Nov. 8, 1966 N. R. TOFFOLON 3,283,518

SOIL FOOTING

Filed April 15, 1965 2 Sheets-Sheet 1

FIG. 1

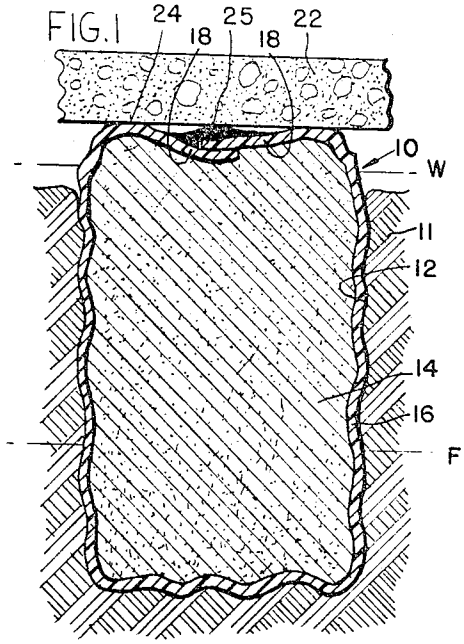


FIG. 2

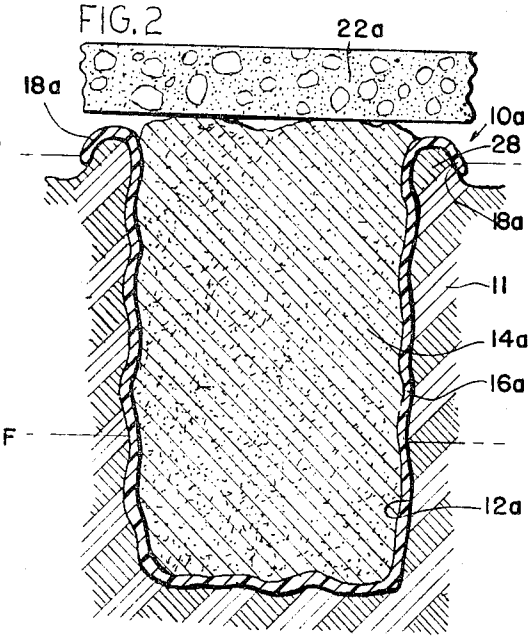
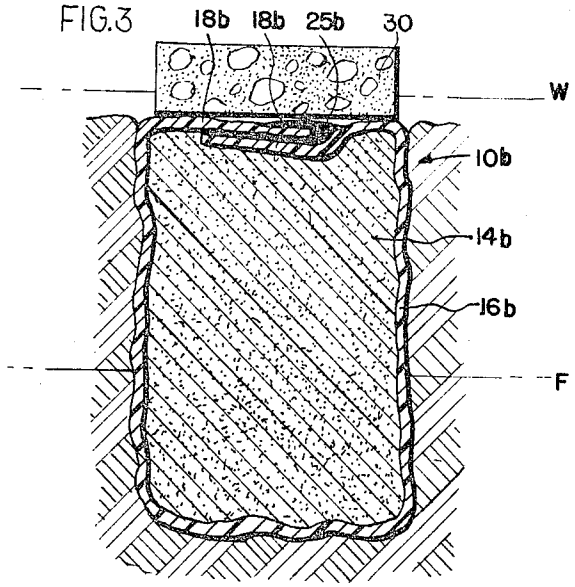


