

SPECIFICATION

PILE RAPID LOADING TESTING DEVICE

TECHNICAL FIELD

[0001]

This invention relates to a pile rapid loading testing device that performs confirmation of pile bearing power by applying an axial pushing force to a pile in such a way as to allow a weight to fall onto a pile head protruded from a ground surface, with a soft cushion interposed on the pile head, and is constituted so as to be capable of quickly catching the weight that has fallen onto the weight and bounced, thereby avoiding the occurrence of repetitive bouncing of the weight above the pile.

BACKGROUND ARTS

[0002]

As for one method for determining pile vertical bearing power, a static loading test that takes place on the same conditions as those for a pile to be actually used has been hitherto known, in which case, however, the need to use a reaction force resistor or the like for a loading device exists, and hence, the extension of a construction period and the increase in costs have been caused particularly in the case of loading of a large load, resulting in the occurrence of problems such that the time is taken for execution of the test.

[0003]

For that reason, a pile rapid loading test executed for confirmation of pile bearing power by applying an axial pushing force to a pile in such a way as to allow a weight to fall onto a pile head protruded from a ground surface on about a pile driven into the ground, with a soft cushion interposed on the pile head,

has been put into practice as one possible measure to overcome the above problems.

[0004]

In a patent document 1 below, for instance, there is disclosed an invention relating to a rapid loading testing device that is a device used for a pile rapid loading test executed by striking a pile head with a weight and is characterized by having the weight and a shock absorbing material interposed between the weight and the pile head, wherein the shock absorbing material is formed of an elastic material into the shape of an outer shell having a hollow part.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent document 1: Japanese Unexamined Patent Application Publication No. 2005-68802

Patent document 2: Japanese Unexamined Patent Application Publication No. 2002-303570

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

With this pile rapid loading test, bouncing of the weight which has fallen onto the pile head occurs repeatedly due to an elastic force of the shock absorbing material, and consequently, there have been some problems involving the need to ensure the safety, the problem of repeatedly generated noises and the occurrence of errors having an effect on measurement values, all of which are caused by vibrations resulting from the occurrence

of repetitive bouncing of the weight to a testing device.

[0007]

The present invention is provided to overcome the above problems, and accordingly, it is an object of the present invention to provide a pile rapid loading testing device that is constituted so as to be capable of quickly catching a weight that has fallen onto a pile head and bounced, thereby bringing the occurrence of repetitive bouncing of the weight to a stop.

MEANS FOR SOLVING THE PROBLEMS

[0008]

The present invention relates to a pile rapid loading testing device that performs confirmation of pile bearing power by applying an axial pushing force to a pile in such a way as to allow a weight to fall onto a pile head protruded from a ground surface, with a soft cushion interposed on the pile head, and is characterized by having a weight-catching device for catching, in midair, the weight which has fallen onto the pile head and bounced.

[0009]

As for the weight-catching device, there can be proposed a weight-catching device comprising a clamp case having a holder inscription hole whose inner circumferential surface forms a tapered surface that gradually decreases in diameter downwards, a movable body holder disposed above the clamp case and configured to fall and become inscribed in the holder inscription hole, and a permanent electromagnetic holder disposed above the movable body holder and configured to attract the movable body holder only when generating a magnetic force, wherein the movable body holder has a holder body and a plurality of movable bodies which are pushed

by the inner circumferential surface of the holder inscription hole at the same time as falling into the holder inscription hole, thereby being allowed to clamp a weight-catching rod extending from the weight. Examples of the movable bodies include balls (spherical bodies) as shown in FIG. 4 and wedge-shaped pieces as shown in FIG. 6, for instance.

[0010]

Moreover, as for a different type of the weight-catching device, there can be also proposed a weight-catching device comprising guide rails vertically installed near the weight, disc brakes installed on the weight and configured to respectively clamp the guide rails so that the weight is brought to a stop in midair, and an operating unit for operating the disc brakes, or alternatively, a weight-catching device comprising hydraulic jack cylinders vertically installed near the weight and configured to catch the weight in midair by a hydraulically-controlled expansion/contraction stroke (or piston rod), and a hydraulic system for controlling hydraulic pressures of the hydraulic jack cylinders.

[0011]

Besides, any weight-catching device described the above is also constituted so as to be capable of allowing the weight to freely fall onto the pile head and of catching, in midair, the bouncing weight above the pile head by remote operation or automatic control based on a wired or wireless system.

