(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 351 229 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89307151.4**

(22) Date of filing: **14.07.89**

(51) Int. Cl.[5]: **E 02 D 3/00**

(30) Priority: **15.07.88 GB 8816849**

(43) Date of publication of application:
17.01.90 Bulletin 90/03

(84) Designated Contracting States: **FR GB IT**

(71) Applicant: **HELIX REINFORCEMENTS LIMITED**
2 Fieldings Road
Cheshunt Hertfordshire (GB)

(72) Inventor: **Kemp, Ernest**
3 Horrocks Close
Ware Hertfordshire (GB)

Jones, Frank George
56 Fernleigh Road
Winchmore Hill London N21 3AH (GB)

(74) Representative: **Carmichael, David Andrew Halliday et al**
G.F. REDFERN & CO. High Holborn House 52/54 High Holborn
London WC1V 6RL (GB)

(54) Improvements relating to soil reinforcement.

(57) A method of soil reinforcement which includes the use of reinforcing elements in which the reinforcing elements are in the form of spirals.

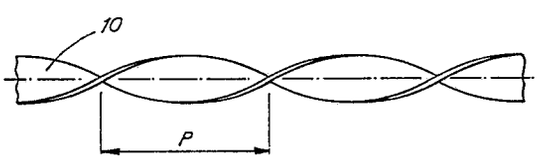

FIG. 1

EP 0 351 229 A2

Description

IMPROVEMENTS RELATING TO SOIL REINFORCEMENT

This inventions relates to earth and soil reinforcement (conveniently referred to as soil hereafter).

The engineering properties of soil may be improved in certain conditions by the introduction of reinforcement elements.

These may take various forms but there are two basic ways of employing reinforcement elements in the soil structure which are briefly as follows

1. Insitu reinforcement.

Here the reinforcement is introduced in to the existing ground. This technique maybe divided into three categories, soil nailing, micro piling, and dowelling.

In soil nailing strip reinforcements are laid either horizontally or sub-horizontally in order to enhance the shearing resistance of the soil by reacting in the tensile mode. The nailing element should always act in a tensile mode, otherwise the mass shear resistance may be reduced.

The construction technique employed in soil nailing is generally referred to as "top down", Grouting techniques are usually employed to bond the reinforcements to the surrounding soil and hence transfer the shear force to the soil.

2. Constructed reinforcement.

Here the reinforcement is introduced to the soil structure during the fill stage of construction and hence becomes an integral part of the soil mass structure. The construction method employed in this method of soil reinforcement is referred to as "bottom up". With this technique the friction shear force transfer acts directly on the reinforcement element.

These techniques are well known and for further details reference is made to:

1. Lee K.L. "Mechanisms, analysis and designs of reinforced earth state of the art report". ASCE . Symposium on Earth Reinforcement, Pittsburgh 1978.

2. McKittrick DP reinforced earth; applications of theory and research to practice, Ground Engineering, January 1979.

3. Bruce DA and Jewell RA; Soil Nailing; Application and practice, Ground Engineering November 1986 and January 1987.

It is an object of the present invention to provide an improved method of soil reinforcement.

According to the present invention a method of soil reinforcement which includes the use of reinforcement elements in which the reinforcement elements are in the form of spirals.

In one form of the method the spirals may be continuous, whilst in an alternative form the spirals may be intermittent (ie. interspersed with portions of other shapes).

In one arrangement the elements are formed of stainless steel. In this case the spirals of the elements are of substantially flattened section, ie, that which would be obtained by twisting a flat strip of metal into a spiral.

The reinforcement elements may be laid between layers of soil and/or aggregates which are laid horizontally, sub-horizontally, vertically or sub-vertically. They may be laid singly, singly spaced apart, or in groups.

The invention may be performed in various ways and the following drawings illustrate reinforcing elements for use with the method according to the present invention, in which

Figure 1 - is a general view of reinforcing elements incorporating a spiral according to the present invention

Figure 2 - is a similar view to Figure 1 of an arrangement in which the spiral is not continuous and

Figure 3 - is a view of an element with a wall anchor on the end.

In the arrangement shown in Figures 1 and also 1A a reinforcing element 10 is of flattened section twisted into a spiral as can be seen from the cross-section in Figure 1A. In this Figure 'D' indicates the diameter, 'P' indicates the pitch and 't' indicates the thickness. The D and P parameters are important in relation to the category and soil specifications ie, whether it is granular, clay or the like, along with particle size and shape. The thickness t will basically control the strip strength together with the diameter D.

Figure 2 shows an arrangement in which a second strip indicated generally at 11 has a spiral portion 12 a flat portion 13 and a second spiral portion 14 and a second flat portion 15. As will be seen in the Figure the length of the spiral portion 12, is indicated by A, that of the flat portion 14 by B, and that of the spiral portion 14 by C. The respective lengths of the portions are indicated by a, b & c. The ratios a/b, b/c or a/c are determined by the soil structure and application. The portions 13 and 15 are conveniently made from an untwisted portion of the spiral.

