Abstract: An edge lift anchor for a concrete product, the anchor having a head portion for coupling to lifting equipment and an anchoring portion, and a separate member mounted on the anchor and having integral legs extending to each side of the anchoring portion to increase the lifting capacity of the anchor. Alternatively or in addition, the separate member may provide a mounting for a tension bar to increase the lifting capacity. The invention also provides a support chair for retaining the edge lift anchor, together with an associated shear bar and tension bar if present.
CONCRETE LIFTING ANCHORS

The present invention relates to anchors for use in the lifting of cast concrete products such as wall panels during the erection thereof. More particularly the invention relates to edge lift anchors.

In the fabrication of precast concrete wall panels either at an offsite casting yard or onsite, it is necessary to lift the panel from the horizontal configuration in which it is cast to a vertical configuration for transportation and/or erection. For offsite casting and for some onsite casting, lifting of the panel takes place from the edge of the panel which is the upper edge in the erected condition of the panel. For this purpose so-called edge lift anchors are incorporated into the reinforcing structure of the panel prior to casting. During casting the head of the anchor is encased within a removable or disposable void former to form within the edge surface of the panel a recess within which the head of the anchor lies for releasable coupling to lifting equipment.

Various forms of edge lift anchor are currently available. When the panel is being lifted when in its vertical configuration, the edge lift anchors must take the entire weight of the panel and edge lift anchors are appropriately sized for this purpose. Typically, the anchors are produced in a range of load carrying capacities from 2 tonne to 10 tonne, with anchors of appropriate capacity being selected for each particular job. For an anchor of given type and size, its load carrying capacity can be increased by the incorporation of an aperture beneath the head of the anchor to receive a tension bar which is a length of reinforcing bar which passes through the aperture and is bent to extend on either side of the body of the anchor to increase its effective depth of embedment relative to the upper edge of the panel.

Incorporation of the tension bar may sometimes be relatively time consuming. Moreover when the tension bar is installed a primary potential failure mode when under load is a shearing or guillotine action between the bar and the opposite edges of the aperture in the anchor through which the bar passes. To avoid such failure the cross-sectional dimension of the bar is such as to provide a significant factor of safety and this does mean that the size of the bar is greater than that which is really necessary to increase the load carrying capacity of the anchor.
One aspect of the present invention relates to alternative means for increasing the load carrying capacity of the anchor to avoid these difficulties. Other aspects of the invention relate to alternative tension bar mounting configurations which result in increased versatility.

According to one aspect of the invention there is provided an edge lift anchor for a concrete product, the anchor having a head portion for coupling to lifting equipment and an anchoring portion, and a separate member mounted on the anchor and having integral legs extending to each side of the anchoring portion to increase the lifting capacity of the anchor.

In a preferred embodiment, the separate member is in the form of a collar mounted on the head of the anchor.

Advantageously, the collar includes an aperture for optional receipt of a tension bar to further increase the lifting capacity of the anchor.

According to a further aspect of the invention there is provided an edge lift anchor for a concrete product, the anchor having a head portion for engagement with lifting equipment and an anchoring portion, and a separate member mounted on the anchor, the member having an aperture for receipt of a tension bar to increase the lifting capacity of the anchor.

Yet another aspect of the invention provides an assembly comprising an edge lift anchor for a concrete product mounted to a support chair for installation on a casting base, the chair having provision for locating a shear bar associated with the anchor and a tension bar if present.

