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### Technical field of the invention

5 Firstly, the present invention relates to a method for checking the load-bearing capacity of screw-in foundations. In particular in this context, the invention relates to a method in which the determination of the screw-in foundations on which the load test is to be performed is made on the basis of the insertion torque-displacement curves of the screw-in foundations.

10 The present invention further relates to a method and apparatus for characterizing foundation soil. In particular in this context, the invention relates to a method in which foundation soil characterization is carried out on the basis of the insertion torque-displacement curves of test bodies, and to an apparatus for foundation soil characterization. In particular, the invention relates to an apparatus that enables foundation soil characterization independent of form factor.

### State of the art

15 Screw-in foundations or ground screws, usually made of steel, are an interesting alternative to foundations made of concrete. Their length can vary from a few tens of centimeters to several meters. Generally speaking, screw-in foundations have a shape comparable to that of a normal screw, that is, they consist of an elongated body in the form of a cylinder with a part that includes an external thread. Screw-in foundations are often designed as a hollow body which is closed with a flange. Figure 1 shows some examples of typical screw-in foundations.

25 The great advantage of screw-in foundations is that they are immediately capable of supporting a load, and they can be completely dismantled and reused. Furthermore, there is no necessity to wait for curing periods. Screw-in foundations are increasingly used in a wide variety of situations, for example as foundations for noise barriers, solar panels, or for small or medium-sized houses.

30 Like all foundations, screw-in foundations must be tested for their load-bearing capacity after they have been inserted in the ground. Nowadays, foundations are usually tested for their load-bearing capacity by means of static test methods. Unfortunately, these methods are lengthy and laborious. Faster methods, especially dynamic methods,

are often too inaccurate. Lengthy testing times and complex installations incur high costs for foundation testing and delay the completion of the construction project due to the required testing times. Inaccuracies result in costly oversizing.

In addition, test methods nowadays are performed on a number of randomly selected screw-in foundations in a construction field. This means that for the majority of the installed screw-in foundations, there is no proof of their load-bearing capacity. Unfortunately, this can pose a significant safety risk. In order to minimize the risk, existing methods require a minimum number of screw-in foundations to be tested on the construction site. For this reason, relatively large oversizing is accepted nowadays in order to compensate for the inevitable uncertainties. This, of course, increases the overall inspection time, in turn delaying the completion of the construction project and therefore incurring unnecessary costs.

In addition, the design of a construction project in which screw-in foundations are used is usually carried out by inserting commercial screw-in foundations selected for the project and measuring their response to static loads. These measurements are often not sufficiently relevant to ensure optimum planning. In particular, these measurements cannot be used to determine exactly which type of screw foundation should be used at which location. An optimization concerning the often individually stratified foundation soil, the local load transfer and the choice of model is not possible, since only the response of one specific commercial foundation was measured at one installation point and the properties of the soil cannot be precisely determined layer by layer. This also means that if the project is changed during the design phase, the measurements will lead to significant inaccuracy in the prediction if the model is changed, or it will mean measurements have to be repeated with the newly selected screw-in foundation model. This results in high costs and time delays in planning, therefore also delaying implementation of the construction project.

EP 1520938 A2 discloses a method for determining the load-bearing response of displacement piles.

Based on the prior art, the present invention is therefore based on the task of overcoming the aforementioned disadvantages and providing a method for checking the load-bearing capacity of screw-in foundations which enables more accurate and faster load testing of screw-in foundations. It is also an objective of the present invention to propose a method that allows for accurate foundation soil characterization and thus more

efficient site planning. Another objective of the present invention is to propose an apparatus that enables characterization of the foundation soil layer by layer.

#### Summary of the invention

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According to the present invention, these objectives are achieved primarily by the elements of the independent claim. Further advantageous embodiments are further apparent from the dependent claims and the description.

10 In particular, the objectives of the present invention are achieved by a method for checking the load-bearing capacity of screw-in foundations, comprising the following steps:

- a. Screwing the screw-in foundation into the ground,
  - b. Determining the screw-in foundations on which a load test to check the load-bearing capacity is to be performed,
  - 15 c. Performing the load test on the determined screw-in foundations,
- whereby for each screw-in foundation the screw-in torque and the screw-in path are continuously measured during the screwing in, whereby for each screw-in foundation an insertion torque-displacement curve is established, and whereby the determination of the screw-in foundations on which a load test is to be performed is made on the basis of
- 20 the insertion torque-displacement curve.

Thanks to such a method, the determination of the screw-in foundations on which the load test is to be performed is made selectively rather than randomly. This is because it was shown that there is a close correlation between the insertion torque-displacement

25 curve of a screw-in foundation and its ultimate load or static behavior under load. The screw-in foundations that are to be tested can therefore be determined on the basis of the information that can be drawn from the insertion torque-displacement curve. In other words, because of the scientifically proven correlation, selective testing of the worst screw-in foundations can be performed instead of random testing. This results in a

30 reduction of the statistically necessary screw-in foundations to be tested.

In addition, the scatter factor known to a person skilled in the art with regard to the nominal load to be applied can be reduced to the value 1 due to the selective testing of the worst screw-in foundations.

This results in a reduction of the number of screw-in foundations to be tested, a reduction of the testing time and, due to the reduction of the test load to be applied, a reduction of the necessary test installation. Consequently, further costs are eliminated for the customer in that the construction process is accelerated and waiting time is eliminated. It was also shown that it is sufficient to actually check the “worst” screw-in foundations, i.e. the ones with the lowest load-bearing capacity, for their load-bearing capacity on the basis of the insertion torque-displacement curve. If these weakest screw-in foundations meet the criteria of a load-bearing capacity test, then it can be determined with certainty that all foundations meet the structural requirements.

Furthermore, the method according to the invention increases safety, since an insertion torque-displacement curve is generated for each foundation. A poor foundation can therefore be identified immediately. By contrast, state-of-the-art methods only enable poor foundations to be detected by chance in some cases. Furthermore, the method according to the invention also allows adaptation of the installation technique or model selection during the installation process according to the given situation.

Furthermore, the method according to the invention enables traceability. Each screw-in foundation is assigned an insertion torque-displacement curve. This can be beneficial in case of future problems, as it allows an even better understanding of the complex relationship between screw-in torque and breaking load.

