

IMPROVED FORMWORK

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FIELD OF THE INVENTION

The present invention relates to the construction of pile caps used to transfer load from an above ground structure to sub-surface piles. In particular, the invention relates to the formation of concrete pile caps using permanent formwork.

BACKGROUND OF THE INVENTION

Pile caps are used to collect and transfer column loads to a pile, or group of piles, directly beneath the pile cap. Because of the substantial load the pile cap must transfer, they are of considerable size and strength, particularly for multi-storey buildings. The piles themselves may be driven or cast-in-place.

Conventional construction methods for the formation of concrete pile caps relies on the placement of temporary formwork about the previously fixed reinforcement of the pile cap. Once in place, the concrete is poured, and allowed to cure. Only after curing can the formwork be stripped, ready for a further usage or storage, delaying the project timeline.

The formwork provides a clean smooth surface against which the concrete is poured, a structural support structure to maintain the rigidity of the surface and a bracing system to resist the hydrostatic pressure of the wet concrete as it is poured. The surface can comprise timber, often marine plywood, or metal sheet.

As discussed, the formwork must have a high degree of rigidity to ensure it does not deform or deflect and thus destroy the function and finish of the cured pile cap. Thus, the formwork itself must be of significant size and weight to achieve the required rigidity, making the cost and transport of the formwork considerable.

In preparation of the pile cap being poured, each of the surfaces of the formwork must be smeared with a water immiscible material such as oil or grease so as to ensure the cured concrete does not bond with the surface of the formwork.

As an alternative to the dis-assembly of the formwork it is possible to leave it in place and thus make the formwork a permanent fixture of the finished pile cap. This has the advantage of not having to be concerned with the surface finish of the pile cap, and also saves the cost of a dis-assembly of the formwork.



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However, the cost of lost materials is substantial due to the requirement that the formwork must resist the hydrostatic pressure during the concrete pour of the large pile cap.

Thus, the problem exists to find a system for the forming of concrete pile caps that reduces the time in constructing the pile cap, and so the overall time of construction of the project, without incurring large costs through loss of materials.

STATEMENT OF INVENTION

Therefore, it is an object of the invention to provide a formwork system that reduces the total construction time of a pile cap, at a reduced cost, as compared to the prior art.

Therefore, the invention provides for a system of permanent formwork for the casting of a concrete pile cap, the system including a plurality of formwork units, said units having lapping means wherein the lapping means are adapted for integrally bonding with adjacent formwork units.

Whilst the invention relates specifically to pile caps, it may be equally applicable to other structural concrete elements, including beams and columns.

By bonding adjacent units, a formwork system can be created from the formwork units collectively assembling a single, unitary structure. This is distinct from known permanent formwork systems which, whilst they may be left in place, do not of their own form a structural element.

Thus, following the bonding process, the formwork and pile cap may be backfilled, with the soil loads being resisted by the formwork system. Because of the size of the pile cap, the curing time of the concrete is extensive. By providing the capacity to backfill prior to the curing of the pile cap, the present invention provides a significant time saving over conventional systems.

In a preferred embodiment of the invention, the formwork units may be formed from reinforced concrete members. Concrete is an extremely cheap material, providing considerable strength. It is also readily joined by infilling the interstitial spaces between the units with concrete. In this case, the lapping means may be the reinforcement of the units, with the reinforcement of adjacent units being lapped prior to infilling, to form a single reinforced concrete structure.

~~In a~~ more preferred embodiment, the formwork units may be formed on-site for immediate use. Alternatively, the formwork units may be formed in a

factory environment ahead of the expected use, and transported to site when needed. Concrete has the advantage of being easily moulded in both a factory and on-site situation, merely by having available reusable moulds. Being in unit form, each mould can be relatively small, as compared with the moulding of large structures, such as a pile cap.

5 In a preferred embodiment, there may be a kit of formwork units, wherein the types of units within the kit conform to a finite number of shapes. By having a discrete number unit shapes, the infrastructure of moulds and the like may be limited so that the establishment cost of creating the formwork system kit of the
10 invention may be comparatively small without limiting functionality and applicability.

In more preferred embodiment, the finite number of shapes may consist of a straight section and a corner section. It is the case that, except for architectural features, the vast majority of structural elements are rectilinear in shape. Thus,
15 each structural element, including a pile cap can be formed using the combination of a straight and corner shape. Whilst notionally, a straight shape alone is sufficient to define a rectilinear shape, the use of a corner unit provides for any loss of strength within the formwork system due to a discontinuity of the formwork.

In more preferred embodiment the units within the formwork system kit
20 may be restricted to a finite number of sizes.

In structural design, it is normal to incorporate within the design methodology the use of a system of standard dimensions. This allows the cost savings associated with applying acquired experience and expertise between projects, and to eliminate compatibility problems within a project. Thus, in the
25 détermination of the appropriate size for a beam, column, wall or pile caps, when the appropriate size has been calculated for functionality, the next size up, or down as the case may be, will be selected for efficiency. This compatibility permits the use of a finite number of appropriately size units.