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

Figure 1 is a perspective view showing an edge lift anchor to which is applied a collar in accordance with a first embodiment of the invention;
Figure 2 is an end view;
Figure 3 is a plan view;
Figure 4 is a side view;
Figures 5 to 8 are views corresponding to Figures 1 to 4 but showing the collar used in conjunction with a shear bar of flat cross-section;
Figure 9 is a perspective view showing the anchor with collar of Figures 1 to 4 mounted to a supporting chair together with an associated shear bar and tension bar;
Figure 10 is an end view;
Figure 11 is a plan view;
Figure 12 is a side view;
Figure 13 is a perspective view similar to Figure 1 but showing an alternative form of collar;
Figure 14 is a perspective view similar to Figure 1 but showing a further alternative form of collar;
Figure 15 is an end view;
Figure 16 is a plan view;
Figure 17 is a side view;
Figure 18 is a perspective view similar to Figure 1 but showing a yet further alternative form of collar;
Figure 19 is a side view; and
Figure 20 is a side view showing a variant of the embodiment of Figures 18 and 19.

Figures 1 to 4 show an edge lift anchor 2 in its installed position for lifting of the panel from its casting configuration in which the upper face of the panel is horizontal. The anchor has a head 4 for coupling to lifting apparatus, and an anchoring portion in the form of a pair of substantially parallel legs 6 extending from the head 4. The particular head 4 shown is designed for cooperation with a lifting clutch in the form of a ring clutch and an arcuate locking bolt received within the eye of the head, although it is to be understood that the head could be of a different detailed design for use with other types of lifting apparatus.

The legs 6 are profiled along their inner edges with a saw tooth profile so as to lock into the surrounding concrete but it is to be understood that the legs may have any other form of profile to achieve that purpose.
The anchor of the general type shown is formed from thick metal plate by cutting and/or pressing techniques as will be well understood by persons skilled in the art. It is orientated in the panel in its casting configuration with an upper edge substantially parallel to the upper face of the panel. In the embodiment shown, the head 4 of the anchor is stepped inwardly relative to the anchoring portion, the step being designated 4a in the drawings. A metal shear bar 8 engages the upper edge of the head 4 adjacent the step 4a as is clearly shown in Figures 1 and 4. The shear bar 8 is provided to resist the shear loading which arises at the commencement of edge lifting when the panel is in its horizontal configuration following casting, as is well known. As shown, the shear bar 8 is formed from a length of reinforcing bar of substantially circular cross-section although it may alternatively be of flat cross-section as disclosed in our co-pending application of even date (Reference no. 30718060). This is shown in Figures 5 to 8 where the shear bar is designated 9.

The head 4 carries a metal collar 10 which is formed separately from the anchor and is applied to the head following manufacture of the anchor. The collar 10 includes pairs of integral legs 12, 14 each extending to respective sides of the anchor. The legs 12, 14 are formed into a zigzag or meandering shape as shown in order to lock into the concrete and thereby to increase the lifting capacity of the anchor. The legs 12, 14 may however be shaped in a manner different to that illustrated in order to achieve the same effect. The incorporation of the collar with the integral legs 12, 14 enables an increase in the lifting capacity of the anchor to be obtained without the need to incorporate a tension bar. The respective legs 12, 14 of each pair are spaced above and below the longitudinal axis of the anchor and thus will lie above and below central reinforcement within the panel. Accordingly, the legs in this configuration will avoid interference with the central reinforcement as may occur with a conventional centrally located shear bar.

It will be seen that in this embodiment, the collar 10 incorporates an aperture 16 inwardly of the eye of the head 4 and thus beneath the eye in the lifting configuration of the anchor. While the presence of this aperture is preferred for reasons to be discussed, it is not essential. When present it enables the lifting capacity of the anchor to be further increased.
by the incorporation of a metal tension bar 18 passing through the aperture in the manner shown in Figures 9 to 12, with the end part of the tension bar 18 passing between the respective legs 12, 14 of each pair. If this tension bar is provided it is likely to be of much smaller diameter than conventional tension bars, due to the effect of the legs 12, 14 which themselves provide substantial increase in the lifting capacity of the anchor. Figures 9 to 12 also show the assembly of the anchor 2, shear bar 8 and tension bar 18 installed in a chair 20 for rapid installation on the casting base prior to casting of the panel. The chair 20 which is formed as a one-piece plastic moulding includes clips 22 for the anchor 2, clips 24 for the shear bar 8 and clips 26 for the tension bar 18. The clips 22, 24, 26 are resilient and engage their associated components with a snap action.