The relevant information for determining the worst screw-in foundations can be drawn from the insertion torque-displacement curve in several ways. For example, the first and second derivatives of the insertion torque-displacement curve can provide highly relevant information. It is particularly important to note that, depending on the situation in which the screw-in foundation is used, the interpretation of the insertion torque-displacement curve may not be the same. For example, an insertion torque-displacement curve of a screw-in foundation to be used in a situation where it will have to withstand a compressive load should not be the same as that of a screw-in foundation that will have to withstand a tensile load.

To measure the torque, force sensors can be used directly which are attached to the machine used for screwing in the screw-in foundations. In addition, however, direct measurement by means of force sensors installed on the screw-in foundation itself is also possible. However, it is also possible to use an indirect measurement of the torque, which is based on the measurement of the current (built-in electric devices) or pressure (liquid-

based rotary devices), taking into account drive-specific multipliers. The screw-in path can also be measured very easily by means known to a person skilled in the art.

In a preferred embodiment of the method according to the invention, the screw-in step is additionally recorded in such a way that an insertion torque-time curve is created, and that the determination of the screw-in foundations on which the load test is to be performed is additionally made on the basis of the insertion torque-time curve. This makes it possible to determine the screw-in foundations on which the load test is to be performed even more precisely.

In another preferred embodiment of the method according to the invention, the angular velocity is additionally measured during the screwing in. Using the angular velocity and thread pitch of the screw-in foundation, an insertion rotation path can be calculated and compared with the actual measured screw-in path. The determination of the screw-in foundations on which the load test is to be performed is then made on the basis of this comparison. This allows a so-called slip analysis to be made. This ensures that if foundation slippage occurs during insertion, it is taken into account when determining the screw-in foundations on which the load test is to be performed.

In a further preferred embodiment of the method according to the invention, the determination of the screw-in foundations on which the load test is to be performed is additionally made on the basis of previous soil assessments.

This can ensure that a load-bearing capacity test is performed on the screw-in foundations that have the worst insertion torque-displacement curves and are located in the soil with the lowest load-bearing capacity.

In another preferred embodiment of the method according to the invention, the determination of the screw-in foundations on which the load test is to be performed is made on the basis of the magnitude of the insertion torque-displacement curve integral.

This is because it was shown that there is a particularly high correlation between the magnitude of the insertion torque-displacement curve integral and the breaking load of a screw-in foundation. Based on the magnitude of the insertion torque-displacement curve integral, it is simple to accurately identify the worst screw-in foundations. Typically, the magnitude of the insertion torque-displacement curve integral is determined over the entire screw-in path and is used to determine the worst screw-in foundations. However, it is also conceivable to determine and use a magnitude of the integral only over a partial range of the screw-in path. This can be particularly advantageous if the screw-in

foundation has been screwed into a very heterogeneous soil. For a foundation that is required to supporting a compressive load, it is advantageous to determine the value of the integral over the range of the screw-in path that corresponds to the end of the screwing in. On the contrary, for a foundation that is required to support a tensile load, it is advantageous to determine the value of the integral over the entire screw-in path.

In another preferred embodiment of the method according to the invention, the determination of the screw-in foundations on which the load test is to be performed is made on the basis of the maximum insertion torque.

This is because it was shown that there is also a high correlation between the maximum of the insertion torque-displacement curve and the breaking load of a screw-in foundation. This allows the worst screw-in foundations to be identified even more accurately. With the position of the maximum of the insertion torque-displacement curve, important information can also be obtained about the soil properties and the most suitable insertion depth of the screw-in foundation.

In another preferred embodiment of the method according to the invention, the determination of the screw-in foundations on which the load test is to be performed is made on the basis of the final torque limit value.

This is particularly advantageous for determining the worst screw-in foundations that are required to support a compressive load. A low final torque limit value of the screw-in torque displacement means nothing other than that the top of the foundation is in a soil that is not able to support a load. For this reason, this foundation is not well suited to support a compressive load.

In another preferred embodiment of the method according to the invention, the foundation is turned back after the screw-in foundation has been screwed in. During reverse rotation, the torque and displacement are measured. A torque-displacement curve for reverse rotation is then generated, and the determination of the screw-in foundations on which the load test is to be performed is made on the basis of the torque-displacement curve for reverse rotation.

From the torque-displacement curve for reverse rotation, information can be obtained about the static friction and the sliding friction of the foundation. A comparison between the screw-in torque-displacement curve and the torque-displacement curve for reverse rotation can be used to determine how great the load-bearing capacity of different sections of the foundation is. In particular, a so-called difference curve, which is

created from the difference between the screw-in torque-displacement curve and the torque-displacement curve for reverse rotation, can be very helpful for this purpose. A comparison between the screw-in torque-displacement curve and the torque-displacement curve for reverse rotation can be used in particular to determine the proportion of surface friction and peak resistance. By comparing the measured torque at the beginning of the reverse rotation – based on the static friction to be overcome – with the subsequent torque due to the sliding friction – the choice of the foundations to be tested can be made even more selectively.

The curve progression of the reverse rotation and the curve progression of the difference curve between the screwing in and unscrewing process is an indication of the foundation soil properties or characteristics. In fact, the presence of an accentuated peak in the differential curve at the beginning of the reverse rotation implies a high level of static friction and there a cohesive soil subject to an increased risk of creep.

In a further preferred embodiment of the method according to the invention, the determination of the screw-in foundations on which the load test is to be performed is additionally made on the basis of the load to be supported by the screw-in foundation.

It is common in structures for the determined loads to be supported per foundation point not to be equal. This circumstance can be taken into account by putting the information obtained from the screw-in torque-displacement curve into perspective with respect to the load that the foundations are required to support. For example, it is acceptable for a foundation that only has to support a moderate load to have an average insertion torque-displacement curve, while a foundation that has to support a high load must have an insertion torque-displacement curve that assumes a high load-bearing capacity. This makes it possible to determine the screw-in foundations on which the load test is to be performed even more selectively.

It should be noted that the determination with the method according to the invention of the screw-in foundations on which the load test is to be performed can also be made on the basis of a combination of the magnitude of the insertion torque-displacement curve integral, the maximum insertion torque, the final torque limit value or the load to be supported by the screw-in foundation.

The present invention further also proposes a method for soil characterization comprising the following steps:

- a. Screwing the test body into the ground,

b. Continuous measurement of the screw-in torque and the screw-in path during insertion,

c. Characterization of the foundation soil,

wherein an insertion torque-displacement curve is established, and wherein the characterization of the foundation soil is made on the basis of the insertion torque-displacement curve.