FIG. 3



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FIG. 4

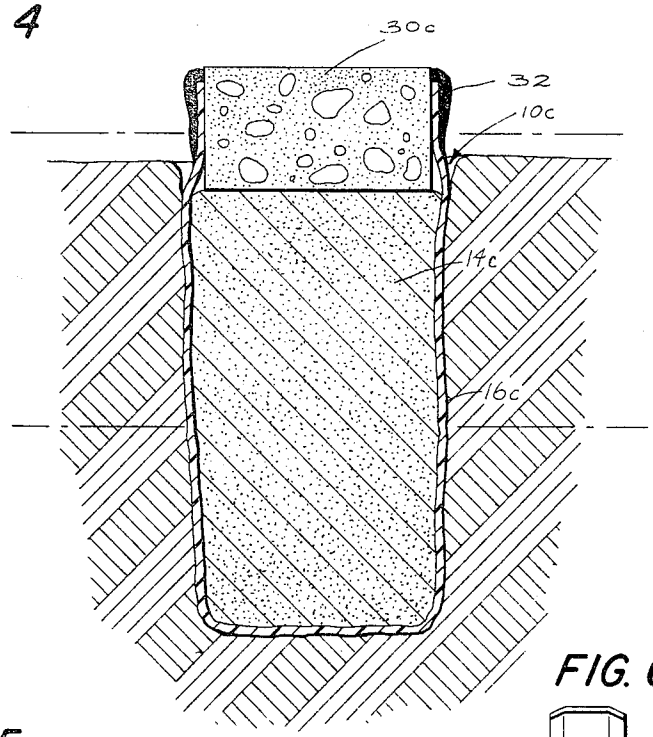


FIG. 5

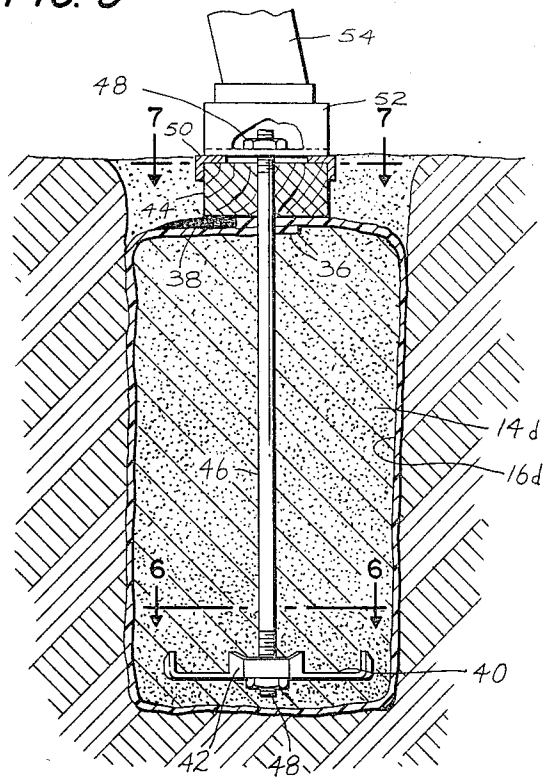


FIG. 6

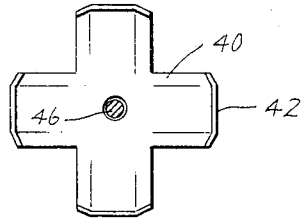
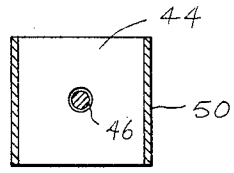


FIG. 7



United States Patent Office 3,283,518 Patented Nov. 8, 1966

3,283,518

SOIL FOOTING

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Filed Apr. 15, 1965, Ser. No. 448,517
14 Claims. (Cl. 61—53)

This application is a continuation-in-part of application Serial No. 137,265, filed September 11, 1961.

This invention relates to a footing which may be employed in the support of building and other structures and to a method of making such a footing. More specifically, the invention relates to a low cost footing which has general utility, but which may be used to particular advantage in the construction of temporary buildings and the like.

It is the general object of the invention to achieve a substantial economic advantage in the construction of a footing.

A more specific object of the invention is to provide a footing employing a cheap, abundant, raw material which is readily available at or in close proximity to the site of the footing.

Another more specific object of the invention is to provide a low cost footing which has ample and enduring strength for the support of a building or other structure and a high degree of immunity to frost action.

Still another specific object of the invention is to provide a footing which can conveniently be adapted to be left in situ on removal of a temporary building or structure supported by the footing.

The drawings show several footings embodying the invention and such embodiments will be described, but it will be understood that various changes may be made from the constructions disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIGS. 1 to 5 respectively illustrate five footings embodying the invention in vertical section.

FIG. 6 is a horizontal sectional view taken generally as indicated at 6—6 in FIG. 5.

FIG. 7 is a horizontal sectional view taken generally as indicated at 7—7 in FIG. 5.

It is well known that ordinary soil in its natural state is subject to "settling" under load. Moreover, frost action within the soil may result in "frost heaves" and in additional shifting and/or twisting sources on a building or other structure supported by the soil. Serious damage to aesthetic and even structural elements in the building can of course result from such forces. However, these detrimental effects and their causes do not arise from any inherent failings of ordinary soil as a structural material. Settling may be caused by the presence of water in the soil, or, the soil may not be sufficiently dense or "compacted" to bear the load applied. Frost action, on the other hand, is due wholly to the presence of water in the soil.

The present invention contemplates the use of ordinary soil as a structural material in the construction of a footing which is of ample strength to bear its applied load without settling and which is immune to frost action. More specifically, a mass or body of soil is employed as the main structural material or member of the footing of the present invention and said mass or body supplied substantially all of the vertical support provided by the footing for the building or other structure. The mass or body of soil is sufficiently compacted to withstand the load applied without settling or change in vertical dimension throughout its life and it is disposed in and substantially fills a ground cavity which extends below frost level so as to be immune to frost action in the surrounding soil. Additionally, the mass or body of soil is rendered substantially dry so as to be immune to frost action within itself. Optionally, an antifreezing medium may be added and distributed substantially throughout the body of soil and isolation of the soil from surface and subsurface water provides for immunity to frost action throughout the life of the footing. When an antifreezing medium is added, it serves to prevent freezing of the soil even when there is moisture present, this being the case whether the moisture is present initially or introduced accidentally during use of the footing.

Sand and gravel and other soils comprising discrete and nonadherent granular particles are preferred for forming the body of the footing of the present invention, but a wide variety of other types of soil may also be employed. Soil containing a high percentage of organic material is less desirable than sand or gravel, but suitable if properly dried and compacted. Wet clay is similarly usable after drying and compacting. Thus, the term "soil" is to be taken herein and throughout the claims which follow in its broad sense and as including substantially all natural raw material normally derived from a ground excavation. In the majority of cases, it is possible to excavate to provide a ground cavity which extends below frost level and which is suitable for the footing of the present invention and to thereafter use the excavated material in forming the footing.

In FIG. 1 there is shown a footing **10** which constitutes a first embodiment of the present invention. The footing is shown disposed in a ground cavity **12** which extends substantially below frost level in the surrounding soil **11** as indicated generally at F. A body **14** of the footing is shown disposed within a shell or liner **16** and the form of the body and the shell or liner may be taken as generally cylindrical. However, it is to be understood that the term "footing" is to be given its broad meaning and is meant to include horizontally elongated "frost walls" and the like as well as more conventional postlike footings of various shapes.

The body **14** of the footing **10** may be formed of various types of soil as mentioned, but is shown as comprising a mass of substantially dry sand or gravel. The sand or gravel in the body **14** is compressed or compacted to a density higher than that of the surrounding soil and to a density or degree of compaction such that it will not settle significantly under its applied load throughout its life. Optionally, the body **14** of the footing may have an antifreezing medium distributed substantially throughout as stated. Such medium may, for example, comprise calcium chloride flakes.

The shell or liner **16** of the footing **10** is generally cylindrical as mentioned and is disposed in and substantially fits the ground cavity **12** in the soil **11**. Said shell or liner is of waterproof material in accordance with the invention, and as shown in FIG. 1, the shell or liner is of a flexible material. A heavy polyethylene film is presently preferred, but waterproof canvas and other flexible waterproof materials are usable in forming the shell.

At least initially, the shell or liner of the footing of the present invention extends above ground level and above the predicted maximum level of surface water as indicated at W. That is, aside from serious flooding conditions, a predicted maximum level W of surface water can be established for a locality in which the footing is to be used. This level W is exceeded vertically, at least initially, by the shell or liner of the footing.

In FIG. 1 it will be noted that the shell or liner **16** extends above the predicted maximum water level W even in the finished footing. The mass or body of soil **14** also extends above the water level W and an upper portion of the shell or liner is folded inwardly over the top surface of said mass or body. Similar opposing upper or free

edge portions 18, 18 of the shell or liner are disposed in overlapping relationship as shown so as to be pressed downwardly against the top surface of the body 14 by a vertically adjacent portion of the building or structure. In FIG. 1, the said vertically adjacent portion of the building or structure takes the form of a concrete slab 22, partially shown. The slab serves to provide a first substantially waterproof joint between overlapped portions 18, 18 of the shell or liner and a second similar joint horizontally outwardly thereof in an annular area 24 to prevent water from entering the body 14.

Preferably, and as shown in FIG. 1, a sealing medium 25 is utilized to positively prevent the entry of water or other moisture into the body 14. Said medium is preferably of the liquid-solid type and may comprise a conventional asphalt or tar sealer. As shown, the sealing medium 25 is disposed atop overlapped portions 18, 18 of the shell or liner 16 and beneath the building portion or slab 22.

It will be apparent that the body 14 in the footing of FIG. 1 is isolated from both surface and sub-surface water. The shell or liner 16 is disposed in adjacent relationship with the bottom and sides thereof and a waterproof joint is formed at the top thereof as described. The body 14 consists of substantially dry and compacted sand or gravel or other soil. Maintained in a substantially dry condition, the body will not be subject to frost action from within. The lower portion of the body is disposed in its cavity 12 below frost level so that the footing is immune to frost action tending to bodily raise or lower the same. Frost action in the soil 11 horizontally adjacent the footing and which applies lateral forces to the sides of the footing is ineffective to cause bulging or vertical displacement of the footing which could effect vertical shifting of the slab 22 and its associated building or other structure. As stated, the soil 11 surrounding the footing is of a lower density or degree of compaction than the soil comprising the body 14. Thus, such frost action may cause heaves in soil adjacent the footing but will not have detrimental effects on the footing or its supported building.

A first step in the formation of a footing involves excavation to provide a suitable ground cavity which extends substantially below frost level. The shape of the cavity will of course vary in keeping with the shape of the footing to be provided. A second step involves the placement of the shell or liner of the footing in the cavity. In the case of the FIG. 1 embodiment, the flexible shell or liner 16 is disposed in the cavity so as to engage or at least approximately engage the side and bottom walls thereof. The upper portions of the shell or liner extend above the ground level and may initially be turned outwardly for ease in filling the liner.

As stated, excavated soil can be employed in forming the body of the footing in the majority of cases. If the soil has too high a percentage of moisture, a drying step may precede filling of the liner. Alternatively when the excavated soil is sufficiently dry, or when other dry soil such as sand or gravel is employed, such soil may be placed directly in the shell or liner. Compaction of the soil in the liner to the degree mentioned may be accomplished in a conventional manner. Ordinarily, successive layers of the soil will be compressed or compacted separately as they are placed within the shell or liner.

If an anti-freezing medium is to be employed, it may be mixed with the filler soil prior to placement of the soil in the liner or, it may be added to the soil after placement in the liner. Calcium chloride flakes may obviously be added by mixing with the soil, by drilling suitable cavities in the compacted soil as layers of soil are added, or by suitable drilling in the completed body.

A final step involves isolating the filler soil or the soil comprising the body of the footing from surface water. This may be accomplished by arranging the portion of the shell or liner which extends above ground level to prevent the entry of surface water into the body of soil therewithin.

In the FIG. 1 embodiment, initially outwardly folded portions of the flexible liner 16 are folded inwardly into overlapping relationship as shown over the top of the body 14. The sealer 25 may then be applied in liquid form and allowed to harden whereupon the aforementioned watertight seal or joint is provided. Alternatively, and when a sealer is not used, the step of folding the portions of the liner or shell inwardly and in overlapping relationship completes the footing, the slab 22 then being placed atop the footing to maintain the overlapped liner portions in sealing relationship.

In FIG. 2 there is shown a footing comprising a second embodiment of the present invention. Said footing is substantially the same as the footing of FIG. 1 except for the upper portion thereof where isolation of the body 14^a of the footing from surface water is accomplished. A shell or liner 16^a of the footing has upper portions 18^a, 18^a which are folded outwardly rather than inwardly, but which nevertheless extend above the predicted maximum level of surface water W. A mound or bank of soil 28 formed adjacent the mouth of and extending around the ground cavity 12^a extends upwardly above the said water level W and said upper or free edge portions 18^a, 18^a of the flexible liner 16^a are folded downwardly and outwardly about said mound or bank so as to prevent surface water from entering the body 14^a. There may be some possibility of water splashing into the body 14^a between the upper portions 18^a, 18^a of the liner and a slab 22^a disposed atop the body 14^a. However, the vertical space between said liner portions and the slab 22^a is exaggerated in the drawings and, in practice, the slab may be in engagement with the said liner portions. In any event, moisture entering the body 14^a in this manner, or by condensation, will not be sufficient to cause significant or objectionable frost action within the body 14^a.

In forming the footing of FIG. 2, the above-described method may be followed with two deviations. First, the soil mound or bank 28 is formed as a secondary or subsidiary step after or during formation of the ground cavity 12^a. Secondly, the step of isolating the body 14^a from surface water involves outward folding of the portions 18^a, 18^a of the liner or shell 16^a rather than the inward folding required for the FIG. 1 footing.

The footing of FIG. 3 is substantially identical with that of FIG. 1 except for the provision of a plug 30 of masonry or the like which preferably has a cross section substantially the same as that of the footing. The plug 30 serves as an upper portion of the footing and the body 14^b therefore extends only to or approximately to ground level as shown. The liner 16^b of the footing of FIG. 3 is substantially identical with the liner 16 in FIG. 1. Said liner has overlapping portions 18^b, 18^b and an associated, sealer 25^b. However, the liner 16^b is folded inwardly over the top surface of the body 14^b at, or substantially at ground level as shown. The predicted maximum level of surface water is above the upper or top surface of the body 14^b and the inwardly folded portions of the liner 16^b. However, surface water is prevented from entering the body 14^b by the watertight joint formed at the top of the liner.

Here, the method set out for FIG. 1 can be followed except for the provision of a footing body which extends above ground level and above the water level W. The body 14^b is instead formed, as mentioned, to extend to or approximately to ground level and an additional step in the method involves the provision of the block 30 of masonry or the like and the placement of said block atop the footing. A slab not shown but which may be similar to the slab 22 may be placed atop the plug 30.

A fourth embodiment of the invention shown in FIG. 4 includes a footing 10^c having a body 14^c and a liner 16^c. The body 14^c is like the body 14^b of FIG. 3 and extends to or approximately to ground level. The shell

or liner 16^c is, or may be substantially identical with the aforementioned flexible shells or liners 16^a and 16^b. A plug of masonry or the like 30^a may be substantially identical with the plug **30** of FIG. 3. Here, however, the liner 16^c is not folded beneath the plug 30^a but instead extends upwardly adjacent the sides thereof. The liner may be fixed in engagement with the sides of the plug 30^a by a suitable adhesive, or it may be secured thereto by means of a suitable tape extending thereabout. Preferably, however, a sealer **32** is provided and is disposed over the upper edge portions of the liner and over contiguous portions of the sides of the plug 30^a. Thus, a watertight joint is provided between the upper edge portion of the liner and the plug to prevent the entry of surface water and also to prevent water entry by splashing or by condensation. The upper surface of the plug 30^a is preferably disposed above the water level W as are the upper edge portions of the liner 16^c.

The method here may be substantially as set forth above except for the steps of placing the upper edge portions of the liner 16^c adjacent the sides of the plug 30^a and fixing the same in position. Application of the sealer **32** may be effected optionally as an additional step.