In a preferred embodiment, the lapping means, in addition to bonding
30 adjacent formwork units, may also bond with the pile cap. By incorporating the reinforcement of the units to also project inwards to the space defining the pile cap, said reinforcement will be incorporated within the concrete mass. Subject to proper surface treatment of the units, the formwork system and pile cap may then

become an integral unit, minimizing cracking or separation during shrinkage of the concrete during the curing phase.

In a more preferred embodiment, the lapping means may form a structural bond with the pile cap. If the aforementioned reinforcement that is directed inwards is actually lapped with the reinforcement of the pile cap, then a structural bond, able to transfer significant loads may be created. Subject to the correct stress development lengths being established, the formwork system and the pile cap may be a composite structure, and making more efficient the design by maximizing the use of materials.

10 DESCRIPTION OF PREFERRED EMBODIMENT

It will be convenient to further describe the present invention with respect to the accompanying drawings, which illustrate possible arrangements of the invention. Other arrangements of the invention are possible and, consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

Figure 1 is a perspective view of the straight formwork unit of the formwork system.

Figure 2 is a perspective view of the corner formwork unit of the formwork system of Figure 1.

Figure 3 is a plan view of the improved formwork system according to the present invention.

Figure 4 is a section view A-A of the formwork system of Figure 3.

Figures 1 and 2 show the formwork units of the present invention being the straight formwork unit 1 and the corner formwork unit 4. Each of the units have projecting from the unit extensions of the respective reinforcement 2 and 5, which is used to bond adjacent units together. The straight unit 1 generally resembles a wall, which, when assembled as the formwork system it functions as. In combination with the corner unit 4, generally being L-shaped, the formwork units can be selected to form any rectilinear shape. In addition to the finite number of unit shapes, each shape is limited to a discrete number of sizes. Thus, the straight unit 1 is available in lengths of 700 mm, 900 mm and 1200 mm, the corner unit 4 of equal length legs is available in 400 mm, and unequal length sizes being 500 mm x 600 mm and 900 mm x 1200 mm. It follows, however, for

an expanded system, or for customised projects, the number of unit sizes can be increased to meet specific demand.

Accordingly, the units are formed using standard sized and shaped moulds, which can be repeatedly used. Typically, these moulds will be constructed from steel, for durability, strength, and to a lesser extent, the ability to transmit vibration forces used to remove air bubbles from the concrete during pouring. Depending on the number of applications of the formwork system for any particular project, the decision to have the formwork units formed within a factory environment, or transporting the moulds to site can be made at any time. It follows that, subject to being able to store moulds not in use, the convenience of having a readily available labour and equipment and regular supplies of concrete delivered to site, plus the saving in transport costs would weigh heavily on forming the units on site, a short time before being needed.

Figures 3 and 4 show the formwork system assembled in a rectangular shape, comprising five straight units 1 along the longer side, two straight units along the shorter side, and four corner units 4, and surrounding the reinforcement 9 of the pile cap. The formwork units 1 and 4 are placed sequentially in the shape desired, spaced by a distance equal to the length of one unit's reinforcement. Thus in the interstitial space 8 between the units, the reinforcement is lapped for its full length. The interstitial space is then infilled with concrete, either at the time of pouring the pile cap, or prior to this. Being a substantially less volume of concrete, as compared to the pile cap, the interstitial concrete will cure at a much faster rate. Also, as the interstitial concrete need only be functional for a short period, up to the curing of the pile cap, normal concerns for rapid curing which will affect the long term quality of the concrete need not be followed. Hence, well before the pile cap is capable of resisting loads as small as a soil loading from backfilling, the formwork system has achieved sufficient strength to protect the pile cap from damage, and thus speed the construction process.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A permanent formwork system for the casting of a concrete pile cap, the system including a plurality of formwork units, said units having lapping means wherein the lapping means are adapted for integrally bonding with adjacent formwork units.
 2. A permanent formwork system according to claim 1, wherein the formwork units are formed from reinforced concrete.
 3. A permanent formwork system according to claims 1 and 2 wherein the formwork units are formed on a construction site encompassing the pile cap.
 4. A permanent formwork system according to claims 1 and 2 wherein the formwork units are formed in a factory environment remote from the pile cap.
 5. The permanent formwork system according to any one of the preceding claims wherein the formwork system includes a kit of parts consisting of different types of formwork units.
 6. The permanent formwork system according to claim 5 wherein the types of units vary by a finite number of shapes.
 7. The permanent formwork system according to claim 6 wherein the units are either straight or corner units.
 8. The permanent formwork system according to claim 5, 6 and 7 wherein the types of units vary by a finite number of sizes.
 9. The permanent formwork system according to any one of the preceding claims wherein the lapping means further bonds with the pile cap.
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REPLACEMENT SHEET

23 SEP 2002

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10. The permanent formwork system according to claim 9 wherein the bond with the pile cap is a structural bond capable of transmitting significant loads.