In a variant shown in Figure 13, the pairs of spaced legs at each side of the anchor are replaced by single legs 12, 14 of increased width. This version has particular utility in an arrangement where the panel has upper and lower reinforcement between which the legs will lie.

The legs 12, 14 (either as pairs of legs or single legs) increase the load carrying capacity of the anchor by acting in tension and not in shear. The failure mode will be tensile failure rather than shear failure which is the failure mode for conventional tension bars as discussed previously. The tensile strength is far greater than the shear strength and therefore the legs do not require the same cross-sectional area as that of a conventional tension bar and also do not require as deep an embedment within the concrete.

The incorporation of the collar with integral legs either with or without the aperture for the tension bar enables an anchor of basic form without the collar to be converted to an anchor of increased lifting capacity by application of the collar following manufacture and thereby the same anchor can be used for a range of different load applications either with or without the presence of the collar. This concept is applied in a somewhat different manner in the embodiment of Figures 14 to 17 in which the collar 10 is formed with the aperture 16 for receipt of a tension bar 18, but without the integral legs 12, 14 whereby an anchor of basic form can readily be converted into an anchor for use with a tension bar by mounting of the collar thereon.
Although the collar with integral legs has applicability to a wide range of anchors including those where the anchoring portion is formed other than by parallel legs (for example, an anchoring portion of solid plate-like form) it will be understood that those versions where the collar is provided with an aperture for receipt of a tension bar are essentially confined to use with anchors of the type having parallel legs to thereby permit passage of the tension bar from one side of the anchor to the other between the legs.

When the collar is formed with an aperture for receipt of a tension bar, the collar can be made of increased length so that the tension bar is positioned further away from the head of the anchor and thereby embedded deeper within the depth of the panel without increasing the length of the bar. Moreover this provision to vary the position of the tension bar enables the tension bar to be moved away from interference with heavy concentrations of steel reinforcement which may be at the top of the panel in some situations. Figures 18 and 19 show the collar 10 of such a length that aperture 16 for tension bar 18 is positioned a significant distance from the head 4, as shown approximately midway along the length of the anchor. Figures 18 and 19 also show the collar with a further aperture 40 between the head 4 and aperture 16 for a metal splice bar 42 to accommodate splicing of a perimeter bar of the reinforcement, the tension bar 18 being positioned beneath and thus away from the reinforcement. Figure 20 shows a variant of this concept in which the aperture 42 is of elongate form to permit substantial variation in the positioning of the splice bar 42.

It is to be noted that the use of the collar 10 with aperture 16 for a tension bar provides significant versatility in the location of the tension bar which is not achievable in an arrangement in which the tension bar passes directly through the head of the anchor.

The embodiments are described by way of example only and modifications are possible within the scope of the invention.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An edge lift anchor for a concrete product, the anchor having a head portion for coupling to lifting equipment and an anchoring portion, and a separate member mounted on the anchor and having integral legs extending to each side of the anchoring portion to increase the lifting capacity of the anchor.

2. An edge lift anchor according to claim 1, wherein the legs are of a meandering shape so as to lock into the concrete.

3. An edge lift anchor according to claim 1 or claim 2, wherein the separate member has at each side of the anchoring portion a pair of integral legs spaced on opposite sides of the longitudinal axis of the anchor to thereby lie on opposite sides of central reinforcement of a concrete panel or other component within which the anchor is to be installed.

4. An edge lift anchor according to any one of claims 1 to 3, wherein the separate member has an aperture for receipt of a tension bar.

5. An edge lift anchor according to claim 4, wherein the aperture is provided within a collar portion of the member mounted to the head portion of the anchor.

6. An edge lift anchor according to claim 4 or 5 when dependent on claim 3, in combination with a tension bar engaged within the aperture, the tension bar having divergent legs which pass between the legs of each pair of legs of the separate member.