Thanks to such a method, the characterization of the foundation soil is made on the basis of the same parameters that are subsequently used for the determination of the screw-in foundations on which the load test is to be performed. This gives the soil characterization greater validity. This is because it was possible to show that a close correlation exists between the insertion torque-displacement curve of a test body and the foundation soil properties. Consequently, thanks to the method according to the invention, the foundation soil is characterized more precisely, thereby simplifying construction site planning. In particular, thanks to the method according to the invention, a decision can be made more effectively as to which screw-in foundations are to be used at which location, in particular their design, length, diameter and position of the functional elements (coils, plate, conical part). Consequently, costs are eliminated for the customer thanks to the acceleration of the planning process.

The relevant information for the characterization of the foundation soil can be derived from the insertion torque-displacement curve in various ways. For example, the first and second derivatives of the insertion torque-displacement curve can provide highly relevant information. It is particularly important to note that depending on the situation, the interpretation of the insertion torque-displacement curve may not be the same. For example, an insertion torque-displacement curve of a test body taken at a location where a screw-in foundation will have to withstand a compressive load need not be the same as at a location where a screw-in foundation will have to withstand a tensile load.

To measure the torque, force sensors can be used directly which are attached to the machine used for screwing in the test body. In addition, direct measurement is also possible using force sensors installed on the test body itself. An indirect measurement is based on the measurement of the current (built-in electric devices) or pressure (liquid-based rotary devices), taking into account drive-specific multipliers. The acting torques in the respective foundation section can be determined by strain gauges. The screw-in path

can also be measured very easily by means known to a person skilled in the art.

In a preferred embodiment of the proposed method, the screw-in step is additionally recorded such that an insertion torque-time curve is created and that the foundation soil characterization is carried out based on the insertion torque-displacement  
5 curve and the insertion torque-time curve. This allows the foundation soil characterization to be carried out with even greater precision.

In another preferred embodiment of the method, the angular velocity is additionally measured during insertion and a comparison is made between the insertion rotation path and the screw-in path. The foundation soil characterization is then  
10 additionally carried out on the basis of this comparison.

By means of angular velocity and thread pitch of the test body, an insertion rotation path can be determined and a comparison made between this value and the measured insertion path. This allows a so-called slip analysis to be made. This ensures that if slippage of the test body occurs during insertion, it is accounted for in the foundation soil  
15 characterization.

In another preferred embodiment of the proposed method, the foundation soil characterization is carried out on the basis of the magnitude of the torque-displacement curve integral.

This is because it was shown that there is a particularly high correlation between  
20 the magnitude of the insertion torque-displacement curve integral and the soil properties. Based on the magnitude of the insertion torque-displacement curve integral, characterization of the foundation soil is therefore simple and accurate. Typically, the magnitude of the insertion torque-displacement curve integral is determined over the entire screw-in path and is used for the purpose of foundation soil characterization.  
25 However, it is also conceivable to determine and use a magnitude of the integral only over a partial range of the screw-in path. This can be particularly advantageous if the test body has been screwed into a very heterogeneous soil.

In a preferred embodiment of the proposed method, the foundation soil characterization is carried out on the basis of the maximum insertion torque.

This is because it was shown that there is also a high correlation between the  
30 maximum of the insertion torque-displacement curve and soil properties. This allows the foundation soil characterization to be carried out with even greater precision. With the position of the maximum of the insertion torque-displacement curve, important

information can also be obtained about the most suitable insertion depth of a screw-in foundation.

In another preferred embodiment of the proposed method, the foundation soil characterization is carried out on the basis of the final torque limit value.

5 This is particularly advantageous for foundation soil characterization in locations where screw-in foundations have to support a compressive load. A low final torque limit value of the screw-in torque displacement means nothing other than that the top of the foundation will be in a soil that is not able to support a load. For this reason, this foundation is not well suited to supporting a compressive load.

10 In another preferred embodiment of the proposed method, the test body is a screw-in foundation. This allows the foundation soil to be characterized for the exact foundation model to be used.

In another preferred embodiment of the proposed method, the test body is an apparatus according to another aspect of the present invention. In this way, the  
15 foundation soil can be characterized independently of the form factor.

In another preferred embodiment of the proposed method, the screwing in is performed layer by layer and a load test is performed for each layer. The foundation soil characterization is additionally carried out on the basis of the behavior of the test body during the load test. This results in a foundation soil characterization which is based on a  
20 test body and dependent on depth. This allows the prediction of the load transfer behavior of different screw-in foundation models at different installation depths, even in inhomogeneous, layered soils.

In another preferred embodiment of the proposed method, the load test is performed until breakage of the foundation soil layer is reached. This allows the  
25 foundation soil layer to be characterized more precisely.

It should also be noted here that the characterization of the foundation soil with the proposed method can also be made based on a combination of the magnitude of the insertion torque-displacement curve integral, the maximum insertion torque, or the final torque limit value.

30 The present invention also proposes a foundation soil characterization apparatus comprising a cylindrical portion having an outer diameter and a conical portion having a maximum outer diameter, the conical portion comprising an external thread configured to allow rotation of the apparatus into the foundation soil, characterized in that the outer

diameter of the cylindrical portion is smaller than the maximum outer diameter of the conical portion.

By means of the proposed apparatus, a precise layer-by-layer characterization of the foundation soil can be achieved. Since the diameter of the cylindrical part of the apparatus is smaller than the maximum diameter of the conical part, the frictional forces that are generated by the outer surface of the cylindrical part during the screwing in and load tests are not relevant to the characterization of the foundation soil.

In a preferred embodiment of the proposed apparatus, the cylindrical part is extendable by means of further cylindrical parts. This makes it easy to reach deeper layers. Further details of the invention will now become apparent from the following description of preferred embodiments of the invention, which are shown in the accompanying drawings. The description also reveals the further advantages of the present invention, as well as suggestions and proposals as to how the objects of the invention could be modified or even further developed within the scope of the claims.

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#### Brief description of the drawings

Figure 1 shows different models of screw-in foundations

Figure 2 illustrates the screwing in process of a screw-in foundation

20 Figure 3 shows a preferred embodiment of a first method according to the invention for load testing of screw-in foundations.

Figure 4 shows a schematic representation of an insertion torque-displacement curve.

Figure 5 shows measured insertion torque-displacement curves

25 Figure 6 shows a measured insertion torque-time curve

Figure 7 shows a graph demonstrating the relationship between the breaking load and the screw-in torque.

Figure 8 shows a preferred embodiment of a proposed method for foundation soil characterization.

30 Figure 9 illustrates a preferred embodiment of the proposed method for foundation soil characterization.

Figure 10A shows a side view of a preferred embodiment of a proposed apparatus for foundation soil characterization.

Figure 10B shows a perspective view of a preferred embodiment of a proposed apparatus for foundation soil characterization.

#### Preferred embodiments of the invention

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Figure 2 schematically illustrates the screwing in process of a screw-in foundation SF into the soil B. During the screwing in, the screw-in path W and the screw-in torque D are continuously measured by means known to a person skilled in the art.

10 Figure 3 illustrates a preferred embodiment of the first method according to the invention for checking the load-bearing capacity of screw-in foundations. According to this embodiment, the process according to the invention starts with screwing the screw-in foundations into the ground. During the screwing in, the screw-in path, screw-in torque and angular velocity are measured continuously for each foundation. Subsequently, an insertion torque-displacement curve is created. As shown in this figure, the insertion time  
15 can also be measured and an insertion torque-time curve can be generated. The “worst” screw-in foundations are identified based on at least the insertion torque-displacement curve. The term “worst screw-in foundations” is understood to mean those screw-in foundations for which the least optimum load-bearing capacity can be expected. As shown in this figure, an important parameter for the identification of these “worst”  
20 foundations is the final torque limit value. This value is highly relevant, in particular for foundations which are required to support compressive load. Another possible parameter is the magnitude of the insertion torque displacement integral. After determining the screw-in foundations on which the load test is to be performed on the basis of the torque-displacement curve or the torque-time curve, this test is performed on precisely these  
25 screw-in foundations.

Figure 4 is a schematic representation of a torque-displacement curve. As can be seen in this figure, the screw-in torque increases with insertion depth. However, the course of the curve is not regular and a maximum insertion torque can be identified. With this curve, it is also possible to determine the final torque limit value and the magnitude  
30 of the integral.

Figure 5 shows actual measured screw-in torque-displacement curves which were always measured with the same screw-in foundation model. As it can be seen from this figure, the progression, integral, maximum and final value can vary greatly depending on

the location of the insertion.

As mentioned above, the insertion time can also be measured during the screwing in of the screw-in foundations. This allows the creation of a screw-in torque versus time curve. An example of such a curve is shown in Figure 6. This clearly shows the phases of insertion where insertion has not occurred regularly but where the foundation has slipped. This “slip analysis” can therefore provide additional important information for determining the “worst” screw-in foundations.

It was possible to show that a close correlation exists between the insertion torque-displacement curve and the breaking load and the foundation soil properties. Figure 7 shows a graph demonstrating this relationship. The magnitude of the insertion torque-displacement integral and the load causing breakage were measured and compared for different screw-in foundation designs. As can be seen from this graph, there is a high correlation between these values. Using the torque integral, it is therefore possible to identify the “worst” screw-in foundations, i.e. those that can only support a small load.

Figure 8 illustrates a preferred embodiment of the proposed method for foundation soil characterization. In this embodiment, the proposed method starts with the screwing in of the test body into a foundation layer of depth T1. During the screwing in, the screw-in path, screw-in torque and angular velocity are measured continuously. Subsequently, an insertion torque-displacement curve is created. As shown in this figure, the insertion time can also be measured and an insertion torque-time curve can be generated. When the test body has reached the depth T1, a load test is performed and the behavior of the test body (for example displacement amount and displacement velocity) is measured. The foundation soil layer of depth T1 is characterized based on the insertion torque-displacement curve and the behavior of the test body during the load test. As shown in the figure, layer-by-layer foundation soil characterization is repeated until the depth to be characterized is reached.

Figure 9 illustrates a preferred embodiment of the proposed method for foundation soil characterization. As can be seen in this figure, the test body 10 is screwed into the foundation soil step by step and a load test is performed between two screwing in steps.

Figure 10A and 10B illustrate a preferred embodiment of the proposed apparatus 1 for foundation soil characterization. The apparatus 1 comprises a cylindrical part 2 with external diameter D2 and a conical part 3 with maximum external diameter D3 and external thread 4. In this preferred embodiment, the apparatus 1 further comprises a

coupling part 5 which allows coupling of the apparatus 1 to a screwing machine (not shown here) having an integrated loading device.

5 Finally, it should be pointed out once again that the exemplary embodiments described here represent only possible implementations of the ideas according to the invention and should in no way be regarded as limiting. It will be understood by those skilled in the art that other implementations of the invention and other elements are possible without neglecting the essential features of the invention. In particular, it should be noted that the various methods according to the invention can be combined with each other. For example, the soil characterization procedure can be applied first, followed by  
10 the screwing in of screw-in foundations and the application of the method for determining the screw-in foundations on which a load test is to be performed. Furthermore, it should be noted that the method for foundation soil characterization according to the invention also enables location and detection of subsurface structures such as river courses or foundation soil changes due to civilizational activities.

## Patentkrav

**1.** Fremgangsmåde til kontrol af skruefundamenters bæreevne omfattende følgende trin:

- a. indskruning af skruefundamentene i jorden,
- 5 b. bestemmelse af de skruefundamenter, på hvilke der skal gennemføres en belastningskontrol til kontrol af bæreevnen,
- c. gennemførelse af belastningskontrollen på de bestemte skruefundamenter,

**kendetegnet ved,**

10 **at** indskruningsmomentet og indskruningsvejen måles kontinuerligt under indskruningen for hvert skruefundament, at der for hvert skruefundament oprettes en indskruningsmoment-vej-kurve, og at bestemmelsen af de skruefundamenter, på hvilke der skal gennemføres en belastningskontrol, foretages på grundlag af indskruningsmoment-vej-kurven.

15

**2.** Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** indskruningsprocessen desuden optegnes således, at der oprettes en indskruningsmoment-tid-kurve, og at bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, endvidere foretages på grundlag af indskruningsmoment-tid-

20 kurven.

**3.** Fremgangsmåde ifølge et af kravene 1 eller 2, **kendetegnet ved, at** også vinkelhastigheden måles under indskruningen, at der foretages en sammenligning mellem indskruningsrotationsvejen og indskruningsvejen, og at bestemmelsen af

25 de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, foretages på grundlag af denne sammenligning.

**4.** Fremgangsmåde ifølge et af kravene 1 til 3, **kendetegnet ved, at** bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal

30 gennemføres, endvidere foretages på grundlag af forudgående jordbedømmelser.

**5.** Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, foretages på grundlag af værdien af indskruningsmoment-vej-

kurve-integralet.

**6.** Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, foretages på grundlag af det maksimale indskruningsmoment.

**7.** Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, foretages på grundlag af slutværdien for indskruningsmomentet.

**8.** Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, endvidere foretages på grundlag af den last, der skal støttes på skruefundamentet.

**9.** Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** fundamentet skrues tilbage efter indskruningen af skruefundamentet, og at drejningsmomentet og vejen måles under tilbageskrningen, at der oprettes en drejningsmoment-vej-kurve for tilbageskrningen, og at bestemmelsen af de skruefundamenter, på hvilke belastningskontrollen skal gennemføres, endvidere foretages på grundlag af drejningsmoment-vej-kurven for tilbageskrningen.

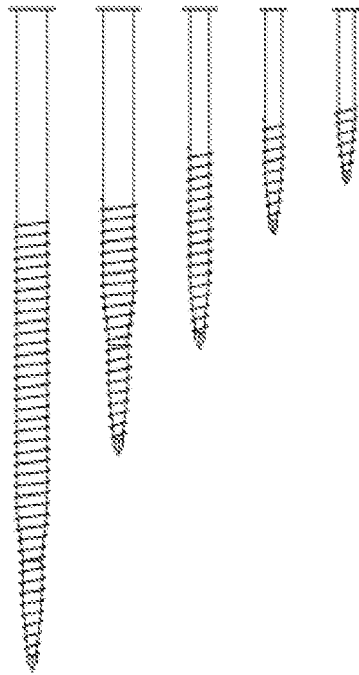


Fig. 1

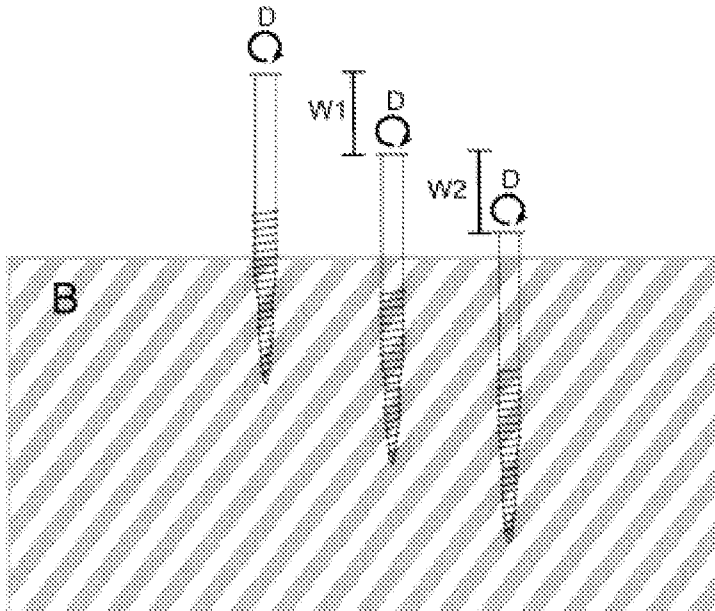


Fig. 2

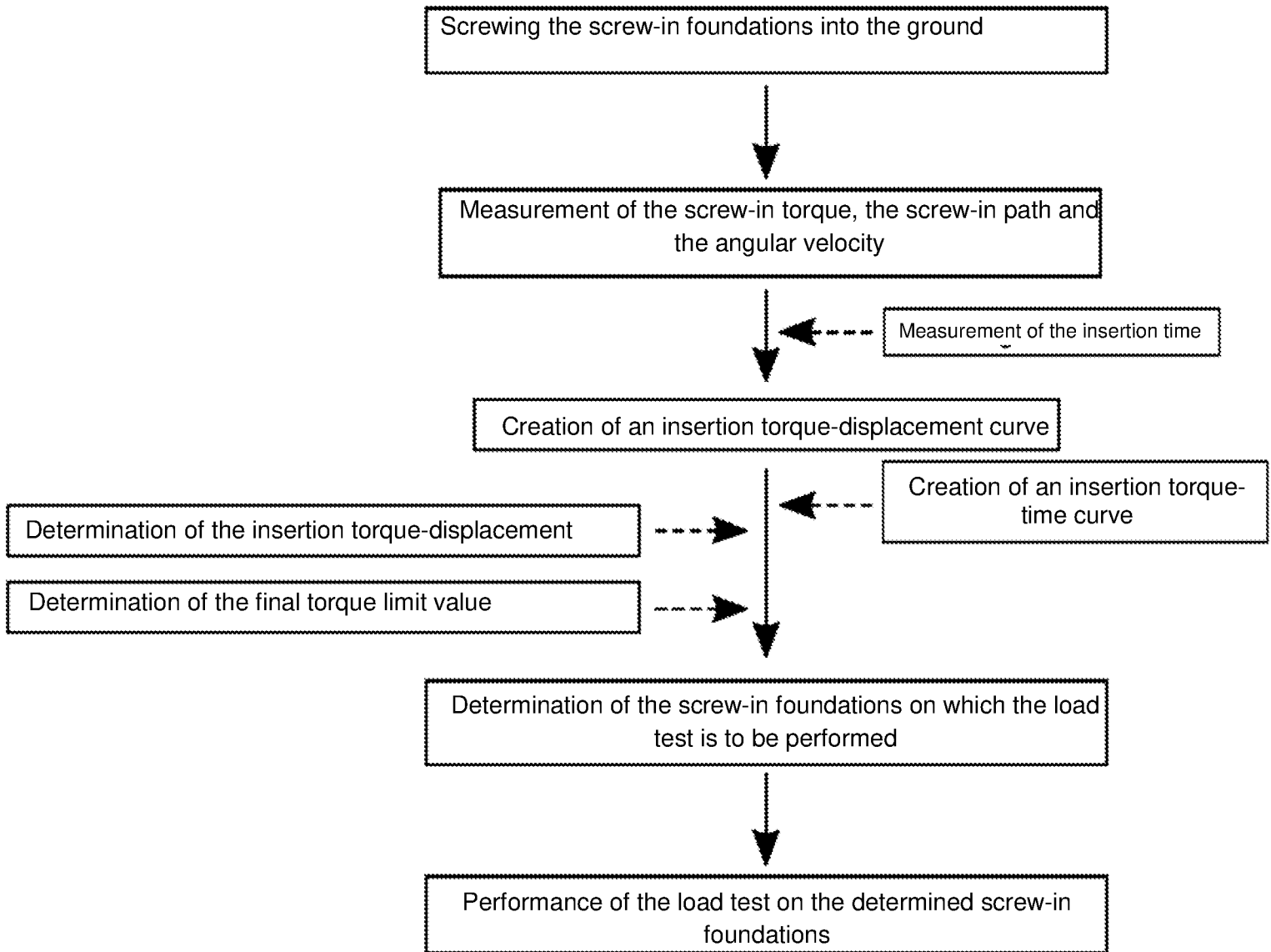


Fig. 3

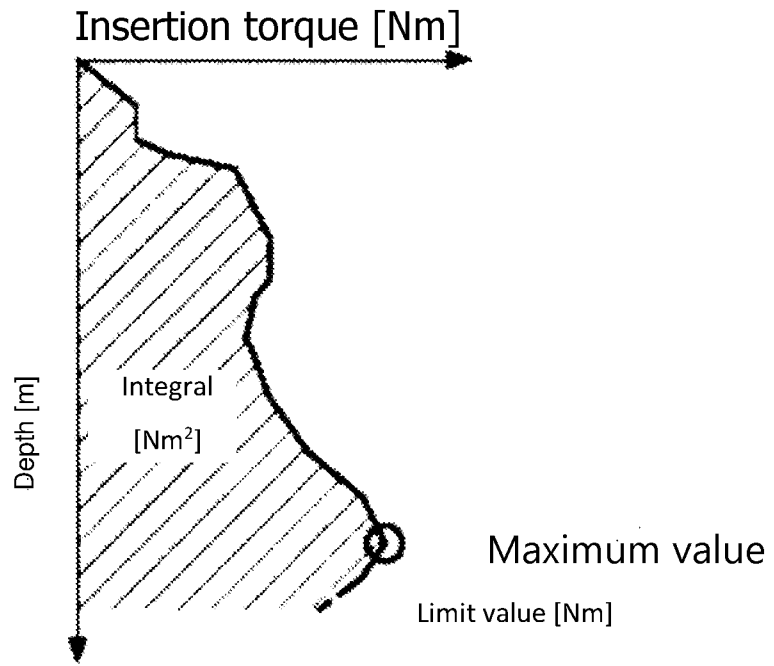


Fig. 4

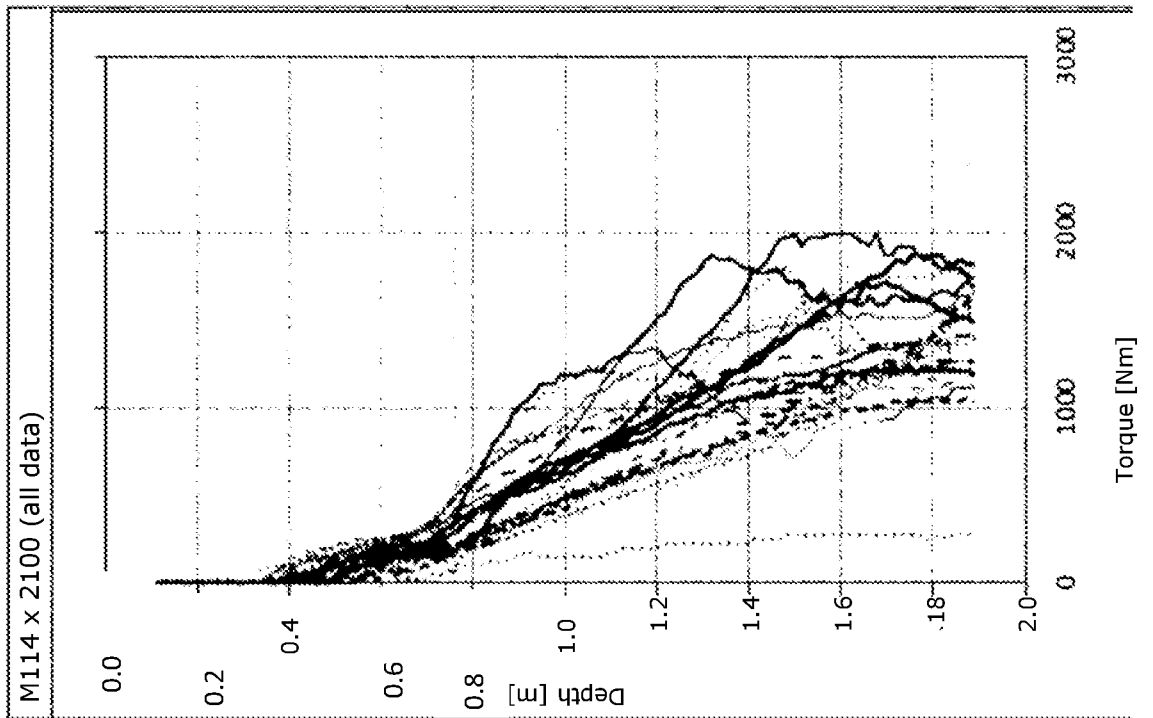


Fig. 5

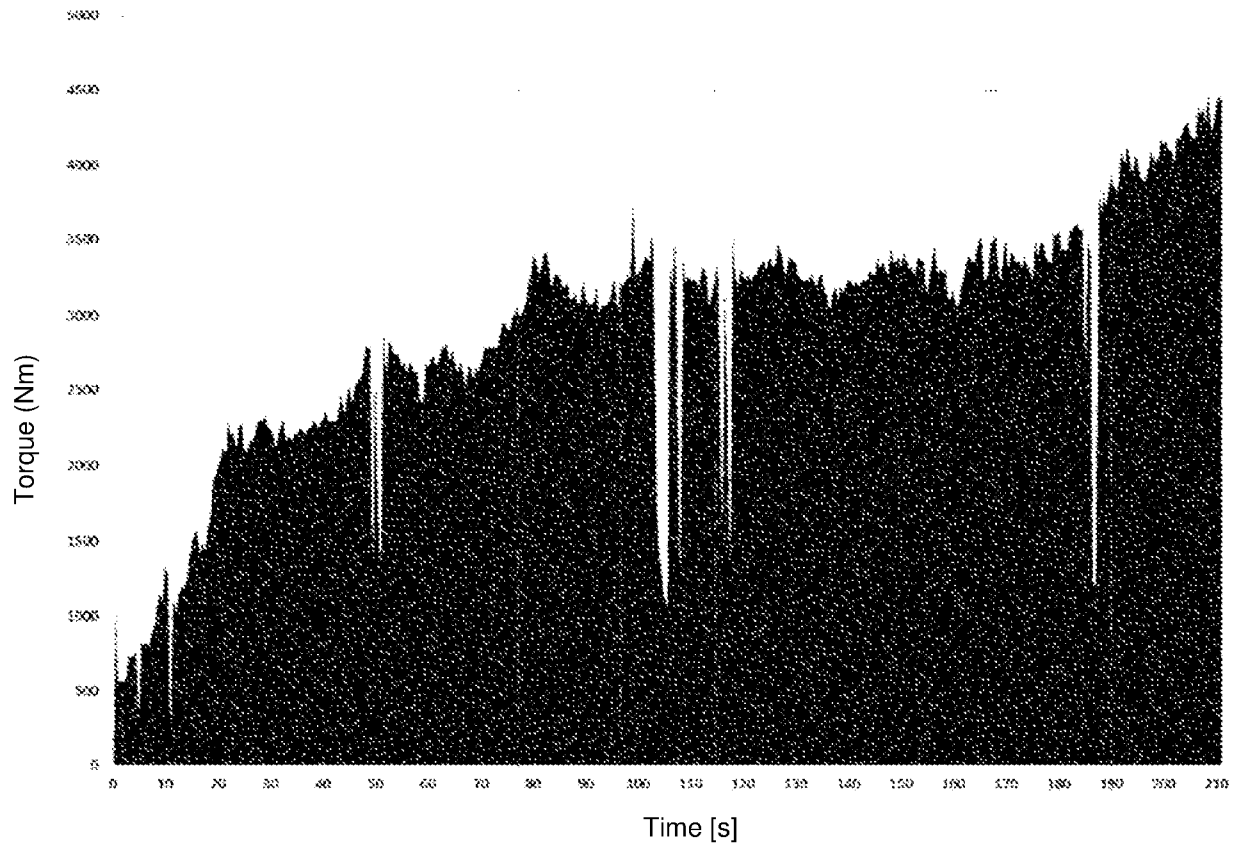


Fig. 6

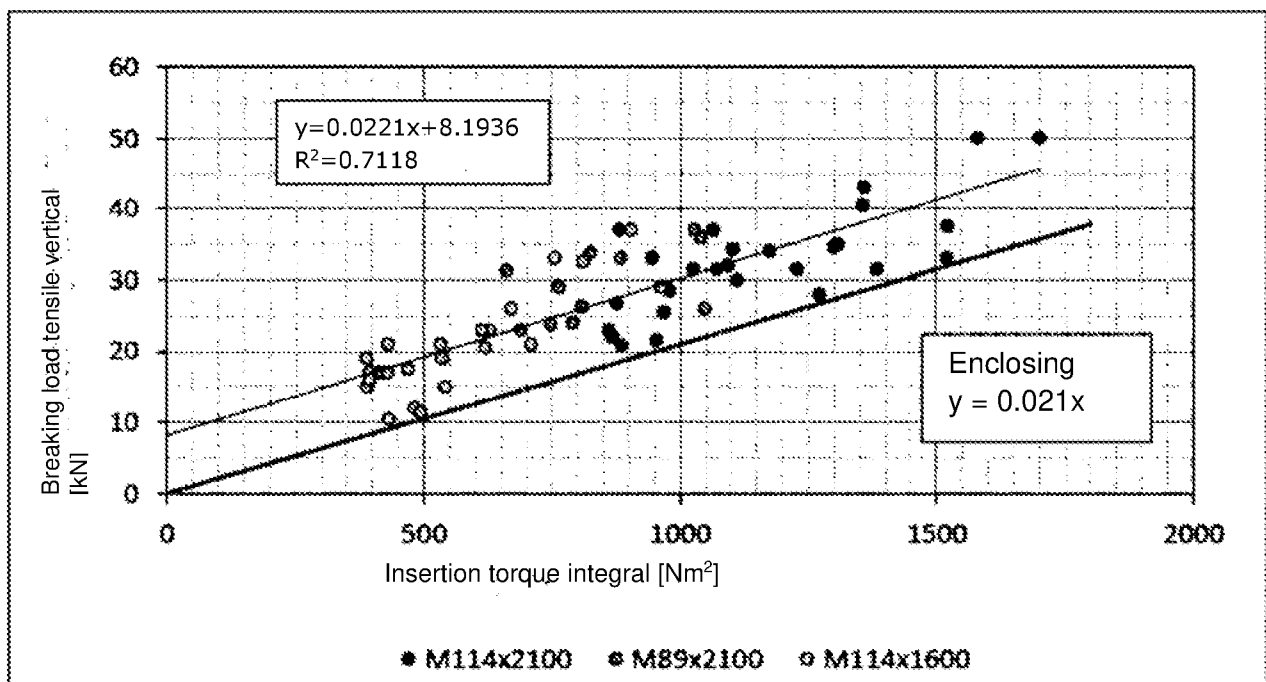


Fig. 7

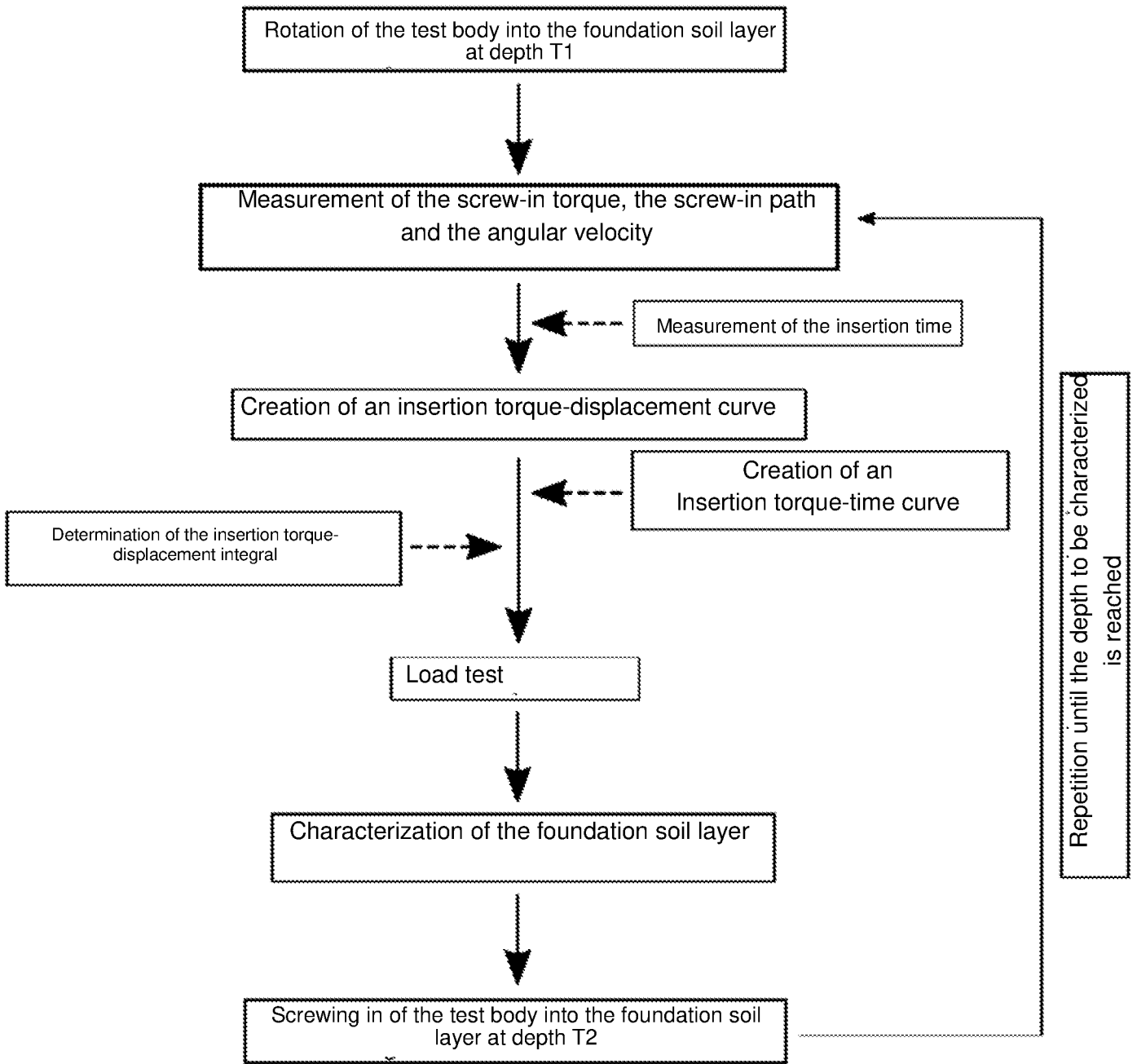


Fig. 8

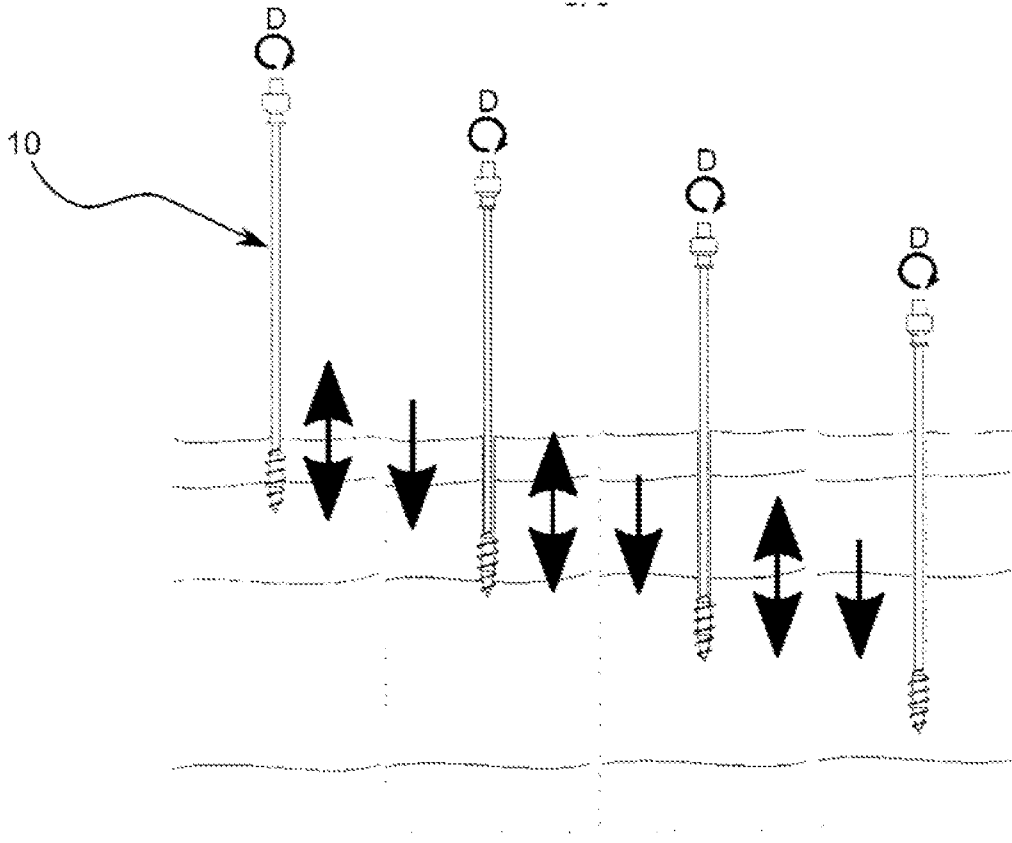


Fig. 9

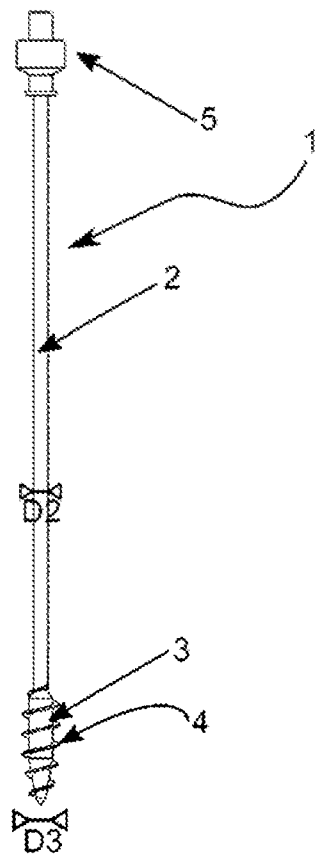


Fig. 10A

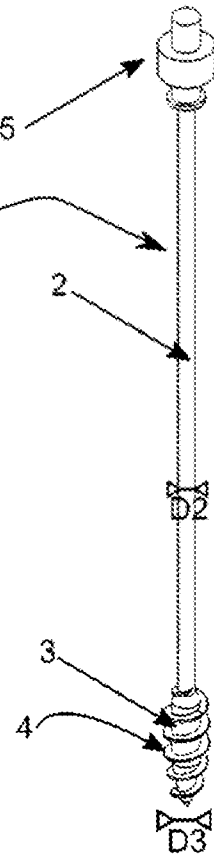


Fig. 10B