometric isolated view of the unitary socket module 60. The unitary socket module 60 may be provided corresponding to each projection and each bolt. In accordance with a highly advantageous element, the socket module is formed of a unitary or one-piece construction. The single piece element advantageously defines both the projection passageway 65 and bolt passageway 62 without the need for secondary operations such as welding components together. Known designs providing connection between precast piles typically involves welding multiple components together. Advantageously the socket module can be made unitary, as the manufacture of unitary socket modules may then be done remote from the job site before precast piles are connected together. The unitary socket module surrounds the projection and the bolt when these two elements are connected together, and help resist relative movement of these two elements with respect to each other, which in turn helps to secure the first pile to the second adjacent pile immediately below the first pile with proper alignment. The unitary socket module 60 may be made as a cast part, for example. Each unitary socket module 60 defines internal passageways; bolt passageway 62 and projection

passageway 65, for both a corresponding projection and for a corresponding bolt, respectively. The projection passageway 65 is perpendicular to the bolt passageway 62. The bolt passageway may also have a pocket 63. The pocket can be formed from a ledge of the bolt passageway to serve as a stop for a head of the bolt. The bolt can be rotated into releasable engagement with the projection until the bolt head abuts against the ledge of the unitary socket module. Thus, the bolt passageway 62 has a first portion or pocket 63 which can be of a different size to the remaining second portion of the bolt passageway, which also helps to limit travel of the bolt toward the corresponding adjacent projection when assembled.

[0024] A portion 64 of the bolt passageway can optionally extend beyond the projection passageway 65. That is, the bolt passageway 62 extends from an edge of the unitary socket module (adjacent one of the side walls of the second collar plate), though the projection passageway 65 and beyond the projection passageway.

Typically, in assembly the projection 45 extends into the projection passageway 65 of the unitary socket module 60 first, and then the corresponding bolt 64 is inserted into the bolt passageway 62 (through side wall opening 82 of the side wall 80).

When properly aligned, the bolt passageway 62 of the unitary socket module 60 is axially aligned with the corresponding side opening 82, and the projection passageway 65 is also axially aligned with second end plate holes 57 (as well as the corresponding first endplate openings 44). When installed, the bolt passageway 62 is generally perpendicular to the corresponding projection 45 such that the bolt 64

can extend into the channel 46 of the corresponding projection 45. As shown in the drawings, four bolts 64 may be used in this embodiment. Alternatively different numbers of bolts can be used, including just one bolt (and one corresponding unitary socket module and one corresponding projection), more than one bolt may be used per side wall, or less than one bolt per side wall (such as side openings on alternating side walls, for example) may be used. The bolts 64 cooperate with the corresponding projections 45 to secure the first end plate 40 to the second end plate 50, and in turn secure the first precast pile 20 to the second precast pile 30 (since the end plates are rigidly attached to their corresponding precast piles). Thus, the first precast pile is locked to the second precast pile by the bolt engaging the corresponding projection in the unitary socket module. In the embodiment shown in the Figs., each of the four bolts 64 extends through the corresponding side opening 82 of the side wall of the second collar plate 80, into the bolt passageway 62 of the unitary socket module 60, and then into the corresponding channel 46 of projection 45. The projection 45 extends through the first end plate 40 and the second end plate 50 into projection passageway 65 of the unitary socket module 60 such that the corresponding bolt 64 can reach the projection. The bolt is threaded and the corresponding channel 46 is threaded and adapted to engage the threads of the corresponding bolt merely by rotating the bolt into place to secure the piles together. The bolts 64 can be threadably attached/tightened to the projections 45 where the bolt passageway 62 meets the projection passageway 65.

[0025] Fig. 9 is an underside view of the second end plate 50 showing location for the unitary socket modules beneath the second end plate, and adjacent the side walls of the second collar plate 80. As shown in this embodiment there are four unitary socket modules 60, four corresponding bolts 64 which releasably secure four corresponding projections 45. Side openings 82 are aligned with bolt passageways 62. In this embodiment with four unitary socket modules, each unitary socket module is positioned at 90 degrees with respect to an adjacent unitary socket module, and the unitary socket modules on opposite sides are positioned offset and rotated 180 degrees with respect to each other.

[0026] Fig. 10 is a cross section view taken along line A-A in Fig. 9, and shows hole 87 aligned with projection passageway 65. The bolt passageway 62 is shown to be at a right angle to the projection passageway 65. The unitary socket modules may be affixed to the collar plate 80 and/or the second end plate 50 by a weld, for example. When this embodiment is assembled together, the opening 47 of the first end plate 40 aligns with the projection passageway 65 of the unitary socket module 60, and the hole 87 of the second end plate 50. Also, the second collar plate side opening 82 aligns with the bolt passageway 62 of the unitary socket module 60.

[0027] From the foregoing disclosure and detailed description of certain embodiments, it will be apparent that various modifications, additions and other alternative embodiments are possible without departing from the true scope of the

invention. The embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to use the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

CLAIMS

What is claimed is:

1. A precast pile assembly formed from at least a first precast pile and a second precast pile comprising, in combination:
 - a first end plate attached to the first precast pile and a first collar plate, wherein the first end plate defines at least one opening;
 - a second end plate attached to the second precast pile and a second collar plate;
 - a projection which extends from the first precast pile through a corresponding one of the at least one openings, wherein the second end plate defines a hole adapted to receive one of the corresponding projections from the first end plate; wherein each projection defines a channel extending through the projection; and
 - a bolt and a unitary socket module, wherein the unitary socket module defines a bolt passageway and a projection passageway, with the projection passageway adapted to receive one of the corresponding projections, and the bolt passageway is adapted to receive the bolt;
 - wherein the bolt extends through the channel of the corresponding projection such that the bolt cooperates with the corresponding projection to hold the corresponding projection with respect to the bolt.

2. The precast pile assembly of claim 1 wherein the first endplate defines four openings, a corresponding projection extends through each corresponding opening, and each projection defines one of the corresponding channels extending through the corresponding projection;

the second end plate defines four holes each adapted to receive one of the corresponding projections from the first end plate, such that each corresponding projection extends through the corresponding opening of the first end plate, and the corresponding hole of the second end plate;

the bolt comprises four bolts, one bolt corresponding to each projection; and

the unitary socket module comprises four unitary socket modules, one unitary socket module corresponding to each projection.

3. The precast pile assembly of claim 2, wherein each bolt is threaded, and each corresponding projection passageway is threaded such that each bolt is tightened into the corresponding projection passageway to secure each bolt to the corresponding projection.

4. The precast pile assembly of claim 2 wherein each unitary socket module further defines a pocket defined by a ledge, such that the bolt head abuts against the ledge of the corresponding unitary socket module to resist further movement of the bolt toward the projection passageway.

5. The precast pile assembly of claim 2 wherein the projection passageway is perpendicular to the bolt passageway.
6. The precast pile assembly of claim 2 wherein the second collar plate has four side walls, and each side wall defines a side opening, with each side wall opening adapted to receive one of the bolts.
7. The precast pile assembly of claim 4 wherein the bolt passageway extends from an edge of the unitary socket module, through the projection passageway and beyond the projection passageway.
8. The precast pile assembly of claim 1 wherein the first precast pile is locked to the second precast pile by the bolt engaging the corresponding projection in the unitary socket module.
9. The precast pile assembly of claim 8 wherein the opening of the first end plate aligns with the corresponding hole of the second end plate.
10. The precast pile assembly of claim 8 wherein the opening of the first end plate aligns with both the hole of the second end plate and the projection passageway of the unitary socket module, and the second collar plate side opening aligns with the bolt passageway of the unitary socket module.