

Description

Title of Invention: Hanging Bolt Support Fitting

Technical Field

5 [0001] The present invention relates to a hanging bolt support fitting that supports a hanging bolt to maintain being in a state of hanging down from a deck plate.

Background Art

[0002] Conventionally, a hanging bolt is attached to a ceiling slab such as concrete placed
10 on the upper surface of a deck plate by a method of fitting an insert in advance into an attachment hole formed at the plate deck before placement of the ceiling slab on the upper surface of the deck plate, and attaching and fixing the hanging bolt to a nut of the insert projecting from the lower surface of the deck plate after placement of the ceiling slab (patent literature 1, for example). The hanging bolt may be attached to the ceiling slab by
15 a different method using a post-construction anchor, for example (patent literature 2, for example).

[0003] A deck plate is formed using a steel plate having a thickness of about some millimeters. Such deck plates are categorized into various types depending on their configurations. Fig. 17 shows a deck plate 9 of one of these types. The deck plate 9
20 shown in Fig. 17 includes multiple slits 9a each having a width from about 12 to 14 mm at predetermined intervals extending parallel to each other, and an upper space 8 having a trapezoidal shape in outline formed at an upper portion of each slit 9a. The upper space 8 is formed in such a manner that a lower portion of the upper space 8 of the slit 9a. The upper space 8 becomes wider as it goes to the upper portion from the slit 9a. If a ceiling
25 slab S is placed on the upper surface of the deck plate 9, the upper space 8 of each slit 9a is

used as a structure for supporting a hanging bolt.

[0004] Fig. 18 illustrates a conventional construction method of attaching a hanging bolt 7 to the upper space 8 of each slit 9a at the deck plate 9. For attachment of the hanging bolt 7 to the upper space 8 of the slit 9a, a fixing tool 100 including a nut 101 and a pair of paper strips 102 and 103 bonded to the opposite ends of the nut 101 is conventionally used, as shown in Fig. 18(a), for example. As shown in Fig. 18(a), according to the conventional construction method, a worker inserts the nut 101 into the upper space 8 through the slit 9a and pulls the paper strips 102 and 103 at the opposite ends of the nut 101, thereby placing the nut 101 in a posture that enables the opposite ends of the nut 101 to be engaged with the inner wall of the upper space 8. Then, as shown in Fig. 18(b), while the worker places the nut 101 in a stable posture by holding the paper strips 102 and 103 extending from the opposite ends of the nut 101 with fingers, for example, the worker inserts and fits the tip of the hanging bolt 7 into a screw hole of the nut 101.

Prior Art Literatures

Patent Literatures

[0005] Patent Literature 1: Publication of Design Registration No. 1529203

Patent Literature 2: Japanese Patent Application Laid-Open No. 2012-177290

Summary of Invention

Problems to be Solved by Invention

[0006] However, the construction method shown in Fig. 18 has a problem that stabilizing the posture of the nut 101 in the upper space 8 after insertion of the nut 101 into the slit 9a takes time. The foregoing work is to be done by a worker at high places. Hence, each time the work of attaching the single hanging bolt 7 is completed, the worker is required to get down to a floor surface once and then move a stepladder, a stool or the like to a next

attachment position. Hence, such work particularly has a problem that attachment of multiple hanging bolts 7 requires a great deal of time and effort.

[0007] The present invention has been made to solve the foregoing conventional problem.

It is an object of the present invention to provide a hanging bolt support fitting achieving
5 increased efficiency in work of attaching a hanging bolt to a deck plate with a slit, compared to conventional cases.

Means of Solving Problems

[0008] To achieve the foregoing object, according to a first configuration of the present
10 invention, a hanging bolt support fitting (1, 1a, 60) is to be attached to a deck plate (9) and used for supporting a hanging bolt (7) as being attached to the deck plate (9). The deck plate (9) includes: a slit (9a) of a predetermined width (D) formed at the lower surface of the deck plate (9); a pair of walls (9b, 9c) extending upwardly from the opposite ends of the slit (9a) so as to be separated at an interval increased gradually; and a top plate (9d)
15 provided at a position at a predetermined height from the slit (9a) and connecting respective upper end portions of the pair of walls (9b, 9c). The hanging bolt support fitting (1, 1a, 60) comprises: a male screw member (4, 61a) to be inserted into a space between the pair of walls (9b, 9c) through the slit (9a) at the deck plate (9); a spreading member (5) fitted to the male screw member (4, 61a), the spreading member (5) including a pair of spreading
20 walls (5b, 5c) standing upright so as to face each other across the male screw member (4, 61a), the pair of spreading walls (5b, 5c) being arranged at an interval less than the width of the slit (9a) at the deck plate (9); a widening member (6) provided at the upper end of the male screw member (4, 61a) and joined to the tips of the pair of spreading walls (5b, 5c) in a lengthwise direction perpendicular to the axis direction of the male screw member
25 (4, 61a), the widening member (6) being formed into a shape such that a maximum width

of the widening member (6) in a transverse direction perpendicular to the axis direction of the male screw member (4, 61a) is less than the width of the slit (9a) at the deck plate (9) and the width of the widening member (6) is reduced gradually and downwardly from a portion corresponding to the maximum width, the widening member (6) being attached
 5 with a lower portion of the widening member (6) below the portion corresponding to the maximum width being put in between the pair of spreading walls (5b, 5c); and a hanging bolt support member (70) provided at a lower portion of the male screw member (4, 61a), joined to the lower surface of the deck plate (9), and to which the hanging bolt (70) is attachable.

10 [0009] The first configuration allows the hanging bolt support fitting to be fixed firmly to the slit at the deck plate through simple work, thereby increasing working efficiency compared to conventional cases.

[0010] According to a second configuration of the present invention, in the hanging bolt support fitting (1, 1a) having the first configuration, the hanging bolt support member (70)
 15 is formed using a long nut (2), and the long nut (2) includes a screw hole (2b) formed at the lower surface of the long nut (2) and capable of receiving the hanging bolt (7) therein.

[0011] The second configuration allows the hanging bolt to be attached to a position at the deck plate where the slit is formed while the hanging bolt is in a state of hanging down.

[0012] According to a third configuration of the present invention, in the hanging bolt
 20 support fitting (1, 1a) having the second configuration, the hanging bolt support member (70) further includes a washer (3) fitted to the male screw member (4). In response to rotation of the long nut (2) as the widening member (6) and the spreading member (5) are being inserted between the pair of walls (9b, 9c) through the slit (9a) at the deck plate (9) and the washer (3) is in abutting in contact with an edge of the slit (9a) at the deck plate (9),
 25 the widening member (6) moves down and goes into inside the pair of spreading walls (5b,

5c) to spread the pair of spreading walls (5b, 5c), thereby closely attaching and fixing the pair of spreading walls (5b, 5c) to the pair of walls (9b, 9c) at the deck plate (9).

[0013] According to a fourth configuration of the present invention, in the hanging bolt support fitting (1, 1a) having the second or third configuration, the male screw member (4) is smaller in diameter than the hanging bolt (7).

[0014] The fourth configuration allows the hanging bolt support fitting to be fixed to the slit even if a gap of the slit is narrow.

[0015] According to a fifth configuration of the present invention, in the hanging bolt support fitting (1a) having any of the second to fourth configurations, the long nut (2) includes: a hole (30a) having a predetermined inner diameter from the lower surface of the long nut (2) to a first depth position; the screw hole (2b) having a diameter less than the predetermined inner diameter from the first depth position to a second depth position and capable of receiving the hanging bolt (7) therein; and an annular break groove (31) at a predetermined position outside a portion where the hole (30a) having the predetermined inner diameter is formed.

[0016] The fifth configuration allows management of a torque applied during attachment of the hanging bolt support fitting to the slit at the deck plate, so that the hanging bolt support fitting can be attached with stable strength.

[0017] According to a sixth configuration of the present invention, the hanging bolt support fitting (1a) having the fifth configuration further comprises a cap member (30b) for closing the hole (30a) having the predetermined inner diameter. When the break groove (31) fractures, the cap member (30b) comes off the long nut (2) together with a lower portion of the long nut (2) below the break groove (31).

[0018] The sixth configuration is capable of preventing installation of the hanging bolt using the cap member if the hanging bolt support fitting is not attached with strength of a

certain degree or more.

[0019] According to a seventh configuration of the present invention, in the hanging bolt support fitting (1, 1a) having any of the second to sixth configurations, the long nut (2) includes a communication hole (2c) communicating with the lateral surface of the long nut (2) and formed at a position near the bottom of the screw hole (2b) capable of receiving the hanging bolt (7) therein, a deforming member (40) to deform in response to installation of the hanging bolt (7) is provided at the bottom of the screw hole (2b), and the deforming member (40) deforms in response to installation of the hanging bolt (7) in the screw hole (2b) to partially project to the outside through the communication hole (2c).

10 [0020] The seventh configuration allows the state of the installation of the hanging bolt to the lower surface of the long nut to be checked easily, thereby increasing working efficiency.

[0021] According to an eighth configuration of the present invention, in the hanging bolt support fitting (60) having the first configuration, the slit (9a) at the deck plate (9) includes multiple slits (9a) arranged at a predetermined interval. The hanging bolt support member (70) includes: a rail member (65) longer than the interval between the slits (9a) at the deck plate (9); and a hanging bolt coupling member (67) supported by the rail member (65), capable of being placed at a position adjustable in the lengthwise direction of the rail member (65), and to which the hanging bolt (7) is attachable.

20 [0022] The eighth configuration allows the hanging bolt to be attached to a position at the deck plate where the slit is not formed while the hanging bolt is in a state of hanging down.

[0023] According to a ninth configuration of the present invention, in the hanging bolt support fitting (60) having the eighth configuration, the hanging bolt coupling member (67) includes a screw through hole capable of receiving the hanging bolt (7) therein. The tip of the hanging bolt (7) fitted in the screw through hole presses the rail member (65) to fix

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the hanging bolt coupling member (67) in the lengthwise direction of the rail member (65).

[0024] The ninth configuration allows the hanging bolt to be fixed at any position at the rail member.

[0025] According to a tenth configuration of the present invention, in the hanging bolt support fitting (1, 1a, 60) having any of the first to sixth configurations, the spreading member (5) includes a passage hole (11) and a thick part (15). The passage hole (11) is formed at the center of a base end (5a) and capable of passing the male screw member (4) therethrough. The thick part (15) is formed at each of opposite end portions of each of the pair of spreading walls (5b, 5c) to have an inwardly increasing thickness compared to a thickness at a central portion of each of the spreading walls (5b, 5c).

[0026] According to an eleventh configuration of the present invention, in the hanging bolt support fitting (1, 1a, 60) having the tenth configuration, the thick part (15) has a configuration determined by stacking pieces of a plate member to form the pair of spreading walls (5b, 5c) inwardly from the pair of spreading walls (5b, 5c).

[0027] According to a twelfth configuration of the present invention, in the hanging bolt support fitting (1, 1a, 60) having the tenth or eleventh configuration, an interval between the thick parts (15) provided at the respective opposite end portions of the pair of spreading walls (5b, 5c) and facing each other is less than the diameter of the male screw member (4).

20 Advantageous Effects of Invention

[0028] According to the present invention, work of attaching a hanging bolt to a deck plate with a slit can be done with increased efficiency.

Brief Description of Drawings

[0029] Fig. 1 is a perspective view showing constituting members of a hanging bolt support fitting of a first embodiment separately;

Fig. 2 is a perspective view showing the constituting members of the hanging bolt support fitting of the first embodiment in an assembled state;

Fig. 3 illustrates a side view and a sectional view of the hanging bolt support fitting of the first embodiment;

5 Fig. 4 shows the concept of the configuration of a spreading member;

Fig. 5 shows a first step of a construction method using the hanging bolt support fitting of the first embodiment;

Fig. 6 shows a second step of the construction method using the hanging bolt support fitting of the first embodiment;

10 Fig. 7 shows a third step of the construction method using the hanging bolt support fitting of the first embodiment;

Fig. 8 shows a fourth step of the construction method using the hanging bolt support fitting of the first embodiment;

15 Fig. 9 shows an example of a member a long nut and a male screw member formed integrally with a member;

Fig. 10 is a perspective view showing constituting members of a hanging bolt support fitting of a second embodiment in an assembled state;

Fig. 11 is a sectional view of the hanging bolt support fitting;

20 Fig. 12 shows a first step of a construction method using the hanging bolt support fitting of the second embodiment;

Fig. 13 shows a second step of the construction method using the hanging bolt support fitting of the second embodiment;

Fig. 14 shows a third step of the construction method using the hanging bolt support fitting of the second embodiment;

25 Fig. 15 is a perspective view showing constituting members of a hanging bolt

support fitting of a third embodiment;

Fig. 16 is a partially cutaway sectional view showing a state in which attachment of a hanging bolt is completed in the third embodiment;

Fig. 17 shows an example of a deck plate with slits; and

5 Fig. 18 shows a conventional construction method of attaching a hanging bolt to an upper space of a slit at the deck plate.

Description of Embodiment(s)

[0030] Preferred embodiments of the present invention will be described below based on
10 the drawings. Members common between the drawings referred to below are identified by the same signs. Overlapping description of these members will not be given repeatedly.

[0031] (First Embodiment)

Fig. 1 is a perspective view showing constituting members of a hanging bolt
15 support fitting 1 separately according to a first embodiment of the present invention. Fig. 2 is a perspective view showing the constituting members of the hanging bolt support fitting 1 in an assembled state. Fig. 3(a) is a side view of the hanging bolt support fitting 1. Fig. 3(b) is a sectional view of the hanging bolt support fitting 1. As shown in Fig. 1, for example, the hanging bolt support fitting 1 includes a long nut 2, a washer 3, a male screw member 4, a spreading member 5, and a widening member 6. As shown in Fig. 2, the hanging bolt support fitting 1 is used in a state where these constituting members are assembled. As shown in Fig. 5, for example, the hanging bolt support fitting 1 is attachable to a steel deck plate 9 including a slit 9a having a predetermined width D formed at the lower surface of the deck plate 9, a pair of walls 9b and 9c extending upwardly from
20 the opposite ends of the slit 9a so as to gradually increase in an interval between each other,

and a top plate 9d provided at a position at a predetermined height from the slit 9a and respectively connecting the upper end portions of the pair of the walls 9b and 9c. The hanging bolt support fitting 1 is to support a hanging bolt 7 in a state of hanging down from the slit 9a. Specifically, the hanging bolt support fitting 1 is a fitting to be attached to an upper space 8 of the slit 9a at the deck plate 9 so as to be engaged with the pair of the walls 9b and 9c. The hanging bolt support fitting 1 supports the hanging bolt 7 while the hanging bolt 7 is installed in a screw hole 2b formed at the lower surface of the long nut 2, as shown in Fig. 2.

[0032] For example, the hanging bolt support fitting 1 is fixed to the upper space 8 of the slit 9a after a ceiling slab S such as concrete is placed on the upper surface of the deck plate 9. The width D of the slit 9a is about 12 to 14 mm, for example. If an M10 bolt is used as an example of the hanging bolt 7, the diameter of the hanging bolt 7 is slightly less than 10 mm length. In this case, the hanging bolt support fitting 1 of this embodiment is to be attached to the upper space 8 through the slit 9a having the width D greater by about 20 to 40% than the diameter of the hanging bolt 7. The hanging bolt support fitting 1 of the foregoing configuration will be described in detail below.

[0033] The long nut 2 and the washer 3 of the hanging bolt support fitting 1 are members forming a hanging bolt support member 70 attached to a lower portion of the male screw member 4 and to which the hanging bolt 7 is attachable while the hanging bolt support member 70 is joined to the lower surface of the deck plate 9. Specifically, the hanging bolt support member 70 is a member to support the hanging bolt 7 in a state of hanging down from the lower surface of the deck plate 9.

[0034] The long nut 2 of the hanging bolt support fitting 1 is a hexagon nut having a predetermined length in the axis direction (vertical direction) of the male screw member 4 and including a screw hole 2a and a screw hole 2b formed at the upper surface and the

lower surface of the long nut 2. As shown in Fig. 3(b), for example, the two screw holes 2a and 2b are formed as screw holes having different diameters to enable male screw of different size to be threadedly engaged. As an example, the screw hole 2a formed at the upper surface of the long nut 2 is a screw hole in M8 size to be threadedly engaged with an M8 bolt. If the hanging bolt 7 is to be fitted to the lower surface of the long nut 2, the screw hole 2b formed at the lower surface of the long nut 2 is a screw hole in M10 size to be threadedly engaged with the M10 hanging bolt 7, for example. As shown in Fig. 3(b), the long nut 2 is configured in such a manner that the first screw hole 2a and the second screw hole 2b communicate with each other at a substantially center position of the long nut 2. In the description given below, the bottom of the first screw hole 2a and the bottom of the second screw hole 2b mean the portions where the first screw hole 2a and the second screw hole 2b communicate with each other.

[0035] If the width D of the slit 9a at the deck plate 9 is relatively greater than the diameter of the hanging bolt 7 (if the width D of the slit 9a is greater by about 80% or more than the diameter of the hanging bolt 7, for example), the first screw hole 2a and the second screw hole 2b may be formed as screw holes having the same size. The first screw hole 2a and the second screw hole 2b are not always required to communicate with each other inside the long nut 2.

[0036] The male screw member 4 has a predetermined length in the axis direction and includes male threads 4a formed to cover the entire region of the outer peripheral surface of the male screw member 4 in the axis direction. For example, the male screw member 4 is formed using an M8 bolt smaller in diameter than the hanging bolt 7. The lower portion of the male screw member 4 is fitted in the screw hole 2a formed at the surface of the long nut 2. In this embodiment, as shown in Fig. 3, for example, the male screw member 4 is attached to the screw hole 2a in such a manner that the lower end of the male

screw member 4 is slightly floating above the bottom of the screw hole 2a.

[0037] The washer 3 is a disk-shaped member including a hole 3a formed at the center of the washer 3 into which the male screw member 4 may be inserted. The washer 3 has an outer diameter greater than the width D of the slit 9a at the deck plate 9. The hole 3a has an inner diameter greater than the outer diameter of the male screw member 4 and less than the outer diameter of the long nut 2. The washer 3 is attached to the hanging bolt support fitting 1 by inserting the male screw member 4 fitted to the upper surface of the long nut 2 into the hole 3a at the center of the washer 3. Specifically, the washer 3 is attached as the lower surface of the washer 3 being joined to the upper surface of the long nut 2.

[0038] The spreading member 5 includes a base end 5a with a hole 11 for insertion of the male screw member 4, and a pair of spreading walls 5b and 5c extending from the opposite ends of the base end 5a and standing upright so as to face each other substantially parallel to each other at a predetermined interval therebetween. The spreading member 5 is formed by bending a metallic plate formed into a predetermined shape in advance.

[0039] Fig. 4 shows a plan view of a metallic plate 10 as a base material to become the spreading member 5 and a plan view of the spreading member 5 taken from above. As shown in Fig. 4(a), the metallic plate 10 as a base material forming the spreading member 5 has a substantially H-shape with four extensions 12 in total extending outwardly from two positions at each of the opposite ends of the H-shape in the lengthwise direction (two positions corresponding to opposite ends in a transverse direction). The metallic plate 10 has the hole 11 formed at the center of the metallic plate 10 slightly greater than the outer diameter of the male screw member 4. The metallic plate 10 is bent inwardly at 180 degrees at the respective roots of the four extensions 12 and then bent 90 degrees at two positions near the hole 11, thereby forming the pair of the spreading walls 5b and 5c standing upright from the opposite ends of the base end 5a. The pair of the spreading

walls 5b and 5c are capable of displacing their tips in a direction in which the tips are separated further from each other in response to pressing force acting outwardly from inside.

[0040] As shown in Fig. 4(b), the spreading member 5 has thick parts 15 at the opposite ends of the pair of the spreading walls 5b and 5c formed by bending the extensions 12

5 inwardly. Each of the thick parts 15 has a thickness of two pieces of the metallic plate 10

stacked on top of each other. Meanwhile, the respective pieces of the metallic plate 10 are not stacked on top of a central portion 16 of the pair of the spreading walls 5b and 5c, so

that the central portion 16 is thinner than the thick parts 15. As shown in Fig. 4(b), an interval between the central portions 16 of the pair of the spreading walls 5b and 5c is

10 substantially equal to the diameter of the hole 11 formed at the base end 5a and slightly greater than the outer diameter of the male screw member 4 to be inserted into the hole 11.

By contrast, the respective thick parts 15 at the opposite ends of the pair of the spreading walls 5b and 5c have a thickness twice the thickness of the central portion 16. Thus, an

interval between the thick parts 15 facing each other is less than the diameter of the male

15 screw member 4. As a result, when the male screw member 4 is inserted into the hole 11 at the base end 5a, the thick parts 15 at the opposite ends of the pair of the spreading walls 5b and 5c are positioned outside the periphery of the male screw member 4 to prevent interference with the male screw member 4.

[0041] Regarding the spreading member 5, the pair of the spreading walls 5b and 5c has

20 a length L1 in the lateral direction slightly greater than width D of the slit 9a at the deck plate 9. For example, the length L1 is set at a predetermined length of about 15 mm, for

example. Specifically, the length L1 of the pair of the spreading walls 5b and 5c in the lateral direction and the width D of the slit 9a at the deck plate 9 have a relation of $L1 > D$.

The pair of the spreading walls 5b and 5c is arranged to stand upright at an interval W1

25 equal to or less than the width D of the slit 9a at the deck plate 9. Specifically, the interval

W1 between the outer lateral surfaces of the pair of the spreading walls 5b and 5c standing upright in substantially parallel positions and the width D of the slit 9a at the deck plate 9 have a relation of $W1 \leq D$. In this way, while the pair of the spreading walls 5b and 5c is placed parallel to the slit 9a, the spreading member 5 becomes capable of being inserted
 5 into the upper space 8 of the slit 9a through the slit 9a. Additionally, after the insertion into the upper space 8 of the slit 9a, rotation of the spreading member 5 around the axis of the male screw member 4 is prohibited.

[0042] As shown in Fig. 1, while the tips of the pair of the spreading walls 5b and 5c of the spreading member 5 having the foregoing configuration are pointed upwardly, the male
 10 screw member 4 is inserted into the hole 11 formed at the base end 5a. Thus, after the spreading member 5 is fitted to the male screw member 4, the base end 5a becomes joined to the upper surface of the washer 3.

[0043] The widening member 6 is a nut member attached to the tip (upper end) of the male screw member 4, for example. The widening member 6 of this embodiment is a
 15 member prepared by arranging a columnar fitting having a predetermined length in the lateral direction, and forming a screw through hole 6a at the outer peripheral surface of the fitting in such a manner that the screw through hole 6a penetrates the fitting in the vertical direction while passing through the center of the fitting. The screw through hole 6a is a
 20 screw hole to be threaded engaged with the tip of the male screw member 4 and is formed as a screw hole in the M8 size to be threadedly engaged with the male screw member 4 having the M8 size, for example.

[0044] The widening member 6 has a length L2 in a lengthwise direction perpendicular to the axis direction of the male screw member 4 substantially equal to the length of the pair of the spreading walls 5b and 5c. Specifically, the length L2 of the widening member
 25 6 in the lengthwise direction is substantially equal to the length L1 of the pair of the

spreading walls 5b and 5c in the lateral direction. The widening member 6 has a maximum width W2 in a transverse direction perpendicular to the axis direction of the male screw member 4 equal to or less than the width D of the slit 9a at the deck plate 9. Specifically, the maximum width W2 of the widening member 6 and the width D of the slit 9a at the deck plate 9 have a relation of $W2 \leq D$. In this embodiment, as shown in Fig. 3(a), the maximum width W2 of the widening member 6 is determined to be substantially equal to the interval W1 between the outer lateral surfaces of the pair of the spreading walls 5b and 5c. Specifically, in this embodiment, the interval W1 between the outer lateral surfaces of the pair of the spreading walls 5b and 5c and the maximum width W2 of the widening member 6 are determined to satisfy a relation of $W1 = W2 = W$. The maximum width W2 of the widening member 6 corresponds to the diameter of the columnar fitting. The columnar fitting is arranged in the lateral direction to be used as the widening member 6. This forms the widening member 6 into a shape such that the width of the widening member 6 is reduced gradually as it goes toward lower part from a portion corresponding to the maximum width W2 in the transverse direction perpendicular to the axis direction of the male screw member 4.

[0045] As shown in Fig. 2, a tip 4b of the male screw member 4 is fitted by threaded engagement to the screw through hole 6a at the widening member 6 having the foregoing configuration. The widening member 6 is fitted to the tip of the male screw member 4 so as to be parallel to the pair of the spreading walls 5b and 5c and is fitted to the tip 4b of the male screw member 4 in such a manner that a lower portion of the widening member 6 is put in between the tips of the pair of the spreading walls 5b and 5c. In other words, as shown in Fig. 3(a), the widening member 6 is fitted to the male screw member 4 in such a manner that a lower portion of the arc-like shape of the widening member 6 is engaged with the inner sides of the tip portions of the thick parts 15 of the pair of the spreading walls 5b

and 5c, specifically, with the inner sides of curved portions resulting from bending of the extensions 12. Making the fit so as to engage the lower portion of the widening member 6 with the tips of the pair of the spreading walls 5b and 5c allows restriction of rotation of the widening member 6 in a direction around the axis of the male screw member 4.

5 [0046] After the constituting members are assembled in the foregoing manner, the width W of the hanging bolt support fitting 1 at an upper portion above the washer 3 becomes less than the width D of the slit 9a as shown in Fig. 3(a). In this way, the hanging bolt support fitting 1 is configured as a fitting having the upper portion including the spreading member 5 and the widening member 6 that may be inserted into the upper space 8 through a gap of
10 the slit 9a at the deck plate 9. According to the exemplary order of assembly described above, the male screw member 4 is fitted in the screw hole 2a formed at the upper surface of the long nut 2. Then, the washer 3, the spreading member 5, and the widening member 6 are fitted sequentially to the male screw member 4. However, this is not the only order of assembling the hanging bolt support fitting 1. Specifically, the hanging bolt support
15 fitting 1 may be assembled in an opposite order from the foregoing order. First, the widening member 6 is fitted to the tip 4b of the male screw member 4. Then, the spreading member 5, the washer 3, and the long nut 2 are fitted sequentially to the lower portion of the male screw member 4.

[0047] A construction method of attaching the hanging bolt 7 to the deck plate 9 using the
20 hanging bolt support fitting 1 having the foregoing configuration will be described next. Figs. 5 to 8 each shows a step of the construction method using the hanging bolt support fitting 1. First, as shown in Fig. 5, a worker attaches a working tool 20 to a lower portion of the long nut 2 of the hanging bolt support fitting 1. To allow the worker to proceed the work from a floor surface, for example, the working tool 20 has an elongated shaft part 21
25 and an engagement part 22 provided at the tip of the shaft part 21. The engagement part

22 is a cylindrical part capable of receiving and holding the lower portion of the long nut 2 therein. The inner wall of the engagement part 22 is formed in a hexagonal shape so as to be engaged with the outer peripheral surface of the long nut 2. After the worker attaches the working tool 20 to the lower portion of the long nut 2 of the hanging bolt support fitting 1, the worker lifts the tip of the shaft part 21 while holding the lower end of the shaft part 21, and places the hanging bolt support fitting 1 at a position near the slit 9a at the deck plate 9. Then, the worker places the widening member 6 of the hanging bolt support fitting 1 in a state substantially parallel to the slit 9a at the deck plate 9. By doing so, the upper portion of the hanging bolt support fitting 1 becomes capable of being inserted into the upper space 8 of the slit 9a through the gap of the slit 9a. Then, the worker lifts the shaft part 21 of the working tool 20 to insert the upper portion of the hanging bolt support fitting 1 upwardly from the downward of the slit 9a. At this time, the worker continues inserting the upper portion of the hanging bolt support fitting 1 until the washer 3 comes into abutting on the edge of the slit 9a. Specifically, the washer 3 has a function as a stopper for preventing excessive insertion of the hanging bolt support fitting 1 into the upper space 8 of the slit 9a and a positioning function for placing the spreading member 5 at a position near the slit 9a. As a result, a state shown in Fig. 6 is formed. In this state, the spreading member 5 and the widening member 6 of the hanging bolt support fitting 1 are inserted in the upper space 8 of the slit 9a at the deck plate 9.

[0048] Next, the worker attaches an electrical tool at the lower end of the shaft part 21 of the working tool 20, for example, and rotates the shaft part 21 in a predetermined rotation direction (clockwise direction) R. As the working tool 20 rotates, the long nut 2 of the hanging bolt support fitting 1 rotates together with the working tool 20. This causes the rotation of the male screw member 4 together with the working tool 20 and further rotation of the spreading member 5 and the widening member 6 inserted in the upper space 8 of the

slit 9a in the rotation direction R. As described above, however, the lengths L1 of the pair of the spreading walls 5b and 5c in the lateral direction and the length L2 of the widening member 6 in the lengthwise direction are greater than the width D of the slit 9a. This causes an interference of the pair of the spreading walls 5b and 5c with the pair of the walls 9b and 9c in the upper space 8. Thus, even when the long nut 2 rotates, rotations of the spreading member 5 and the widening member 6 are restricted by the pair of the walls 9b and 9c, so that the spreading member 5 and the widening member 6 do not rotate together with the long nut 2. As the widening member 6 does not rotate, the male screw member 4 does not rotate together with the long nut 2 either. As a result, the male screw member 4 moves down in response to the rotation of the long nut 2. Specifically, the male screw member 4 moves toward the bottom of the screw hole 2a formed at the long nut 2. In response to this movement, the widening member 6 also moves down together with the male screw member 4. At this time, the widening member 6 presses the pair of the spreading walls 5b and 5c of the spreading member 5 outwardly. In response to the downward movement of the widening member 6, the pair of the spreading walls 5b and 5c deform their tips in a direction in which the tips are separated further from each other in response to receipt of the pressing force acting from the widening member 6. Then, as shown in Fig. 7, the pair of the spreading walls 5b and 5c presses the pair of the walls 9b and 9c in the upper space 8 of the slit 9a to fix the hanging bolt support fitting 1 to the upper space 8 of the slit 9a.

[0049] Even if the lower end of the male screw member 4 is inserted in advance to reach the bottom of the screw hole 2a, the foregoing effect is still achieved. Specifically, if the lower end of the male screw member 4 reaches the bottom of the screw hole 2a, rotation of the long nut 2 causes the male screw member 4 to rotate together with the long nut 2. At this time, the male screw member 4 rotates as being threadedly engaged with the screw

through hole 6a at the widening member 6 which is not rotated. In response to this rotation, the widening member 6 threadedly engaged with the tip of the male screw member 4 moves downward in the axis direction of the male screw member 4. In response to the downward movement of the widening member 6, the pair of the spreading walls 5b and 5c deforms
5 their tips in a direction in which the tips are separated further from each other to press the pair of the walls 9b and 9c from inside. As a result, the hanging bolt support fitting 1 can be fixed to the upper space 8 of the slit 9a.

[0050] After the hanging bolt support fitting 1 is attached to the upper space 8 of the slit 9a in the foregoing manner, the thick parts 15 of the pair of the spreading walls 5b and 5c
10 become sandwiched between the widening member 6 and the pair of the walls 9b and 9c. Specifically, the hanging bolt support fitting 1 presses the pair of the walls 9b and 9c in the upper space 8 of the slit 9a through the thick parts 15 of the pair of the spreading walls 5b and 5c. This may reduce the amount of downward movement of the widening member 6 to advantageously reduce the size of the hanging bolt support fitting 1 as a whole. Even
15 if the width D of the slit 9a is relatively wide such as a degree of about 14 mm, pressing the pair of the walls 9b and 9c in the upper space 8 of the slit 9a through the thick parts 15 of the pair of the spreading walls 5b and 5c still achieves the advantage of closely attaching and fixing the pair of the spreading walls 5b and 5c reliably to the pair of the walls 9b and 9c in the upper space 8 of the slit 9a.

20 [0051] As shown in Fig. 7, after the pair of the spreading walls 5b and 5c is closely attached to the pair of the walls 9b and 9c in the upper space 8 of the slit 9a to fix the hanging bolt support fitting 1, the worker pulls the working tool 20 out of the lower portion of the long nut 2. Then, as shown in Fig. 8, the worker inserts the hanging bolt 7 into the screw hole 2b formed at the lower surface of the long nut 2, thereby attaching the hanging
25 bolt 7 to the deck plate 9. This work of fitting the hanging bolt 7 into the screw hole 2b

at the long nut 2 can also be done by the worker staying at a floor surface.

[0052] In this way, the construction of fixing the hanging bolt 7 to the deck plate 9 using the hanging bolt support fitting 1 is completed. All the foregoing works in the corresponding steps can be done by the worker from a floor surface. Thus, the worker is not required to work at high places, resulting in increase in working efficiency significantly, compared to conventional cases. In particular, the hanging bolt support fitting 1 for supporting the hanging bolt 7 becomes firmly fixed to the upper space 8 of the slit 9a by the foregoing construction method. This achieves the advantageous of holding the hanging bolt 7 in a stable posture and reducing the vibration of the hanging bolt 7.

[0053] In the foregoing example, the long nut 2 and the male screw member 4 are configured as separate members. However, this is not the only case but the long nut 2 and the male screw member 4 are integrally formed in advance with a member may be used. Fig. 9 shows an example of the long nut 2 and the male screw member 4 integrally formed with a member 51. Fig. 9(a) is a perspective view of the member 51. Fig. 9(b) is a sectional view of the member 51. As shown in Fig. 9, the member 51 is configured as a component formed by joining the male screw member 4 in advance to one end of the long nut 2. The screw hole 2b for fitting the hanging bolt 7 therein is formed at the opposite end (lower surface) of the long nut 2. The member 51 with the long nut 2 and male screw member 4 integrated in this way allows formation of the screw hole 2b for fitting the hanging bolt 7 therein into a greater depth, resulting in increase in stability at the time of a fitting of the hanging bolt 7. It does not require assembly of the long nut 2 and the male screw member 4 by using the member 51, so that working efficiency may be increased to a greater extent.

[0054] During construction of the hanging bolt support fitting 1 using the member 51 with which the integrated long nut 2 and male screw member 4 are integrally formed as shown

in Fig. 9, rotation of the long nut 2 certainly causes the male screw member 4 to rotate together with the long nut 2. Thus, the widening member 6 threadedly engaged with the tip of the male screw member 4 moves downward in the axis direction of the male screw member 4 to deform the pair of the spreading walls 5b and 5c in a direction in which these walls are separated further from each other. This makes the pair of the spreading walls 5b and 5c press the pair of the walls 9b and 9c from inside, allowing the hanging bolt support fitting 1 to be fixed to the upper space 8 of the slit 9a.

[0055] (Second Embodiment)

10 A second embodiment of the present invention will be described next. Fig. 10 is a perspective view showing constituting members of a hanging bolt support fitting 1a of the second embodiment in an assembled state. Fig. 11(a) is a sectional view of the hanging bolt support fitting 1a. Fig. 11(b) shows a deforming member 40 fitted in advance to the bottom of the screw hole 2b at the long nut 2. Like the hanging bolt support fitting 1, the hanging bolt support fitting 1a includes the long nut 2, the washer 3, the male screw member 4, the spreading member 5, and the widening member 6. The hanging bolt support fitting 1a differs from the hanging bolt support fitting 1 of the first embodiment in the configuration of the long nut 2. The configuration of the long nut 2 of the second embodiment will be described in detail below.

20 [0056] As shown Fig. 11(a), for example, the internal configuration of the long nut 2 of this embodiment includes: the screw hole 2a capable of receiving the male screw member 4 therein and extending from the upper surface to a predetermined depth; a hole 30a having a predetermined inner diameter from the lower surface to a first depth position; and the screw hole 2b having a diameter less than the inner diameter of the hole 30a from the first depth position to a second depth position and capable of receiving the hanging bolt 7 therein.

As shown in Fig. 10, the long nut 2 includes an annular break groove 31 formed at a predetermined position outside a portion where the hole 30a is formed. A lower portion of the long nut 2 below the break groove 31 is a tool fitting part 30 for fitting the working tool 20.

5 [0057] The break groove 31 is a thin part designed to fracture in advance if a torque acting on the tool fitting part 30 of the long nut 2 becomes a predetermined value or more. Specifically, the thickness of the long nut 2 at the place of the break groove 31 is designed in advance to be responsive to the torque to cause fracture of the break groove 31. The break groove 31 is provided at a position near a part of transition from the hole 30a having
10 the predetermined inner diameter to the screw hole 2b.

[0058] The long nut 2 includes a communication hole 2c formed at a position near the bottom of the screw hole 2b for fitting the hanging bolt 7 therein and communicating with the lateral surface of the long nut 2. As shown in Fig. 11(a), the deforming member 40 to deform in response to a fit of the hanging bolt 7 is provided at the bottom of the screw hole

15 2b. The deforming member 40 is a component formed using flexible resin such as polypropylene, for example. As shown in Fig. 11(b), for example, the deforming member 40 includes a disk-shaped fitting part 41 and a substantially L-shaped flexible part 42 connected to the peripheral edge of the fitting part 41 and standing in an upright position. The fitting part 41 is formed into a diameter substantially equal to or slightly less than the
20 inner diameter of the screw hole 2b. The fitting part 41 is inserted through the hole 30a at the lower surface of the long nut 2 and fitted to the bottom of the screw hole 2b. The flexible part 42 has a shape with one end fixed to the peripheral edge of the fitting part 41 and bent into a substantially L-shape at the center of the flexible part 42. The flexible part 42 has an opposite end where a tip portion 43 is formed in advance so as to project slightly
25 outwardly from the peripheral edge of the fitting part 41. To allow the deforming member

40 to be visually recognizable from a worker at a floor surface, the deforming member 40 is preferably tinted in a predetermined color such as red or blue, for example.

[0059] As shown in Fig. 11(a), in insertion of the deforming member 40 through the hole 30a having the predetermined inner diameter, the fitting part 41 is pointed toward the bottom of the screw hole 2b. Regarding the flexible part 42, an angle of the bend at the center of the flexible part 42 is reduced slightly to insert the flexible part 42 in a compressed state. As a result of depressing the fitting part 41 into the bottom of the screw hole 2b, the deforming member 40 is fitted to the bottom of the screw hole 2b. At this time, the tip portion 43 of the flexible part 42 is placed at a position facing the communication hole 2c formed at the position near the bottom of the screw hole 2b to communicate with the outside. By doing so, the tip portion 43 of the flexible part 42 of the deforming member 40 is located inner side of the communication hole 2c formed at the long nut 2 as shown in Fig. 10, for example.

[0060] The long nut 2 includes a cap member 30b for blocking an opening of the hole 30a formed at the lower surface of the long nut 2. The cap member 30b is used for blocking the hole 30a at the lower surface of the long nut 2 in order to prevent the hanging bolt 7 from being fitted to the screw hole 2b while construction of the hanging bolt support fitting 1a is not completed. The cap member 30b may be made of metal or cured resin. The cap member 30b is fitted in advance into the hole 30a at the lower surface of the long nut 2. To allow the cap member 30b to be visually recognizable from a worker at a floor surface, the cap member 30b is preferably tinted in a predetermined color such as red or yellow. The color of the cap member 30b is preferably different from the foregoing color of the deforming member 40. Except for the foregoing configurations, the configurations of the second embodiment are the same as those described in the first embodiment.

[0061] For construction to place the hanging bolt 7 at the upper space 8 of the slit 9a at

the deck plate 9 using the hanging bolt support fitting 1a of this embodiment, a worker engages the engagement part 22 of the working tool 20 with the tool fitting part 30 of the long nut 2 which is positioned in the lower part than the break groove 31. Then, the worker fixes the hanging bolt support fitting 1a to the upper space 8 of the slit 9a in the same manner as in the first embodiment. Specifically, the worker inserts the spreading member 5 and the widening member 6 of the hanging bolt support fitting 1a into the upper space 8 of the slit 9a. With the washer 3 abutting on the edge of the slit 9a, the worker rotates the shaft part 21 of the working tool 20 with an electrical tool, for example, thereby moving down the widening member 6 along the male screw member 4 and separating the pair of the walls 5b and 5c further. In this way, the hanging bolt support fitting 1a is fixed to the upper space 8. At this time, as the widening member 6 moves downward further along the male screw member 4, a torque applied during the rotation of the long nut 2 is increased. This increases force of pressing the pair of the walls 9b and 9c in the upper space 8 with the pair of the spreading walls 5b and 5c so that the hanging bolt support fitting 1a is firmly fixed. In this state, the torque applied during the rotation of the long nut 2 exceeds the predetermined value. At this time, the break groove 31 formed at the long nut 2 fractures, as shown in Fig. 12. Specifically, the hanging bolt support fitting 1a of this embodiment is capable of letting the worker know that the hanging bolt support fitting 1a is firmly attached to the upper space 8 of the slit 9a by means of fracture of the break groove 31. This eliminates fluctuations in the strength of fastening by the worker, etc., and a stable construction state may be realized.

[0062] As shown in Fig. 12, fracture of the break groove 31 causes the tool fitting part 30 of the long nut 2 to come off the long nut 2 as the tool fitting part 30 is engaged with the engagement part 22 of the working tool 20. At this time, the cap member 30b also comes off the long nut 2 together with the tool fitting part 30. As a result, the screw hole 2b for

fitting the hanging bolt 7 therein becomes exposed at the lower surface of the long nut 2.

[0063] As shown in Fig. 13, the worker inserts the hanging bolt 7 into the screw hole 2b exposed at the lower surface of the long nut 2 by rotating the hanging bolt 7. When the tip of the hanging bolt 7 contacts with the flexible part 42 of the deforming member 40 fitted to the bottom of the screw hole 2b and then the hanging bolt 7 is inserted further, the flexible part 42 of the deforming member 40 is pressed with the tip of the hanging bolt 7. As a result, the tip portion 43 of the flexible part 42 appears outside through the communication hole 2c at the long nut 2 to become recognizable from outside. When the tip of the hanging bolt 7 is inserted further into a sufficient depth near the bottom of the screw hole 2b, the tip portion 43 of the flexible part 42 projects a predetermined length through the communication hole 2c, as shown in Fig. 14. This allows the worker to find that the hanging bolt 7 has been inserted sufficiently into the screw hole 2b of the long nut 2 as the worker is proceeding the work on a floor surface. In this way, a stable construction state can be realized without causing fluctuations in the depth of the hanging bolt 7 inserted by the worker, for example.

[0064] As described above, in addition to the advantage of excellent working efficiency achieved by the first embodiment, the hanging bolt support fitting 1a of this embodiment has the advantage of realizing a stable construction state by reducing fluctuations in construction work by a worker. In particular, in the hanging bolt support fitting 1a of this embodiment, the cap member 30b is attached at the lower surface of the long nut 2 while the break groove 31 does not fracture. This achieves further advantage of preventing the hanging bolt 7 from being fitted to the long nut 2 unintentionally while the hanging bolt support fitting 1a is not fixed to the upper space 8 of the slit 9a at sufficient strength.

[0065] Like in the first embodiment, a member formed by integrating the long nut 2 and the male screw member 4 in advance may be used in this embodiment.

[0066] (Third Embodiment)

A third embodiment of the present invention will be described next. Each of the foregoing hanging bolt support fittings 1 and 1a is a fitting for supporting the hanging bolt 7 in a state of hanging down at a position at the deck plate 9 where the slit 9a is formed. In other words, each of the foregoing hanging bolt support fittings 1 and 1a is not capable of supporting the hanging bolt 7 in a state of hanging down at a position without the slit 9a. In this regard, an example of a hanging bolt support fitting described in this embodiment is capable of attaching the hanging bolt 7 in a state of hanging down at any position at the lower surface of the deck plate 9.

[0067] Fig. 15 is a perspective view showing constituting members of a hanging bolt support fitting 60 according to the third embodiment of the present invention. The hanging bolt support fitting 60 is a fitting to be attached to multiple slits 9a at the deck plate 9 and capable of supporting the hanging bolt 7 in a state of hanging down at any position between these slits 9a. The hanging bolt support fitting 60 includes a hanging bolt support member 70 joined to the lower surface of the deck plate 9 and to which the hanging bolt 7 is attachable. The hanging bolt support member 70 includes an elongated rail member 65 longer than an interval between the multiple slits 9a at the deck plate 9, and a hanging bolt coupling member 67 supported by the rail member 65, capable of being placed at a position adjustable in the lengthwise direction of the rail member 65, and to which the hanging bolt 7 is attachable.

[0068] As shown in Fig. 15, the rail member 65 is made of C-shaped steel (lip channel steel), for example. Specifically, the rail member 65 has a configuration including a top plate 65a, a pair of side plates 65b, 65b hanging down from opposite sides of the top plate 65a, a pair of flanges 65c, 65c formed by bending the lower end portions of the pair of the

side plates 65b, 65b inwardly, and long holes 65d, 65d formed at multiple places of the top plate 65a and extending in the lengthwise direction of the rail member 65. The multiple long holes 65d, 65d are formed in such a manner that the respective center positions of the long holes 65d, 65d substantially conform to the distances of the slits 9a at the deck plate

5 9. An interval between the pair of the flanges 65c, 65c is determined to be greater than the diameter of the washer 3, for example.

[0069] The hanging bolt coupling member 67 includes a rectangular flat plate 67a, and a nut 67b fixed to the center of the flat plate 67a. A through hole is formed at the center of the flat plate 67a. The nut 67b is fixed to be coaxial with this through hole. In this way,

10 a screw through hole vertically penetrating the hanging bolt coupling member 67 is formed at a position where the nut 67b is fixed. One side of the flat plate 67a is in a size less than an interval between the pair of the side plates 65b, 65b of the rail member 65 and greater than an interval between the tips of the flanges 65c, 65c facing each other. Thus, the hanging bolt coupling member 67 is allowed to be housed inside the rail member 65 and to

15 move in the lengthwise direction of the rail member 65 while being housed inside the rail member 65. The nut 67b has a female screw to be threadedly engaged with the hanging bolt 7 and to which the hanging bolt 7 is attachable.

[0070] The hanging bolt support fitting 60 further includes the washer 3, a bolt 61, the spreading member 5, and the widening member 6. These members are arranged for each

20 of the multiple long holes 65d, 65d formed at the rail member 65, and are used for fixing the rail member 65 to each of the multiple slits 9a at the deck plate 9. The bolt 61 includes a male screw member 61a and a bolt head 61b. The spreading member 5 and the widening member 6 are arranged above the long hole 65d at the rail member 65. The washer 3 and the bolt 61 are attached to the rail member 65 from the downward of the long hole 65d.

25 The washer 3 has a diameter greater than the width of the long hole 65d. Thus, passing

the male screw member 61a of the bolt 61 through the long hole 65d while the washer 3 is fitted to the male screw member 61a makes the male screw member 61a project upwardly from the rail member 65. The spreading member 5 and the widening member 6 are fitted to the projecting portion of the male screw member 61a. The spreading member 5 and the widening member 6 are fitted to the male screw member 61a in the way described in the first embodiment.

[0071] The following describes a construction method of attaching the hanging bolt 7 to the deck plate 9 using the hanging bolt support fitting 60 having the foregoing configuration.

Fig. 16 is a partially cutaway sectional view showing a state in which attachment of the hanging bolt 7 using the hanging bolt support fitting 60 is completed. To realize the state shown in Fig. 16, the hanging bolt support fitting 60 is first fixed to the multiple slits 9a. Specifically, a worker inserts the spreading member 5 and the widening member 6 fitted to the male screw member 61a of the bolt 61 into the upper space 8 through a gap of the slit 9a, attaches the foregoing working tool 20 to the bolt head 61b of the bolt 61, and rotates the bolt 61. The bolt 61 is in the long hole 65d. Thus, during insertion of the spreading member 5 and the widening member 6 into the upper space 8 through the gap of the slit 9a, the relative positions of the spreading member 5 and the widening member 6 can be adjusted on the rail member 65. With rotating the bolt 61, the widening member 6 may be moved downward along the male screw member 61a. As a result, the pair of the spreading walls 5b and 5c of the spreading member 5 are pressed outwardly to be separated further by the widening member 6. In this way, the pair of the spreading walls 5b and 5c are fixed as pressing the pair of the walls 9b and 9c in the upper space 8 of the slit 9a. The worker proceeds the foregoing work on every bolt 61 provided at the multiple slits 9a, so that the rail member 65 can be fixed in a state of being joined to the lower surface of the deck plate 9.

[0072] Next, the worker inserts the hanging bolt coupling member 67 fitted to the tip of the hanging bolt 7 into inside of the rail member 65 through an end portion of the rail member 65 fixed to the deck plate 9, for example, and moves the hanging bolt coupling member 67 to a position where the hanging bolt 7 is to be attached. Then, the worker
5 rotates the hanging bolt 7 to make the tip of the hanging bolt 7 to be in contact with the top plate 65a of the rail member 65, as shown in Fig. 16. If the worker further tries to rotate the hanging bolt 7 after the tip of the hanging bolt 7 has been in contact with the top plate 65a, the top plate 65a of the rail member 65 is pressed by the tip of the hanging bolt 7. At this time, axial force acted on the hanging bolt 7 tries to depress the flat plate 67a of the
10 hanging bolt coupling member 67. This axial force functions to engage the flat plate 67a with the pair of the flanges 65c, 65c of the rail member 65 to generate strong force of friction with the pair of the flanges 65c, 65c, preventing the hanging bolt coupling member 67 from moving in the lengthwise direction of the rail member 65. Specifically, the hanging bolt coupling member 67 is fixed at a predetermined position at the rail member
15 65 in response to receipt of the axial force from the hanging bolt 7. This further acts to fix the hanging bolt 7 so as to be prevented from moving in the lengthwise direction of the rail member 65.

[0073] As described above, in this embodiment, the rail member 65 and the hanging bolt coupling member 67 are used as the hanging bolt support member 70. This allows
20 attachment of the hanging bolt 7 in a state of hanging down at a position at the deck plate 9 even where the slit 9a is not formed. Thus, the hanging bolt support fitting 60 of this embodiment has high flexibility in terms of installation of the hanging bolt 7 and achieves excellent convenience.

[0074] In the foregoing example, the rail member 65 is attached to two adjacent slits 9a
25 at the deck plate 9. However, this is not the only case. For example, the rail member 65

may be arranged to extend across three slits 9a or more. Except for the foregoing features, the configuration of the hanging bolt support fitting 60 of this embodiment is the same as the foregoing configuration described in the first embodiment.

5 [0075] (Modifications)

While some embodiments according to the present invention have been described hereinabove, the present invention is not limited to each of the foregoing embodiments but various modifications are applicable.

[0076] In the exemplary case of each of the foregoing embodiments, work in each step of
10 the method of constructing the hanging bolt support fitting 1, 1a, or 60 is done after the ceiling slab S such as concrete is placed on the upper surface of the deck plate 9. After placement of the ceiling slab S on the upper surface of the deck plate 9, the pair of the walls 9b and 9c in the upper space 8 of the slit 9a are not deformed by application of pressing force acting on the pair of the walls 9b and 9c. Thus, after placement of the ceiling slab
15 S, the hanging bolt support fittings 1 and 1a can firmly be fixed to the pair of the walls 9b and 9c. However, this is not the only case. If the deck plate 9 is relatively thick and thus has strength of such a degree as to prevent deformation of the pair of the walls 9b and 9c even before placement of the ceiling slab S, for example, the foregoing work in each step may be done before placement of the ceiling slab S.

20 [0077] In the exemplary case of each of the foregoing embodiments, the widening member 6 is prepared by arranging a columnar fitting having a predetermined length in the lateral direction. However, the widening member 6 is not always required to be a columnar shape. For example, the widening member 6 may have a half-columnar shape, a trapezoidal shape, or a shape like an ingot.

25 [0078] In the exemplary case of each of the foregoing embodiments, the widening

member 6 is configured as a nut member having the screw through hole 6a and configured to be attached to the tip of the male screw member 4 by making threaded engagement of the tip (upper end) of the male screw member 4 with the screw through hole 6a. However, the widening member 6 is not always required to be a member such as a nut to be provided separately from the male screw member 4. Specifically, the widening member 6 may be provided as the head of the male screw member 4 integrally with the tip (upper end) of the male screw member 4. If the widening member 6 is provided as the head of the male screw member 4 integrally with the male screw member 4, the widening member 6 is required to move down in response to rotation of the long nut 2. In this case, the male screw member 4 and the long nut 2 are required to be configured as separate members. To move down the widening member 6 in response to rotation of the long nut 2, the lower end of the male screw member 4 is required to float above the bottom of the screw hole 2a at least by a predetermined distance as the constituting members of the hanging bolt support fitting 1 or 1a are being in an assembled state. This predetermined distance is set in advance so as to conform to a required amount of downward movement of the widening member 6.

[0079] The foregoing configuration described in the second embodiment including the communication hole 2c at the long nut 2 and the deforming member 40 at the bottom of the screw hole 2b is further applicable to the foregoing first embodiment.

20

Reference Signs List

[0080] 1, 1a, 60 Hanging bolt support fitting

2 Long nut

2a Screw hole (first screw hole)

25 2b Screw hole (second screw hole)

	2c	Communication hole
	3	Washer
	4	Male screw member
	5	Spreading member
5	5a	Base end
	5b, 5c	Spreading wall
	6	Widening member
	6a	Screw through hole
	7	Hanging bolt
10	8	Upper space
	9	Deck plate
	9a	Slit
	9b, 9c	Wall
	9d	Top plate
15	11	Hole (passage hole)
	15	Thick part
	30b	Cap member
	31	Break groove
	40	Deforming member
20	65	Rail member
	67	Hanging bolt coupling member
	70	Hanging bolt support member

CLAIMS

1. A hanging bolt support fitting to be attached to a deck plate and used for supporting a hanging bolt as being attached to the deck plate, the deck plate including: a
5 slit of a predetermined width formed at the lower surface of the deck plate; a pair of walls extending upwardly from the opposite ends of the slit so as to be separated at an interval increased gradually; and a top plate provided at a position at a predetermined height from the slit and connecting respective upper end portions of the pair of walls, the hanging bolt support fitting comprising:

10 a male screw member to be inserted into a space between the pair of walls through the slit at the deck plate;

a spreading member fitted to the male screw member, the spreading member including a pair of spreading walls standing upright so as to face each other across the male screw member, the pair of spreading walls being arranged at an interval less than the width
15 of the slit at the deck plate;

a widening member provided at the upper end of the male screw member and joined to the tips of the pair of spreading walls in a lengthwise direction perpendicular to the axis direction of the male screw member, the widening member being formed into a shape such that a maximum width of the widening member in a transverse direction
20 perpendicular to the axis direction of the male screw member is less than the width of the slit at the deck plate and the width of the widening member is reduced gradually as it goes downwardly from a portion corresponding to the maximum width, the widening member being attached with a lower portion of the widening member below the portion corresponding to the maximum width being put in between the pair of spreading walls; and

25 a hanging bolt support member provided at a lower portion of the male screw

member, joined to the lower surface of the deck plate, and to which the hanging bolt is attachable.

2. The hanging bolt support fitting according to claim 1, wherein

the hanging bolt support member is formed using a long nut, and the long nut
5 includes a screw hole formed at the lower surface of the long nut and capable of receiving the hanging bolt therein.

3. The hanging bolt support fitting according to claim 2, wherein

the hanging bolt support member further includes a washer fitted to the male screw member, and

10 in response to rotation of the long nut as the widening member and the spreading member are being inserted between the pair of walls through the slit at the deck plate and the washer is in abutting in contact with an edge of the slit at the deck plate, the widening member moves down and goes into inside of the pair of spreading walls to spread the spreading walls, thereby closely attaching and fixing the pair of spreading walls to the pair
15 of walls at the deck plate.

4. The hanging bolt support fitting according to claim 2 or 3, wherein

the male screw member is smaller in diameter than the hanging bolt.

5. The hanging bolt support fitting according to any one of claims 2 to 4, wherein the long nut includes:

20 a hole having a predetermined inner diameter from the lower surface of the long nut to a first depth position;

the screw hole having a diameter less than the predetermined inner diameter from the first depth position to a second depth position and capable of receiving the hanging bolt therein; and

25 an annular break groove at a predetermined position outside a portion where the

hole having the predetermined inner diameter is formed.

6. The hanging bolt support fitting according to claim 5, further comprising:

a cap member for closing the hole having the predetermined inner diameter,
wherein

5 when the break groove fractures, the cap member comes off the long nut together
with a lower end portion of the long nut below the break groove.

7. The hanging bolt support fitting according to any one of claims 2 to 6, wherein

the long nut includes a communication hole communicating with the lateral
surface of the long nut and formed at a position near the bottom of the screw hole capable

10 of receiving the hanging bolt therein,

a deforming member to deform in response to installation of the hanging bolt is
provided at the bottom of the screw hole, and

the deforming member deforms in response to installation of the hanging bolt in
the screw hole capable of receiving the hanging bolt therein to partially project to the
15 outside through the communication hole.

8. The hanging bolt support fitting according to claim 1, wherein

the slit at the deck plate includes multiple slits arranged at a predetermined interval,
and

the hanging bolt support member includes:

20 a rail member longer than the interval between the slits at the deck plate; and

a hanging bolt coupling member supported by the rail member, capable of being
placed at a position adjustable in the lengthwise direction of the rail member, and to which
the hanging bolt is attachable.

9. The hanging bolt support fitting according to claim 8, wherein

25 the hanging bolt coupling member includes a screw through hole capable of

receiving the hanging bolt therein, and

the tip of the hanging bolt fitted in the screw through hole presses the rail member to fix the hanging bolt coupling member in the lengthwise direction of the rail member.

10. The hanging bolt support fitting support fitting according to any one of claims
5 1 to 9, wherein

the spreading member includes a passage hole and a thick part, the passage hole being formed at the center of a base end and capable of passing the male screw member therethrough, the thick part being formed at each of opposite end portions of each of the pair of spreading walls to have an inwardly increasing thickness compared to a thickness
10 at a central portion of each of the spreading walls.

11. The hanging bolt support fitting according to claim 10, wherein

the thick part has a configuration determined by stacking pieces of a plate member to form the pair of spreading walls inwardly from the pair of spreading walls.

12. The hanging bolt support fitting according to claim 10 or 11, wherein

15 an interval between the thick parts provided at the respective opposite end portions of the pair of spreading walls and facing each other is less than the diameter of the male screw member.