EFFECTS OF THE INVENTION

[0012]

According to the present invention, with the pile rapid loading testing device that performs confirmation of the pile

bearing power by applying the axial pushing force to the pile in such a way as to allow the weight to fall onto the pile head, with the soft cushion interposed on the pile head, it is possible to quickly catch, in midair, the weight that has fallen onto the pile head and bounced, thereby preventing the weight from repetitively bouncing off the pile head.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

[FIG.1] FIG. 1 illustrates one embodiment of the present invention, more specifically, it is a front view of a pile rapid loading testing device showing a state in which a weight is lifted up to a falling height.

[FIG. 2] FIG. 2 is an enlarged view of a portion A shown in FIG. 1.

[FIG. 3] FIG. 3 illustrates the pile rapid loading testing device shown in FIG. 1, more specifically, it is a front view showing a state in which the weight has fallen onto a pile head.

[FIG. 4] FIG. 4 illustrates the pile rapid loading testing device shown in FIG. 1, more specifically, it is a front view showing a state in which the weight which has fallen onto the pile head and bounced is caught in midair.

[FIG. 5] FIGS. 5(a) to 5(c) are sectional views respectively showing an operation of a weight-catching device for catching, in midair, the weight which has fallen onto the pile head and bounced.

[FIG. 6] FIG. 6 is an exploded perspective view of the weight-catching device shown in FIG. 5.

[FIG. 7] FIG. 7 illustrates a modification of the weight-catching device shown in FIGS. 5 and 6, more specifically, FIG. 7(a) is

a longitudinal sectional view, FIG. 7(b) is a view taken in the direction of arrows along a line B-B shown in FIG. 7(a), and FIG. 7(c) is a view taken in the direction of arrows along a line C-C shown in FIG. 7(a).

[FIG. 8] FIG. 8 illustrates a different embodiment of the present invention, more specifically, FIG. 8(a) is a front view of the pile rapid loading testing device showing a state in which the weight is lifted up to the falling height, FIG. 8(b) is a plan view, FIG. 8(c) is an enlarged view of a portion D shown in FIG. 8(b), and FIG. 8(d) is an enlarged view of a portion E shown in FIG. 8(a).

[FIG. 9] FIG. 9 illustrates a further different embodiment of the present invention, more specifically, FIG. 9(a) is a plan view, and FIG. 9(b) is a front view of the pile rapid loading testing device showing a state in which the weight is lifted up to the falling height.

MODE FOR EMBODYING THE INVENTION

[0014]

[First Embodiment]

FIGS. 1 to 6 respectively illustrate one embodiment of the present invention, and a pile rapid loading testing device 1 illustrated is constituted such that a rapid loading testing frame (note that the terms of a rapid loading testing frame will be hereinafter simply referred to as a frame) 2 assembled in a tower shape directly above a pile head "a" protruded from a ground surface on about a pile driven into the ground is equipped with a weight 3 allowed to fall onto the pile head "a", a weight lifting-up plate or a steel bar (note that there is shown a weight lifting-up plate in these Figures, and the terms of a weight lifting-up plate or a steel bar will be hereinafter simply

referred to as a weight lifting-up plate or the like) 4 for lifting the weight 3 up to a preset falling height H, and a weight-catching device 5 for catching, in midair, the weight 3 which has fallen from the falling height H onto the pile head "a" and bounced. Moreover, a soft cushion 6 for regulating a loading time and/or a load of the weight 3 is installed on the pile head "a".

[0015]

The weight 3 is detachably hung at a lower end of the weight lifting-up plate or the like 4 suspended from an upper side of the frame 2 toward directly above the pile head "a". And, the weight 3 can be lifted up to the preset falling height H through the weight lifting-up plate or the like 4, and is also allowed to freely fall onto the pile head "a" by remotely operating or automatically controlling the weight-catching device 5 based on a wired or wireless system.

[0016]

Besides, the weight 3 has a plurality of weight-catching rods 7, 7, each of which extends upwards directly from the weight 3 in parallel with the weight lifting-up plate or the like 4 and has a lower end connected to the weight 3, and with the catching rods 7, 7 clamped with the weight-catching devices 5, 5, it is possible to catch, in midair, the weight 3 which has fallen onto the pile head "a" and bounced off the pile head "a".

[0017]

The weight-catching device 5 comprises a movable body holder 8, a clamp case 9 and a permanent electromagnetic holder 10, all of which are installed on an axis of each weight-catching rod 7, and moreover, the movable body holder 8 has a holder body 11 and a plurality of balls (movable bodies) 12.

[0018]

The holder body 11 is disposed between the clamp case 9 and the permanent electromagnetic holder 10 and has, in the center thereof, a holder hole 13 that allows the weight-catching rod 7 to pass therethrough. The holder hole 13 takes the form of a loose hole relative to the weight-catching rod 7.

[0019]

Moreover, an outer circumferential surface 11a of the holder body 11 forms a tapered surface that has a maximum outer diameter in an upper end portion and gradually decreases in diameter as going toward a downward direction. In addition, a plurality of hollow parts 14 each having an inner circumferential surface forming a concave curved surface are formed between the holder hole 13 and the outer circumferential surface 11a at uniform intervals in a circumferential direction and a vertical direction of the holder body 11, and a holder hole 13-side and an outer circumferential surface 11a-side of each hollow part 14 are open. Each hollow part 14 accommodates the ball 12 respectively.

[0020]

The ball 12 is accommodated in each hollow part 14 so as to be freely rotatable and also movable in a radial direction of the holder body 11 and is formed in a size that allows a part of the ball to be protruded into at least one of a holder hole 13-side opening and an outer circumferential surface 11a-side opening.

[0021]

The clamp case 9 is fixed to the frame 2 directly below the movable body holder 8, and a movable body holder inscription hole 15 in which the movable body holder 8 is inscribed is formed in

the center of the clamp case so as to pass through the clamp case in a vertical direction.

[0022]

More specifically, an inner circumferential surface 15a of the movable body holder inscription hole 15 forms a tapered surface that has a maximum inner diameter in an upper end portion and gradually decreases in diameter as going toward a downward direction.

[0023]

The permanent electromagnetic holder 10 is fixed to the frame 2 directly above the movable body holder 8 or alternatively, fixed thereto through a shock absorbing material 27 (see FIG. 2) such as a coil spring and vibration-proof rubber for mitigating an impact to the frame 2 in falling of the weight and has, in the center thereof, a holder hole 16 that allows the weight-catching rod 7 to pass therethrough. The holder hole 16 takes the form of a loose hole relative to the weight-catching rod 7. Moreover, the permanent electromagnetic holder 10 is configured to attract the movable body holder 8 only when generating a magnetic force and is also allowed to generate the magnetic force by remote operation or automatic control with a wired or wireless rectifier 17 for the permanent electromagnetic holder.

[0024]

In such constitution, operation procedures will now be described. To begin with, the weight 3 is hung at the lower end of the weight lifting-up plate or the like 4, followed by being lifted up to the preset falling height H through the weight lifting-up plate or the like 4.

[0025]

And, energizing to the permanent electromagnetic holder 10 is performed to generate the magnetic force by the remote operation or automatic control with the wired or wireless rectifier 17 for the permanent electromagnetic holder, so that the movable body holder 8 is attracted to the permanent electromagnetic holder 10.

[0026]

Then, the weight 3 is made to fall onto the pile head "a", and immediately after the occurrence of collision of the weight 3 against the pile head "a", energizing to the permanent electromagnetic holder 10 is stopped manually or automatically to dissipate the magnetic force of the permanent electromagnetic holder 10. By so doing, the movable body holder 8 is released from the permanent electromagnetic holder 10 and then falls into the holder inscription hole 15 of the clamp case 9.

[0027]

Moreover, each ball 12 of the movable body holder 8 is pushed toward the holder hole 13-side by the inner circumferential surface 15a of the holder inscription hole 15, so that a part of each ball 12 is protruded into the holder hole 13. When bouncing of the weight-catching rod 7 occurs upwards, each ball 12 in such protruded state acts in a direction away from the inner circumferential surface 15a of the holder inscription hole 15, so that the catching rod 7 is allowed to freely pass through, whereas when falling of the weight 3 recurs following the occurrence of bouncing thereof, each ball 12 is pushed toward the holder hole 13-side by the inner circumferential surface 15a of the holder inscription hole 15, so that the part of each ball 12 is protruded into the holder hole 13.

[0028]

With this constitution, the weight-catching rod 7 passing through the holder hole 13 is firmly held from its outer circumferential surface side by the plurality of balls 12, and accordingly, it is possible to quickly catch the bouncing weight 3 above the pile head "a" in midair through the weight-catching rod 7, thereby avoiding the occurrence of repetitive bouncing of the weight 3.

[0029]

It is noted that the permanent electromagnetic holder 10 configured to attract the movable body holder 8 is mounted to the frame 2 through the shock absorbing material 27 (see FIG. 2) such as the coil spring and vibration-proof rubber and therefore, can be surely operated by the rectifier 17 for the permanent electromagnetic holder without causing the permanent electromagnetic holder to fall due to the impact in falling of the weight 3.

[0030]

FIGS. 7(a) to 7(c) respectively illustrate a modification relating to the holder body 11 and the movable body 12 of the movable body holder 8, and according to this modification, there are provided, in place of the hollow parts 14, a plurality of slits 18 which are formed circumferentially at uniform intervals between the holder hole 13 and the outer circumferential surface 11a of the holder body 11, in which case, in place of the ball 12, a wedge-shaped piece 19 is inserted in each slit 18.

[0031]

In such constitution, energizing to the permanent electromagnetic holder 10 is performed to generate the magnetic force by the remote operation or automatic control with the wired or wireless rectifier 17 for the permanent electromagnetic holder,

so that the movable body holder 8 is attracted to the permanent electromagnetic holder 10, whereas when the magnetic force of the permanent electromagnetic holder 10 is dissipated, the movable body holder 8 is released from the permanent electromagnetic holder 10 and then falls into the movable body holder inscription hole 15 of the clamp case 9.

[0032]

By so doing, each wedge-shaped piece 19 of the movable body holder 8 is pushed toward the holder hole 13-side by the inner circumferential surface 15a of the holder inscription hole 15, so that an end of each wedge-shaped piece 19 is protruded into the holder hole 13.

[0033]

When bouncing of the weight-catching rod 7 occurs upwards, each wedge-shaped piece 19 in such protruded state acts in a direction away from the inner circumferential surface 15a of the holder inscription hole 15, so that the catching rod 7 is allowed to freely pass through, whereas when falling of the weight 3 recurs following the occurrence of bouncing thereof, each wedge-shaped piece 19 is pushed toward the holder hole 13-side by the inner circumferential surface 15a of the holder inscription hole 15, so that the end of each wedge-shaped piece 19 is protruded into the holder hole 13.

[0034]

With this constitution, the weight-catching rod 7 passing through the holder hole 13 is firmly held from its outer circumferential surface side, and accordingly, it is possible to catch the bouncing weight 3 above the pile head "a" in midair through the weight-catching rod 4, thereby avoiding the occurrence of repetitive bouncing of the weight 3.

[0035]

[Second Embodiment]

FIGS. 8(a) to 8(d) respectively illustrate a different embodiment of the present invention, and according to this embodiment, the weight-catching device 5 comprises a plurality of guide rails 20 installed near the weight 3 of the frame 2, a plurality of disc brakes 21 each mounted facing each guide rail 20 on the side of the weight 3 and configured to hold each guide rail 20, and a wired or wireless hydraulic or pneumatic system 22 for operating each disc brake 21.

[0036]

The guide rails 20 are installed on both sides of the weight 3 symmetrically and vertically continuously. The disc brakes 21 are installed on both sides of the weight 3 in upper and lower two stages so as to face each guide rail 20.

[0037]

In such constitution, immediately after the occurrence of bouncing of the weight 3 above the pile head "a", a hydraulic pressure or air is supplied to each disc brake 21 to hold each guide rail 20 with each disc brake 21 by remote operation or automatic control with the wired or wireless hydraulic or pneumatic system 22, and accordingly, it is possible to catch the bouncing weight 3 above the pile head "a" in midair, thereby avoiding the occurrence of repetitive bouncing of the weight 3.

[0038]

Moreover, a holding force by each disc brake 21 can be relieved by releasing the hydraulic pressure or air from each disc brake 21.

[0039]

[Third Embodiment]

FIGS. 9(a) and 9(b) respectively illustrate a further different embodiment of the present invention likewise, and according to this embodiment, the weight-catching device 5 comprises hydraulic jack cylinders 23 and a hydraulic system 24 for performing wired or wireless remote operation or automatic control of hydraulic pressures of the hydraulic jack cylinders 23, wherein the hydraulic jack cylinders 23 are installed on both sides of the weight 3 vertically symmetrically and in close proximity to the weight 3.

[0040]

Moreover, a lower end of each hydraulic jack cylinder 23 is connected to the frame 2, while an upper end thereof is connected to the side of the weight 3 through a bracket 24.

[0041]

In such constitution, a stroke 23a of each hydraulic jack cylinder 23 is in an expansion state when the weight 3 is at the stage of being lifted up to the preset falling height H, and both pushing-side and drawing back-side valves 26 of hydraulic hoses 25 are kept opened during a period up to just before the weight 3 falls onto the pile head "a" and bounces.

[0042]

Then, the valves 26 of the hydraulic hoses 25 are closed to fix the stroke 23a of each hydraulic jack cylinder 23 when the bouncing weight 3 above the pile head "a" reaches the maximum height, and accordingly, it is possible to catch the bouncing weight 3 above the pile head "a" in midair, thereby avoiding the occurrence of repetitive bouncing of the weight 3. Meanwhile, the stroke 23a can be contracted by opening the valves 26.

INDUSTRIAL AVAILABILITY

[0043]

According to the present invention, with the pile rapid loading testing device used for the pile rapid loading test executed for confirmation of pile bearing power by applying the axial pushing force to the pile in such a way as to allow the weight to fall onto the pile head protruded from the ground surface, it is possible to catch, in midair, the weight which has fallen onto the pile head and bounced, thereby avoiding the occurrence of repetitive bouncing of the weight.

EXPLANATION OF REFERENCE NUMERALS

[0044]

a: Pile head

H: Preset falling height

1: Pile rapid loading testing device

2: Frame (Rapid loading testing frame)

3: Weight

4: Weight lifting-up plate

5: Weight-catching device

6: Shock absorbing cushion

7: Weight-catching rod

8: Movable body holder

9: Clamp case

10: Permanent electromagnetic holder

11: Holder body

12: Ball (Movable body)

- 13: Holder hole
- 14: Hollow part
- 15: Holder inscription hole
- 15a: Inner circumferential surface
- 16: Holder hole
- 17: Rectifier for permanent electromagnetic holder
- 18: Slit
- 19: Wedge-shaped piece (Movable body)
- 20: Guide rail
- 21: Disc brake
- 22: Hydraulic system
- 23: Hydraulic jack cylinder
- 23a: Piston rod
- 24: Hydraulic system
- 25: Hydraulic hose
- 26: Valve
- 27: Shock absorbing material

CLAIMS

[Claim 1]

A pile rapid loading testing device for confirmation of pile bearing power by applying an axial pushing force to a pile in such a way as to allow a weight to fall onto a pile head, the pile rapid loading testing device being characterized by having a weight-catching device for catching, in midair, said weight which has fallen onto said pile head and bounced, wherein said weight-catching device comprises a clamp case having a holder inscription hole whose inner circumferential surface forms a tapered surface that gradually decreases in diameter downwards, a movable body holder disposed above the clamp case and configured to fall and become inscribed in said holder inscription hole, and a permanent electromagnetic holder disposed above the movable body holder and configured to attract said movable body holder only when generating a magnetic force, and said movable body holder has a plurality of movable bodies which are pushed by the inner circumferential surface of said holder inscription hole at the same time as falling into said holder inscription hole, thereby being allowed to clamp a weight-catching rod extending from said weight.

[Claim 2]

The pile rapid loading testing device according to claim 1, wherein said movable bodies include balls or wedge-shaped pieces.

[Claim 3]

A pile rapid loading testing device for confirmation of pile bearing power by applying an axial pushing force to a pile in such a way as to allow a weight to fall onto a pile head, the pile rapid loading testing device being characterized by having a

weight-catching device for catching, in midair, said weight which has fallen onto said pile head and bounced, wherein said weight-catching device comprises hydraulic jack cylinders each vertically installed near said weight and configured to catch said weight in midair by a hydraulically-controlled extension/contraction piston rod, and a hydraulic system for controlling hydraulic pressures of the hydraulic jack cylinders, wherein the hydraulic pressures of said hydraulic jack cylinders are controlled such that both pushing-side and drawing back-side valves of hydraulic hoses connected to said hydraulic jack cylinders are kept opened during a period up to just before said weight falls onto said pile head and bounces, and also that both the pushing-side and drawing back-side valves of said hydraulic hoses are closed to fix the strokes of said hydraulic jack cylinders when said weight bounces off said pile head and reaches the maximum height.