7. An edge lift anchor for a concrete product, the anchor having a head portion for coupling to lifting equipment and an anchoring portion, and a separate member mounted on the anchor, the member having an aperture for receipt of a tension bar to increase the lifting capacity of the anchor.

8. An edge lift anchor according to claim 7, wherein the aperture is formed in a part of
the member positioned remote from the head portion.

9. An edge lift anchor according to claim 8, wherein the separate member has a further aperture for receipt of a splice bar for splicing of a perimeter bar of reinforcement of a concrete component within which the anchor is to be incorporated.

10. An edge lift anchor according to any one of claims 1 to 3 or 7 to 9, wherein the separate member is applied to the anchor by engagement of a collar portion of the member with the head portion of the anchor.

11. A support chair for an edge lift anchor, the chair having a clipping system for retaining the edge lift anchor so as to position the anchor relative to a casting base.

12. A chair according to claim 11, having means for locating a shear bar associated with the anchor.

13. A chair according to claim 11 or claim 12 having means for locating a tension bar associated with the anchor.

14. A chair according to any one of claims 11 to 13, wherein the locating means include clips.

15. An assembly comprising an edge lift anchor for a concrete product mounted to a support chair for installation on a casting base, the chair having provision for locating a shear bar associated with the anchor and a tension bar if present.
INTERNATIONAL SEARCH REPORT

PCT/AU20 10/000829

A  CLASSIFICATION OF SUBJECT MATTER

C1
e04c/12 (2006 01)  e04c/18 (2006 01)

According to International Patent Classification (IPC) or to both national classification and IPC

B  FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable search terms used)

WPI, EPDOC IC, ECLA E04C 5/1 2, 5/1 6, 5/1 8 E04G2 1/14, 2 1/1 6 B66H 9/02/IC B66F1 9/EC & Key words (concrete+, cement+, build+, wall, slab, panel+, anchor+, leg8, arm9) Key words alone chair9, seat+, base, support+, chp1 lock+, connect+, snap+, anchor+, cement+, concrete+, lift+, rais+

C  DOCUMENTS CONSIDERED TO BE RELEVANT

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<tr>
<td>X</td>
<td>EP 0908583 B1 (WAKAI &amp; CO LTD) 22 August 2001 Fig 4</td>
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<td>X</td>
<td>US 4580378 A (KELLY et al) 8 April 1986 Fig 1</td>
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[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents

"A" document defining the general state of the art which & not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 03 August 2010

Date of mailing of the international search report 9 AUG 2010

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address pct@ipaustrialta.gov.au
Fax 61 02 6283 7999

Authorized officer SARAVANAMUTHU PONNAMPALAM

AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service)

Telephone No 02 6283 2070

Form PCT/ISA/2 10 (second sheet) (July 2009)
Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

(a) claims 1-10
(b) claims 11-15

.../Continued in Supplemental Box I

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☑ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☒ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.
This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-10 are directed to an edge lift anchor. It is considered that a separate member mounted on the anchor to increase the lifting capacity of the anchor comprises a first distinguishing feature.

- Claims 11-15 are directed to a support chair for an edge lift anchor. It is considered that having a clipping system for retaining the edge lift anchor comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.
## DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>AU 200027607 B2 (ADNUNAT PTY LTD) 19 September 2002 Item 32 in fig 3</td>
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<td><strong>X</strong></td>
<td>US 4000591 A (COURTOIS) 4 January 1977 Items 112, 132 in figs 7-9</td>
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<td>US 4437642 A (HOLT) 20 March 1984 Item 22 in fig 6</td>
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<td>AU 2008203309 A1 (REINFORCED CONCRETE PIPES PTY LTD) 14 August 2008 Items 12, 14, 56, 58, 60 in fig 1</td>
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<td>US 6279274 B1 (AMIET et al.) 28 August 2001 Item 2, 6 in fig 1</td>
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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX