

## EXPANSION ANCHOR

The present invention relates to an expansion anchor and more particularly to an expansion anchor for temporarily anchoring a brace or other component in building  
5 construction.

In the construction of a building structure using precast concrete panels, the panels are temporarily supported on site by braces until the panels are physically connected into, and become an integral part of, the building structure. Typically, two braces are used to  
10 support each panel to resist wind loading acting to cause the panel to fall over. Usually, the upper end of the brace is fixed to the panel by bolting into a ferrule which is incorporated into the panel during casting. The lower end of the brace is usually fixed into the horizontal slab which may either be on the ground, or suspended if a multi-storey application, using a masonry anchor of expansion type which, for this purpose, is termed a  
15 brace anchor. Brace anchors may also sometimes be used for fixing the upper ends of the brace to the panel in circumstances where that is the preference of the engineer or builder or when the cast-in ferrule has been incorrectly installed.

Most commercially available braces are of similar construction and have at each end a  
20 steel anchor plate of between 12 and 20mm in thickness (depending on construction) with a slot of approximately 22 to 24mm in width for receiving the brace anchor or ferrule bolt.

Following a number of panel collapses from wind loading through failure of the brace anchors, an Australian Standard (AS 3850-2003) was introduced to prescribe minimum  
25 performance requirements for anchors used as brace anchors. Although there are currently available a number of expansion anchors which meet these standards, none are specifically designed for that usage and, as a result, compromises have to be made when using these anchors. In particular, expansion anchors are conventionally designed for permanent installation. When used as a temporary brace anchor, significant difficulties  
30 can arise both in releasing the anchor to permit removal of the brace and then in the actions necessary to ensure that remaining parts of the anchor do not project beyond the

surface of the slab, involving either the use of an angle grinder to cut any projecting parts flush with the base or tapping any projecting parts flush with the surface and which might compromise the integrity of a waterproof membrane underneath the slab. Moreover, the across-flats (AF) head size of bolt heads of suitable currently available expansion anchors  
5 is less than the width of the anchor slot incorporated into the base plates of currently available braces with the result that the washer installed between the head and the anchor plate will bend and must take the full fixing load in this mode.

According to one aspect of the invention there is provided an expansion anchor for  
10 temporarily anchoring a component to concrete structure, the anchor having a bolt with a threaded shank which mates with an internally threaded expansion cone, an expansion sleeve which cooperates with the expansion cone whereby the expansion sleeve is expanded into anchoring engagement with the wall of a hole drilled into the concrete structure as the cone is drawn into the sleeve by rotation of the bolt, means for forming an  
15 anti-rotation mechanical interlock with the wall of the hole in order to prevent rotation of the cone to permit release of the bolt after setting of the anchor, and a spacer arrangement between the expansion sleeve and outer end of the bolt shank, the spacer arrangement consisting of or including a spacer sleeve having an inner end portion adapted to lie within the outer end portion of the hole when the anchor is set such that after subsequent removal  
20 of the bolt and the component, the spacer sleeve projecting from the concrete structure can be removed from the outer part of the hole.

In a preferred embodiment of the invention the spacer arrangement includes an inner sleeve between the spacer sleeve and expansion sleeve. Advantageously the inner sleeve  
25 is of a structure which permits axial collapse of the sleeve during setting of the anchor to provide a pull-down effect.

In alternative constructions the expansion sleeve itself may include structure which provides a pull-down effect or otherwise may be of a length such that the inner spacer  
30 sleeve is not required, in which case the outer spacer sleeve will directly follow the expansion sleeve on the shank of the bolt and thereby provide the spacer assembly.

Particularly advantageously the bolt shank is of stepped diameter with the expansion cone being mounted on the smaller diameter portion of the shank and the spacer sleeve lying on the larger diameter portion of the shank.

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In one particularly preferred practical embodiment of the invention, the outer end of the spacer sleeve abuts against the head of the bolt via a metal washer and a low friction washer, and the bolt head is a hex head of 30mm width across-flats (AF) with the outer diameter of the expansion sleeve and spacer sleeve being substantially 20mm. This means  
10 that when the anchor is used with currently available braces having a slot of between approximately 22 and 24mm in the anchor plate, the head of the anchor will span the entire width of the slot and the underlying metal washer will not be subject to load transmission by bending.

15 In order to provide the anti-rotation lock to facilitate release of the bolt while the expansion cone is held against rotation under the applied torque, the expansion cone is preferably formed to a size such that it is an interference fit within the hole with formations which broach into the wall of the hole during insertion of the anchor to provide a physical anti-rotation lock. In one form, these formations can consist of rib-like  
20 projections although other formations which achieve the required interlock during insertion can alternatively be used. In a further alternative the expansion sleeve could be provided with the anti-rotation formations which broach into the wall during insertion; since, when the anchor is set, the expansion cone will be wedged very firmly into the expansion sleeve, rotation of the expansion cone will thereby be prevented.

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According to another aspect of the invention there is provided a temporary anchorage between a concrete structure and an anchor plate of a brace, said anchorage being provided by an expansion anchor as defined above extending through the anchor plate into a hole drilled into the structure, wherein the spacer sleeve is of such a length that its outer  
30 end is substantially flush with the upper surface of the anchor plate and its lower end

extends into the hole to a depth which permits ready removal of the spacer sleeve after removal of the bolt and anchor plate.

According to another aspect of the invention there is provided an expansion anchor  
5 providing a temporary anchorage for a component during the construction of a building,  
the anchor being set into a hole drilled into concrete structure by expansion of an  
expansion sleeve of the anchor, the anchor having an anchor bolt which is releasable and  
removable after setting the anchor to permit removal of the component, and the anchor  
10 further having a spacer sleeve between an expansion sleeve and head of the bolt and which  
is located only in the outer part of the hole so as to be easily removable after removal of  
the bolt so that no remaining part of the anchor then projects from the hole.

An embodiment of the invention will now be described by way of example only with  
reference to the accompanying drawings in which:

15 Figure 1 is a perspective view of an expansion anchor in accordance with a  
preferred embodiment of the invention;

Figure 2 shows the component parts of the anchor;

Figure 3 is a cross-section showing the anchor in its installed position to act as a  
temporary anchor for a brace;

20 Figure 4 is a section similar to Figure 3 showing the anchor after the bolt and  
brace have been removed; and

Figure 5 shows schematically the removal of the outer spacer sleeve which  
remains projecting after removal of the bolt and brace.

25 With initial reference to Figures 1 and 2, an expansion anchor specifically designed as a  
temporary brace anchor comprises a bolt having a stepped shank 2 of which the inner,  
smaller diameter, end portion 2a is threaded (the thread is not shown in Figure 2) to  
receive an internally threaded cone nut 4 forming an expansion cone. An expansion sleeve  
6 is mounted on the smaller diameter portion 2a for cooperation with the cone nut 4 in  
30 conventional manner. A spacer assembly interposed between the expansion sleeve 6 and  
washer 8 adjacent the head 10 of the bolt is, in the embodiment shown, of two part

construction having an inner spacer sleeve 12 and an outer spacer sleeve 14. In the particular embodiment shown, the inner sleeve 12 is formed with a series of apertures 16 which form within the sleeve inclined struts 18 able to deform when axial loading is applied to the sleeve during setting of the anchor within the hole so as to result in a contraction in the axial length of the sleeve which facilitates so-called "pull-down" to ensure that the anchor is able to draw the brace anchor plate down to the concrete slab and anchor it firmly. A pull-down action of this type is described in greater detail in Australian patent no. 559285 and Australian patent no. 697330. In the embodiment shown, the apertures within the sleeve 12 are of the general shape described in Australian patent no. 697330 although it is to be understood that other constructions of sleeve which provide a pull-down effect could alternatively be used. It is to be noted that although it is preferred to form this inner sleeve to provide a pull-down effect this is not essential to the working of the invention and in other constructions an inner spacer sleeve without that capacity could alternatively be used.

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The larger diameter end of the cone nut 4 is formed with a series of flats 18 around its peripheral surface which define longitudinal locking ribs 20. This end of the cone nut 4 is dimensioned so that the ribs 20 are an interference fit within the hole into which the anchor is fitted and thereby during installation of the anchor they will broach into the concrete to provide a mechanical interlock between the cone nut 4 and concrete in order to prevent rotation of the cone nut within the hole. As a result of this anti-rotation interlock the bolt is readily able to be released by unscrewing from the cone nut when it is required to remove the brace.

25 Preferably, a low-friction washer 21 for example of PTFE is incorporated between the bolt head 10 and main washer 8 to reduce so-called static friction acting on the bolt head during setting of the anchor and thereby to ensure that more of the torque applied to the bolt head is translated into expansion of the expansion sleeve and hence setting of the anchor within the hole.

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The installed condition of the brace anchor is shown in Figure 3. The anchor is inserted in its assembled form through the anchor plate 22 of the brace into the hole predilled into the concrete slab 24 so that the underside of the washer 8 and outer end of the outer spacer sleeve 14 are flush with the upper surface of the anchor plate 22 and the bolt is then  
5 tightened to a specified torque in order to set the anchor in the usual way. As previously mentioned, the anchor plates of currently available braces are of a thickness which varies between approximately 12 and 20mm depending on its method of construction. The length of the outer spacer sleeve 14 is greater than the likely maximum thickness of base plate, but not significantly so, so that its inner, lower, end will lie within the upper part of the  
10 hole in the slab 24. As a result of this, when the anchor bolt and brace have been removed, the projecting part of the spacer sleeve 14 which only extends a relatively short distance into the hole, the extent of penetration depending on the actual thickness of the anchor plate with which the anchor has been used, can readily be removed by knocking the sleeve sideways or even by kicking it out (see Figures 4 and 5). The rest of the anchor consisting  
15 of inner spacer sleeve, expansion sleeve and cone nut will remain within the hole but beneath the surface of the slab. The end of the hole is then sealed with a suitable filler.

The bolt is formed with a particularly large head 10 such that it is able to fully span the slot width of currently available braces, typically a slot width of 22 to 24mm as previously  
20 mentioned. In one practical example, with a bolt shank diameter of 20mm the head size is 30mm across flats (AF) so that the underlying washer 8 will be subject to a direct compressive loading, not a bending loading. The 30mm AF head also corresponds to the head size of metric M20 threaded bolts as would typically be used with cast-in ferrules at the upper end of the brace so that an installer can thereby use the same socket for fixing  
25 both ends of the brace. Moreover the head size, being unusually large for an expansion anchor of this size will be readily identifiable from simple inspection when installed and the head will also carry special identification markings to identify that the anchor is a specially designed brace anchor. Both of these aspects will ease the problems of on-site inspection by work-safety personnel to ensure that the correct anchors are being used. It  
30 will of course be understood that the anchor can be used both for fixing the lower end of

the brace to the slab and the upper end to the concrete panel if required instead of a cast-in ferrule.

Although the anchor has principally been described in terms of the temporary anchorage  
5 of a brace, the anchor also has applicability to other anchoring situations which arise in  
building construction where a temporary anchorage is required, for example balustrades,  
guard rails, hand rails, and scaffolding.

The embodiments of the invention have been described by way of example only and  
10 modifications are possible within the scope of the invention.

**CLAIMS:**

1. An expansion anchor for temporarily anchoring a component to concrete structure, the anchor having a bolt with a threaded shank which mates with an internally  
5 threaded expansion cone, an expansion sleeve which cooperates with the expansion cone whereby the expansion sleeve is expanded into anchoring engagement with the wall of a hole drilled into the concrete structure as the cone is drawn into the sleeve by rotation of the bolt, means for forming an anti-rotation mechanical interlock with the wall of the hole in order to prevent rotation of the cone to permit release of the bolt after setting of the  
10 anchor, and a spacer arrangement between the expansion sleeve and outer end of the bolt shank, the spacer arrangement consisting of or including a spacer sleeve having an inner end portion adapted to lie within the outer end portion of the hole when the anchor is set such that after subsequent removal of the bolt and the component, the spacer sleeve projecting from the concrete structure can be removed from the outer part of the hole.  
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2. An anchor according to claim 1, wherein the spacer arrangement includes an inner sleeve between the spacer sleeve and expansion sleeve.
3. An anchor according to claim 2, wherein the inner sleeve is of a structure which  
20 permits axial collapse of the sleeve during setting of the anchor to provide a pull-down effect between the component and the concrete structure.
4. An anchor according to claim 2, wherein the expansion sleeve includes structure which provides a pull-down effect between the component and the concrete structure.  
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5. An anchor according to any one of claims 1 to 4, wherein the bolt shank is of stepped diameter with the expansion cone being mounted on the smaller diameter portion of the shank and the spacer sleeve lying on the larger diameter portion of the shank.
- 30 6. An anchor according to any one of claims 1 to 5, wherein the outer end of the spacer sleeve abuts against the head of the bolt via a metal washer and a low friction

washer, and the bolt head is a hex head of 30mm width across-flats (AF) with the outer diameter of the expansion sleeve and spacer sleeve being substantially 20mm.

7. An anchor according to any one of claims 1 to 6, wherein the anti-rotation  
5 interlock is provided by portions of the expansion cone which broach into the wall of the hole during insertion of the anchor to provide a physical anti-rotation lock between the cone and the wall.

8. An anchor according to claim 7, wherein the portions are formed by rib-like  
10 projections of the expansion cone.

9. An anchor according to any one of claims 1 to 6, wherein the anti-rotation  
interlock is provided by anti-rotation formations on the expansion sleeve which broach  
into the wall during insertion.

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10. An expansion anchor substantially as hereinbefore described with reference to the  
drawings.

11. An expansion anchor according to any one of claims 1 to 10 when used to  
20 temporarily anchor an anchor plate to concrete structure.

12. An expansion anchor according to claim 11, wherein the anchor plate is part of a  
brace for temporarily bracing a panel during building construction.

25 13. A temporary anchorage between a concrete structure and an anchor plate, said anchorage being provided by an expansion anchor according to any one of claims 1 to 10 extending through the anchor plate into a hole drilled into the structure, wherein the spacer sleeve is of such a length that its outer end is substantially flush with the upper surface of the anchor plate and its lower end extends into the hole to a depth which permits ready  
30 removal of the spacer sleeve after removal of the bolt and anchor plate.

14. A temporary anchorage according to claim 13, wherein the anchor plate forms part of a brace.

15. A temporary anchorage according to claim 13 or claim 14, wherein the depth to which the spacer sleeve extends into the hole is such that the sleeve can be removed by knocking the sleeve sideways.

16. An expansion anchor providing a temporary anchorage for a component during the construction of a building, the anchor being set into a hole drilled into concrete structure by expansion of an expansion sleeve of the anchor, the anchor having an anchor bolt which is releasable and removable after setting the anchor to permit removal of the component, and the anchor further having a spacer sleeve between an expansion sleeve and head of the bolt and which is located only in the outer part of the hole so as to be easily removable after removal of the bolt so that no remaining part of the anchor then projects from the hole.

17. An anchor according to claim 16, having an inner sleeve between the expansion sleeve and spacer sleeve, the inner sleeve being of a structure which permits axial collapse of the sleeve during setting of the anchor to provide a pull-down effect between the component and the concrete structure.