Either of the arrangements shown in Figures 1 and 2 may be made from any suitable material compatible with the soil structure and working environment. If longevity is aonsideration they are preferably made of stainless steel.

The ends of the structure shown in Figures 1 and 2 may be modified to incorporate structural fixings in order to attach and hence tie back a retaining wall or other structural element. In the arrangement shown in Figure 3 a strip 16 has secured to one end thereof an anchor 17. The anchor preferably incorporate means to secure the end of the strip either by bonding or welding, and may be of any suitable shape.

The density and reinforcement configuration will be a function of the soil structure, grading and structural function. The reinforcements may be laid between layers of soil and/or aggregates and may be laid horizontally, sub-horizontally, vertically or sub-vertically according to the requirements of the site. One or more layers of the reinforcements may

be used and may for example be spaced from one another according to the requirements of the site. They may lie parallel to the slope, and normal to the reinforcing wall or although other angles may be used if required. They may be laid singly, pairs or more, laid close to one another, or in any suitable configuration known in the art.

The reinforcing elements according to the present invention are particularly useful in increasing and improving soil reinforcement because of their shape and strength. Furthermore when they are made of stainless steel there is no tendency to corrode in normal environmental conditions.

Claims

1) A method of soil reinforcement which includes the use of reinforcing elements in which the reinforcing elements are in the form of spirals.

2) A method as claimed in Claim 1, in which the spirals are continuous.

3) A method as claimed in Claim 2, in which the spirals are intermittent.

4) A method as claimed in Claim 2 or Claim 3, in which the elements are formed of stainless steel.

5) A method as claimed in any of of Claims 1 to 4, in which the spirals of the elements are of substantially flattened section, ie that which would be obtained by twisting a flat strip of material into a spiral.

6) A method as claimed in any one of Claims 1 to 5, in which the reinforcements are laid between layers of soil and/or aggregates and are laid horizontally, sub-horizontally, vertically or sub-vertically.

7) A method as claimed in any one of the preceding Claims, in which the elements are laid singly, spaced apart or in groups.

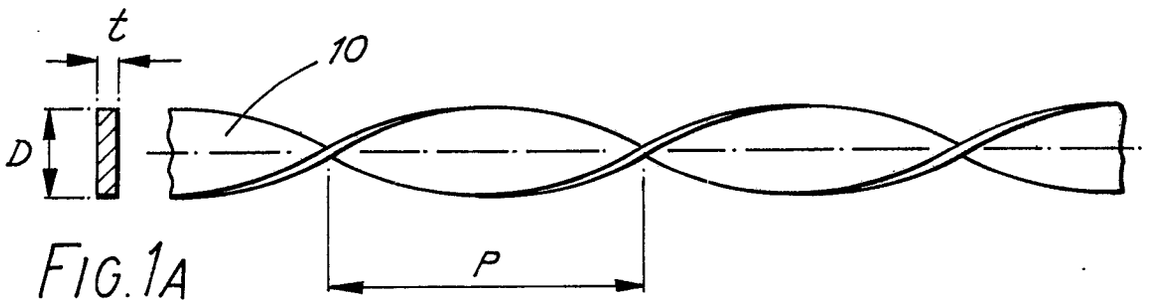

FIG. 1A

FIG. 1

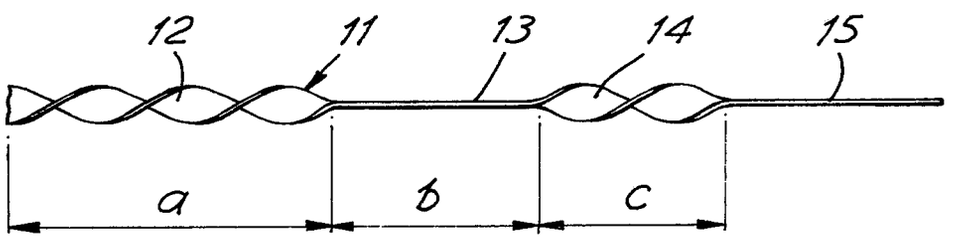

FIG. 2

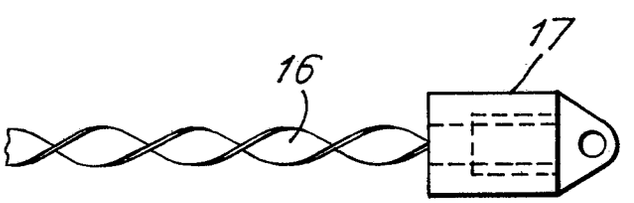

FIG. 3