In FIG. 5 there is shown a footing 10^d which constitutes a fifth embodiment of the present invention. The footing comprises a body 14^d which may be substantially identical with the body **14** of FIG. 1. A shell or liner 16^d of the footing 10^d may be identical with those described above and it will be observed that an upper portion **36** thereof is folded into overlapping relationship above the body and preferably provided with a sealing medium **38**.

An anchor **40** disposed within and at a lower portion of the body 14^d may vary widely in form but is preferably of spiderlike shape and provided with substantial horizontal surface area as best shown in FIG. 6. Short upstanding flanges **42**, **42** at the end of each arm of the anchor are preferably provided to prevent sidewise movement of the anchor in the body 14^d.

A compression block **44** disposed atop the body 14^d cooperates with the upper portion of the shell 16^d to form a watertight seal and, as shown, the block rests atop the overlapping portion and presses down thereon. The block **44** is preferably of wood or a woodlike material and may have a square plan form when employed with a "postlike" footing of the type shown.

Connecting means between the anchor **40** and the compression block **44** preferably take the form of an elongated rod **46** threaded at opposite ends. Suitable central openings in the anchor **40** and block **44** respectively receive the threaded rod end portions and nuts **48**, **48** are engaged with the said end portions to draw the anchor and block together vertically. Thus, the body 14^d of the footing is maintained at least under a slight compression between the anchor and block and the block is effectively secured against both vertical and horizontal movement.

One manner in which the FIG. 5 footing may be employed is illustrated in a consideration of an attached channel **50**, a short vertical flange **52**, and a base portion **54** of a building sidewall. The building sidewall exerts both horizontal and vertical forces on the flange **52** to which it is attached and the said flange in turn exerts similar forces on the channel **50** and the footing through the compression block **44**. The block is secured positively as mentioned and provides firm and effective support for the building.

In the formation of the FIG. 5 footing, the soil is firmly tamped or compacted around and above the anchor **40** and the method described above may be generally followed. Preferably, soil is also firmly compacted above the body 14^d and around the compression block **44** as shown.

From the foregoing, it will be apparent that economy is well served by the footing construction of the present invention. In all cases, the shell or liner of the footing is a nonstructural member and a foldable, thin walled, inexpensive and easily transported shell or liner can be used. Flexible shells or liners have very little bulk or weight as would entail excessive transportation costs. Such shells or liners may be transported in a flattened condition and may be opened and prepared for use on site.

The body of the footing is formed of a raw material available in abundance in nature and which entails only a nominal cost at most. When as in the majority of cases excavated material is used for the body of the footing, there is obviously no expense involved in removing excavated material from the site of the footing as is ordinarily encountered. Even when sand or gravel are employed in place of excavated material, the costs encountered are greatly reduced as compared with those involved with conventional footings of masonry or the like.

Finally, when the footing of the present invention is used in the construction of temporary buildings or like structures, still another advantage is obtained. Ordinarily, on removal of a temporary building or like structure, it is necessary to bodily remove footings which may be of masonry or the like. With the footing of the present invention, the expense of such removal is wholly or at least substantially eliminated. In most cases it will be necessary merely to puncture the bottom of the shell or liner in order that the footing can be left in situ. Such puncturing will prevent the formation of a water or mud pocket and the exposed portions of the footing will ordinarily not be found objectionable. If exposed upper portions of the footing are found unattractive or unacceptable, such portions can be conveniently removed without bodily removal of the footing. For example, in the FIGS. 3 and 4 footings, the masonry plugs may be removed, the shells or liners punctured and the "clean up operation" is complete. In FIGS. 1 and 2, puncturing of the liners may be followed by a bulldozing operation wherein exposed footing portions are reduced to ground level and possibly covered with loose soil. In FIG. 5, the compression block **44** may be removed and the rod **46** may be turned out of the lower nut **48** and withdrawn through the anchor **40** and the footing body 14^d.

The invention claimed is:

1. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil in said body comprising discrete and nonadherent granular particles compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, and said body serving to supply substantially all of the vertical support provided by the footing for the building or structure, and a waterproof flexible shell disposed about the sides and bottom of the body and serving to prevent the entry of subsurface water into the body, said shell serving also at an upper portion to prevent the entry of surface water into the body.

2. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil in said body comprising discrete and nonadherent granular particles compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, and said body serving to supply substantially all of the vertical support which is provided by the footing for the building or structure, an antifreezing medium distributed substantially throughout the body, and a flexible waterproof shell disposed about the sides and bottom of the body and serving to prevent the entry of subsurface water into the body, said shell serving also at an upper portion to prevent the entry of surface water into the body.

3. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil in said body comprising discrete and nonadherent granular particles compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, and said body serving to supply substantially all of the vertical support provided by the footing for the building or structure, and a flexible waterproof shell disposed about the sides and bottom of the body and extending above ground level and above the predicted maximum level of surface water to prevent the entry of surface and subsurface water into the body.

4. A footing as set forth in claim 3 wherein an upper portion of said shell is disposed over the top of the body with free edge portions thereof in overlapping relationship.

5. A footing as set forth in claim 4 and including a sealing medium disposed over said overlapping portions of the shell and forming a watertight joint therebetween.

6. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in a ground cavity extending below frost level and which has a bank of soil adjacent and around its upper edge and extending above the predicted maximum level of surface water, the soil in said body comprising discrete and nonadherent granular particles compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, and said body substantially filling said cavity and having its top surface above said soil bank so as to supply substantially all of the vertical support provided by the footing for the building or structure, and a flexible waterproof shell disposed about the sides and bottom of the body and extending outwardly and downwardly over said soil bank to prevent the entry of surface and subsurface water into the body.

7. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil in said body comprising discrete and nonadherent granular particles compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, a flexible waterproof shell disposed about the sides and bottom of the body and folded inwardly over the top of the body, and a solid plug disposed atop the body over the folded portions of the shell and cooperating with the body to supply substantially all of the vertical support provided by the footing for the building or structure, said plug serving also to press the said folded portions of the shell into firm engagement with the top of the body to form a substantially watertight seal.

8. A footing as set forth in claim 7 and which includes a sealing medium disposed over the folded portions of the shell and beneath the plug.

9. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil

in said body being compacted to a density higher than that of the surrounding soil and so that it will bear its applied load without settling, a solid plug disposed atop the body in engagement with the body to supply substantially all of the vertical support provided by the footing for the building or structure, a flexible waterproof shell disposed about the sides and bottom of the body and extending upwardly adjacent and being fixed in engagement with the sides of said plug to form a substantially watertight seal therewith.

10. A footing as set forth in claim 9 and which includes a sealing medium disposed over upper edge portions of said liner and contiguous portions of the sides of said plug.

11. A footing for supporting a building or other structure and comprising a body formed of substantially dry soil and which is disposed in and at least approximately fills a ground cavity extending below frost level, the soil in said body being compacted to a density higher than that of the surrounding soil so that it will bear its applied load without settling, and said body serving to supply substantially all of the vertical support provided by the footing for the building or structure, a waterproof flexible shell disposed about the sides and bottom of the body and serving to prevent the entry of subsurface water into the body, an anchor disposed within and at a lower portion of said body, a compression block disposed atop said body and cooperating with an adjacent upper portion of said flexible shell to prevent the entry of surface water into said body, and a means extending vertically at least partially through said body and connected between said anchor and compression block and serving to maintain the body between said anchor and block at least under slight compression, said connecting means, anchor, and body serving to secure said block against both vertical and horizontal movement.

12. A footing as set forth in claim 11 and including an antifreezing medium distributed substantially throughout the body.

13. A footing as set forth in claim 11 wherein said upper portion of said flexible shell is folded into overlapping relationship beneath said compression block, and wherein a sealing medium is disposed over said overlapping portion to form a watertight joint.

14. A footing as set forth in claim 11 wherein said anchor is somewhat spiderlike in outline with substantial horizontal area, wherein said compression block is formed of woodlike material, and wherein said connecting means comprises an elongated rod extending between and connected with the said anchor and block.

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EARL J. WITMER, *Primary Examiner.*